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The effect of hatha yoga on range of motion and strength in patients with breast cancer

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Abstract

Introduction. The study investigated the effects of hatha yoga on range of motion and strength in women with breast cancer.
Methods. A total of 93 patients completed the study. Their mean age was 57.53 ± 1.92 years in the yoga group and 58.10 ± 1.17 years in the control group. The yoga group ($n = 48$) received hatha yoga intervention for 3 months; the control group ($n = 45$) received current best practice care, including recommendation about compression sleeves, skin protection, and care of the affected arm. The control group was offered hatha yoga intervention after the final measurement. The outcomes were dynamometry and shoulder range of motion to analyse the functional capacity of the affected upper limb.
Results. After 3 months of performing hatha yoga, the active shoulder range of motion improved significantly in the affected limb and was significantly higher than in the control group: by 76.76° for flexion ($p < 0.001$), by 18.92° for extension ($p < 0.001$), by 80.21° for abduction ($p < 0.001$), by 33.29° for internal rotation ($p < 0.001$), by 27.36° for external rotation ($p < 0.01$). Strength for wrist flexion and power index in the affected limb improved by 6.0 kg ($p < 0.001$) and 8.25% ($p < 0.001$), respectively, in the yoga group and only by 1.1 kg ($p > 0.05$) and 1.44% ($p > 0.05$) in the control group.
Conclusions. Hatha yoga is more beneficial than usual care for improving active shoulder range of motion and upper limb strength.
Key words: range of motion, dynamometry, yoga, breast cancer

Introduction

There is a growing number of breast cancer patients treated with specific cancer therapy methods and having problems with upper limb conditions [1–3]. Surgery treatment of breast cancer frequently leads to postoperative complications (skin stiffness, soft tissue swelling on the affected side, restriction of active and passive range of motion) because, in addition to the breast removal, the area of surgery involves lymph nodes, nerves, and nerve trunks [4, 5]. The occurrence of such complications is associated not only with the nature of the breast surgery and its scope, but also with the use of radiation therapy, which is an integral component of combined treatment of breast cancer, recurrence, and metastasis of the tumour. According to recent studies, these women experience various symptoms, such as decreased shoulder range of motion, lower muscle strength, and secondary breast-cancer-related lymphoedema in the affected upper limb [6, 7].

It is worth noting that the removal of axillary lymph nodes, thoracic nerve injuries, muscle spasm in the cervical spine, and prolonged immobilization caused by pain are factors that can decrease the upper limb range of motion [8].

Therapeutic benefits of yoga exercises have been used for reducing arm volume [9–12], anxiety, aggression and depression [13, 14], and fatigue [15], as well as for improving range of motion [16], physical fitness [17], psychological health, and quality of life [18] in patients with breast cancer.

However, there are conflicting opinions about the effect of yoga on arm swelling. On the basis of a systematic review [19], the role of yoga in reducing arm volume in patients with breast-cancer-related lymphoedema and risk for breast-cancer-related lymphoedema is not fully clarified. Wei et al. [19] found that 8-week yoga classes led to a significant improvement in the range of shoulder motion and spinal mobility, but long-term yoga practice did not provide additional benefits in reducing arm swelling.

Consequently, the aim of the current study was to investigate the effects of hatha yoga on range of motion and strength in women with breast cancer.

Subjects and methods

A total of 93 patients completed the study and were involved in the final analysis. The participants were > 55 years of age and had undergone surgical treatment by Madden

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mastectomy for breast cancer. Their mean age was 57.53 ± 1.92 years in the yoga group (YG) and 58.10 ± 1.17 years in the control group (CG). The women were randomly assigned into 2 groups. YG (n = 48) received hatha yoga intervention for 3 months and CG (n = 45) received current best practice care, including recommendation about compression sleeves, skin protection, and care with respect to the affected arm. CG was offered hatha yoga intervention after the final measurement.

