

Physiotherapy in women after breast cancer treatment – review

Skutnik K.^{1A,B,C,D}, Ustymowicz W.^{2B,C}, Zubrewicz K.^{3B,C}, Zińczuk J.^{4B,C}, Kamińska D.^{2B,C}, Prczynicz A.*^{2E,F}.

1. Nursing Home Care “Złota Jesień”, Racibórz, Poland
2. Department of Oncological Surgery, Białystok Oncology Centre, Białystok, Poland
3. Department of Rehabilitation, Białystok Oncology Centre, Białystok, Poland
4. Department of General Pathomorphology, Medical University of Białystok, Białystok, Poland

A - Conception and study design; **B** - Collection of data; **C** - Data analysis; **D** - Writing the paper; **E** - Review article; **F** - Approval of the final version of the article; **G** - Other (please specify)

ABSTRACT

Introduction: Breast cancer is the most common malignant tumor in women in the Polish region. Surgery is a basic method of breast cancer treatment. Surgery often carries a lot of unwanted changes as follows: limitation of mobility in the shoulder joint on the operated side, secondary lymphoedema, post mastectomy pain syndrome (PMPS), reduction of muscle strength or disorders in body posture. Therefore, the implementation of physiotherapeutic activities that are designed to prevent and eliminate postoperative complications seems very important. The main aim of this work was to present physiotherapeutic management in women after mastectomy based on the analysis of available literature. The physiotherapeutic process can be divided into three periods: early hospital, early ambulatory and the late ambulatory period. In the first period, active slow exercises, self-support of the upper limb on the operated side and breathing exercises on the thoracic track are used to prevent circulatory disorders, pulmonary complications, and edema. The early ambulatory period includes corrective exercises, general improvement exercises,

stretching and learning of automatic massage of the upper limb of the operated side. The last period should be enriched by recreational methods of physical activity such as swimming, cycling or Nordic walking to maintain physical fitness, proper mobility of the shoulder girdle and improve the patient's psychophysical state. It is very important the patient regular continues the rehabilitation program after curing of breast cancer as well. In the case of secondary lymphoedema of the upper limb, comprehensive rehabilitation physiotherapy is used, consisting of manual lymphatic drainage, healing exercises, compression therapy, and skin care.

Conclusions: Physiotherapy in women after breast cancer surgery is a complex and long-term process. Physiotherapeutic methods are effective in treating complications after surgery of breast cancer surgery. It is necessary to constantly update the physiotherapy knowledge in women after breast cancer surgery.

Keywords: breast cancer, rehabilitation, mastectomy, physiotherapy

DOI

***Corresponding author:**

Anna Prczynicz

Department of General Pathomorphology, Medical University of Białystok, Poland

e-mail: prczynicz.anna@gmail.com

Received: 09.02.2019

Accepted: 16.04.2019

Progress in Health Sciences

Vol. 9(1) 2019 pp 162-168

© Medical University of Białystok, Poland

BREAST CANCER

Breast cancer is the second most frequent cause of cancer death in the world [1]. Since the beginning of the last decade, there has been a decrease in mortality from breast cancer. The largest mortality occurs after the age of 50, and the risk of death increases with age [2]. The reasons for the development of breast cancer are not fully known, but due to many years of clinical researches, factors that increase the probability of occurrence of this cancer have been identified, which makes it possible to assess the risk of developing the disease in separate cases. The risk factors for breast cancer include age, genetic factors and family history of breast cancer, reproductive factors, dietary and environmental factors, benign breast proliferative diseases, exposure to ionizing radiation at an early age and long-term hormone replacement therapy [3].

