Kabała Magdalena, Wilczyński Jacek. Evaluation of equivalent reactions in women after mastectomy using biodex balance system. Journal of Education, Health and Sport. 2017;7(12):565-578. eISSN 2391-8306. DOI http://dx.doi.org/10.5281/zenodo.1133958
http://ojs.ukw.edu.pl/index.php/johs/article/view/5178
https://pbn.nauka.gov.pl/sedno-webapp/works/843238

The journal has had 7 points in Ministry of Science and Higher Education parametric evaluation. Part B item 1223 (26.01.2017).
1223 Journal of Education, Health and Sport eISSN 2391-8306 7

The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 01.12.2017. Revised: 15.12.2017. Accepted: 29.12.2017.

EVALUATION OF EQUIVALENT REACTIONS IN WOMEN AFTER MASTECTOMY USING BIODEX BALANCE SYSTEM

OCENA REAKCJI RÓWNOWAŻNYCH U KOBIET PO MASTEKTOMII ZA POMOCĄ URZĄDZENIA BIODEX BALANCE SYSTEM

Magdalena Kabała[1], Jacek Wilczyński[2]

[1] Ph.D. student, Institute of Physiotherapy, Faculty of Medicine and Health Science, Jan Kochanowski University, Kielce, Poland

[2] Head of Department Posturology, Hearing and Balance Rehabilitation, Faculty of Medicine and Health Sciences, Jan Kochanowski University in Kielce, Poland

Corresponding author:

Prof. nadzw. dr hab. **Jacek Wilczyński**

Department of Posturology, Hearning and Balance Rehabilitation, Institute of Physiotherapy, Faculty of Medicine and Health Sciences, Jan Kochanowski University, Kielce, Al. IX Wieków Kielc 19, 25-317 Kielce, Poland, Tel. 603-703-926, e-mail: jwilczyński@onet.pl, w.w.w.jacekwilczynski.com.pl

Abstract

Introduction: Breast cancer is the most commonly diagnosed malignant tumour in women in Poland, as well as in developed countries of the world. The unilateral radical mastectomy may result in disturbance of statics and body balance. Disturbances in body coordination may be associated with unevenly distributed tension of postural muscles between left and right side.

Aim of the research: Evaluation of equivalent reactions in women after mastectomy on the basis of posturographic examination.

Material and methods: 40 women were provided with the study, including 16 female patients (40%) after right-sided mastectomy and 24 female patients (60%) after left-sided treatment. The average age of respondents was 68.5 years. The Postural Stability Test, as well as Sensor Integration and Balance Test on the Biodex Balance System platform were used to evaluate the equivalent reactions. Research was carried out at the Posturology Laboratory of Physiotherapy Institute of the Jan Kochanowski University in Kielce.

Results and conclusions: Mann-Whitney U-test showed a statistically significant relation in the Postural Stability Test in dynamic mode between M/L stability index and the side of carried out mastectomy (p=0.027). Women after right-sided mastectomy mostly had lower parameters in dynamic posture, especially in the frontal plane (M/L). Pearson's correlation coefficient showed a significant relation between the Postural Stability Test in dynamic mode and the Sensor Integration and Balance Test on a soft open-eye surface (p=0.001). The standing position of examined was characterized by higher leavings in the sagittal plane than in the frontal plane (A/P>M//L).

Key words: stability index, mastectomy, Biodex Balance System.

Streszczenie

Wprowadzenie: Rak piersi jest najczęściej rozpoznawanym nowotworem złośliwym u kobiet w Polsce, jak również w rozwiniętych krajach świata. Konsekwencją zabiegu jednostronnej radykalnej mastektomii może stanowić zaburzenie statyki i równowagi ciała. Zakłócenia koordynacji postawy ciała mogą być związane z nierównomiernie rozłożonym napięciem mięśni posturalnych pomiędzy lewą a prawą stroną.

Cel pracy: Ocena reakcji równoważnych u kobiet po mastektomii na postawie badania posturograficznego.

Materiał i metody: Badaniami objęto 40 kobiet, w tym 16 pacjentek (40%) po prawostronnej mastektomii i 24 pacjentek (60%) po lewostronnym zabiegu. Średni wiek badanych wynosił 68,5 lat. Do oceny reakcji równoważnych zastosowano Test Stabilności Posturalnej oraz Test Integracji Sensorycznej i Równowagi na platformie Biodex Balance System. Badania wykonano w Laboratorium Posturologii Instytutu Fizjoterapii Uniwersytetu Jana Kochanowskiego w Kielcach.

