Physical Functionality of the Upper Limb after Breast Cancer Surgery in Southern Brazilian Survivors: Cross-Sectional Study

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Funcionalidade do Membro Superior após a Cirurgia do Câncer de Mama em Sobreviventes do Sul do Brasil: Estudo de Corte Transversal

Función Física de la Extremidad Superior Después de una Cirugía de Cáncer de Mama en Sobrevivientes del Sur de Brasil: Estudio Transversal

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ABSTRACT

Introduction: Surgical treatment after the diagnosis of breast cancer can lead to several consequences of the survivor's upper limb. **Objective:** Analyze the physical function of the upper limb after breast cancer surgery in Southern Brazilian survivors. **Method:** 82 breast cancer survivors (55±10 years) receiving hormone therapy were included. A questionnaire for general information, pain (Visual Analogue Scale), and upper limb functionality (DASH) were applied, followed by physical tests; the shoulder range of motion (goniometer), strength (dynamometer), proprioception (kinesimeter) and arm volume (perimeter of the arm). **Results:** No differences were found for any variable of physical function in relation to mastectomy or breast-conserving surgery. However, better scores of strength and the shoulder range of motion were found for the non-surgery arm. Linear regression demonstrated a relation between pain, strength, range of motion, proprioception, and arm volume with the disabilities of the upper limb, and when adjusted by surgery modality, shoulder range of motion, arm volume, and proprioception maintained significantly. **Conclusion:** Breast cancer survivors presented physical disabilities on the upper limb after surgery, regardless of the modality of surgery. Results elucidate the need for an efficient post-treatment program to prevent poor physical function after breast cancer surgery and provide better daily activities to these women.

Key words: Breast Neoplasms; Mastectomy; Pain; Muscle Strength; Upper Extremity/physiopathology.

RESUMO

Introdução: O tratamento cirúrgico do câncer de mama pode levar a consequências físicas no membro superior de sobreviventes. **Objetivo:** Analisar a funcionalidade do membro superior após cirurgia de câncer de mama em sobreviventes do Sul do Brasil. **Método:** Foram avaliadas 82 sobreviventes de câncer de mama (55±10 anos) em tratamento com hormonioterapia. Foi aplicado um questionário para informações gerais, dor (Escala Visual Analógica) e funcionalidade do membro superior (DASH), seguido de testes físicos; amplitude de movimento (goniômetro), força (dinamômetro), propriocepção (cinesiômetro) e volume do braço (perímetro do braço). **Resultados:** Não foram encontradas diferenças para nenhuma das variáveis de funcionalidade em relação à mastectomia ou cirurgia conservadora de mama. No entanto, melhores escores de força e amplitude de movimento foram apresentados no membro contralateral à cirurgia. A regressão linear demonstrou uma relação entre dor, força, amplitude de movimento, propriocepção e volume do braço com as disfunções do membro superior e, quando ajustada pela modalidade de cirurgia, apenas a amplitude de movimento, volume do braço e propriocepção mantiveram-se significativamente. **Conclusão:** A cirurgia do câncer de mama pode levar à pior funcionalidade no membro superior, independentemente da modalidade da cirurgia. Os resultados elucidam a necessidade de um programa eficiente de pós-tratamento para prevenir as consequências na função física do membro superior após cirurgia de câncer de mama e proporcionar melhora nas atividades de vida diária nessa população.

Palavras-chave: Neoplasias da Mama; Mastectomia; Dor; Força Muscular; Extremidade Superior/fisiopatologia.

