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EFEITO DO TREINAMENTO CONCORRENTE (AERÓBIO + RESISTÊNCIA) MAIS ALONGAMENTO ESTÁTICO NA FLEXIBILIDADE EM MULHERES COM CÂNCER DE MAMA

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Resumo: Objetivo. Avaliar a flexibilidade em mulheres com câncer de mama que realizaram treinamento concorrente (aeróbio + resistência) (TC) mais alongamento estático. **Métodos.** Este foi um estudo piloto controlado, com 31 mulheres (de 30 a 59 anos) em tratamento para câncer de mama, 14 mulheres foram alocadas em um grupo de treinamento (GT) que realizaram TC mais alongamento estático, concomitante a tratamento hospitalar e 17 mulheres para o grupo de controle (GC) que somente realizaram tratamento hospitalar. O TC mais alongamento estático foram realizados em 12 semanas com 5 sessões semanais, três sessões (aeróbia + resistência) e duas sessões (exercícios de alongamento) em dias alternados. A flexibilidade do ombro foi medida por meio do goniômetro de pêndulo 360º Sanny e a flexibilidade de membros inferiores foi avaliada por meio do teste de sentar e alcançar. Os dados foram analisados usando o Teste ANOVA de medidas repetidas e Post-hoc de Bonferroni no software SPSS 21, com α de 5%. **Resultados.** O GT apresentou aumento da flexibilidade na abdução horizontal do ombro direito (p=0,001) e nos membros inferiores (p<0,001), mas o GC apresentou redução da abdução horizontal do ombro direito (p=0,003). O tamanho do efeito para abdução horizontal do ombro direito foi médio (p=0,508) e para membros inferiores foi grande (p=0,839). **Conclusão.** O TC mais alongamento estático podem ser uma intervenção terapêutica para aumentar a flexibilidade de membros superiores e inferiores em mulheres com câncer de mama.

Palavras-chave: Exercício; Exercícios de Alongamento Muscular; Neoplasias.

Afiliação

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EFFECT OF CONCURRENT TRAINING (AEROBIC+RESISTANCE) MORE STATIC STRETCHING ON FLEXIBILITY IN WOMEN WITH BREAST CANCER

Abstract: Objective. was to assess flexibility in women with breast cancer who underwent concurrent training (aerobic+resistance) (CT) more static stretching. **Methods.** This was a controlled pilot study, with 31 women (age 30 to 59) under breast cancer treatment, 14 women were allocated to a training group (TG) who underwent CT more static stretching, concomitant to hospital treatment and 17 women for the control group (CG) who only underwent hospital treatment. The CT more static stretching was performed in 12 weeks with 5 sessions per week, three sessions (aerobic+resistance) and two sessions (stretching exercises) on alternate days. The flexibility of the shoulder was measured by means of the 360º Sanny pendulum goniometer and the flexibility of the lower limbs was assessed through the sit-and-reach test. Data were analyzed using repeated measures ANOVA Test and Bonferroni Post-hoc using SPSS 21 software, with α of 5%. **Results.** The TG presented increased flexibility in the horizontal abduction of the right shoulder (p=0.001) and in the lower limbs (p<0.001), but the CG showed a reduction in the horizontal abduction of the right shoulder (p=0.003). The effect size for horizontal abduction of the right shoulder was medium (p=0.508) and for the lower limbs was large (p=0.839). **Conclusion.** CT more static stretching may be a therapeutic intervention to increase flexibility of upper and lower limbs in women with breast cancer.

Key words: Exercise; Muscle Stretching Exercises; Neoplasms.

Introdução

Breast cancer is considered one of the diseases with high incidence worldwide. In Brazil, 66,280 new cases are estimated in 2021, with this type of cancer as the most diagnosed in women[1]. Breast cancer treatment can lead to adverse effects such as reduced cardiorespiratory capacity, decreased strength and limited range of motion (LRM) of the shoulder[2].

