ORIGINAL ARTICLE

Effects of physiotherapeutic intervention on shoulder range of motion and map thermography of elderlies submitted to surgery for breast cancer treatment

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ABSTRACT

Age is the main risk factor for developing breast cancer and clinically, older women have a more difficult rehabilitation process. **Objective:** The aim of the study was to evaluate the effects of physiotherapy intervention in range of motion (ROM) of shoulder and thermographic map of elderly postoperative treatment of breast cancer. **Methods:** A total of 10 elderly, undergoing surgery for breast cancer. The evaluation was done before and after the intervention by means of the goniometer for ADM measures and thermographic camera Eletrophysics PV320T, to identify the temperature of the thoracic region. We used the Wilcoxon test and Spearman correlation, with a 0.05 significance level. **Results:** The patients showed significant improvement in range of all movements of the affected limb, except internal rotation. When comparing the assessment of temperature values with the revaluation, there was an increase in temperature of the thoracic regions, and only significant values preserved breast. By comparing the temperature of the region preserved with compromised in the evaluation, there was a significant difference, since the revaluation, there was an approximation of these values. **Conclusion:** The correlation between increased temperature and ADM was significant for both members adduction and internal rotation member preserved in the evaluation. Intervention assured resolution or reduction of amendments on physical examination, improved ROM, increased temperature of the thoracic regions, and correlation between temperature increase and ROM bilateral adduction and internal rotation member preserved in the initial evaluation.

Keywords: Breast Neoplasms, Range of Motion, Articular, Physical Therapy Modalities, Thermography

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INTRODUCTION

Breast cancer is the second most common type in the world, and the leading cause of death due to cancer among women. About four out of five cases occur after the age of 50, what shows that age remains one of the main risk factors for the development of breast cancer.[1] The reduction in functional capacity, characteristic of the aging process, added to the years of exposure to risk factors, makes the elderly more vulnerable to the disease.[2,3]

Surgery is the main treatment for breast neoplasm, which mechanically removes of all malignant cells of the primary cancer, leading to increased survival time.[4] Surgery often generates comorbidities that cause great concern among women.[5,6] Regardless the surgical approach (radical or conservative), some postoperative physical complications in the homolateral upper limb are frequent, such as pain, lymphedema, tissue adhesions, paresthesia, decreased muscle strength, reduced range of motion (ROM) and postural alterations.[7,8]

Another frequent complication that may result from the surgical treatment is the seroma, the accumulation of serous fluids in between the axillary flaps, that causes discomfort to the patients.[9] Also, visible lymphatic tissue strands under the skin in abduction and external rotation of the shoulder, associated with the extension of the elbow, wrist and fingers may be present, what causes joint amplitude limitations.[6,10]

The shoulder is the most affected joint after the surgical removal of breast cancer.[11] The removal of the pectoralis major muscle in the Halsted radical mastectomy, the possibility of long thoracic nerve trauma, the pain and spasms of all cervical musculature and scapular girdle contribute to a decrease in strength and function of the upper limb.[12]

Concerning these aspects and considering that from the clinical point of view it is believed that older women have a more difficult rehabilitation process,[3] it is fundamental that interdisciplinary teams include a physiotherapist in order to prevent complications, promote adequate functional recovery and, as a result, promote improved quality of life.[13]

Physiotherapy treatment includes kinesiotherapy and manual therapy techniques, substantial in post-surgical recovery,[14] however, quality measures are necessary to evaluate the therapeutic intervention and the recovery process in a detailed way.

One of the possibilities is the universal goniometer, which is the most used instrument in the evaluation of ROM,[15] and the early assessment of this measure aims to prevent functional changes, along the treatment evolution. The thermography, on the other hand, allows the thermal mapping of areas and points of interest,[16] and its initial use was destined to the diagnosis of breast cancer. Currently, it may be an option that serves as a tool to monitor the evolution of inflammatory conditions, muscular tensions, joint and tendon overloads, common post-operative characteristics that may be related to the restriction of joint movement.[6,17]

OBJECTIVE

The objective of this study is to evaluate the effects of physiotherapeutic intervention on shoulder range of motion and on the thermographic map of elderly women submitted to surgery for breast cancer removal.