RESUMEN

Introducción: El tratamiento quirúrgico después del diagnóstico de cáncer de seno puede conducir a varias consecuencias de la extremidad superior de la sobreviviente. **Objetivo:** Analizar la función física de la extremidad superior después de una cirugía de cáncer de mama en sobrevivientes del sur de Brasil. **Método:** Se incluyeron 82 sobrevivientes de cáncer de mama (55±10 años) que recibieron terapia hormonal. Se aplicó un cuestionario para información general, dolor (escala analógica visual) y funcionalidad de la extremidad superior (DASH), seguido de pruebas físicas; el rango de movimiento (goniómetro), fuerza (dinamómetro), propiocepción (kinesímetro) y volumen del brazo (perímetro del brazo). **Resultados:** No se encontraron diferencias para ninguna variable de la función física con respecto a someterse a una mastectomía o cirugía conservadora de seno. Sin embargo, se encontraron mejores puntajes de fuerza y rango de movimiento para el brazo no quirúrgico. La regresión lineal demostró una relación entre el dolor, la fuerza, el rango de movimiento, la propiocepción y el volumen del brazo con las discapacidades de la extremidad superior, y cuando se ajustó por la modalidad quirúrgica, el rango de movimiento, el volumen del brazo y la propiocepción se mantuvieron significativamente. **Conclusión:** Las sobrevivientes de cáncer de mama presentaron discapacidades físicas en la extremidad superior después de la cirugía, independientemente de la modalidad de la cirugía. Los resultados aclaran la necesidad de un programa de postratamiento eficiente para prevenir la mala función física después de la cirugía de cáncer de mama y proporcionar mejores actividades diarias a estas mujeres.

Palabras-clave: Neoplasias de la Mama; Mastecomía; Dolor; Fuerza Muscular; Extremidad Superior/fisiopatología.

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INTRODUCTION

Oncoplastic surgery is the primary treatment for breast cancer, and may be preceded by neoadjuvant chemotherapy and target therapy treatments, and followed by adjuvant radiotherapy, chemotherapy, target therapy or hormone therapy, these treatments are intended to interfere in the progression or prevent breast neoplasm recurrence[1,2].

Despite the development of new surgical techniques and the success of adjuvant or neoadjuvant treatments, some consequences are identified and can lead to functional physical impairment in women, affecting the surgery side upper limb, shoulder range of motion, causing muscle weakness, pain, loss of upper limb functionality, decreased proprioception and lymphedema[3-8]. These treatment consequences can cause hypomobility of the upper limb, implicating in physical and psychological distress in women's lives, decreasing the performance of daily living activities[9,10].

Therefore, investigations of shoulder range of motion, strength, pain, upper limb functionality, and proprioception after breast cancer surgery are essential, considering the possibility of permanent weakness of the muscles from the breast and the shoulder girdle, or temporary weakness of the anterior serratus, as well as other upper limb muscles[11]. Arm and breast pain are some of the most reported symptoms occurring in 70% of the patients after five years of treatment[9,12].

Given the importance of studies in this area, it is essential to investigate if the type of surgery is related to physical function of the upper limb, and also, to identify the differences between the side of the arm submitted to surgery and contralateral arm; besides, it is important to contribute to health professionals to improve their evidence-based treatments, especially in low- and middle-income countries as Brazil. Thus, the aim of this study was to (i) analyze the physical function of the upper limb after breast cancer surgery in Brazilian survivors, and (ii) compare the type of surgery and the changes in the homolateral and contralateral arm submitted to surgery.

METHOD

Study design

Analytic, observational, and cross-sectional design study according to STROBE recommendation, and baseline data analyses from the MoveMama study, a randomized clinical trial registered at ClinicalTrials.gov (NCT03194997) and described in detail elsewhere[13].

Participants

Eighty-two women (55±10 years) with breast cancer undergoing clinical treatment at the Cancer Research Center (CEPON) in the city of Florianopolis, Santa Catarina, Brazil were invited. The sample size was calculated using the software G*Power 3.1.9.2., considering a significance level of 0.05, power of 72%, and effect size of 0.5.

Inclusion criteria were defined as: (1) Age older than 18 years; (2) breast cancer clinical stage I to III (data collected in the medical record); (3) in adjuvant treatment with hormone therapy, chemotherapy or radiotherapy; (4) living in the cities of Florianopolis or São José, State of Santa Catarina.