The decreased LRM, as flexion and abduction movements that suffer the greatest impairment, influence the functional capacity and physical activities, due to stiffness and loss of muscle flexibility[3]. However, studies have shown that to reduce the complications triggered by this disease, physical exercises, such as stretching for rehabilitation and prevention provide a return to daily tasks and a more comfortable performance of any movement[4-6].

Another adverse event, caused by cancer, is the risk of death from cardiovascular disease, which is higher in women with breast cancer and those with a tumor in the left limb when compared to women in the general population[7], however, flexibility training is also capable of improving the cardiovascular system[8].

In addition, aerobic exercise combined with strength and flexibility exercise is a non-drug treatment method to enhance cardiorespiratory fitness, strength, and flexibility[2,9]. However, little is known about the effect of static stretching, more concurrent training (aerobic+ resistant) in women with breast cancer. Thus, the goal is to assess flexibility in women with breast cancer who underwent concurrent training (aerobic+ resistant) (CT) more static stretching. In the hypothesis that CT more static stretching increases flexibility in women with breast cancer.

Material and Methods

Participants

Thirty-six women selected from the hospital participated in the study, through invitations to standardized and routine meetings at the institution. As inclusion criteria, the following was considered: 1) not engaging in physical training for at least 6 months, 2) being treated (chemotherapy, radiotherapy, or hormone therapy) or monitored for breast neoplasms. As excluded criteria, the following was considered: 1) had a diagnosis of mental disorders or psychological disorders, 2) were unable to communicate verbally and move 3) pregnant or nursing mothers, 4) had three consecutive absences in physical training, 5) did not perform all evaluations, 6) had no previous medical release.

Study design

The research was approved by the Research Ethics Committee of the Federal University of Maranhão, number: 20665713.2.0000.5087, recorded in the Registry of Clinical Trials, protocol: NCT03061773. All the procedures were conducted in accordance with the Declaration of Helsinki. Thereafter, the participants were informed about the aim, procedures as well as a complete explanation of the study along with a written informed consent signed by interested participants.

The sample was chosen on the basis of the convenience. Who were randomly assigned to two groups: Training Group (TG) with 18 patients undergoing CT more static stretching for 12 weeks, in addition to continuing with conventional hospital treatment (THC) (chemotherapy, radiotherapy, hormone therapy, and physiotherapy); Control Group (CG) with 18 patients who only used THC for 12 weeks.

The sample size was calculated using statistical software (G-power 3.1; Dusseldorf, Germany). This revealed that with twelve participants, a medium effect size of 0.60 would be achieved, with α error probability of 0.05, power (1-β error probability) of 0.95 and correlation of 0.5, in repeated-measurement analysis of variance (ANOVA) on within-between interaction; and with non-sphericity correction of one, for two groups and measurements.

Procedures

The participants' clinical characteristics were verified at the baseline through an anamnesis. The body composition was verified by Body Mass Index (BMI)[10].

The flexibility was evaluated by means of the 360º full-circle Sanny pendulum goniometer (Sanny®, Brazil)[11]. In the active assessment of flexibility, the patients were instructed to warm up and the evaluated movement immediately followed, with the device firm at the joint starting at a 0º angle, registering the maximum amplitude angle[11]. For the shoulder joint, the following was measured: flexion, extension, adduction, lateral and horizontal abduction.

The flexibility of the upper limbs (shoulder) was also evaluated by means of the behind-the-back-reach test using a tape measure (Sanny®, Brazil), with 0.1 cm precision. Those surveyed stood with one of the upper limbs flexing the shoulder and elbow with the hand flat on the back. The other limb also had the hand flattened on the back, however, in a shoulder extension with internal rotation, with the palm upwards, trying to touch or overlap the middle fingers[10].

The flexibility of the lower limbs was assessed through the sit-and-reach test using the Wells Portable Instant Sanny Bank (Instant Pro Portable, Sanny®, Brazil). The patients were seated with their knees extended and their feet resting on the bench, hands clasped one on top of the other, shortly after the patients projected the torso forward without flexing the knees, holding for 2 seconds[10].

Intervention

The physical training program for 12 weeks consisted of CT in three days per week (monday, wednesday and friday), more flexibility training in two days (tuesday and thursday).

