

STUDY REGARDING THE MUSCLE STRENGTH AFTER BREAST CANCER SURGERY

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Abstract: A number of 2.09 million breast cancer cases are diagnosed annually, according to the latest World Health Organization reports. The treatment can lead to multiple side effects, that negatively impact the quality of life, such as: decreased shoulder mobility and strength of the upper limb, chronic pain, anxiety, depression. The present paper is a study case aimed to identify the effects of an individualized low-intensity exercises program practiced in order to increase the upper limb strength. We included in this study 25 female subjects (n=25), aged between 33 and 70 years old, who underwent radical mastectomy and received chemotherapy and radiotherapy.

Key words: breast cancer, physical therapy, muscle strength, quality of life.

1. Introduction

Breast cancer is seen as a public health issue almost everywhere in the world, particularly in developed nations. A number of 2.26 million breast cancer cases are diagnosed annually, according to the latest World Health Organization reports, which is higher than in 2018, when there were diagnosed 2.09 million cases worldwide [20]. The primary breast cancer treatment is surgery and after that, most of the patients undergo radiotherapy and adjuvant therapy compounding chemotherapy and/or hormonal therapy [6].

Following the treatment, various complications can occur, such as: pain in the breast, chest wall and arm, upper limb lymphedema, decreased arm motion and

muscle strength, nausea, gynecological symptoms, anxiety, depression [12].

At the same time, breast cancer survivors experience long-lasting sequelae that appear as a consequence of the treatment. Symptoms might include functional, mental, emotional and physical changes that can profoundly impact the quality of life. These symptoms include: lymphedema, axillary web syndrome, chronic pain, decreased strength and range of motion, fatigue, fear of recurrence [4].

The success of cancer treatment has significantly decreased the mortality after the diagnosis in a way that cancer can be considered nowadays as a chronic disease. Although, numerous cancer patients are elderly, and their serious comorbid

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conditions may worsen as a result of the therapy. The immediate effects of chemotherapy and radiotherapy might speed up the development of cardiovascular disease, fact that can increase the mortality after adjuvant therapy. Physical inactivity, independent of the disease state, is an important risk factor to disease burden. For cancer patients, physical activity is usually recommended to enhance quality of life, decrease fatigue and to better the functional level [5].

Nowadays, there are multiple health public campaigns aimed to raise awareness regarding breast cancer, but there is also a need for more accurately information for women to really understand their risk. Compared to middle-aged and elderly women, the young ones tend to believe they have a greater risk to develop breast cancer [13].

Women highlight major discrepancies between their expectations following the surgery and the reality of physical function limitations, which is why they indicate the need for further more information regarding the side effects of treatment [1], [9].

Considering that the most used treatment after breast cancer surgery is chemotherapy, the effects it has on the human body have been more and more studied. Therefore, determining the best physical therapy approach is wanted in order to manage these negative consequences. Marques V. et al. [11] highlight that the patients' quality of life and handgrip isometric strength may be impaired during and after chemotherapy.

After receiving the cancer diagnosis most of the patient tend to their physical activity level and, sometimes they don't even adhere to a physical therapy program.

Self-reported physical function can be enhanced by performing, 3 times a week for 8 to 12 weeks, moderate-intensity aerobic training, resistance exercises or a combination of aerobic and resistance exercises. For older patient unsupervised physical therapy programs may be beneficial, but supervised exercises seem to be more beneficial than unsupervised or home-based therapy [2].

According to the *American College of Sports Medicine*, in order to increase the physical function, breast cancer survivors should practice 30 to 60 minutes of aerobic training 3 times/week, exercises for major muscle groups 8 to 12 repetitions, 2 sets performed 2-3 times per week or a combined program that consists of 20-40 minutes of moderate aerobic exercises practiced 3 times/week and strength exercises 2-3 times/week [19].

Merchant C.R. et al analysed the disparity in muscle strength between the shoulders. The authors highlight that the affected side was considerably weaker than the unaffected one especially in the extensor muscles, protractor and retractor muscles [14].