Treatment of breast cancer is a combination of treatment, which can be broadly divided into local treatment (surgery, radiotherapy) and systemic treatment (chemotherapy, hormonotherapy). The method of treatment depends on: stage of cancer, histological type of cancer, regional lymph node status, expression of ER/PgR and HER2 receptors, hormonal status and age of the patient. Surgery is a basic and indispensable element of the breast cancer treatment regimen. Depending on the severity of the disease, the procedure consists in partial removal of the breast (breast-conserving surgery - lumpectomy) or amputation (mastectomy). In the case of regional lymph nodes involvement, an operation is performed in which an entire group of lymph nodes (axillary lymphadenectomy) is dissected, or only one or several sentinel nodes. The supplementary method is post-operative radiotherapy (PORT), which is usually used after the breast-conserving surgery, mastectomy (a tumor with a diameter of more than 5 cm) and in case of metastases in at least 4 axillary nodes. The goal of PORT is to eliminate possibility of detection persistent cancer cells in the area of the removed tumor, which prevents the recurrence of the disease. Another method of the breast cancer treatment is chemotherapy, which practice cytostatics (in the most cases anthracyclines and taxanes) killing the cells of cancer. It can be carried out at any stage of the therapeutic process, both before surgery (neoadjuvant) and after surgery (adjuvant). Another form of systemic treatment is hormonotherapy (HTH). The selection of drug in HTH is largely dependent on the menopausal state, where tamoxifen is administered before menopause, and aromatase inhibitors or tamoxifen after menopause. Treatment with hormonotherapy involves regulating the secretion of specific types of hormones, by blocking the hormone sensitive receptors of breast cancer cells. Hormone therapy is mainly used in women with ER/PgR expression and after menopause [4-6].

PHYSIOTHERAPY PROCEDURE IN WOMEN AFTER BREAST CANCER TREATMENT

Surgical treatment of breast cancer can cause many undesirable changes in the upper limb on the operated side such as: mobility deficits of shoulder joint, impaired rotator cuff function, joint pain, post mastectomy pain syndrome (PMPS), paresthesia, lymphedema and decreased muscle strength [7,8]. Very often after mastectomy there is decreasing of the chest mobility as well as impaired statics and correct body posture (deepening of thoracic kyphosis, protruding shoulder and raised or lowered shoulder on the operated side) [9]. Physiotherapy aims to prevent, reduce or eliminate the adverse consequences of surgical intervention, and as a result to improve the quality of life of patients after breast cancer surgery. Therefore, it is an indispensable component in their rehabilitation process [10].

The Polish literature describes the rehabilitation scheme, including physiotherapeutic activities, created by doctor Krystyna Mika during three periods (early hospital period, early ambulatory, late ambulatory period), which is currently used in all facilities treating breast cancer in Poland [11,12].

Early hospital period

The physiotherapist's role in this period is to prevent:

- circulatory disorders,
- pulmonary complications,
- edema of the operated upper limb [13].

Opinions about the time when the self-support of shoulder girdle of the operated side should be started vary between different authors. Doctor Mika [14] recommends starting the exercise as soon as possible, it means during the first day after surgery. A study carried out by Cinar et al. [15] confirmed that exercises started already during the first day after surgery increase mobility in the shoulder joint without any adverse effects. However, according to the results of a study made by Shamley [16] and Todd [17], exercises performed in the first days after surgery prolong wound healing and increase the risk of lymphoedema at a later time. Therefore, according to them, self-support of shoulder girdle should start on about the 7th day after surgery procedure [16,17].

Initially, free active exercises are used, as follow: bending, straightening, adduction and abduction of fingers, rolling of the wrist and joints, active exercises in the relief in the Universal Cabinet

for Medical Improvement (UGUL), self-assisted shoulder exercises in the sagittal plane (for example with the use of a gymnastic stick), isometric exercises of forearm and hand muscles, breathing exercises on the thorax track and exercises of

effective coughing in the supine position (0-3 days after the surgery), and after the upright position also in the sitting position (4-6 day) and standing position (7-9 day) [11,12,18,19]. Exercises in this period should be performed with low intensity, but in a full and painless range of movability [16,17]. In one of the studies was shown that a well-developed physical rehabilitation program conducted by a physiotherapist from the first day after surgery gives better results in recovering the efficiency of the upper limb from the operation than any exercises without a schedule. It is worth to note that no edema formation or enlargement was observed in any of the patients [20]. Additionally, for edema prevention, the gentle limb massage on the operated side, omitting the surgical wound area should be performed. The position of the upper limb on the high wedge (hand above the heart level) is used [14]. The education of the patient, presented by the physiotherapist, have a very important role in counteracting edema. In one study conducted in Taiwan was documented that education and the inclusion of physiotherapy in the first week after surgery, reduces the risk of lymphoedema, than the use of only one of these components [21].