CT was performed presential in hospital and each training session containing resistance+aerobic exercise, lasted 60 minutes, following the order: 30 minutes on a cycle ergometer, hip flexion and extension, shoulder development, Swiss ball squats, French triceps and curved row. Familiarization of resistance and aerobic training was achieved in a week with three sessions, in which the load was 15 watts on the cycle ergometer and resistance exercises was shin guards, dumbbells, elastic bands (therabands) and their own body weight in the execution of 8 to 12 repetitions and intervals of 1 minute for each exercise.

The aerobic training was controlled by the training heart rate (THR)[12]. In the cardiorespiratory test, the ramp protocol adapted by Neil et al[13] in a cycle ergometer (ERGO FIT brand, model ERGO 167-FITC CYCLE), with an initial load of 15 watts for 5 minutes of warming up, followed by incremental stages of 60 seconds with an increase of 15 watts each[13]. After the maximum stage was reached, an active recovery of 3 minutes with the initial load was performed with 70 to 90 rotations per minute for each stage. The blood pressure (conventional mercury column apparatus BD®), heart rate (Polar FT2) and subjective perception (Borg scale, Inforfisic Mark)[10] were measured every 15 seconds to finish the stages and were static.

The resistance training protocol was 3 sets of each exercise with 8 to 12 repetitions and a 1-min interval between sets and repetitions. The execution speed of each movement was three seconds for the concentric and eccentric phases[14]. The exercises were alternated by segments, prioritizing the large muscle groups, and the loads were carried out with shin guards, dumbbells, elastic bands (therabands) and their own body weight. The resistance training load was verified through the maximum repetition test[15].

The load progressions of the CT were every 4 weeks[16]. The training protocol constituted of three phases: 1) Weeks 1 to 4 with 50% to 60% of THR, plus resistance exercises with body weight or 1kg dumbbells and shin guards, as well as a moderate elastic band (Theraband); 2) Weeks 5 to 8 with 70% to 80% of THR, plus resistance exercises with an increase of 1kg and a heavy elastic band; 3) Weeks 9 to12 with 80% to 90% of THR and maintenance of resistance exercises.

Familiarization with flexibility training occurred over two weeks, with three sessions per week. The flexibility exercise was performed in home-based, yet presential supervised and each training session lasted for 20 minutes, intercalated between days of the TC.

The flexibility training was static active (greater LRM performed in a contraction of the agonists and relaxation of the antagonists), without pain, where each exercise lasted 20 seconds in 3 sets, performing the exercises alternately, therefore without intervals[16]. The flexibility exercises were: 1) Adduction of the shoulder with extension of the elbow, bilateral; 2) Shoulder and elbow flexion with palm of the hand on the back, bilateral; 3) Wrist flexion; 4) Wrist extension; 5) Hip extension with flexed knees; 6) Sitting, shoulder abduction and elbow flexion; 7) Sitting, legs outstretched touching feet with hands; 8) Sitting, legs extended and crossed touching the feet, bilateral; 9) Shoulder flexion and adduction with hands joined in front of the trunk; 10) Back flexion of the foot on the wall.

The evaluations were performed at baseline and after 12 weeks. The team was trained for the application of each instrument to conduct the tests. Physical evaluations were performed blindly by the evaluator.

Statistical Analysis

Descriptive statistics were presented by mean, standard deviation, absolute and relative frequency. The Kolmogorov-Smirnov and Shapiro Wilk tests were used to verify data normality. The independent Student's T-test was used for BMI and age. The Chi-square test was used to evaluate the type of surgery and the Fisher's exact test for the following variables: clinical period, neoplasia type, the postoperative period of the breast, member affected by surgery and dominant limb. For repeated measures, ANOVA was applied to evaluate the flexibility (goniometer, upper mobility, and Wells bench). When there was an interaction between time and group, the Bonferroni Post-hoc test was employed. The size effect was verified by means of the Partial Square Eta. The statistical analysis was performed on SPSS 21

(SPSS Inc., Chicago, IL, USA) and GraphPad Prism 5 software (San Diego, CA, USA). Software with $p<0.05$ was considered statistically significant.

