Effect of Rehabilitative Therapy on Upper Limb Functions among Patients with Breast Cancer undergoing Radiotherapy

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Abstract: **Background:** radiation therapy can destroy cancer cells, but it also damage normal cells. Breast cancer patients often experience limitation in shoulder functions after radiotherapy. **Purpose**: to examine the effect of rehabilitative therapy on upper limb functions among breast cancer patients undergoing radiotherapy. **Design**: a quasi-experimental research design was utilized for this study. **Setting**: the study was conducted at the Oncology outpatient clinic of radiation therapy department at Menoufia University Hospital in Shibin El Koum, Egypt. **Sample**: a convenient sample of 100 patients who met the inclusion criteria was selected and divided into two equal groups (Study & Control). **Instruments**: two instruments were used for data collection: Structured interview questionnaire and The University of California, Los Angeles Shoulder Rating scale (UCLA). **Results**: the study results revealed a statistical significant increase in the total mean UCLA score within the study group participants at four weeks post intervention and follow up after 12 weeks (4.8±1.8 and 8.8±1.47 respectively) in addition to a highly statistically significant difference was existed between the both groups (study& control) at four weeks and 12 weeks after intervention. Conclusions: rehabilitative therapy had a significant effect on improvement of upper limb functions among study group than control group. **Recommendations**: Nursing staff at radiotherapy unit should be encouraged about the use of rehabilitative therapy for patients with breast cancer throughout their radiotherapy course to improve the upper limb function.

Key words: - *Breast cancer, Rehabilitative Therapy, upper limb functions, Radiotherapy.*

Introduction

Breast Cancer (BC) is a worldwide vital issue, also the main cause of women's illnesses and deaths both in developed and developing nations. It ranks the highest third leading cause of cancers and the highest 5th reason of mortality among females (American Cancer Society, 2023).

The standard management therapy for BC includes surgery, chemotherapy; radiotherapy and immunotherapy are used in combination to treat breast cancer, depending on the stage and type of tumor. These treatment modalities have resulted in significant improvements in overall survival and patient-reported outcomes (Mugundhan & Mohan 2024). Radiation therapy has a significant role in local control of breast cancer, primarily in the adjuvant setting, but may also be used for palliative therapy. In early-stage breast cancer, adjuvant radiotherapy has been shown to reduce the risk of breast recurrent disease by approximately 50% (Ibraheim et al., 2024).

Radiotherapy in any of its modalities also has adverse effects. These effects appear on average in the third week of radiation treatment (Abreu et al., 2021). Radiotherapy after mastectomy will cause a large area of dissection wound, excessive swelling, scar formation and pain of the affected limb, which adversely affect the recovery of the upper limb functions (Zhang et al., 2023).

Previous study has found that patients treated with axillary lymph node dissection followed by radiation have the highest risk of developing impairment of the arm and shoulder, including range of motion (ROM) restriction, reduced arm strength and limitation in activities of daily living (ADLs). Breast cancer survivors complain of disabling side effects to the ipsilateral arm and shoulder such as pain and loss of functions. Physical disability may persist long-term after the treatments significantly worsening the patient's ability to perform ROM (Ferrara et al., 2024).

Massage therapy is one of non-pharmacological approaches featuring a safe, inexpensive and easy to use method that can be utilized by breast cancer patients without measurable side effects (Bahceli et al., 2022). Swedish massage technique is used to remove excess interstitial fluid, increase lymphatic transfer in manual lymph drainage also improve limb blood circulation and motor function as results of its relaxing nature which can be especially helpful with relieving shoulder pain and improving its function (Goll and Aghamohamadi, 2020).

In addition functional exercise is a convenient, effective and economical evidence based nursing intervention for patients with breast cancer, as early progressive functional exercise is necessary for breast cancer patients to improve blood and lymphatic circulation in the affected limb so reduce subcutaneous effusion and prevent further complications (Qiu et al., 2024).. Nurses worldwide play a vital role in encouraging breast cancer survivors to practice healthy behavior to reduce their risk of exacerbation and

it is critically important for nurses to know and understand how best to holistically approach and assist breast cancer patients during their treatment (Mohammed & Soultan, 2021). So this study was carried out to examine the effect of rehabilitative therapy on upper limb functions among breast cancer patients undergoing radiotherapy.