Early ambulatory period

In some sources have been also referred to as an early post-hospital period. Physiotherapeutic management focuses on:

- anti-oedematous prophylaxis,
- increasing the range of movability in the joints of the upper limb on the mastectomy side,
- improvement of the overall performance of the patient,
- maintenance of muscle strength [11,12].

During this period, lymphatic massage of the operated upper limb and fascial massage to the surgical area are implemented to make the postoperative seam more flexible. To exercises from the first period, exercises on the cycloergometer, general exercises and corrective exercises (mainly strengthening the back muscles) and postural reeducation are added [9,12,13,19]. Active slow exercises of shoulder girdle joints should take place in the sagittal, frontal and transverse planes [14]. According to practical guidelines for the rehabilitation of breast cancer, active stretching (stretching exercises) can be implemented after one week of surgery, which should be used for 6-8 weeks or until the full range of mobility in the weakened limb is obtained [22]. In addition, the patient should be trained to perform a massage of the upper limb of the operated side supporting lymph flow, which should be performed in the morning and in the evening for 10 minutes [18]. To a large extent, the patient performs exercises alone at home according to the instructions of the physiotherapist. In the event of significant limitation of mobility in the upper limb

on the operated side, the exercises with achieving pain limits and PIR (Post-isometric exercise relaxation technique) are implemented. The physiotherapist at this stage of rehabilitation should familiarize the patient with the norms of conduction in everyday life such as avoiding prolonged loading, lifting and carry heavy objects or measuring arterial pressure on the operated upper limb [12,13].

Late ambulatory period

The goal of the last period of rehabilitation treatment is:

- maintaining the proper mobility of the upper limb on the operated side,
- maintaining function and fitness,
- prevention or reduction of existing edema,
- maintaining a correct posture,
- improvement of the psychophysical state of the patient [12,13].

According to these goals, exercises from previous periods are continued and other forms of movement are introduced in the form of activities at the pool, cycling, walking or Nordic walking. It is recommended to perform moderate physical activity lasting about 30 minutes on most of the weekly days [22]. In a study conducted in 2009 in the Świętokrzyski Club "Amazons" in Kielce [23], the impact of regular exercise kinesitherapeutic exercises on the functionality of the upper limb was examined along with the use of lymphatic massage in women one year after the mastectomy. One group systematically participated in the program of classes, about three times a week, and the other less frequently than once in a week. The results showed that women who made the exercise systematically, improved the functional condition of their upper limb significantly and the risk of lymphoedema on the operated side was reduced [23]. Therefore, it is very important for the patient to continue the rehabilitation program on a regular basis also after curing of breast cancer.

To gain muscle strength, weight training is used by women after breast cancer surgery. In recent studies, it has been proven that weight training performed with low or moderate intensity with relatively slow progression significantly increases the strength of upper limbs and lower limbs and helps maintain a proper body weight without increasing the risk of lymphoedema of the upper limb [24]. In practical guidelines for the rehabilitation of women after surgical treatment of breast cancer, it is recommended to train progressive resistance exercise from the 4th or 6th week after surgery [22].

The issue of using physical procedures is controversial. Only a few of them suggests using of the physical therapy for relieving pain (diadynamic currents), reducing lymphedema (electrostimulation) or in cases of superficial sensation (electroplating) with the prior consent of an

oncologist [14,25]. Generally, they are not indicated due to the lack of sufficient evidence to justify the effectiveness of these treatments [22]. Nevertheless, in a study conducted in 2013 on patients after mastectomy suffering from intercostal-brachial nerve pain, the effect of TENS (Transcutaneous Electrical Nerve Stimulation) was analyzed. As a result, it was proven that the application of this electrical stimulation significantly alleviated pain thanks to its analgesic action (by reducing cortical electrical activity) [26]. Therefore, there is a great need for research into the effects of physical treatments that could help in the treatment of the consequences of surgical treatment of breast cancer.

In patients with painful and increased tissue tension caused by a large postoperative scar, a tensegressive massage is proposed. In a given method of massage, the technique of spotting muscle attachments is used, based on the tensegration law, thanks to this is possible to determine which structures are needed to be irritated to regulate the increasing the tension of tissues. A study was made on the effectiveness of this therapy and it was shown that tensegressive massage effectively eliminates pain and increased tension of tissues associated with scarring after mastectomy [27].