Wyniki i wnioski: Test U Mann-Whitney'a wykazał istotny statystycznie związek w Teście Stabilności Posturalnej w trybie dynamicznym pomiędzy wskaźnikiem stabilności M/L a stroną wykonanej mastektomii (p=0,027). Kobiety po prawostronnej mastektomii posiadały w większości niższe parametry w posturografii dynamicznej, szczególnie w płaszczyźnie czołowej (M/L). Współczynnik korelacji Pearsona wykazał istotną zależność pomiędzy Testem Stabilności Posturalnej w trybie dynamicznym a Testem Integracji Sensorycznej i Równowagi na miękkiej powierzchni przy oczach otwartych (p=0,001). Postawę stojącą badanych charakteryzowały większe wychwiania w płaszczyźnie strzałkowej niż czołowej (A/P>M//L).

Słowa kluczowe: wskaźnik stabilności, mastektomia, platforma Biodex Balance System.

Introduction

The equilibrium system makes it possible to maintain proper posture during physical activity and in the rest [1]. Maintaining static and kinetic balance is a multifaceted process. It concerns the principles of mobility, carrying out appropriate correction sequences which will enable to return to the appropriate position of the body's centre of gravity in relation to the support plane [2-4]. Breast amputation can have a significant negative impact on the overall physical fitness of women after mastectomy and their posture [5-7]. The effectiveness in identification of persons with disorder of posture coordination is shown by static and dynamic posturographic, which are used to diversify visual causes, somatosensory and atrial equilibrium disorders [8].

Aim of the research

An aim of this study was to evaluate the equivalent reactions in women after mastectomy on the basis of post-urographic study. Particular attention was paid to the division of women according to the side of surgical procedure.

Material and methods

40 women after mastectomy were provided with the study, who belonged to the Świętokrzyski Club of "Amazon" by the Świętokrzyski Centre of Oncology in Kielce. Patients were divided into two groups according to the side of operated breast. 16 women (40%) were subjected to the right-sided radical mastectomy, while 24 women (460%) were subjected to the left-sided radical mastectomy. The age range of patients was 52 up to 87 years (average age 68.5). Amazons performed an examination with external breast prosthesis. Biodex Balance System platform was used to evaluate the equivalent reactions. The Postural Stability Test was carried out in static and dynamic mode in the position of on both feet on stable and movable surface with open eyes. Additionally, the Sensory Integration and Balance Test (CTSiB) was conducted to differentiate between visual, somatosensory and atrial equilibrium disorders. The Postural Stability Test consisted of three 20-second attempts, separated by a 10-second break. The patient's eyesight during the examination was focused on the monitor screen, where a characteristic point of the center of pressure (COP) was displayed, which reflected the centre of body mass. In fact, COP is an application point of the resultant force of substrate reaction. The role of patients was to coordinate the body, so that the centre of body gravity was in the circular centre, visible on the monitor, at the intersection of axis of coordinates. The position was determined by entering on the screen of the camera the angle of the foot using the center line (scale 0°–45° separately for the right and left foot,

eg. 25° for the left foot and 30° for the right foot) and the position of the heel (scale B –J, 1 – 21 separately for the right and left foot, eg. F7 left foot and E15 right foot).

During the test, the patients had prosthesis on the mastectomy side. The dynamic mode test was similar with the additional use of mobile platform. In patients after mastectomy, at the beginning of test level 12 (most stable) was started and then the device gradually moved to level 6, which was more difficult mode with an unstable platform surface [9]. The parameters analyzed are as follows:

1. The overall stability index (SI) represents the volatility of the position of the platform from the horizontal plane, expressed in degrees, during all movements in the test. Its high value indicates a high amount of movements in the test.
2. Anterior/posterior stability index (A/P) reflects the volatility of the position of the platform for movements in the sagittal plane, expressed in degrees.
3. Medial/lateral stability index (M/L) reflects the volatility of the position of the platform for movements in the frontal plane, expressed in degrees [9].