METHODS

This is a quasi-experimental study, once there is no random distribution of the subjects, neither a control group to test the effectiveness of interventions. The sample consisted of ten elderly women who underwent conservative or modified radical surgery for removing breast cancer in the *Maternity Carmela Dutra* (MCD), a public institution in the city of *Florianópolis*. The inclusion criteria were: age equal or superior to 60 years; preserved cognition; living in Florianópolis or in the neighboring cities; up to four months after surgery, which had to be unilateral and the first surgical procedure for removing the breast. The exclusion criteria were: postoperative complications (such as infections and / or bleeding); Immediate breast reconstruction; Neurological or orthopedic diseases that might interfere with the proposed intervention and other types of regular physical activity at the time of data collection.

The present study was approved by the Ethics Committee on Research of the *Maternity Carmela Dutra*, and was registered as CAAE: 11902813.8.0000.0121. After explaining the phases of data collection, the women who agreed to participate in the study read and signed the free and informed consent form. The data collection occurred from January 2013 to April 2015.

The initial evaluation consisted of an anamnesis for personal data, surgical history, associated diseases, social history, and complaints the patients could report. A physical examination was then performed for the assessment of anthropometric data, chest and upper limbs inspection, and the active shoulder ROM was measured by a universal goniometer (CARCI®). The patients had their clothes of the region to be evaluated removed and performed active-free movement of the shoulder (flexion, extension, abduction, adduction, internal rotation (IR) and external rotation (ER)) according to the Method of Norkin and White.[18]

The Electrophysics Infrared Camera (model PV 320 T, USA) was used for the thermographic images of the thoracic region. The Velocity 2.3 support software was used for data analysis. The patient was advised not to perform physical activity for at least one hour prior to the evaluation, not to drink tea, coffee, alcoholic beverages and / or vasodilator medications, not to smoke and not to use any topical product.[19] Before the thermographic image was captured, they removed their clothing and remained for about 20 minutes at rest until there was thermal balance. Then, they were placed one meter from the camera in the orthostatic position during the thermograpy. The evaluation room had the temperature controlled between 18ºC and 23ºC, without other thermal artifacts.

After the evaluation, the intervention begin with exercises per Pereira, Vieira and Alcântara,[20] Bergmann et al.[21] and Petito and Gutiérrez,[22] with passive and active stretching, scapular mobilization, passive upper limb mobilization, active upper limb exercises, upper limb active exercises, cervical and thoracic pompage, upper extremity metabolic exercises, respiratory exercises, resisted exercises, scar mobilization, and sensitization of the breast region with different textures. The visits lasted about one hour and was attended twice a week. A total of 15 visits of one hour were carried out.

When the patient was unable to perform some exercise proposed by this protocol, adaptations were made according to their condition, and a follow up record was then filled with the evolution and the need for changes / maintenance of the exercises.

Once the 15 visits were completed, a reevaluation was performed for assessing the same variables of the initial evaluation. The variables were characterized by descriptive statistics, means, and standard deviations.

For the comparison between regions and between collection moments, inferential statistics were performed by Wilcoxon test. The correlation between variables was made by the Spearman correlation test, with significance value of 0.05.

RESULTS

The participants (ten) had a mean age of 66.4 (± 5.3) years, ranging from 60 to 78 years of age. Regarding their marital status, five of them were married, three were divorced, one was widow and one was single. The schooling level of four women was more than eight years of schooling and the six others with less than eight years of schooling.

Regarding the gynecological and obstetric history, the mean age of the menarche was 13.1 years (± 3.0) and the menopause of 47 years (± 5.5). The mean number of pregnancies was 3.9 (± 3.4) and 3.2 (± 3.4). Most of the women breastfed their children (seven) and had a family history of cancer (seven). The most prevalent disease was Systemic Arterial Hypertension (seven), followed by Diabetes Mellitus (five), thyroid dysfunction (two) and esophageal hernia (one).