Results

Thirty-six patients were available and participated in the sample. However, one patient of TG was excluded due to a diagnosis of mental disorder, more three did not finish the assessment (4 dropout), and one patient of CG died of cancer (1 dropout). The study was completed by 31 patients (14 TG and 17 CG) with 30 to 59 years old.

Patients did not present statistical differences between the groups in the baseline period (Table 1). Regarding the clinical aspect, patients from both groups did not perform breast reconstruction.

Table 1 - Body composition and clinical aspects of patients with breast cancer (n=31).

Variables	TG (n=14)	CG (n=17)	p value
	mean± SD	mean± SD	
Body Mass Index (Kg/m^2)	24.35±3.56	26.96±4.93	0.108
Age (years)	47.64±7.60	49.94±11.99	0.539
	n(%)	n(%)	
Clinical Period[c]			
Attendance	6 (42.9%)	4 (23.5%)	0.384
Hormonetherapy	6 (42.9%)	7 (41.2%)	
Chemotherapy	0	3 (17.6%)	
Radiotherapy	2 (14.3%)	3 (17.6%)	
Neoplasia Type[c]			
Ductal Carcinoma	14 (100%)	14 (82.4%)	0.232
Fusocellular and Epithelial	0	3 (17.6%)	
Post breast surgery time[c]			
< 2 years	6 (42.9%)	10 (58.8%)	0.166
2 the 4 years	5 (35.7%)	1 (5.9%)	
> 4 years	3 (21.4%)	5 (29.4%)	
Did not have surgery	0	1 (5.9%)	
SurgeryType[b]			

Quadrant	0	3 (17.6%)	0.151
Total Mastectomy	14 (100%)	13 (76.5%)	
Did not have surgery	0	1 (5.9%)	
Affected limb from surgery[c]			
Right	7 (50%)	10 (58.8%)	0.915
Left	6 (42.9%)	5 (29.4%)	
Bilateral	1 (7.1%)	1 (5.9%)	
Did not have surgery	0	1 (5.9%)	
Dominant Limb[c]			
Right	13 (92.9%)	13 (76.5%)	0.344
Left	1 (7.1%)	4 (23.5%)	

[a]Independent T-Test; [b]Chi-Square Test; [c]Exact Fisher Test; TG: Training Group; CG: Control Group; SD: standard deviation; Expressed values: mean± standard deviation. absolute frequency (relative frequency).

The patients experienced a change after 12 weeks (time effect) in the horizontal abduction of the right shoulder (f=13.438, p=0.003), as well as in the upper limbs (behind-the-back test), with the left dominant limb (f=7.571, p=0.016) and in the lower limbs (f=43.328, p<0.001). However, there was only interaction in the horizontal abduction of the right shoulder (f=16.618, p<0.001) and in the lower limbs (f=12.303, p=0.004). The post-hoc test showed increased flexibility in the horizontal abduction of the right shoulder (p=0.001) and the lower limbs (p<0.001) of the TG, and only a reduction in the horizontal abduction of the right shoulder (p=0.003) of the CG (Figures 1 and 2).