The CTSiB quantification consisted of four 20 second samples. The test was carried out in sensory conflict conditions in a standing position with method for recording leavings, based on movements of the foot pressure centre. The first test consisted of the following: opened eyes, hard surface; the second was closed eye; the third was opened eye, foam surface; and the fourth was closed eye, foam surface. Each test was followed by a 5 second break. The respondents were recommended to adopt a two-legged standing position with their hands hanging freely along the torso, with their eyes facing the monitor [9]. The participants conducted test with breast prosthesis. All parameters recorded by the posturographic platform were collected in a completely non-invasive way and the device was safe for the research group. The study was conducted in May 2016 at the Posturology Laboratory of the Physiotherapy Institute in the Medical University of Kielce.

The obtained parameters were saved in one database and developed statistically. The variables were evaluated using among others arithmetic mean, standard deviation (SD), and median. The Mann-Whitney U-test was used to determine the correlation between postural stability indices and mastectomy side. Pearson's correlations were used to compare the Postural Stability Test and the Sensory Integration and Balance Test. The results were recorded in Excel spreadsheet. Statistical significance was assumed at the level of $p<0.05$.

Results

Women after left-sided mastectomy constituted the majority of research group (60%), while right-sided mastectomy was treated 40% of women. The average age of examined group was 68.5 years, with a standard deviation of ± 8.80. The median value for distribution of results on this scale is 68 years, and the range of age from 52 up to 87 years. The average height of body was 160.1 cm with a standard deviation of ± 5.10 cm. The median value for distribution of results of this scale is 159 cm, and the range of growth from 149 up to 172 cm. The average body weight was 70.6 kg with a standard deviation of ± 10.1 kg. The median value for distribution of results of this scale is 69.8 kg, and the range from 47.1 up to 96.1 kg. The average body mass index (BMI) was 27.5 kg/m² with a standard deviation of ± 3.8 kg/m². The median value for distribution of results of this scale is 27 kg/m², and the range from 19.7 up to 38.5 kg/m². The average value of overall stability index of the static mode was 1.11, with a standard deviation of ± 0.94. The median distribution of results of this scale is 0.75, and the range of results from 0.5 up to 4.8. The average value of a/p stability index was 0.82 with a standard deviation of ± 0.82. The median distribution of results of this scale is 0.4, and the range of results from 0.2 up to 4.5. The average value of stability index m/l was 0.51 with a standard deviation of ± 0.47. The median distribution of results of this scale is 0.3, and the range of results from 0.2 up to 2.3. The average value of overall stability index of the dynamic mode was 1.81 with a standard deviation of ± 0.84. The median distribution of results of this scale is 1.6, and the range of results from 0.8 up to 5.2. The average value of stability index a/p was 1.4 with a standard deviation of ± 0.8. The median distribution of results of this scale is 1.2, and the range of results from 0.4 up to 4.3. The average value of stability index m/l was 0.87 with a standard deviation of ± 0.4. The median distribution of results of this scale is 0.75, and the range of results from 0.4 up to 2.2 (Table 1).

The stability indicators of Postural Stability Test were then analyzed in static and dynamic mode in terms of the mastectomy side. The average value of overall static stability index in both right- and left-sided mastectomy was 1.11, and the median was 0.8 and 0.65 respectively. No significant difference was found between the side of mastectomy ($p = 0.267$). The average value of A/P stability index in the group of women after right-sided treatment was 0.83 and the median was 0.5. While amongst women after the left-sided treatment the average value was 0.81, and the median was 0.4. Slightly higher averages and medians were stated in the group of women after right-sided treatment. No significant difference was found between the side of mastectomy ($p = 0{,}374$). The average value of M/L stability index in women after right-sided treatment was 0.47 and the median was 0.35. However, in the second

group the average value of mentioned index was 0.53, and the median was 0.3. Higher averages and medians were stated in the group of women after left-sided treatment. There were no significant differences between analyzed scales (p = 0,486) (Table 2).