In the physical examination, it was observed that the average Body Mass Index (BMI) among the evaluated women was 28.0 (± 2.8), presenting three cases of obesity grade one, six cases of overweight and one case of normal weight. The main changes observed were wound retractions (eight) and pericardial seroma (four), wound inflammatory alterations (three), palpation pain (three), seroma in the lateral region of the thorax (three) and chest edema (two). In the reevaluation, however, only two women presented wound retractions and one presented chest edema, and the other alterations were no longer observed. However, two women developed lymphatic cording and one developed hand and wrist edema in the affected limb at the end of the intervention.

Regarding the type of surgery, six participants underwent radical modified mastectomy and four underwent quadrantectomy (segmental mastectomy). Five patients underwent surgery on the left and five on the right breast. Only one patient did not undergo axillary intervention, and the other six performed lymphadenectomy and three performed only sentinel node biopsy. The mean postoperative time at the start of data collection was 2.2 (± 1.1) months.

Table 1 presents the relationship between the ROM of the homolateral limb and contralateral to the surgery in the evaluation and reevaluation, as well as the movement of the same segment in the evaluation and reevaluation.

By analyzing the table above, it was observed that there was a statistically significant difference in the ROM of the preserved limb (contralateral) when compared to the homolateral, where the limitation of movement was found to be greater in the homolateral segment to the breast surgery in all the movements evaluated. In the reevaluation, an improvement in the ROM means of all movements was noticed, but the flexion, abduction and external rotation still showed a statistically significant difference between the preserved and compromised limb. Comparing the preserved limb in the evaluation and reevaluation, it is possible to state that there was a significant difference in flexion and abduction of the shoulder, which in this case represents an increase in the ROM for these movements. The compromised limb, in turn, showed a significant improvement of the ROM of flexion, extension, abduction, adduction and external rotation, when compared to the reevaluation. The table 2 shows the comparison of the temperature values of the different quadrants, in the two moments of evaluation.

It is possible to observe a significant increase in the temperature of the preserved breast when evaluation and reevaluation are compared, since the compromised hemithorax also presented temperature increase, however this last increase was not statistically significant.

The table 3 indicates the temperature comparisons between both the preserved and the treated breast at the two moments of evaluation.

In general, the compromised hemithorax (homolateral) presented higher temperature values in relation to the preserved breast, however, in the reevaluation, there were no significant differences between the two regions.

Table 4 shows the relationship between the ROM and the temperature in each quadrant in the evaluation and in the revaluation.

According to the data presented above, there was a correlation between the ROM of adduction of both limbs and the temperature of all quadrants. In addition, the internal rotation ROM of the preserved limb has also shown a significant correlation with temperature, in all quadrants. In the reevaluation, there was no correlation between motion and temperature.

DISCUSSION

The patients in this study presented some alterations in the physical examination, and the most frequent was wound retraction (eight participants). Rehabilitation programs for women undergoing mastectomy have emerged from the need to prevent complications that are common postoperatively, due to the increased incidence of breast cancer. The presence of complications occurs in 63.6% of the cases of women undergoing surgical and complementary treatment, among them the infection in the surgical wound, skin alterations, seroma, healing disorders and shoulder disabilities, as well as lymphedema in a later process. This information is in aligned with the identified changes in the physical examination of the patients in the present study.[23]

Regarding the risk factors, in this study the presence of obesity and overweight was

Table 1. Relation between the ROM of the contralateral (C) and homolateral (H) limb (C) and the regarding the surgery over the two evaluation times