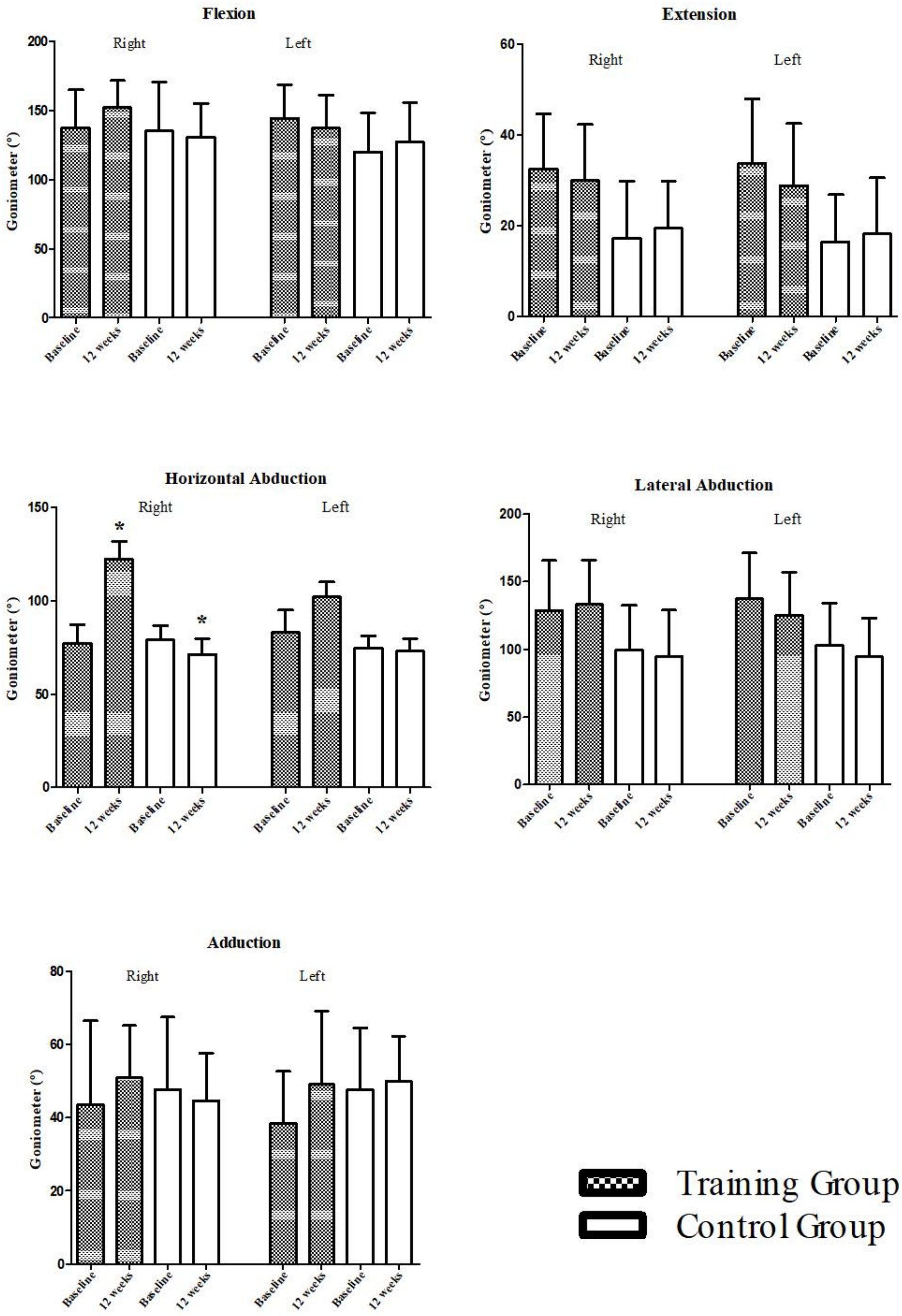

Figure 1 – Flexibility of shoulder in patients with breast cancer submitted to combined training more static stretching (n=31).

Expressed values: mean, standard deviation. Statistical test: ANOVA test of repeated measurements with Bonferroni Post-hoc; *p<0.05