In case of Postural Stability Test carried out in the dynamic mode, the average value of overall stability index in women after right-sided treatment was 1.56, and the median 1.5. Whereas among women after left-sided treatment the average value was 1.98, and the median 1.8. Higher averages and medians were stated in the group of women after left-sided treatment. No significant difference was found between the side of mastectomy (p = 0.165). The average value of A/P stability index in the group of women after right-sided treatment was 1.26, and the median was 1.15. In case of women after left-sided treatment, the average value was 1.49, and the median 1.25. Higher averages and medians were stated in the group of women after left-sided surgery. No significant difference was found between the side of mastectomy (p = 0.389). The average value of M/L stability index in women after right-sided treatment was 0.69, and the median was 0.6. In the second group, the average value of this indicator was 0.98 and the median 0.95. Higher averages and medians were observed in women after left-sided treatment. A significant difference was found between analyzed scales (p = 0.027). The values of Postural Stability Test in dynamic mode in all criteria were higher in comparison to the static test. Lower stabilometric parameters indicate better postural stability (Table 2). The Mann-Whitney U-test showed a statistically significant difference in the Postural Stability Test in dynamic mode between the mastectomy stability index m/l and mastectomy side (Table 2). Lower parameters indicate better postural stability. On the basis of above tables (Table 3-4), the value of Pearson's correlation coefficient is mostly positive. An exception may constitute the criterion of "closed eyes, sponge surface" in combination with the overall stability rate and A/P stability index (static mode), where the values are negative (-0.0139, -0.0766 respectively). In case of the condition "opened eyes, sponge surface" in comparison with the overall stability rate and A/P stability index (static, dynamic mode), the values are: 0.5436, 0.5575, 0.5309, 0.5169, which indicates a moderate correlation and significant relation. The level of statistical significance was adopted as $p \leq 0.05$.

Discussion

There are many works referring to the influence of mastectomy on musculoskeletal apparatus, quality of life and psychological condition of the subjects. However, there are no reliable reports of the effects of breast amputation on coordination and balance [10]. Proposed approach to the subject was an attempt to take a different view of the equivalent reactions. In case of women after mastectomy, this was an innovative approach, and therefore it is difficult

to take a stance on reports of researchers, who developed a similar subject in a similar dimension. It should be based mainly on reports of general patterns and phenomena occurring during the evaluation of equivalent reactions [11-12]. Breast amputation has a negative impact on the body posture, musculoskeletal system, coordination or overall physical fitness of women after radical mastectomy [5, 6, 13, 14]. The asymmetrical alignment of the shoulder lines (elevation of the shoulder blade of treated side) is a frequent consequence of unilateral mastectomy [15-17]. In most patients, radical mastectomy reduces mobility in the shoulder joint, weakens muscle strength and leads to lymphoedema and impaired lung ventilation [10, 18]. In addition, damage to the muscle of widest dorsal area affects the loss of function and muscle strength of the upper limb on the surgical side [19]. The treatment of breast cancer can lead to neurological dysfunctions, muscle balance disorders in the chest wall and postural muscles, which may lead to postural defects [20, 21].

Hojan K. et al. [22] in order to determine whether the weight of external breast prosthesis may contribute to abnormalities of body posture, the electromyographic test was carried out on the example of erector spinae. 51 women were examined with one-sided right or left mastectomy. The results showed that the weight of external prosthesis did not affect differences in activity of mentioned muscle. In addition, functional balance disorders of erector spinae were smaller after the left-sided treatment compared to the right-sided [22]. Hojan K. et al. concluded that the use of external breast prostheses had a positive effect on walking parameters of the research group [10].

Angin et al. examined the effect of lymphoedema of the upper limb on postural stability. 18 women after one-sided mastectomy and 18 women of similar age, who were not affected by the disease, were included in the study. The stability test was carried out on one leg on the lymphoedema side and on the opposite leg with opened and closed eyes, as well as the stability limit test. The results confirmed higher imbalances in case of women with oedema, showing weaker postural stability compared to the control group. Summing up, the state of uneven weight distribution has a negative impact on the body posture [23]. Moreover, the frequency of body deflection may be associated with increased muscle tension, which often accompanies women after radical mastectomy [10].

Rachwał et al. [10] in order to assess the importance of visual control in maintaining static equilibrium, they examined 150 persons using tensiometric platform, including 75 amazons and 75 women with similar anthropometric parameters. The examination consisted of two tests: with opened and closed eyes. The test results showed that equivalent reactions of amazons were dependent on the visual organ, while postural stability of patients after

mastectomy was better compared to the control group. This difference could be related to applied program of the streamlining women after oncological treatment in order to maintain stable body posture [10].