	EVALUATION			REEVALUATION			p (Ev x Reev)	
Mean ± SD	P	C	p (PxC)	P	C	p (PxC)	P	C
Flexion	139.2 ± 29.16	91.6 ± 34.08	0.007*	162.3 ± 16.65	149.5 ± 17.54	0.011*	0.042*	0.005*
Extension	49.5 ± 13	37.5 ± 12.66	0.012*	53.9 ± 10,37	48.5 ± 7.27	0.107	0.173	0.008*
Abduction	118.2 ± 44.76	95.5 ± 35.53	0.037*	159.8 ± 16.04	148.1 ± 21.02	0.035*	0.008*	0.008*
Adduction	33.5 ± 15.28	23.9 ± 9.91	0.017*	41 ± 11	36.2 ± 8.8	0.067	0.066	0.013*
ER	63.9 ± 26.88	50.1 ± 26.88	0.017*	77.4 ± 24.56	68.6 ± 23.45	0.018*	0.091	0.028*
IR	67.2 ± 26.18	53.4 ± 28.27	0.007*	65.4 ± 14.2	60.7 ± 16.96	0.123	0.944	0.292

* p ≤ 0.05 at the Wilcoxon statistics test; SD, standard deviation; C, contralateral and preserved limb; H, homolateral and affected limb; Ev, evaluation; Reev – Reevaluation.

Table 2. Temperature comparison (°C) of the same quadrant of both moments of evaluation

	CONTRALATERAL				HOMOLATERAL			
Mean ± SD	ESQ	ISQ	EIQ	IIQ	ESQ	ISQ	EIQ	IIQ
EVALUATION	33.9 ± 5.63	34.06 ± 5.39	33.73 ± 5.52	34.56 ± 5.4	35.79 ± 5.65	36.06 ± 5.52	36.33 ± 5.71	36.24 ± 5.71
REEVALUATION	40.28 ± 7.99	40.16 ± 8.24	39.84 ± 7.78	39.55 ± 7.37	41.35 ± 7.87	40.09 ± 8.11	41.35 ± 8.21	41.26 ± 8.07
p (Ev x Reev)	0.051*	0.05*	0.051*	0.05*	0.074	0.086	0.066	0.086

* p ≤ 0.05 at the Wilcoxon statistics test; ESQ, external superior quadrant; ISQ, internal superior quadrant; EIQ, external inferior quadrant; IIQ, internal inferior quadrant; SD, standard deviation; Ev, evaluation; Reev, reevaluation.

Table 3. Temperature (°C) comparisons between the homolateral (H) and contralateral (C), therefore preserved, hemithorax at the evaluation and reevaluation

	EVALUATION			REEVALUATION		
Mean ± SD	C	H	p (CxH)	C	H	p (CxH)
ESQ	33.9 ± 5.63	35.79 ± 5.65	0.005*	40.28 ± 7.99	41.35 ± 7.87	0.139
ISQ	34.06 ± 5.39	36.06 ± 5.52	0.005*	40.16 ± 8.24	40.09 ± 8.11	0.241
EIQ	33.73 ± 5.52	36.33 ± 5.71	0.005*	39.84 ± 7.78	41.35 ± 8.21	0.139
IIQ	34.56 ± 5.4	36.24 ± 5.71	0.007*	39.55 ± 7.37	41.26 ± 8.07	0.093

* p ≤ 0.05 at the Wilcoxon statistics test; C, contralateral (preserved); H, homolateral; ESQ, external superior quadrant; ISQ, internal superior quadrant; EIQ, external inferior quadrant; IIQ, internal inferior quadrant; SD, standard deviation; Ev, evaluation; Reev, reevaluation.

Table 4. Correlation of temperature (C°) and ROM of at evaluation and reevaluation