Significance of study

Shoulder complications are the most common sequel following treatment for breast cancer, It includes a restricted shoulder range of motion, stiffness, weakness to shoulder muscle reported by 10- 60 % of patients (Lin et al, 2020).The existing routine nursing care is mostly disease-centered and ignores the actual needs of patients (Liu, 2020). By using rehabilitative therapy the nurse can give guidance to patients upon their admission, and performs targeted nursing measures such as upper limb exercises and massage so as to enhance upper limb functions (Li et al., 2021).

Purpose of the study

The purpose of the current study was to examine the effect rehabilitative therapy on upper limb functions among breast cancer patients undergoing radiotherapy.

Research Hypotheses

1) Patients receiving radiotherapy for BC who implement the rehabilitative therapy (Study group) will exhibit improvement in upper limb functions, than patients who don't (control group).

Operational Definitions

Rehabilitative Therapy:

is operationally defined as implementing Swedish massage and rehabilitation exercises;

- Swedish massage it is helpful for restoring range of motion and reducing scar tissue. Relaxing and massaging the shoulder muscles of the affected upper limbs; kneading of the trapezius muscle, the muscles around the rotator cuff, the supraspinatus muscle, and the infraspinatus muscle was carried out.

- The rehabilitation exercises, were divided into four phases, each patient was performed the (active muscle stretching of the shoulder flexion and abduction, isotonic and isometric muscle contraction of the shoulder and isometric handgrip exercise)

Methods:

Research Design

A quasi-experimental research design (study and control) was utilized to achieve the purpose of the current study.

Setting

The current study was conducted at outpatient clinics of radiation therapy of Oncology department, Menoufia University Hospital, at Shebin El-Kom, Menoufia Governorate, Egypt

Sampling

A convenient sample of 100 adult patients with breast cancer from the previously mentioned setting was

selected. A simple random sampling technique was used to assign them into two equal groups (study and control). 50 patients for each group. They were selected according to the following criteria

Inclusion criteria:

- Adult female patients diagnosed with breast cancer, had mastectomy (radical, modified radical, lumpectomy and conservative), undergoing postoperative radiotherapy for the first time, may have chronic disease (hypertension, diabetes …) and be able to communicate.

Exclusion criteria

- Patients having Lymphedema due to cancer recurrence because the results from this condition may interfere with complications of metastasis.
- Patients who are unable to cooperate due to mental illness, because they will not be able to understand the nature of intervention.
- Complicated cases with organ dysfunction because of patients' need for supportive and special health care.

Sample size was determined based on the following equation:

$$n0 = Z^2 \, p \, q \, / \, e^2$$

Z^2 = was the desired confidence level which is 95% (1.96) (The value for Z is found in statistical tables which contain the area under the normal curve)

e = was the desired level of precision 0.05 (±5%),

p = was the estimated proportion of an attribute that is present in the population, and q is 1-p.

As the sample included breast cancer patients with certain inclusion criteria, the sample size (n0) could be adjusted as:

$$n = n0 \, / \, [1 + \{(n0 - 1) \, / \, N\}]$$

Where (n) was the sample size and N was the population size.

Instruments of the study:

Two instruments were used for collecting the data in this study. These instruments were:

<u>Instrument one</u>: Structured interview questionnaire.

It was developed by the researcher to assess baseline personal and medical data. After reviewing the relevant literature (Douglass et al., 2016 and Dong-suk et al., 2021). It comprised of two parts as the following:

- **<u>Part 1</u>: Bio-Sociodemographic data**: It comprised of nine questions about patient's age, gender, marital status, level of education, occupation, residence, weight, height and body mass index (BMI).
- **<u>Part 2</u>: Medical data**: It comprised of nine questions related to past and present medical history such as number of hospitalization after diagnosis, presence of chronic diseases, duration of suffering from the tumor, tumor location; tumor stage; type of surgery; additional treatment, radiotherapy device and number of radiotherapy sessions.

Instrument two: - The University of California, Los Angeles Shoulder Rating scale (UCLA).

This scale was adopted from Amstutz et al., (1981), it was used to assess shoulder function, it had 26 questions regarding five separate domain areas: pain, function, strength of forward flexion, active forward flexion, and overall patient satisfaction.

Scoring system:

The scale is weighted by pain, and function accounts for 20 points. The other domains (Active forward flexion of affected arm, Strength of forward flexion & Satisfaction of patient) account for 15 points, giving a total score of 35 points. A score less than 29 rated as poor, score 29 to 33 rated as good, and score 34 to 35 rated as excellent (Constant et al., 2008).