PHYSIOTHERAPY FOR A SECONDARY LYMPHEDEMA OF UPPER LIMB

Lymphoedema of the upper limb is the most problematic complication after surgical treatment of breast cancer, which occurs in about 30% of patients. It appears within the first eighteen months of treatment in most cases [28]. The greatest risk of developing secondary lymphoedema is associated with the excision of lymph nodes, which increases the number of removed nodes and radiotherapy. This complication results in a reduction in the ability of physical and social functioning, pain and can lead to erysipelas and even to the development of lymphatic cancer [29].

Comprehensive physiotherapy

Currently, the standard conservative treatment of secondary lymphoedema in women after mastectomy is comprehensive physical therapy (CPT- Combined Physical Therapy; CDP- Complex Decongestive Physiotherapy) [19,30]. The CDP includes:

- Manual Lymphatic Drainage (MLD), which is defined as a delicate elastic deformation of the skin along with the subcutaneous tissue. It is based on four shanks: pumping, rotating, drawing and circular movements. Every move should be made calmly and be repeated 5-7 times. Firstly, the lymph nodes of the proximal parts of the body are developed (the region of the neck and torso), and then successively pass

to the distal parts of the upper limb affected by the swollen swelling (arm, forearm, hand). MLD effectively stimulates the outflow of lymph and contributes to the formation of new lymphatic vessels in unhealthy places [31,32].

- Compression therapy, which is based on multilayer bandaging of the upper limb with lymphoedema. This method uses bandages with low elasticity (CB-Compression Bandaging). Bandaging begins with hand where compression is highlighted as a greatest, and then going to the forearm and arm, where it's gradually decreased. Bandages should be applied in a way that the patient is able to perform movements in the joints of the limb. This method is performed directly after MLD to preserve its positive results. The pressure generated by CB contributes to the reduction of the volume of the tissue fluid as well as prevents backflow of the lymph. The recommendation is using the bandages daily for 24 hours a day per 4-6 weeks. Compressive therapy also uses compression sleeves, which should be selected individually depending on the degree of absorption swelling [32-34]. They are made from a material that exerts pressure in the range of 20-60 mmHg. Compression sleeves should be worn for at least 20 hours a day and be replaced after 3-6 months, as they lose their elasticity over time [19].
- Healing exercises, such as free active exercises, self-assisted upper limbs on the side of the lymphatic edema and breathing exercises. They should be performed at a quiet place, several times a day, with a small number of repetitions, in positions conducive to the outflow of lymph from the limb [33,34]. The combination of exercise and compression therapy stimulates the functioning of the lymphatic system and accelerates protein resorption [19]. In one of the studies, it was shown that using the gentle exercises of the upper limb together with breathing exercises twice a day for 10 minutes affect the reduction of lymphatic edema [35].
- Skin care that aims to prevent bacterial and fungal infections. Care should be taken to ensure cleanliness and proper hydration of the swollen upper limb through the use of mild emollients [19].

The CDP treatment process is divided into two successive phases. The first phase, called the intensive phase, takes place in a hospital or in an outpatient center. It consists in the daily performance of MLD by a specialized physiotherapist, using of upper limb bandaging on the side of lymphatic edema, performing therapeutic exercises, and learning the patient to perform lymphatic massage alone. In addition, the patient should be familiar with the principles of careful skin care. The intensive phase lasts from 1 to 6 weeks and its main goal is to

achieve maximum reduction of lymphatic edema in the shortest possible time. Currently, the aim is to reduce the time of this stage by increasing the number of sessions to improve the quality of life of patients and according to the economic reasons [36,37]. It has been proven that longer CDP treatment has no impact for getting the better effects in edema reduction, because, according to studies, the largest decrease in volume of the upper limb covered by lymphoedema occurs during the first 10 days of its use, and after that time the results are not so satisfactory [38]. The second phase of CDP, known as the maintenance phase, is attend for preservation of the lymphoedema reduction. This phase includes the use of compression sleeves instead of CB, healing exercises and skin care, while MDL performed by a physiotherapist is used sporadically. This stage lasts until the end of life, because secondary lymphoedema is a chronic disorder that cannot be cured [36,37].