The women were randomized by using sequentially numbered opaque sealed envelopes. The randomization was performed by an independent person via random numbers generated in the Microsoft Excel software. An independent person who had no role in the patients' assessment or recruitment opened the envelope. The subjects were recruited through direct referrals from oncologists at the Zaporizhzhya Regional Cancer Centre. An independent researcher administered the dynamometry and goniometry was blinded to the group assignment.

Detailed demographic and clinical characteristics of the participants are presented in Table 1. There were no significant differences in baseline range of shoulder motion parameters and muscle strength between the groups ($p > 0.05$).

The study involved Ukrainian women with tumour stage 1 or 2 and average time after surgical treatment by Madden mastectomy of 3–4 weeks. Exclusion criteria comprised heart failure, stage 3 of tumour, and refusal to take part in the study.

YG participants performed the assigned program 3 times per week for 3 months. Hatha yoga intervention sessions lasted 60 minutes. Exercise intensity was individualized for the patient and varied from 50% to 60% of heart rate reserve. Hatha yoga was practised at the Zaporizhzhya Regional Cancer Centre and was taught by a certified yoga therapist.

Each session of hatha yoga consisted of several continuous poses (dynamic, static, stato-dynamic, relaxing, and respiratory), whose retention depended on the functional state of the upper limb. The yoga intervention consisted of breathing exercises (10 minutes), asanas in standing, sitting, lying positions (40 minutes), and relaxation exercises in lying position (10 minutes). Before performing asanas and breathing exercises, the patients practised joint gymnastics, which prepared the body for the main load and helped to increase range of motion, including in the shoulder. Emphasis was put to the joints of the upper extremity as it was necessary to reduce the manifestations of lymphostasis and improve the range of motion.

Range of motion was gradually increased, the sequence of joint involvement was as follows: at first, movements were performed in the distal parts of the upper extremity, then they gradually included the proximal part, and were smoothly combined into one integral structure.

Coordination of movements with respiration was performed in such a way that the movement in its initial phase coincided with the beginning of inspiration and continued throughout the respiratory cycle. This sequence helped to maintain the optimal pace and fusion of movements throughout the performing of asanas.

For successful training, most breathing exercises were applied in stable sitting postures, which allowed to maintain a comfortable position for a long time and contributed to the greatest concentration of attention on the muscles involved in the act of breathing.

In each session, regardless of the functional state of the upper extremity, asanas were performed from different starting positions to fully involve various muscle groups and avoid local and general fatigue, while the complexity of the selected asanas was different and corresponded to the patient's functionality. The duration of each asana holding was 10–15 seconds at the beginning of the classes and was gradually increased to 15–20 seconds. Inverted asanas for women with high blood pressure were used with caution. Blood pressure ranged from 120/80 to 150/90 in the breast cancer patients, but we did not use inverted asanas for women with blood pressure exceeding 140/90.

In addition, the performance of both static exercises and dynamic complexes was necessarily accompanied by alternating movements with relaxation and stretching to relieve muscle tension. At the end of the session, the women achieved muscular and mental relaxation by performing Shavasana, Makarasana, or Balasana asanas.

The study outcomes were dynamometry and shoulder range of motion to analyse the functional capacity of the affected upper limb in patients with breast cancer. The outcomes were measured at baseline and after 3 months and processed with the Statistical Package for the Social Sciences computer program.