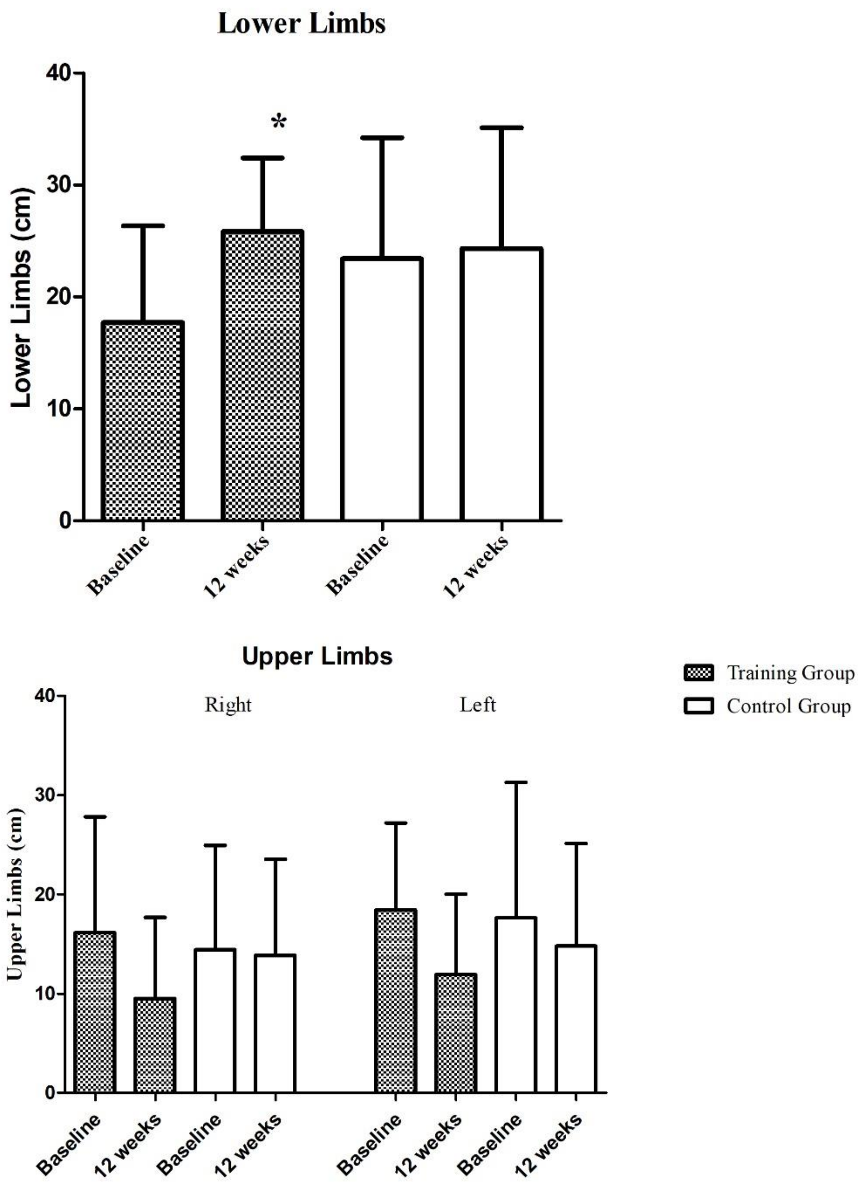

Figure 2 – Flexibility of lower and upper limbs in patients with breast cancer submitted to combined training more static stretching (n=31)

Expressed values: mean, standard deviation. Statistical test: ANOVA test of repeated measurements with Bonferroni Post-hoc; *p<0.05

The difference between groups was obtained in the extension of the right (f=24.155, p<0.001) and left (f = 44.255, p <0.001) shoulders, abduction of the right (f=9.543, p=0.009) and left (f=15.848, p=0.002) and horizontal abduction of the left shoulder (f=5.029, p=0.043). Nonetheless, there was only a tendency to increase flexibility in the abduction of the right shoulder (Δ=4.50) and horizontal abduction of the left shoulder (Δ=19.07) for the TG (Figure 1).

In regard to the size effect, only the horizontal abduction of the right shoulder was classified as medium (eta partial square= 0.508) and the lower limbs had a large size effect (eta partial square= 0.769).

Discussion

The goal of this study was to assess flexibility in women with breast cancer who underwent CT (aerobic+ resistant) more static stretching. We found that the 12-week CT more static stretching provided a significant increase for lower limb flexibility and horizontal abduction of the right shoulder in patients with breast cancer.

The flexibility training of our study was home-based, performed at home, squares, among others, and the aerobic+resistance training was conducted in the same training session within the hospital. This study provides the flexibility training with static stretching in the home-based, more concurrent training in the sessions of aerobic+resistance, the combination of both may have helped to improve the LRM.