Physiotherapeutic complementary methods

In addition to CDP, it is also proposed to apply other physiotherapeutic methods which can be used as a support of the secondary lymphedema treatment. One of them is intermittent pneumatic compression (IPC). This treatment involves using the multi- or single-chamber pump in the form of a sleeve, which exerts cyclical pressure on the swollen limb. This improves the movement of the lymph from the limb to the proximal lymphatic vessels. Parameters such as press level during pressure, duration of pressure, breaks and the entire procedure are adjusted individually, remembering that the pressure lasts 2-3 times longer than the break, and the pressure in the sleeve does not exceed diastolic blood pressure [14,39]. In addition, the use of laser therapy (LLLT- Low Level Laser Therapy) is suggested. Studies have shown that it accelerates the rate of lymph pumping and supports the regeneration of lymphatic vessels [39,40]. Another method is kinesiotaping which is based on the appropriate technique of application of special tapes that give the effect of a slight elevation of the superficial part of the skin, thanks to which the area between the fascia and the proper skin is widened, which in turn reduces the stagnation of the lymph. Moreover, it has been proven that the use of kinesiotaping at CDP extends its treatment effects and intensifies lymphatic microcirculation [41,42].

In one of the review, based on many studies, it was undertaken to examine the influence of some conservative methods in the treatment of secondary lymphoedema. It was found that intensive and conducted by specialized therapists such treatments as CDF, laser therapy or IPC obtained better results in reducing the volume of edema than self-massage or exercises performed independently by the patient [40].

CONCLUSIONS

Physiotherapy in women after breast cancer surgery is a complex and a long-term process. Physiotherapeutic methods are effective during the treating complications after surgical breast cancer. Therefore, there is a requirement of constantly updating the knowledge about physiotherapy in women after breast cancer surgery.

Conflicts of interest

The authors declare that they have no conflicts of interest.

REFERENCES

1. GLOBOCAN 2018: Estimated Cancer Incidence, Mortality and Prevalence Worldwide in 2018, World Health Organization (online). http://globocan.iarc.fr/Pages/fact_sheets_cancer.aspx [cited 28 Feb 2019].
2. Wojciechowska U, Didkowska J, Zatoński W. Nowotwory złośliwe w Polsce w 2012 roku. Ministerstwo Zdrowia, Warszawa 2014. (Polish)
3. Hulka BS, Moorman PG. Breast cancer: hormones and other risk factors. *Maturitas* 2001 Feb;38(1):103-13.
4. Curigliano G, Burstein HJ, P Winer E, Gnant M, Dubsy P, Loibl S, Colleoni M, Regan MM, Piccart-Gebhart M, Senn HJ, Thürlimann B. St. Gallen International Expert Consensus on the Primary Therapy of Early Breast Cancer 2017, André F, Baselga J, Bergh J, Bonnefoi H, Y Brucker S, Cardoso F, Carey L, Ciruelos E, Cuzick J, Denkert C, Di Leo A, Ejlertsen B, Francis P, Galimberti V, Garber J, Gulluoglu B, Goodwin P, Harbeck N, Hayes DF, Huang CS, Huober J, Hussein K, Jassem J, Jiang Z, Karlsson P, Morrow M, Orecchia R, Osborne KC, Pagani O, Partridge AH, Pritchard K, Ro J, Rutgers EJT, Sedlmayer F, Semiglazov V, Shao Z, Smith I, Toi M, Tutt A, Viale G, Watanabe T, Whelan TJ, Xu B. De-escalating and escalating treatments for early-stage breast cancer: the St. Gallen International Expert Consensus Conference on the Primary Therapy of Early Breast Cancer 2017. *Ann Oncol.* 2017 Aug;28(8):1700-12.
5. Castaneda SA, Strasser J. Updates in the Treatment of Breast Cancer with Radiotherapy. *Surg Oncol Clin N Am* 2017 Jul;26(3):371-82.
6. Hu X, Li T, Wang B, Zhang J, Yu X, Shao Z. Comparison of 4th ESO-ESMO international consensus guidelines for advance breast cancer and Chinese anti-cancer association committee of Breast Cancer Society guideline. *Breast.* 2019 Feb;45:36-42.
7. Stubblefield MD, Keole N. Upper body pain and functional disorders in patients with breast cancer. *PMR.* 2014 Feb;6(2):170-83.