During the treatment, breast cancer patients tend to become less active while receiving chemotherapy and radiation therapy, which may result in a loss of muscle mass and strength.

An alternative to boost exercise adherence and enhance muscle strength in breast cancer survivors could be a supervised resistance training practiced once a week. The training program can become more effective because of the careful monitoring of the physical therapist during the individual approach [17].

Shoulder range of motion and muscular strength contribute to a high functional level of the shoulder. In order to improve

the shoulder mobility, patients should engage into both strengthening and mobility exercises [18].

A modern way to approach breast cancer patients is kinesiotaping combined to resistive exercises. It seems that a resistive exercises program plus kinesiotaping has more beneficial effects than performing resistive exercises alone. [16]

The present paper is a study case aimed to identify the effects of an individualized low-intensity exercises program practiced in order to increase the upper limb strength.

2. Material and Methods

We included in this study 25 female subjects (n=25), aged between 33 and 70 years old (3 subjects are 33, 2 subjects are 45, 2 subjects are 49, 3 subjects are 53, 1 subject is 57, 2 subjects are 58, 2 subjects are 63, 1 subject is 67, 2 subjects are 68, 3 subjects are 69 and 4 subjects are 70), who underwent radical mastectomy and received chemotherapy (n=22) and radiotherapy (n=20). 18 subjects received both chemotherapy and radiation therapy. 8 subjects have breast reconstruction.

We considered it useful to include in the research only the subjects who underwent mastectomy surgery 6 months ago.

The upper limb strength was evaluated using the muscle balance test for the following movements: flexion, extension, abduction, internal and external rotation. The results were quantified on a scale from 0 to 5, where:

- 0 = the impossibility to perform the movement of the upper limb;
- 1 = the contraction of the muscle can be felt when palpating it or the tendon;
- 2 = the limb can be moved at complete range of motion, but with gravitation removed;
- 3 = the limb can be moved at complete range of motion against gravitation;
- 4 = the movement can be performed against a minimal external resistance;
- 5 = performing the movement against medium external resistance.

The subjects received manual lymph drainage based on the dr. Vodder's protocol and after that they performed a low-intensity exercises program, 3 times a week, for 3 months. These exercises include shoulder flexion, extension, abduction, internal and external rotation, elbow flexion and extension. We used elastic bands and 0.5 kg dumbbells. The number of repetitions varied between 8 and 10.

3. Results

The muscle strength for shoulder flexion movement improved by 1.1 points, from 3.6 obtained at the initial evaluation to 4.7 at the last evaluation. The minimum value increased from 3 points to 4 points, and the maximum value remained 5 points. The average values show a group-wide improvement. The bilateral t test revealed a statistically significant difference between the two means, the significant threshold $p < 0.001 < 0.05$ (table 1).

Table 1

Statistical indicators – muscle strength for shoulder flexion

Assessment	Mean	Standard deviation	Amplitude	Variaton Coefficient	T test (t value)	P value	Effect size
Initial	3.6	0.6	2	16.4%	12.27	<0.0001	2.45
Final	4.7	0.5	1	9.7%			

The mean value, obtained after the initial and final muscle strength for shoulder extension movement assessment, has increased by 1.3 points, from 3.4 to 4.7. the minimum value increased by 2 points, while the maximum value improved by 1 point. The average values show a group-wide improvement from *moving the limb through full range of motion against gravitation to moving the limb against a maximum resistance*. The

values obtained from the measurements are dispersed relatively homogenously at the initial evaluation and homogeneously at the final evaluation. There is a statistically significant difference between the two mean values, the significant threshold $p < 0.001 < 0.05$. The effect size (2.78) highlights the subjects progress (table 2).