Interpretation of total scoring system:

Interpretation	Score
Poor	less than 29
Good	29-33
Excellent	34-35

Validity of the instruments: -

All instruments were tested for its content validity by a jury of seven experts in the field of Medical Surgical Nursing specialties, faculty of nursing, Menoufia University to ascertain relevance, completeness, and clarity comprehensiveness, understanding, clarity and applicability. Modifications were done accordingly to ascertain relevance and completeness.

Reliability of the instruments: -

The first instrument was tested using a test- retest method to ascertain consistency. The period between both tests was two weeks. The results were 0.97 for the first instrument. The reliability of UCLA scale had shown to be very high, the test retest reliability was 0.673 (Oh et al., 2009).

Pilot study

A pilot study was conducted prior to data collection on 10% of the study sample (ten patients) to test the feasibility; clarity and applicability of the instruments and to identify the difficulties that would be faced by the researchers during the application. Necessary modifications were made. These patients were excluded from the study sample to avoid bias.

Ethical Considerations:

The researchers obtained approval to conduct the study from the Research Ethics Committee of the Faculty of Nursing, Menoufia University (approval number 856). The participants in the study were provided with a verbal and written explanation of the study's purpose and asked to provide their consent to participate. Each participant was assured that their information would be kept confidential and used only for scientific research. The researchers made it clear that participation in the study was voluntary, and patient's anonymity was guaranteed through data coding. Participants were informed that they could withdraw from the study at any time and their decision not to participate would not affect their care.

They were also assured that the study would not cause any physical or emotional harm.

Procedure:

A written official letter was submitted from the Dean of the Faculty of Nursing, Menoufia University to the director of Oncology department hospital including the purpose of the study and methods of data collection

- The researchers collected the data from outpatient radiation clinics (unit). The researchers attended two days/ week (Sunday and Thursday) for the control and study groups until data was completed throughout a period extended over nine months from the beginning of December 2023 to the end of August 2024.

- The period of data collection started from the beginning of radiotherapy which lasted four weeks and continued to 12 weeks after finishing radiotherapy Total period of data collection was 16 weeks.

- Each patient who met the eligibility criteria and agreed to participate in the study was interviewed individually at the radiotherapy waiting area for about 30 to 40 minutes for each patient. In the first meeting with subjects lasted from 9 am to 4 pm in which subjects attended according to their scheduled time according to their residence.

- The researchers dealt with the control group firstly then the study group to avoid the contamination of results.

- The study was conducted throughout four phases: Assessment, planning, implementation, and evaluation phase as following:

- Each patient of both groups was interviewed individually in the radiotherapy waiting area and assessed for patient's personal and medical data at the first day of radiotherapy using instrument I (Structured interview questionnaire). Each patient of both groups was assessed for their anxiety level using instrument two (Zung Self-rating Anxiety Scale and pain level using instrument three (VAS).

- A colored instructional booklet was prepared containing all information about (breast cancer, treatment modalities, side effect from radiotherapy and how to overcome rehabilitation exercises and swedish massage) to meet patients' needs in order to improve the level of pain and anxiety. For study group a special rehabilitation exercises and massage was used to deal with patients' psychological problems based on the guidance of the previously listed literatures.

- The intervention was performed for patients by the researchers throughout three sessions extended for (30-40) minutes for each during the patients' visit to the oncology unit for the purpose of treatment and follow-up at the waiting area of radiotherapy for the study group. Small group discussions (2-4 patients) were used to provide educational information and

training practices about rehabilitation exercises by using (demonstration and return-demonstration Immediate practice was done immediately on the same day by asking the patient to repeat each movement after the researchers. Then,it was repeated five days/ week for four weeks Telephone was used for encouraging the practice while during the period of radiation and continue for 12 weeks at home after completion of radiation sessions.

A structured colored booklet was used in providing

- Massage therapy was explained to the patient and family member in the study group. The proposed massage therapy was adapted from (Hegazy et al., 2022). The patient was instructed to receive a 10-minute Swedish massage of shoulder muscles of the affected upper limbs; kneading of the trapezius muscle, the muscles around the rotator cuff, the supraspinatus muscle, and the infraspinatus muscle

- At the same time, of massage assist the patient to perform back extension exercise of the shoulder joint. The strength of the traction was based on the degree of the patient's pain sensitivity, with an average of three times a day for 10 minutes each time for the study period (16 weeks).