8. Binkley JM, Harris SR, Levangie PK, Pearl M, Guglielmino J, Kraus V, Rowden D. Patient perspectives on breast cancer treatment side effects and prospective surveillance model for physical rehabilitation for women with breast cancer. *Cancer*. 2012 Apr;118(8):2207-16.
9. Bąk M. Postawa ciała w płaszczyźnie strzałkowej kobiet po mastektomii aktywnie uczestniczących w rehabilitacji ruchowej. *Fizjoterapia*. 2008;16(4):35-43. (Polish)
10. Kalinowski P, Krawulska A. Rola fizjoterapii po mastektomii w opinii pacjentek. *Med Og Nauk Zdr* 2012;18(4):292-6. (Polish)
11. Madetko R, Cwiertnia B. Rehabilitacja po mastektomii. *Probl Pielęg*. 2008;16(4):397-400. (Polish)
12. Samusik K. Wybrane problemy w rehabilitacji pacjentek z rakiem piersi. *Rehabil Prakt* 2010;(2):26-7. (Polish)
13. Mikołajewska E. Postępowanie fizjoterapeutyczne po mastektomii. *Praktyczna fizjoterapia i Rehabilitacja*. 2010;10:42-5. (Polish)
14. Mika K. Po odjęciu piersi. Wydawnictwo Lekarskie PZWL, Warszawa 2005. (Polish)
15. Cinar N, Seckin U, Bodur H, Bozkurt B, Cenqiz Q. The effectiveness of early rehabilitation in patients with modified radical mastectomy. *Cancer Nurs*. 2008 Mar-Apr;31(2):160-5.
16. Shamley DR, Barker K, Simonite V, Beardshaw A. Delayed versus immediate exercise following surgery for breast cancer: a systematic review. *Breast Cancer Res Treat*. 2005 Apr;90(3):263-71.
17. Todd J, Scally A, Dodwell D, Horgan K, Topping A. A randomized controlled trial of two programs of shoulder exercise following axillary node dissection for invasive breast cancer. *Physiotherap.y* 2008;94(4):265-73.
18. Pasek J, Sieroń A, Pasek T, Manierak A. Fizjoterapia w okresie szpitalnym po zabiegu mastektomii. *Rehabil Prakt*. 2008;(1):39-41. (Polish)
19. Gomide L B, Matheus J P C, Candido dos Reis FJ. Morbidity after breast cancer and physiotherapeutic performance. *Int J Clin Pract*. 2007 Jun;61(6):972-82.
20. de Rezende LF, Franco RL, de Rezende MF, Beletti PO, Morais SS, Gurgel MS. Two exercise schemes in postoperative breast cancer: comparison of effects on shoulder movement and lymphatic disturbance. *Tumori*. 2006 Jan-Feb; 92(1):55-61.
21. Lu SR, Hong RB, Chou W, Hsiau PC. Role of physiotherapy and patient education in lymphedema control following breast cancer surgery. *Ther Clin Risk Manag*. 2015 Feb;11:319-27.
22. Harris SR, Schmitz KH, Campbell KL, Mc Neely ML. Clinical practice guidelines for breast cancer rehabilitation: syntheses of guideline recommendations and qualitative appraisals. *Cancer*. 2012 Apr;118(8 Suppl): 2312-24.
23. Puszczalowska-Lizis E, Lizis P. Wpływ systematycznego usprawniania na stan funkcjonalny kończyny górnej u kobiet po mastektomii. *Fizjoter Pol*. 2011;11(1):41-8. (Polish)
24. Paramanandam VS, Roberts D. Weight training is not harmful for women with breast cancer-related lymphoedema: a systematic review. *J Physiother*. 2014 Sep;60(3):136-43.
25. Kołodziejski L, Niedbała E. Problems associated with physiotherapeutic management of patients after breast cancer surgery. *Rehabilitacja Medyczna*. 2008;12(2):16-21.
26. Silva JG, Santana CG, Inocencio KR, Irsini M, Machado S, Bergmann A. Electrocardiogram Analysis of patients with intercostobrachial pain with TENT after breast cancer surgery. *J Phys Ther Sci*. 2014 Mar;26(3):349-53.
27. Wilk I, Kurpas D, Mroczek B, Andrzejewski W, OkreglickaForysiak E, Krawiecka-Jaworska E, Kassolik K. Application of tensegrity massage to relieve complications after mastectomy- case report. *Rehabil Nurs*. 2015 Sep-Oct;40(5):294-304.
28. Hayes SC, Janda M, Cornish B, Battistutta D, Newman B. Lymphedema after breast cancer: incidence, risk factors, and effect on upper body function. *J Clin Oncol*. 2008 Jul;26(21):3536-42.
29. Rebegea L, Firescu D, Dumitru M, Anghel R: The incidence and risk factors for occurrence of arm lymphedema after treatment of breast cancer. *Chirurgia*. 2015 Jan-Feb;110(1):33-7.
30. Wiktor M, Chęciński P. Obrzęk limfatyczny-niedoceniany problem kliniczny i terapeutyczny. *Prakt Fizjoter Rehabil*. 2010;10:30-6. (Polish)
31. Doś J. Manualny drenaż limfatyczny (MDL) jako forma terapii. *Prakt Fizjoter Rehabil*. 2010;10:38-41. (Polish)
32. Kołodziejski L S, Łobaziewicz W, Ochalek K, Niedbała E. Obrzęk limfatyczny kończyny górnej po radykalnym leczeniu chorych na raka piersi- aktualne zasady postępowania. *Rehabil Med*. 2009;13(2):23-31. (Polish)
33. Krukowska J, Terek M, Macek P, Woldańska-Okońska M. Metody redukcji obrzęku limfatycznego u kobiet po mastektomii. *Fizjoterapia*. 2010;18(4):3-10. (Polish)
34. Majewski M. Fizjoterapia kobiet z obrzękiem chłonnym kończyny górnej po leczeniu raka sutka. *Fizjoterapia* 2006;14(4):60-8. (Polish)
35. Moseley AL, Piller NB, Carati CJ. The effect of gentle arm exercise and deep breathing on secondary arm lymphedema. *Lympholog.y* 2005 Sep;38(3):136-45.
36. Vignes S, Blanchard M, Arrault M, Porcher R. Intensive complete decongestive physiotherapy for cancer-related upper-limb lymphedema: 11