The Institutional Review Board (CEPSH) of Udesc, protocol number. 688.548 and of CEPON (CEP), protocol number 818.174 approved the study. All the participants were invited to participate in the study voluntarily, and those who accepted signed the Informed Consent Form.

Data collection

Data were collected through individual interview with a questionnaire containing personal and clinical information, pain perception and functionality of the upper limb, followed by physical tests to check the upper limb muscular strength, shoulder range of motion, proprioception, and arm volume. Three authors (LB, TBF and BL) from the Laboratory of Research in Leisure and Physical Activity - LAPLAF/CNPq conducted the interview, the tests were applied during 50 minutes in average.

Variables

Self-reported clinical information (current treatment, modality of hormone therapy, previous clinical treatment, characteristics of the surgical intervention and breast reconstruction, date of surgery, presence or absence of lymphedema, treatment in physiotherapy, laterality).

Pain perception

Visual Analogue Scale (VAS) was used to measure the pain. It is a one-dimensional measure for assessing pain intensity. It consists of a 10 cm continuous line, with anchors at both ends, at one end of the line is marked "no pain" and the other "worst pain imaginable". The magnitude of the pain is indicated by marking the line and a ruler is used to quantify the measurement on a scale of 0-100mm[14].

Functionality of the upper limb

Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire translated and validated for Brazilians[15] was used to evaluate the functionality of the upper limb. It is an instrument developed to assess the inability and symptoms

of single or multiple upper limb disorders. It contains 30 questions, involving activities of daily living, symptoms of pain, tingling and stiffness and questions about social aspects, work, sleep, and self-confidence. The final score varies from 0 to 100 points, the higher score indicates dysfunction of the patient's upper limb.

Muscular strength

The Chatillôn® portable digital dynamometer was utilized to assess the muscular strength, which can measure overall appendicular muscle strength and all body segments[16]. The muscle groups of flexion, extension, abduction, internal rotators, and external rotators of the shoulder were assessed. Each muscle group was evaluated three times, and for the analysis the mean of these evaluations[17] was used. The movement was performed for seven seconds bilaterally. In all cases, the patients were instructed before and during the repetitions about the specific position for the evaluation.

Shoulder range of motion

The digital goniometer (Absolute Axis 360°) was used to measure the shoulder range of motion[18] flexion, abduction, and external rotation movements. The abduction movement was performed with the patient sitting, and the movements of flexion and external rotation with the patient lying on the stretcher.

Proprioception

A joint position reproduction in a kinesimeter validated[19] for Brazil and used in breast cancer studies[8,20]. Patients remain seated in front of a table with an instrument showing the degrees of the movement from 0 to 90 degrees. The arm was in supination and moved in three positions, 0 to 90 degrees, then return to 45 degrees and for the last, 105 degrees. The movements were realized two times, first with the investigator moving the patients arms and then the patient alone executed the procedure. In both times the patients' eyes were blinded. The degree of each joint position is recorded and then decreased by the original degree, demonstrating how many degrees were missing or exceeded the exact point. All the degrees are added to provide an absolute error.

Arm volume

Arm volume was measured using the perimeter of the arm technique. It was calculated by five points along the arm: 21 cm and 11.5 cm above the olecranon and 7.5, 14 and 24 cm under the olecranon. The patient was sitting during the evaluation with a flexed arm and the hand at the opposite side of the chest. These measures were summed according to Bergman et al.[21].

Statistical methods

For purposes of statistical analysis of the data, the patients were grouped into a) submitted to mastectomy (total breast removal) and b) breast-conserving surgery (removal of only part of the breast, such as quadrantectomy). To verify the association between the groups with clinical characteristics, the Chi-Square or Fisher's Exact Tests were adopted. The Kolmogorov Smirnov Test was utilized to calculate the normality of the variables. The t-Test was used to compare pain perception, upper limb functionality, strength, shoulder range of motion, proprioception, and arm volume between groups for independent samples, and its corresponding non-parametric Mann Whitney U-Test. The paired T test or Wilcoxon test according to normality tests was used to compare the surgical side and non-surgical side arm. To relate the physical function (independent variables) with the DASH scores (dependent variable) it was used the Linear Regression, and all the variables were included in the adjusted linear regression and controlled by surgical modality. The level of statistical significance adopted in the analyzes was $p<0.05$ and all analyzes were performed using IBM SPSS version 20.0.