Active shoulder range of motion was assessed by using a two-armed goniometer. Flexion, abduction, and extension were established in the initial position of sitting on a chair in the anatomical position of the shoulder. Internal and external rotation were determined from the initial position of the arm abducted to 90°, forearm pronated and parallel to the floor, palm down, with elbow bent to 90°. Strength was assessed with a DRP-10 hand-held dynamometer in the standing position with straight upper limb. The power index was calculated with the formula:

(absolute values of dynamometry [kg] / body weight [kg]) × 100%

Table 1. Demographic and clinical characteristics of the participants

Characteristics		Groups		*p*
		Yoga group (n = 48)	Control group (n = 45)	
Age (years) ($M \pm SD$)		57.53 ± 1.92	58.10 ± 1.17	> 0.05
Race	White, n (%)	46 (96)	44 (97)	> 0.05
	Black, n (%)	2 (4)	1 (3)	> 0.05
Body mass index (kg/m^2) ($M \pm SD$)		24.23 ± 0.38	24.33 ± 0.41	> 0.05
Time since surgery treatment completion (weeks) ($M \pm SD$)		3.23 ± 1.17	3.27 ± 1.18	> 0.05
Cancer stage	1, n (%)	8 (17)	8 (18)	> 0.05
	2, n (%)	40 (83)	37 (82)	> 0.05

M – mean, *SD* – standard deviation

The dynamometry results for both the healthy and the affected upper limb were used to estimate muscle strength.

The Shapiro-Wilk test was preliminarily completed to spot the normal distribution of data. Dependent *t*-test was used to compare pre- and post-treatment range of motion and strength changes for each group. Independent *t*-tests compared post-intervention range of motion and strength parameters between YG and CG.

Ethical approval

The research related to human use has complied with all the relevant national regulations and institutional policies, has followed the tenets of the Declaration of Helsinki, and has been approved by the ethical committee of Khortytsia National Academy.

Informed consent

Informed consent has been obtained from all individuals included in this study.

Results

The present study indicated a positive effect of the hatha yoga intervention on shoulder range of motion and strength. As demonstrated in Table 2, there was a significant increase in range of motion in YG after the intervention.

After 3 months of hatha yoga exercises, a significant increase in range of motion was observed in YG: by 106.28° for flexion ($p < 0.001$), by 23.16° for extension ($p < 0.001$), by 111.08° for abduction ($p < 0.001$), by 35.34° for internal rotation ($p < 0.001$), and by 30.70° for external rotation ($p < 0.001$).

Shoulder range of motion significantly improved for some directions in the affected upper extremity in CG. The results in the shoulder joint improved by 29.32° for active flexion ($p < 0.001$), by 4.12° for extension ($p < 0.05$), by 30.62° for abduction ($p < 0.001$), by 1.17° for internal rotation ($p > 0.05$), and by 2.88° for external rotation ($p > 0.05$).

The comparison of post-intervention results of active range of motion in all directions between YG and CG showed hatha yoga superiority over usual care. Active flexion value was significantly higher in YG compared with CG by 76.76° ($p < 0.001$), extension by 18.92° ($p < 0.001$), abduction by 80.21° ($p < 0.001$), internal rotation by 33.29° ($p< 0.001$), and external rotation by 27.36° ($p < 0.01$).

As presented in Table 3, there was a significant increase in strength and power index in the upper extremity of the affected side: by 6.0 kg ($p < 0.001$) and 8.25% ($p < 0.001$), respectively, in patients YG; in CG, the above mentioned indicators improved by 1.1 kg ($p > 0.05$) and 1.44% ($p > 0.05$), respectively. Significant differences in strength were found between the study groups. The value of strength and power index was statistically higher in YG compared with CG: by 4.5 kg ($p < 0.001$) and 6.69% ($p < 0.001$), respectively.

Discussion

It was shown that the 3-month hatha yoga intervention contributed to a significant improvement of shoulder range of motion and hand strength in women with breast cancer.

Most studies indicate that physical therapy for women after breast cancer surgery might significantly improve the upper limb condition [20], heart rate variability [21], functional state of the cardiopulmonary system [22–24], and quality of life. Theoretical justification for the use of yoga therapy for women's health [25], especially for patients with breast cancer, was based on its positive impact reported in scientific studies [6–9] on the functioning of the upper extremity, cardiovascular system, emotional state, quality life, etc.