Table 2

Statistical indicators – muscle strength for shoulder extension

Assessment	Mean	Standard deviation	Amplitude	Variaton Coefficient	T test (t value)	P value	Effect size
Initial	3.4	0.6	2	16.9%	13.88	<0.0001	2.78
Final	4.7	0.5	1	9.7%			

The strength of the muscle involved in performing shoulder abduction improved by 1.9 points, from 2.8 at the first assessment to 4.7 at the last assessment. The average values changed from *performing the movement to complete range of motion against the gravitation to performing the movement against a*

medium resistance. After the analysis of the results obtained, we noticed that the difference between the two mean values is significant from a statistic point of view ($p < 0.001 < 0.05$). The subjects' progress is highlighted by the effect size (table 3).

Table 3

Statistical indicators - muscle strength for shoulder abduction

Assessment	Mean	Standard deviation	Amplitude	Variaton Coefficient	T test (t value)	P value	Effect size
Initial	2.8	0.6	2	23.1%	21.38	<0.0001	4.28
Final	4.7	0.5	1	10.2%			

Internal and external rotation are movements that are difficult to perform

after breast cancer surgery. We also evaluated this movement in order to identify the level of disability after breast

cancer treatment. Our subjects increased the strength of the rotator muscles.

Regarding both the internal and external rotation movements, most of the subjects evolved from *performing the movement to complete range of motion against the*

gravitation to performing the movement against a medium resistance. In both cases the effectiveness of the exercises program is proven by the effect size (table 4, table 5).

Table 4

Statistical indicators – muscle strength for internal rotation movement

Assessment	Mean	Standard deviation	Amplitude	Variaton Coefficient	T test (t value)	P value	Effect size
Initial	3	0.5	2	16.7%	13.88	<0.0001	2.78
Final	4.4	0.5	1	11.2%			

Table 5

Statistical indicators – muscle strength for external rotation movement

Assessment	Mean	Standard deviation	Amplitude	Variaton Coefficient	T test (t value)	P value	Effect size
Initial	3.3	0.5	2	16.5%	13.88	<0.0001	2.78
Final	4.6	0.5	1	10.6%			

4. Discussion

Increasing muscle strength of breast cancer patients is not a common topic because most of the physical therapist concentrate on decreasing breast cancer related lymphedema and increasing upper limb range of motion. It seems that supervised exercises practiced with weight doesn't raise the risk of breast cancer related lymphedema, on the contrary it is beneficial for the patient well-being considering that this type of exercises is beneficial for muscle strength [15].

Since so much emphasise is place on breast cancer survivors' quality of life, we consider that an important parameter that negatively influences it is upper limb lymphedema developed after the treatment. Most of the therapists first focus on reducing its volume in order to be able to work on range of motion and muscle strength later.

The first thing that patients are thought, immediately after the surgery, is how to manage the lymphedema, in case it occurs. Sometimes patients are recommended to wear a compression sleeve and to address to a physical therapist specialized on lymphedema and rehabilitation after breast cancer treatment. Unfortunately, the existence of lymphedema automatically decreases shoulder range of motion, which is linked to a declined life quality.

Compared to the general population, most cancer survivors experience reductions in physical activity, do not participate in periodic exercise programs and are not inclined to adhere to supervised physical activities.

Cardiovascular fitness is an important parameter for patients in order to gain physical independence. However, studies on cardiovascular fitness development are uncommon for women whose arm

lymphedema is connected to breast cancer. The authors Jonsson & Johanson highlight that Nordic walking can improve breast cancer survivors' well-being, decrease body weight and enhance cardiovascular fitness. Besides the advantage of being practiced outdoors, Nordic walking is also associated with the reduction of breast cancer related lymphedema, if practiced 3 times weekly, 30 to 60 minutes [10].

Moderate-intensity exercises not only increase muscle strength it also enhances upper limb range of motion, walking endurance, cardiovascular fitness and reduce anxiety [3].

Another approach regarding breast cancer survivors may be a yoga adapted exercises program which can contribute to reducing body mass index. This is an important aspect in improving patient self-image and well-being. In addition to resistance exercises, yoga-based programs may optimize the outcomes of patient engagement in physical activities. Thus, there were noticed improvements in physical function, lymphedema and muscle balance [8].