RESULTS

The clinical information of the patients with breast cancer included in the study is described in Table 1. Most of the patients were submitted to left side surgery, and bilateral surgery was more frequent in patients submitted to mastectomy ($p=0.043$).

Most of the patients submitted to mastectomy were also submitted to the axillary lymph node dissection ($p=0.014$) and received chemotherapy ($p<0.001$). The majority of the patients submitted to breast-conserving surgery did not receive any axillary lymph node dissection ($p=0.014$), and previously received chemotherapy and radiotherapy ($p<0.001$). All the patients currently taking chemotherapy were submitted to mastectomy, however, most of the patients in this study were currently receiving hormone therapy ($p=0.002$).

No significant differences were found for the comparison between strength, shoulder range of motion, pain perception, upper limb functionality, proprioception, and arm volume of patients with breast cancer submitted to mastectomy or breast-conserving surgery ($p>0.05$) (Table 2).

Table 3 shows the difference between the surgery and non-surgery upper limb side in muscular strength, shoulder range of motion, proprioception, and arm volume. The non-surgical side demonstrated better values of muscular strength in flexion, extension, and abduction movements ($p=0.012$, $p=0.006$, $p=0.014$, respectively)

and also presented better values of shoulder range of motion in abduction position (p=0.006). Significant differences between the two sides of the upper limb for proprioception and arm volume (p>0.05) were not found.

The relation between DASH scores with pain, muscular strength, shoulder range of motion, proprioception and arm volume from the upper limb surgery side is presented in Table 4. Univariate Linear Regression demonstrated that all the variables showed a relation with upper limb disabilities in which the worse score for pain, strength, shoulder range of motion, proprioception and arm volume were related to worse functionality of the surgical arm. In

Table 1. Characteristics of the breast cancer patients submitted to mastectomy or breast-conserving surgery (n=82)

Variables	Total (n=82)	Mastectomy (n=33)	Breast-conserving surgery (n=49)	p value
Time after surgery (months)	30.4(18.2)	28.0(18.1)	32.0(18.2)	0.334+
Side of the surgery				**0.043****
Right	42.7	36.4	46.9	
Left	48.8	45.5	51.0	
Bilateral	8.5	18.2	2.0	
Lymphadenectomy				**0.014****
Dissection	59.8	78.8	46.9	
Sentinel lymph nodes	18.3	12.1	22.4	
Not performed	22.0	9.1	30.6	
Current treatment				**0.002****
Chemotherapy	7.3	18.2	0.0	
Radiotherapy	2.4	3.0	2.0	
Hormone therapy	84.1	72.7	91.8	
Herceptin	3.7	6.1	2.0	
No treatment	2.4	0.0	4.1	
Modality of Hormone therapy##				0.141*
Aromatase inhibitors	55.9	43.5	62.2	
Tamoxifen	36.6	56.5	37.8	
Previous treatment				**0.000****
Only radiotherapy	25.6	6.9	36.7	
Only chemotherapy	26.9	51.7	12.2	
Chemotherapy and radiotherapy	47.4	41.4	51.0	
Lymphedema				0.414*
Yes	17.1	21.2	14.3	
No	82.9	78.8	85.7	
Feeling of swelling				0.111*
Yes	43.9	54.4	36.7	
No	56.1	45.5	63.3	
Physiotherapy				1.000**
Yes	11.0	12.1	10.2	
No	89.0	87.9	89.8	
Dominant arm				1.000**
Right handed	93.9	93.9	93.9	
Left handed	6.1	6.1	6.1	

Note: + T test for independent samples.
(*) Chi-Square Test.
(**) Fisher's Exact Test.
(##) Only 68 patients undergoing hormone therapy.