- The researchers asked the family member to prepare the environment; the room should be quiet and dim lighting, maintain the patient's privacy then the patient

takes off her clothes and assume a prone position, pillows and towels were put beneath the patient's head and legs to ensure her comfort. The researchers asked the family member to use baby oil and rubbing hands together to warm it and started to distribute the oil on the selected parts for massage to prevent the friction and promote comfort

- Family members were instructed about how to apply swedish massage to the patients in the intervention group using long strokes and gliding motion massage technique with mild pressure using palm of the hand, for greater pressure on the muscle use the edges the hand and kneading of the muscle using the palm of both hands for five min.

- Thumb and fingertips were used to apply penetrating pressure over the muscle to demonstrate friction technique for five min and ending mild pressure using the palm of both hands. After the massage session was completely performed, the family member assisted the patient in wearing her clothes and assuming setting position.

Rehabilitation exercises

were divided into four phases; each patient performed the following exercises for study period from the beginning of radiotherapy to 16 weeks (the period of data collection).

- **Phase 1** consisted of the following movements: The isometric handgrip exercise: This exercise is performed by using stress ball which was

performed for two min of five contractions and five rest-pause intermittently per set, three to five sets per day. The isotonic muscle contraction exercises of the wrist and elbow: Full range of motion for the elbow and rest joint (not loaded). The patient was asked to bend the arm toward the chest until the fingers touch the shoulder then extend the arm beside the body, repeat for 10–15 times per set in each direction, three sets per day. Isometric muscle contraction of the shoulder joint: Range of motion (ROM) for the shoulder joint was performed slowly in both the flexion and abduction directions. Muscles will be allowed to contract using weight (0.5Kg) for 10 s and rest for five s, 10–15 times per set in each direction, three sets per day.

- **Phase 2** used isotonic muscle contraction of the shoulder joint in both flexion and abduction. The appropriate ROM for patients was performed with (gravity as the load). All was performed for 10–15 times per set in each direction, 3 sets per day.

- **Phase 3** involved active muscle stretching of the shoulder flexion and abduction. The patient was asked to face or side face the wall, place the hand on the wall, and slowly crawl fingers upward. When the patient felt that the armpit had a slight pulling or pain he asked to stop moving the fingers, 20–30 s, and then slowly moved the arm away from the wall. The same movement will be repeated 10–15 times per set, three sets per day.

- **Phase 4** involved shoulder flexion and abduction. The appropriate ROM shoulder flexion and abduction for patients was performed with using resistance as the load (hold a small bottle of water). The patients allowed lifting the weight repetitively for eight to 15 times per set in each direction, three sets per day. At the end of the session there was 15-20 minutes, the researchers made conclusion and obtain feedback and the educational booklet was given to the study group. At the second session of intervention (after four weeks) data was collected from patients using the instruments listed before and patients was informed about how to use measuring tape at home for measuring arm circumference during follow up period after (12 weeks).

- During follow up period, the researchers reinfor the participants of the study group by phone to reinstruct them about the importance of adherence to exercises and written instructions in the booklet.

- Each patient was assessed three times throughout the study period: the first time at the beginning of radiotherapy (pre intervention) then four weeks post radiotherapy (post intervention) and finally after 12 weeks post radiotherapy (follow up) at the oncology outpatient clinic and by telephone for patient who didn't attend the outpatient using study instruments II (Zung Self-Rating Anxiety Scale (SAS)) and instrument III (VAS).

Results

Table 1 displays distribution of socio-demographic and personal data for both study and control group of breast cancer patients undergoing radiotherapy shows that the mean age for the study and control group were 47.74 ± 8.98 and 49.5 ± 8.3 respectively. Additionally a higher percentage of individuals in both groups were married (74% of the study group and 62% of the control group). In terms of education, approximately one-third of the participants had a secondary education (36% of the study group and 30% of the control group). There was no statistical significant difference between both groups regarding socio-demographic data.

Table 2 displays present medical history of the studied sample and shows that the higher percentage of the study group (40%) had cancer for more than a year, while 36% of the control group had cancer one year ago. More than half of studied subjects (54% of the study group and 60% of the control group) had cancer in stage two. conservative and radical mastectomy were the most common surgeries among the study group (36.0% and 36.0% respectively) while half of (50%) control group had radical mastectomy. Majority of studied patients received linear radiation (86% for the study group and 96% for the control group). The radiation sessions schedule was 15 sessions every 3 weeks for about half of the sample (48% of the study group and 50% of the control group). There were no statistically significant differences between the study and control group regarding medical data, with a P-value > 0.05.