The results of our study confirmed the opinion of Loudon et al. [7], Cramer et al. [14], and Mazor et al. [16] about significant effects of yoga exercises in improving shoulder range of motion and strength of the upper extremity in postoperative women with breast cancer.

Most previous studies focused on 8-week yoga classes and reported their positive effect on the functional state of the

Table 2. Range of motion (mean ± error of mean) on the affected side in women of both groups during the intervention

Indicator	Yoga group (n = 48)		p	Control group (n = 45)		p
	Baseline	3 months		Baseline	3 months	
Flexion (°)	48.52 ± 2.40	154.80 ± 3.15*	< 0.001	48.72 ± 2.17	78.04 ± 2.26	< 0.001
Extension (°)	26.20 ± 1.51	49.36 ± 1.77*	< 0.001	26.32 ± 1.33	30.44 ± 1.41	< 0.05
Abduction (°)	39.00 ± 1.58	150.08 ± 2.27*	< 0.001	39.19 ± 1.49	69.81 ± 2.26	< 0.001
Internal rotation (°)	38.10 ± 2.11	73.44 ± 1.83*	< 0.001	38.98 ± 1.57	40.15 ± 1.20	> 0.05
External rotation (°)	37.54 ± 1.81	68.24 ± 1.34*	< 0.001	38.00 ± 1.50	40.88 ± 1.14	> 0.05

* $p < 0.001$ for comparing the results of the 3-month intervention between the yoga group and the control group

Table 3. Dynamometry indicators of the upper limb (mean ± error of mean) in women of both groups during the intervention

Indicator	Yoga group (n = 48)		p	Control group (n = 45)		p
	Baseline	3 months		Baseline	3 months	
Strength on the affected side (kg)	18.50 ± 0.82	24.50 ± 0.55*	< 0.001	18.90 ± 1.07	20.00 ± 0.86	> 0.05
Strength on the healthy side (kg)	26.20 ± 0.99	27.50 ± 0.83	> 0.05	26.53 ± 1.31	26.95 ± 1.00	> 0.05
Power index on the affected side (%)	24.41 ± 1.20	32.66 ± 1.45*	< 0.001	24.53 ± 1.50	25.97 ± 1.32	> 0.05
Power index on the healthy side (%)	34.46 ± 1.59	36.61 ± 1.56	> 0.05	34.45 ± 1.92	35.01 ± 1.65	> 0.05

* $p < 0.05$ for comparing the results of the 3-month intervention between the yoga group and the control group

upper limb in breast cancer patients. Improvements were observed in some indicators of movement in the shoulder joint, while our 12-week study demonstrated enhancement in the shoulder range of motion in all directions. However, researchers on shoulder and spinal actions for women with breast-cancer-related lymphoedema indicated that yoga did not lead to statistically significant changes in range of motion across any shoulder movement [7]. During the above-mentioned period (12 weeks), only the strength in shoulder abduction underwent statistically significant changes [7].

The present study applied individualized exercises of hatha yoga in patients after breast cancer surgery considering the degree of lymphostasis, as well as limited movements in the shoulder joint. It has several notable strengths that include complex application of asanas and breathing exercises in accordance with the type of respiratory and autonomic dysfunction. Different asanas were performed in standing, sitting, and lying positions.

Limitations

The limitations of this study comprise homogeneous population and a limited number of participants.

Conclusions

On the basis of the results obtained, it can be deduced that hatha yoga is more beneficial than usual care for improving active shoulder range of motion and upper limb strength. It was observed that the yoga intervention resulted in better shoulder range of motion, strength (by 4.5 kg; $p < 0.001$) and power index (by 6.69%; $p < 0.001$) than usual care. The results can be successfully used by clinicians as yoga has proved to be an effective method of correcting upper limb dysfunctions in patients with breast cancer.

It is planned that further research will be aimed at determining the effectiveness of hatha yoga in improving quality of life among women after Madden mastectomy.

Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflicts of interest

The authors state no conflict of interest.

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