Home-based training has been a strategy for greater adherence to physical training programs[17]. Our study also used home-based flexibility training as a tactic to increase the number of training sessions per week and for a combination of the three training modalities (flexibility+aerobic+resistance). Thus, our study furnished a training program to increase flexibility, according to the guidelines for breast cancer patients[8].

A study with 64 women with breast cancer who underwent surgery used a home-based program consisting of nine exercises with 10 repetitions, affording LRM recovery in the shoulder of the patients, however, the study did not present a CG to compare the training effectiveness[6]. The presented data converge with our study.

Our results showed that CT more static stretching increases lower limb flexibility, corroborating the study by Pachioni, Fregonesi and Mantovani[18], who also had the same result, but used 16 sessions of morphoanalytic therapy in 10 patients after cancer surgery and did not compare the results with the CG.

In contrast, a study with 20 breast cancer survivors utilized six months of home or studio yoga intervention and assessed flexibility through the sit-and-reach test but did not show a significant increase in lower limb flexibility[19].

The flexibility of lower limbs is related to dynamic postural control, which consequently assists in the ability of an individual to remain stable to perform a functional task[20].

Our research found an increase in horizontal abduction of the right shoulder of 44.93º in the group that underwent CT more static stretching and a reduction of 7.89º in the CG. The research of Box et al.[21] corroborates our results since 65 women post breast cancer surgery were allocated to a TG, where they performed exercises with physiotherapy professionals. Additionally, the CG only received information about exercises, the TG after three months of surgery, had a significant increase of 14º of the abduction of the shoulder, conversely, the study does not present the training protocol[21].

An increase in the shoulder abduction is a good indicator for the treatment of patients with breast cancer since surgery causes a decrease in their abduction range of motion, flexion, and shoulder rotation[22].

The size effect converged with the results of the statistical tests in our study since a large effect size was found for the flexibility of lower and middle limbs for horizontal abduction of the right shoulder, which confirms that the CT more static stretching has a strong impact for the increase of flexibility in women with breast cancer[23].

Our study contained only 5 (16.13%) patients with the left dominant side, 11 (35.48%) patients who had surgical intervention in the left limb and 2 (6.45%) patients with bilateral surgery. These characteristics may have influenced the clinical decrease of flexion, extension and abduction of the left shoulder because the tumor located in the non-dominant limb and/or the limb with surgical intervention seems to make it difficult to increase the range of motion. Women who underwent breast cancer surgery had greater convergent movement in the dominant limb, as well as lower shoulder height in relation to the limb that underwent surgery[22]. Besides these factors, when the tumor is in the left limb, it generates a higher risk of death due to cardiovascular disease in patients with breast cancer, when compared to the general population[7].

Our study evaluated the independent flexibility of breast cancer surgery because there are musculoskeletal complications, such as difficulty in raising the arm, associated with women of greater age and breast cancer survival time[24]. There is a lack of studies in the literature that assess flexibility in prolonged periods after surgery and the concomitant use of CT more static stretching as an intervention for range of motion.

Increased flexibility helps improve the quality of life of breast cancer patients since it is related to the improvement of postural control[20], the cardiovascular system[8] and daily activities[4-6].

The limitation of our study was the lymphedema record, that we suggest for future studies. Additionally, the sample size was another limitation in this study, owing to the difficulty in recruiting women with breast cancer who were undergoing THC. However, the strength of our research was the home-based use of CT (dynamic stretching in the sessions of aerobic+resistance) more static stretching. Besides, only in the TG provided increased flexibility in the right horizontal abduction and lower limbs in women with breast cancer. These responses occurred, yet, both groups under THC, which involved physical therapy rehabilitation. We suggest that multicenter studies should be conducted on this population with different types of physical training, as also increasing number the of resistance exercises, especially agonists for the chest and biceps muscles.

Conclusion

CT more static stretching may be a therapeutic intervention to increase flexibility in women with breast cancer since we found that there was an increase in shoulder flexibility, horizontal abduction of the right shoulder and flexibility of lower limbs, only in the group that performed CT more static stretching. From our results, we suggest research that evaluates flexibility by comparing different types of tumors and cancer treatments.

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