Table 2. Comparison between strength, shoulder range of motion, pain perception, upper limb functionality, proprioception and arm volume of the breast cancer patients submitted to mastectomy or breast-conserving surgery (n=82)

Variables	Total (n=82)	Mastectomy (n=33)	Breast-conserving surgery (n=49)	p value
Upper limb muscular strength				
Surgery side				
Flexion	78.0(36.0)	75.3(36.6)	79.3(36.0)	0.626*
Extension	71.6(32.1)	69.0(34.3)	73.4(31.0)	0.532*
Abduction	70.0(32.1)	73.2(34.0)	68.0(30.0)	0.458*
Internal rotation	49.4(22.4)	51.0(27.0)	48.5(19.3)	0.681*
External rotation	53.0(21.5)	54.4(22.5)	52.1(21.1)	0.661*
Non-surgery side				
Flexion	86.5(33.3)	85.3(38.2)	87.4(30.0)	0.781*
Extension	81.1(33.1)	81.5(38.0)	81.0(30.0)	0.930*
Abduction	78.6(34.3)	80.0(36.1)	78.0(33.4)	0.807*
Internal rotation	54.0(20.4)	55.0(23.0)	54.0(19.0)	0.826*
External rotation	58.0(21.3)	57.4(20.4)	58.5(22.1)	0.827*
Shoulder ROM				
Surgery side				
Abduction	146.5(26.6)	142.1(30.0)	150.0(24.0)	0.300**
Flexion	144.4(29.1)	139.5(32.0)	148(27.0)	0.298**
External rotation	75.3(21.1)	74.0(21.0)	76.3(21.5)	0.584*
Non-surgery side				
Abduction	153.4(24.6)	152.2(30.0)	154.3(20.5)	0.887**
Flexion	149.0(26.1)	145.6(29.1)	151.2(24.0)	0.493**
External rotation	80.3(19.1)	78.2(20.0)	82.0(18.6)	0.414*
Pain perception	4.6(2.7)	5.3(2.6)	4.2(3.0)	0.104**
Upper limb functionality	27.0(30.4)	29.3(20.1)	25.3(20.5)	0.393*
Arm volume				
Surgery side	1454.0(405.0)	1480.0(431.3)	1436.3(390.0)	0.674**
Non-surgery side	1438.0(380.0)	1457.0(391.1)	1425.0(375.4)	0.707*
Proprioception				
Surgery side	12.5(13.3)	11.5(10.0)	13.1(15.2)	0.850**
Non-surgery side	11.7(11.1)	12.5(10.0)	11.2(12.0)	0.254**

(*) T test for independent samples.
(**) Mann-Whitney U test. ROM, range of motion. Strength presented in Newtons. Shoulder ROM presented in degrees.

the Multiple Linear Regression, controlled by modality of surgery, the shoulder range of motion abduction, arm volume and proprioception were significantly related to the functionality of the surgical side, demonstrating that regardless of the modality of surgery, the women with worse shoulder range of motion, arm volume and proprioception presented issues in functionality of the surgical side arm.

DISCUSSION

Breast cancer surgical procedures, and adjuvant and neoadjuvant related clinical treatments trigger a series of side effects in the patient's life and functional capacity of daily living[22,23]. Thus, the present study aimed to analyze the physical functional changes in the upper limb of patients submitted to breast cancer surgery, comparing

Table 3. Difference between the surgery and the non-surgery upper limb side strength, shoulder range of motion, proprioception, and arm volume of patients with breast cancer submitted to surgery (n=75)

	Surgery side	Non-surgery side	p value
Strength			
Flexion	78.0(36.0)	86.5(33.3)	**0.012***
Extension	71.6(32.1)	81.1(33.1)	**0.006***
Abduction	70.0(32.1)	78.6(34.3)	**0.014***
Internal rotation	49.4(22.4)	54.0(20.4)	0.080*
External rotation	53.0(21.5)	58.0(21.3)	0.051*
Shoulder ROM			
Abduction	146.5(26.6)	153.4(24.6)	**0.006****
Flexion	144.4(29.1)	149.0(26.1)	0.147**
External rotation	75.3(21.1)	80.3(19.1)	0.050*
Arm volume	1453.8 (405.0)	1437.6(380.0)	0.231*
Proprioception	12.5(13.3)	12.0(11.1)	0.627**

(*) Paired Sample T-test.
(**) Wilcoxon Test. ROM – range of motion. Strength presented in Newtons. Shoulder ROM presented in degrees.