Current scientific work on the assessment of equivalent reactions shows higher leavings of body posture in the sagittal plane compared to the frontal plane [24-26]. In our own studies, during analysis of COP displacement, a higher value of a/p stability index was stated, and thus the dominance of body leavings in the sagittal plane in comparison to the frontal plane. According to Wiszomirska et al. [27], deterioration of postural stability in the anterior and posterior direction (A/P) is visible in women over 40 years of age and continues with age. This situation may be related to slower locomotor reactions and longer response time to specific disturbance stimuli [27].

Based on the received results concerning COP displacement in the Postural Stability Test in static mode, similar results were observed in women both after the left-sided and right-sided mastectomy. In case of dynamic mode, amazons after the right-sided treatment had better results of all stability rates compared to women after the left-sided breasts surgery. Mann Whitney's U-test showed a statistically significant difference between analyzed criteria. Own research, as well as Karczewska et al. [28], showed that left-sided mastectomy had a greater negative impact on the dynamic balance than right-sided mastectomy. It can be assumed that left-sided mastectomy in the examined group of women contributes to more frequent use of dominant body side (right side), which may reduce shoulder rim mobility on the left side. The study also showed better ability to maintain balance on a stable surface. All values of stability rates of the Postural Stability Test in static mode were lower than those of the test carried out in dynamic mode.

Comparing test results of the Postural Stability Test and the Sensory Integration and Balance Test with the Pearson's correlation coefficient, a significant correlation was found. A connection between the stability rates and CTSiB test conditions was stated. Particularly in case of criterion "opened eyes, sponge surface" in comparison with the overall stability index and A/P stability index (static, dynamic mode). Tests results indicate moderate correlation and significant dependence. The evaluation of balance for closed eyes on foam surface was the most difficult test for amazons. Own research, as well as Rachwał et al. 10], prove that visual control in women after mastectomy secured the movement of COPs in the frontal plane, affecting better posture stability [10]. Many researchers, including Pavlou et al. [29], stated that in case of abnormal or proprioceptive disorders, the vision organ has a greater role by assuming the role of corrective information provider [29]. According to Lê and Kapoul [30],

deficits of equivalent reactions on stable surface with closed eyes indicate proprioreceptic defects or central or labyrinthine disorders [30].

Conclusions

1. Mann-Whitney's test showed a statistically significant relation in the Postural Stability Test in dynamic mode between M/L stability index and the side of carried out mastectomy. Women after right-sided mastectomy mostly had better results in dynamic posture graphics.
2. The standing position of examined was characterized by higher leavings in the sagittal plane than in the frontal plane.

References:

1. Wojciechowski Ł, Gamecka – Stanisławek K. Platformy stabilometryczne jako narzędzie oceny zaburzeń równowagi i koordynacji. Rehabilitacja w praktyce 2012; 6: 60 – 63.
2. Mraz M, Szczepaniak D, Ostrowska B i wsp. Ocena koordynacji wzrokowo – ruchowej dynamicznym testem stabilograficznym u osób z chorobą Parkinsona objętych postępowaniem fizjoterapeutycznym. Alter Ego Seniora 2014; 2, 1: 49 – 52.
3. Wilczyński J, Lipińska-Stańczak M, Szaraniec K. Wady postawy a prędkość środka nacisku stóp u dzieci w wieku szkolnym. Studia Medyczne 2014; 30, 3:156–161.
4. Wilczyński J. Posturologia – nauka o postawie ciała człowieka. Studia Medyczne 2011; 23, 3: 7 – 17.
5. Czerniak U, Demuth A, Krzykala M et al. Body fat and quality of life in women treated for breast cancer. Studies In Physical Culture&Tourism 2012; 19, 1: 21 – 24.
6. Nissen MJ, Shapiro A, Swenson KK. Changes in Weight and Body Composition in Women Receiving Chemotherapy for Breast Cancer. Clin Breast Cancer 2011; 11, 1: 52-60.
7. Hanuszkiewicz J, Malicka I, Barczyk-Pawelec K et al. Effects of selected forms of physical activity on body posture in the sagittal plane in women post breast cancer treatment. J Back Musculoskelet Rehabil 2015; 28, 1: 35-42.
8. Wilczyński J. Balance reactions based on the anteroposterior speed of posturegram measured among girls and boys aged 12-15. Studia Medyczne 2010; 20: 13 – 17.
9. Schlein C. System Balansowy SD. Instrukcja obsługi. Gliwice 2013.
10. Rachwał M, Drzał – Grabiec J, Walicka – Cupryś K et al. Control of static balance among women after mastectomy. Vision impast on the quality of the equilibrium response. Postępy rehabilitacji 2013; 3: 13 – 20.
11. Hojan K, Manikowska F, Molinska-Glura M et al. The Impact of an External Breast Prosthesis on the Gait Parameters of Women After Mastectomy. Cancer Nurs 2014; 37, 2: E30 - 6.
12. Głowacka I, Nowikiewicz T, Hagner W et al. Sagittal Plane Postural Changes in Female Patients with Breast Cancer after Different Surgical Techniques. Breast J. 2017; 23, 1: 109-111.
13. Atanes Mendes Peres AC, Dias de Oliveira Latorre MD, Yugo Maesaka J et al. Body Posture After Mastectomy: Comparison Between Immediate Breast Reconstruction Versus Mastectomy Alone. Physiotherapy Research International 2017; 22, 1: e1642.
14. Almstedt HC, Grote S, Perez SE et al. Training-related improvements in musculoskeletal health and balance: a 13-week pilot study of female cancer survivors. Eur J Cancer Care 2017; 26; doi: 10.1111/ecc.12442
15. Drżał-Grabiec J, Rachwał M., Walicka-Cupryś K. Postawa ciała kobiet o mastektomii. Onkologia Polska 2013; 16, 1: 11-15.