	EVALUATION								REEVALUATION							
ρ and p value	ESQ		ISQ		EIQ		IIQ		ESQ		ISQ		EIQ		IIQ	
Motions	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H
Flexion	0.158	0.421	-0.024	0.488	0.213	0.5	0.073	0.518	0.132	-0.468	0.094	-0.468	0.063	-0.468	0.144	-0.383
	0.66	0.22	0.94	0.15	0.55	0.14	0.84	0.12	0.71	0.17	0.79	0.17	0.86	0.17	0.69	0.27
Extension	0.105	0.111	0.012	-0.049	0.056	0.062	-0.062	0.025	0.411	-0.11	-0.368	-0.11	-0.449	-0.11	-0.411	-0.098
	0.77	0.76	0.97	0.89	0.87	0.86	0.86	0.94	0.23	0.76	0.29	0.76	0.19	0.76	0.23	0.78
Abduction	0.122	-0.212	0.049	-0.285	0.091	-0.139	0.304	-0.2	-0.317	-0.086	-0.372	-0.086	-0.421	-0.086	-0.256	-0.037
	0.73	0.55	0.89	0.42	0.80	0.70	0.39	0.58	0.37	0.81	0.29	0.81	0.22	0.81	0.47	0.91
Adduction	0.642(*)	0.798(**)	0.831(**)	0.816(**)	0.673(*)	0.791(**)	0.862(**)	0.865(**)	0.013	-0.148	0.006	-0.148	-0.078	-0.148	0.078	-0.08
	0.045	0.006	0.003	0.004	0.033	0.006	0.001	0.001	0.97	0.68	0.98	0.68	0.83	0.68	0.83	0.82
ER	0.061	-0.055	-0.049	-0.055	-0.024	0.055	-0.152	-0.018	-0.149	-0.232	-0.187	-0.232	-0.187	-0.232	-0.369	-0.274
	0.86	0.88	0.89	0.88	0.94	0.88	0.67	0.69	0.68	0.51	0.60	0.51	0.60	0.51	0.29	0.44
IR	0.659(*)	0.31	0.751(*)	0.146	0.659(*)	0.164	0.726(*)	0.231	-0.093	-0.055	-0.118	-0.055	-0.168	-0.055	0.043	0.094

* p ≤ 0.05 at the Spearman Correlation test; C, contralateral (preserved); H, homolateral; ESQ, external superior quadrant; ISQ, internal superior quadrant; EIQ, external inferior quadrant; IIQ, internal inferior quadrant; r, Spearman correlation coefficient; (**), statistically significant correlation.

evident, since according to BMI results only one patient was found at the appropriate weight and all the others were above the estimated value. This result agrees with what is established in the literature that body fat and abdominal fat is indicated as a risk factor for breast cancer in postmenopausal women.[24]

Their reproductive history includes: early menarche, late menopause and nulliparity,[1] which, somehow, oppose the results found in this study, given the women in this study had mean age of menarche and menopause within the normal range, and only one was nulliparous. It is worth mentioning the genetic influence, since the majority of the patients had a history of cancer in the family and that, even though lactation is a protection factor, in this study most of the women breastfed.[1,24]

According to Jones and Leonard,[25] the treatment of elderly women with breast cancer is an area of growing concern, but age itself is not a barrier to surgical intervention, but rather the pre-existence of comorbidities. According to Bouchardy[26], half of the elderly patients with breast cancer are not treated properly, which consequently greatly decreases survival. For this author, the treatment needs to be adapted to the patient's condition, and it should also offer the best chance for cure. This is the probable reason why, although most of the patients in the present study present associated diseases, modified radical mastectomy associated with axillary intervention was the preferred treatment.

It is known that axillary lymphadenectomy (AL), a procedure performed by 6 patients in this study, is predictive of poor movement of the affected limb.[27] This is due to the local serosity to be removed, leading to adhesions and hindering the movement of the shoulder.[11] Shoulder ROM is compromised in 73% of AL patients,[28] interfering with quality of life, given it may cause functional limitations.

Silva et al.[29] state that limiting the abduction and flexion of the shoulder above 30º is incompatible with the daily tasks performed by a woman, such as combing the hair and buttoning the bra. According to this data, before

the intervention proposed in the present study, both the preserved and the compromised limb presented significant limitation (>30º) of flexion and abduction. After the intervention, the preserved limb ceased to present this functional limitation, but despite the significant increase in ROM, the compromised limb still presented values below 30º, indicating that even after the 15 visits there was still a reduction in functionality.