Table 4. Relation between DASH scores with pain, strength, shoulder range of motion, arm volume and proprioception of the upper limb of the surgery side (n=75)

Variables	Univariate Linear Regression		Multiple Linear Regression	
	Beta (CI 95%)	p value	Beta (CI 95%)	p value
Pain	2.906 (1.434;4.379)	**<0.001**	1.093(-0.284;2.471)	0.118
Strength				
Flexion	-0.247(-0.359; -0.134)	**<0.001**	-0.134(-0.354;0.085)	0.225
Extension	-0.271(-0.397; -0.145)	**<0.001**	-0.029(-0.276;0.217)	0.814
Abduction	-0.277(-0.403; -0.151)	**<0.001**	-0.045(-0.245;0.155)	0.655
Internal rotation	-0.307(-0.489; -0.124)	**<0.001**	-0.061(-0.367;0.245)	0.691
External rotation	-0.309(-0.511; -0.108)	**<0.001**	0.095(-0.183;0.373)	0.498
Shoulder ROM				
Abduction	-0.402(-0.547; -0.257)	**<0.001**	-0.223(-0.400;-0.045)	**0.015**
Flexion	-0.315(-0.453; -0.176)	**<0.001**	0.012(-0.173;0.196)	0.899
External rotation	-0.405(-0.603; -0.207)	**<0.001**	-0.103(-0.327;0.120)	0.359
Arm volume	0.009(-0.002;0.020)	**0.124**	0.012(0.001;0.024)	**0.037**
Proprioception	0.559(0.250;0.869)	**0.001**	0.399(0.032;0.766)	**0.034**

Note: Strength presented in Newtons. Shoulder ROM presented in degrees. For the multiple regression the variables with p<0.20 in the simple linear regression were included. Multiple linear regression was adjusted by the modality of surgery.

the type of surgery and the changes in the homolateral and contralateral upper limb. The main results showed no differences for physical function according to the surgery type, but when analyzing the differences between the surgical and non-surgical arm side, better scores were found for strength and shoulder range of motion of the non-surgical arm side. Also, the results demonstrated a relation between the physical function outcomes and the functionality of the upper limb in the surgical side, presenting worse scores for shoulder range of motion, arm volume and proprioception regardless of the modality of breast cancer surgery.

The decrease in shoulder range of motion after breast cancer surgery occurs in one of every two patients with breast cancer[6,24,25]. The results showed better values of the non-surgical side on abduction and external rotation. These lower degrees of shoulder range of motion identified in patients submitted to mastectomy may be considered as

a process that could compromise the development of the so-called immobilization syndrome. This syndrome occurs due to muscles, lymph nodes and nerves resection, and by cicatricial adherence since these patients usually present contracture of the musculature of the scapular region and sensory alterations[26]. Most patients who underwent mastectomy reported the feeling of swelling in the affected arm; it may be responsible for the reduction in daily living activities and job activities[6], reinforcing that patients were retired or unemployed during data collection.

The axillary lymph node dissection can be responsible for the alteration in shoulder range of motion as well, considering the development of cords of scar tissue in the lymph vessels from the armpit to the elbow, which compromises shoulder movement and may cause pain and tightness on the arm[27]. This modality of procedure was conducted in most of the patients who underwent mastectomy, and although the results did not demonstrate statistically significant results for pain, these patients presented worse pain perception and the results showed a relation between pain and functionality of the arm as well. According to Fretta el al.[28] the decrease in shoulder range of motion, muscle weakness and worse pain are determinant factors to worse functionality of the arm of the surgical side.