16. Karczewska E, Szlachta P, Pytka K et al. Kinesio Taping Method in the asymmetry treatment of the shoulder girdle in women after mastectomy – a pilot study. European Journal of Medical Technologies 2016; 1, 10: 37-43.
17. Serel S, Tuzlalı ZY, Akkaya Z et al. Physical Effects of Unilateral Mastectomy on Spine Deformity. Clin Breast Cancer 2017; 17, 1: 29-33.
18. Potthoff K, Schmidt ME, Wiskemann J et al. Randomized controlled trial to evaluate the effects of progressive resistance training compared to progressive muscle relaxation in breast cancer patients undergoing adjuvant radiotherapy: the BEST study. BMC Cancer 2013; 13, 1: 162 -172.
19. van Huizum MA, Hoornweg MJ, de Ruiter N et al. Effect of latissimus dorsi flap breast reconstruction on the strength profile of the upper extremity. J Plast Surg Hand Surg. 2016; 50, 4: 202-207.
20. Hojan K, Wruk B, Stryła W. The impact of treatment in breast cancer on back pain. Onkologia Polska 2010; 13: 177-184.
21. Lee CE, Warden SJ, Szuck B et al. Preliminary Study on the Efficacy of a Community-Based Physical Activity Intervention on Physical Function-Related Risk Factors for Falls Among Breast Cancer Survivors. Am J Phys Med Rehabil 2016; 95, 8: 561-750.
22. Hojan K, Manikowska F, Chen BP et al. The influence of an external breast prosthesis on the posture of women after mastectomy. J Back Musculoskelet Rehabil. 2016; 29, 2: 337-342.
23. Angin S, Karadibak D, Yavuzşen T et al. Unilateral upper extremity lymphedema deteriorates the postural stability in breast cancer survivors. Contemporary Oncology 2014; 18, 4: 279–284.
24. Wilczyński J, Kabała M, Paprocki M et al. Evaluation of postural stability of people with Parkinson's disease with Biodex Balance System device. Journal of Education, Health and Sport 2016; 6, 10: 365-376.
25. Wilczyński J, Półrola P. Body posture and postural stability of people practicing qigong. Studia Medyczne 2015; 31, 2: 115 – 121.
26. Wilczyński J, Pedrycz A, Mucha D et al. Body Posture, Postural Stability, and Metabolic Age in Patients with Parkinson's Disease. BioMed Research International 2017: 1 – 9.
27. Wiszomirska I, Kaczmarczyk K, Zdrodowska A et al. Evaluation of static and dynamic postural stability in young, elderly and with vision loss women. Postępy rehabilitacji 2013; 3: 33 – 39.
28. Karczewska E, Szlachta P, Chamera S i wsp. Ocena równowagi dynamicznej kobiet po mastektomii jednostronnej i protezowaniu zewnętrznym piersi – badania pilotażowe. Aktualne problemy biomechaniki 2017; 13: 29 – 36.
29. Pavlou M, Quinn C, Murray K et al. The effect of repeated visual motion stimuli on visual dependence and postural control in normal subjects. Gait Posture 2011; 33, 1: 113-118.
30. Lê T, Kapoula Z. Role of ocular convergence in the Romberg quotient. Gait Posture 2008; 27, 3: 493–500