It was found that there is an important relationship between active range of motion, passive range of motion, muscle strength and shoulder disability. Using the *Disabilities of Arm, Shoulder and Hand (DASH)* questionnaire, we can find out breast cancer survivors self-reported impairments that are connected to the upper extremity functional loss. Abduction and external rotation active range of motion are the most decreased movement, which breast cancer patient describe to be disabling and disturbing, affecting the quality of life and functional independence [7].

We believe that identifying more

assessment techniques for shoulder gridle impairments can improve patient rehabilitation in order to increase quality of life and help them be functional independent.

Certainly, our study has some limitations, the most important of which is the low number of participants. Therewith, there are some strength such as approaching a little researched topic, combining different techniques in order to reduce the lymphedema and increase the muscle strength and carrying out the assessment of muscle strength through a practical method.

5. Conclusions

The rehabilitation treatment in breast cancer is based on managing the long-term side effects that negatively impact the breast cancer survivor quality of life.

Decreased muscle strength and range of motion are the most disabling side effects that the treatment, received by the most of the patient, has on the human body.

After statistical analysis and interpretation of the results we noticed that the muscle strength improved for all shoulder moves. According to the bilateral t test, with a p value $<0.001 < 0.05$, the difference between the first and final assessment is significant from a statistical point of view.

In conclusion, the therapy program has proven its efficiency whereas the upper limb strength increased for shoulder flexion, extension, abduction, internal and external rotation, which positively influenced the quality of life.

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References

1. Binkley, J. M., Harris, S.R., Levangie, P., et al.: *Patient perspectives on breast cancer treatment side effects and the prospective surveillance model for physical rehabilitation for women with breast cancer*. In: *Cancer*, Vol. 118, 2012, p. 2207–2216, doi:10.1002/cncr.27469.
2. Campbell, K. L., Winters-Stone, K. M., Wiskemann, J., et al.: *Exercise Guidelines for Cancer Survivors: Consensus Statement from International Multidisciplinary Roundtable*. In: *Medicine and science in sports and exercise*, Vol. 51, 2019, p. 2375–2390. <https://doi.org/10.1249/MSS.0000000000002116>.
3. Dennett, A., Peiris, C., Shields, N., et al.: *Moderate-intensity exercise reduces fatigue and improves mobility in cancer survivors: a systematic review and meta-regression*. In: *Journal of Physiotherapy*, Vol. 62, 2016, p. 68-82, <https://doi.org/10.1016/j.jphys.2016.02.012>.
4. Ewertz, M., Jensen, B.A.: *Late effects of breast cancer treatment and potential for rehabilitation*. In: *Acta Oncologica*, Vol. 50, 2010, p. 187-193, DOI: 10.3109/0284186X.2010.533190.
5. Foley, M., Barnes, V., Hasson, S.: *Effects of a community-based multimodal exercise program on a physical function and quality of life in cancer survivors: a pilot study*. In: *Physiotherapy Theory and Practice*, Vol. 31, 2015, p. 303-312, <https://doi.org/10.3109/09593985.2015.1004390>.
6. Gho, S.A., Steel, J.R., Jones, S.C., et al.: *Self-reported side effects of breast cancer treatment: a cross-sectional study of incidence, associations, and the influence of exercise*. In: *Cancer Causes Control*, Vol. 24, 2013, p. 517-528, <https://doi.org/10.1007/s10552-012-0142-4>.
7. Harrington, S., Padua, D., Battaglini, C. et al: *Upper extremity strength and range of motion and their relationship to function in breast cancer survivors*. In: *Physiotherapy Theory and Practice*, Vol. 29, 2013, p. 513-520, <https://doi.org/10.3109/09593985.2012.757683>.
8. Hughes, D., Darby, N., Gonzalez, K., et al.: *Effects of a six-month yoga exercise intervention on fitness outcomes for breast cancer survivors*. In: *Physiotherapy Theory and Practice*, Vol. 31, 2015, p. 451-460, <https://doi.org/10.3109/09593985.2015.1037409>.
9. Jones, S., Magee, C., Brrie, L., et al.: *Australian Women's Perceptions of Breast Cancer Risk Factors and the Risk of Developing Breast Cancer*. In: *Women's Health Issue*, Vol.21, 2011, p. 353-360, <https://doi.org/10.1016/j.whi.2011.02.004>
10. Jonsson, C., Johansson, K.: *The effects of pole walking on arm lymphedema and cardiovascular fitness in women treated for breast cancer: a pilot and feasibility study*. In: *Physiotherapy Theory and Practice*, Vol. 30, 2014, p. 236-242, <https://doi.org/10.3109/09593985.2013.848961>.
11. Klassen, O., Schmidt, M., Ulrich, C., et al.: *Muscle strength in breast cancer patients receiving different treatment*