In this study, it was observed that even in the absence of neurological or orthopedic diseases that could interfere with the results, the mean flexion and abduction ROM of the preserved limb were below that expected before the intervention. This can be justified because of the complications of the chronic--degenerative processes that follows the age process.[3,30]

Aging coincide with a progressive decrease in range of motion and increased articular stiffness.[3] The specific causes of these changes in old age are not sufficiently clear but it involves deterioration of cartilage, ligaments, tendons, synovial fluid, and muscles.[31]

In the first evaluation, all ROM values of the limb homolateral to the surgery were inferior to the contralateral limb, indicating that in spite of all the surgical advances, the restriction of the movement of the treated shoulder is still one of the most frequent postoperative comorbidities.[32] After the physiotherapeutic intervention, even with increased values found in the beginning, the difference in the treated limb remained significant for flexion, abduction and external rotation, the most affected movements, which clinically and functionally are the most important movements for the activities of daily life.[23,27]

Considering that all physiotherapy treatment was given bilaterally, the preserved limb also showed a significant increase in ROM, comparing the initial and final evaluation for flexion and abduction. There was a significant improvement of nearly all the movements of the he surgery side between the initial and final evaluations, except for the internal rotation. These data are consistent with the findings of several studies[33-35] that also identified improvement of mobility and function of the affected upper limb after the physiotherapeutic treatment, especially of early onset.

Rett et al.[36], who evaluated 10 women after surgical treatment for breast cancer and who applied a protocol of 10 physiotherapy sessions with stretches and active-free exercises, verified that there was improvement of all movements.

The evaluation of dysfunctions by the thermography is based on the presence of temperature asymmetries between the treated area and the corresponding contralateral. Fukushima et al.,[37] in their review of the literature, concluded that axillary surgical intervention produces may cause important vascular changes. Tissue dysfunction caused by the surgical procedure results in circulatory redistribution of heat and is directly influenced by vasomotor activity, which is a hypothesis for the temperature increase that was identified in both breasts in the final evaluation.[38]

When the two regions evaluated at the beginning are compared, there was a significant difference in the treated hemithorax temperature, since it was higher than the contralateral side, and this difference may indicate dysfunction. In the final evaluation, however, the values between the two regions became closer, with greater symmetry, and this greater proximity is what is expected for healthy individuals.

The significant correlation was only observed when the temperature of the evaluated segment when was related to the adduction movement of both limbs and internal rotation of the untreated limb, during the initial evaluation. In the literature, no studies that related these two aspects in this population were found, but it is believed that as the adduction and internal rotation movements cause the body segments to get closer, upper limbs and thorax laterally, there may be a local increase in temperature. In the initial evaluation, the ROM of internal rotation and adduction was already close to normal, although there was a significant difference when compared to the contralateral limb, and although there was temperature increase in the treated breast when compared to the contralateral breast, this increase was not significant when at the reevaluation, therefore there may have been a significant correlation between the variables only in the initial evaluation. In the reevaluation, there was a significant increase in temperature without a significant increase in the ROM of these movements, perhaps for this reason, this relationship was not identified.

The limitations of the present study include the lack of a control group to compare the results with and the reduced sample size, which may hinder the generalizability of the results.

CONCLUSION

The women who participated in this study achieved resolution or reduction of the alterations found in the physical examination, two of them still presented wound retractions and one presented chest edema. The ROM of the affected limb was significantly diminished in relation to that preserved in the initial evaluation, and in the reevaluation there was improvement in all movements, however, flexion, abduction and external rotation remained with difference in relation to the contralateral limb. The preserved limb obtained significant improvement in range of motion for flexion and abduction movements, while the limb treated showed significant improvement for all movements except the internal rotation.

Local temperature was increased in both hemithorax as measured at reevaluation, however, only the values of the contralateral (untreated) breast were significant. In the reevaluation, an approximation of the temperature values of the two evaluated regions occurred, indicating a possible normalization in the patient's clinical condition.

The correlation between temperature and ROM was only significant when related to the adduction movement of both limbs and internal rotation of the contralateral limb in the initial evaluation. Possibly because these movements approximate the body segments, upper limbs and thorax laterally, which may be related to the increase of the local temperature. After the intervention, in fact an increase in temperature was observed in the region, nonetheless, the increase in ROM of these two movements did not increase significantly, which could justify the fact that no correlation was verified in the reevaluation.

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