Table 1. Descriptive statistics of the analysed scales

Analysed scales	Mean	Standard deviation	Minimum	Lower quartile	Median	Upper quartile	Maximum
Age [years]	68.50	8.80	52.00	64.00	68.00	77.00	87.00
Height [cm]	160.10	5.10	149.00	157.00	159.00	164.00	172.00
Weight [kg]	70.60	10.10	47.10	63.83	69.80	75.95	96.10
BMI [kg/m2]	27.50	3.80	19.70	25.65	27.00	29.13	38.50
General stability index (static)	1.11	0.94	0.50	0.50	0.75	1.50	4.80
Stability index A/P (static)	0.82	0.82	0.20	0.30	0.40	1.10	4.50
Stability index M/L (static)	0.51	0.47	0.20	0.20	0.30	0.53	2.30
General stability index (dynamic)	1.81	0.84	0.80	1.30	1.60	2.00	5.20
Stability index A/P (dynamic)	1.40	0.80	0.40	0.90	1.20	1.55	4.30
Stability index M/L (dynamic)	0.87	0.40	0.40	0.60	0.75	1.20	2.20

Table 2. Descriptive statistics of analyzed scales depending on the side of carried out mastectomy

Analysed scales		Mean	Standard deviation	Minimum	Lower quartile	Median	Upper quartile	Maximum	U Mann – Whitney test
General stability index (static)	P[1]	1.11	0.68	0.50	0.60	0.80	1.40	2.90	p= 0.267
	L	1.11	1.10	0.30	0.40	0.65	1.50	4.80	
Stability index A/P (static)	P	0.83	0.64	0.30	0.40	0.50	1.20	2.70	p=0.374
	L	0.81	0.93	0.20	0.30	0.40	0.95	4.50	
Stability index M/L (static)	P	0.47	0.31	0.20	0.30	0.35	0.50	1.40	p=0.486
	L	0.53	0.55	0.10	0.20	0.30	0.60	2.30	
General stability index (dynamic)	P	1.56	0.46	0.80	1.20	1.50	1.70	2.60	p= 0.165
	L	1.98	0.99	0.80	1.40	1.80	2.10	5.20	
Stability index A/P (dynamic)	P	1.26	0.52	0.60	0.90	1.15	1.60	2.40	p=0.389
	L	1.49	0.94	0.40	1.00	1.25	1.50	4.30	
Stability index M/L (dynamic)	P	0.69	0.27	0.40	0.50	0.60	0.70	1.40	**p=0.027**
	L	0.98	0.43	0.40	0.70	0.95	1.20	2.20	

[1] P – right-sided mastectomy, L – left-sided mastectomy

Table 3. Analysis of relation in the Postural Stability Test in static mode with CTSiB with Pearson's correlation coefficients

Condition CTSiB	General stability index		Stability index A/P		Stability index M/L	
	-Pearson correlation	p value	r-Pearson correlation	p value	r-Pearson correlation	p value
Eyes open firm surface	0.4353	**0.005**	0.4185	0.474	0.3176	0.046
Eyes closed firm surface	0.1677	0.301	0.1774	0.274	0.0936	0.566
Eyes open foam surface	0.5436	0.341	0.5575	**0.001**	0.2958	0.064
Eyes closed foam surface	-0.0139	0.932	-0.0766	0.638	0.1531	0.345

Table 4. Analysis of relation in the Postural Stability Test in dynamic mode with CTSiB with Pearson's correlation coefficients

Condition CTSiB	General stability index		Stability index A/P		Stability index M/L	
	r-Pearson correlation	p value	-Pearson correlation	p value	r-Pearson correlation	p value
Eyes open firm surface	0.4552	**0.003**	0.5177	**0.001**	0.0631	0.699
Eyes closed firm surface	0.3307	**0.037**	0.3944	**0.012**	0.0318	0.845
Eyes open foam surface	0.5309	**0.001**	0.5169	**0.001**	0.2796	0.081
Eyes closed foam surface	0.1626	0.316	0.0995	0.541	0.2683	0.094