Furthermore, the clinical treatment may also be associated with pain perception, where most patients were being treated with hormone therapy, and most of them used aromatase inhibitors. Regarding this modality of hormone therapy, consequences are found in relation to pain, as aromatase inhibitors induced arthralgia, that is, joint pain, which is a common symptom and occurred in half of women using aromatase inhibitors[29,30]. This pain may reduce the arm movement, leading to poorer upper limb function[31].

Upper limb functionality and muscle strength may also be associated with the surgery modality and axillary lymph node dissection[32]. However, there was no significant differences between surgery modality, the only differences were found regarding the side of the surgery, where the surgical side presented worse scores for strength in flexion, extension, and abduction and in shoulder range of motion for abduction. And a relation between worse strength on the surgical side and worse functionality of the arm was found. Similar results were encountered in Akoochakian et al.[33] with a significant decrease in muscle strength for women undergoing breast cancer surgery. The study of Belmonte et al.[32] investigated patients submitted to mastectomy and axillary lymph node dissection, and they presented worse upper limb strength, shoulder range of motion and quality of life for five years after surgery. These outcomes are a warning for follow-up of these patients during various periods of treatment and post-treatment.

Upper limb functionality is related to the daily activities of women with breast cancer and impairments from oncological treatment such as increase of the arm volume, pain, paresthesia, muscle weakness and reduction in shoulder range of motion may compromise the reinitiation of these daily activities[34,35]. The results from this study showed a relation between arm volume and worse functionality of the upper limb. One in every five breast cancer survivors will develop increase of arm volume and the risk is worse for women undergoing radiotherapy, surgery, poor general health and obese[36,37]. These results strengthen the need for social support, especially for obese women; it should be recommended physical activity and proper nutrition habits.

All the physical alterations, surgical procedures, radiotherapy, and immobilization of the upper limb on the surgical side can impair the mechanoreceptors of the skin, muscle, tendon, and ligaments, and affect proprioception[38] negatively. The results showed that regardless of the modality of surgery, breast cancer survivors with worse proprioception presented worse upper limb functionality. The study of Zanon et al.[20] demonstrates an absolute error of 14.69 degrees for women with breast cancer after surgery, like the results of this study with an error of 12.0 degrees for the surgical side. In another study with healthy older women using the same instrument of this study and in Zanon et al.[20] the absolute error of proprioception was 11.30 for 59 to 69 years old women[39], demonstrating that women with breast cancer may present worse proprioception in comparison with healthy older women. However, more studies comparing a similar sample should be conducted to confirm these results.

The results of the present study are relevant, since raising awareness of patients submitted to breast cancer surgery is an essential role for accessing reliable sources of health information and collaborate in their treatment and self-care[40]. Some limitations of this study are related to: sample size, which may have been one of the reasons for statistical non-veracity in some variables, most of the women in hormone therapy have received chemotherapy or radiotherapy and it can be a selection bias, self-reported variables, in addition of being a cross-sectional study, which does not allow a cause and effect relation.

CONCLUSION

This study evidences that women with breast cancer with worse scores for pain, shoulder range of motion, upper limb strength, arm volume and proprioception have worse upper limb functionality on the surgical side. Regardless of the modality of surgery, the shoulder range of motion

abduction, the arm volume, and the proprioception lead to a worse functionality of the upper limb. For the surgical side of the upper limb, the movements of flexion, extension and abduction strength and shoulder range of motion abduction were worse comparing to the non-surgical side. And the surgery modality did not promote differences in the physical variables. Due to the findings, it is essential to promote safe interventions on the surgical side of the upper limb regardless of the type of surgery, and alert women to continue with daily activities and physical activity after breast cancer surgery to promote and maintain their physical health and balance between the two sides of the upper limb.

CONTRIBUTION

The authors contributed equally to all the study phases and approved the final version to be published.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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