- days achieved greater volume reduction than 4. *Gynecol Oncol*. 2013 Oct;131(1):127-30.
37. Patricolo GE, Armstrong K, Riutta J, Lanni T. Lymphedema care for the breast cancer patient: An integrative approach. *Breast* 2015 Feb;24(1):82-5.
38. Liao SF, Lu SH, Huang HY, Chen ST, Kuo SJ, Chen DR, Wei TS. The efficacy of complex decongestive physiotherapy (CDP) and predictive factors of lymphedema severity and response to CDP in breast cancer-related lymphedema (BCRL). *Breast*. 2013 Oct;22(5):703-6.
39. Leal NP, Carrara HH, Vieira KF, Ferreira CH. Physiotherapy treatments for breast cancer-related lymphedema: a literature review. *Rev Lat AM Enfermagem*. 2009 Sep-Oct;17(5):730-6.
40. Moseley AL, Carati CJ, Piller NB. A systematic review of common conservative therapies for arm lymphoedema secondary to breast cancer treatment. *Ann Oncol* 2007 Apr; 18(4):639-46.
41. Pekiavas NÖ, Tunay VB, Akbayrak T, Kaya S, Karataş M. Complex decongestive therapy and taping for patients with postmastectomy lymphedema: a randomized controlled study. *Eur J Oncol Nurs*. 2014 Dec;18(6):585-90.
42. Lipińska A, Śliwiński Z, Kiezbak W, Senderek T, Kirenko J. Wpływ aplikacji kinesiotapingu na obrzęk limfatyczny kończyny górnej u kobiet po mastektomii. *Fizjoter Pol*. 2007;7(3):258-69. (Polish)