- regimes*. In: Journal of Cachexia, Sarcopenia and Muscle, Vol. 8, 2016, p.305-316, <https://doi.org/10.1002/jcsm.12165>.
12. Lovelace, D.L., McDaniel, L., Golden, D.: *Long-Term Effects of Breast Cancer Surgery, Treatment, and Survivor Care*. In: Journal of Midwifery & Women Health, Vol. 64, 2029, p. 713-724, <https://doi.org/10.1111/jmwh.13012>.
 13. Marques, V.A., Ferreira-Junior, J.B., Lemos, T.V., et al.: *Effects of Chemotherapy Treatment on Muscle Strength, Quality of Life, Fatigue, and Anxiety in Women with Breast Cancer*. In: International Journal of Environmental Research and Public Health, Vol. 17, 2020, p. 7289-7299, <https://doi.org/10.3390/ijerph17197289>.
 14. Merchant, C.R., Chapman, T., Kilbreath, S.R., et al.: *Decreased muscle strength following management of breast cancer*. In: Disability and Rehabilitation, Vol. 30, 2008, p. 1098-1105, DOI: 10.1080/09638280701478512.
 15. Paramanandam, S.V., Roberts D.: *Weight training is not harmful for women with breast cancer-related lymphoedema: a systematic review*. In: Journal of Physiotherapy, Vol. 60, 2014, p. 136-143, <https://doi.org/10.1016/j.jphys.2014.07.001>.
 16. Ramadan, A., ElDeeb, A., Ramadan, A.A. et al.: *Effects of combined Kinesiotaping and resistive exercises on muscle strength and quality of life in breast cancer survivors: a randomized clinical trial*. In: Journal of the Egyptian National Cancer Institute, Vol. 36, 2024, p. 1-7, <https://doi.org/10.1186/s43046-023-00205-z>.
 17. Ribeiro, I.L., Moreira, R.F.C., Ferrari, A.V., et al.: *Effectiveness of early rehabilitation on range of motion, muscle strength and arm function after breast cancer surgery: a systematic review of randomized controlled trials*. In: *Clinical Rehabilitation*, Vol. 33, 2019, p. 1876-1886, doi:10.1177/0269215519873026.
 18. Santos, W.D.N., Vieira, A., de Lira, C.A.B., et al.: *Once a Week Resistance Training Improves Muscular Strength in Breast Cancer Survivors: A Randomized Controlled Trial*. In: *Integrative Cancer Therapies*, Vol. 18, 2019, p. 1-9, Doi:10.1177/1534735419879748.
 19. *** American College of Sports Medicine https://www.acsm.org/docs/default-source/files-for-resource-library/exercise-guidelines-cancer-infographic.pdf?sfvrsn=c48d8d86_6. Accessed: 30.01.2024.
 20. *** World Health Organization <https://www.who.int/news-room/fact-sheets/detail/cancer>. Accessed: 31.01.2024.