Table 3 indicates that there was no statistically significant difference between the study and control groups in terms of UCLA Shoulder Rating Scale levels pre intervention (p-value = 0.053). However, a highly statistically significant difference was existed between the both groups at four weeks and 12 weeks after intervention, with (p-value of 0.00).

Figure (1) shows that, pre-intervention, 96% of the study group versus 98% of the control group had poor shoulder function. Four weeks after radiation treatment; 58% of the study group had poor shoulder function compared to 100% of the control group had poor shoulder function. However, at 12 weeks; the shoulder function changed to 0% poor for the study group, and 92% poor for the control group.

Table (1): Distribution of socio-demographic and personal data for both study and control group of breast cancer patients undergoing radiotherapy (n=100)

Personal data	Study (no=50)		Control (no=50)		Test of significance	p-value
	No	%	No	%		
Age						
Mean ± SD	47.7±8.98		49.5±8.3		t= 1.005	0.317
Marital status						
Single	2	4.0	7	14.0		
Married	37	74.0	31	62.0	$X^2= 4.59$	0.204
Divorced	3	6.0	6	12.0		
Widow	8	16.0	6	12.0		
Educational level						
Illiterate	11	22.0	12	24.0		
Read and write	10	20.0	14	28.0	$X^2= 1.18$	0.757
secondary education	18	36.0	15	30.0		
High education	11	22.0	9	18.0		
occupation						
Manual work	5	10.0	2	4.0		
Office work	9	18.0	14	28.0	$X^2= 2.66$	0.447
House wife	19	38.0	18	36.0		
Don't work	17	34.0	16	32.0		
Residence						
Rural	26	52.0	23	46.0	$X^2= 0.36$	0.548
urban	24	48.0	27	54.0		

Statistically significant at $P \leq 0.05$

Table 2: Distribution of both group (study and control) regarding present medical history (no=100)

| Present medical history	Study (No=50)		Control (No=50)		Test of significance	p-value
	No	%	No	%		
Duration of breast cancer						
Less than a year	15	30.0	13	26.0	X^2= 0.719	P =0.698(>0.05)
A year	15	30.0	19	38.0		
More than a year	20	40.0	18	36.0		
Affected side of cancer						
Right	31	62.0	31	62.0	X^2= 1.12	P =0.572(>0.05)
Left	18	36.0	16	32.0		
Both	1	2.0	3	6.0		
Stage of the disease						
Stage one	16	32.0	14	28.0	X^2= 0.468	P =0.832(>0.05)
Stage two	27	54.0	30	60.0		
Stage three	7	14.0	6	12.0		
Previous breast surgery						
Yes	50	100.0	50	100.0	X^2= --	P =-- (>0.05)
No	0	0.0	0	0.0		
If yes, which type						
Conservative	18	36.0	21	42.0	X^2= 7.88	P =0.096 (>0.05)
Partial mastectomy	1	2.0	0	0.0		
Modified radical mastectomy	13	26.0	4	8.0		
Radical mastectomy	18	36.0	25	50.0		
Radiotherapy device						
Liner	43	86.0	48	96.0	FE= 3.05	P =0.081 (>0.05)
Copelt	7	14.0	2	4.0		
Number of radiation session						
15 session/3 weeks	24	48.0	25	50.0	X^2= 0.055	P =0.973 (>0.05)
19 session/3 weeks	15	30.0	14	28.0		
20 session/3 weeks	11	22.0	11	22.0		
completed all required sessions						
Yes	50	100.0	50	100.0	X^2= --	P =-- (>0.05)
No	0	0.0	0	0.0		

Table 3: The differences between the study and control group regarding to the mean total score of UCLA Shoulder Rating Scale throughout the study period

Total UCLA score	Study (no=50)	Control (no=50)	Test of sign	p-value
Pre intervention				
Mean ± SD	3.1±1.26	3.5±1.5	U= 1.93	0.053 (>0.05)
Four weeks post intervention				
Mean ± SD	4.8±1.8	2.9±0.92	U= 8.1	0.00** (≤0.001)
Follow up (after 12 weeks)				
Mean ± SD	8.8±1.47	2.9±1.3	U= 8.7	0.00** (≤0.001)
Kruskal Wallis H test and P value	**H1= 5.99,P1= 0.00** **H2 =6.17,P2= 0.00****	**H1=4.73, P1=0.00** **H2= 4.01,P2= 0.00****		

H1, P1 relation of post to pre intervention

H2, p2 relation of follow up to pre intervention

Figure (1): Distribution of UCLA Rating Scale among the subjects of both groups throughout the study period
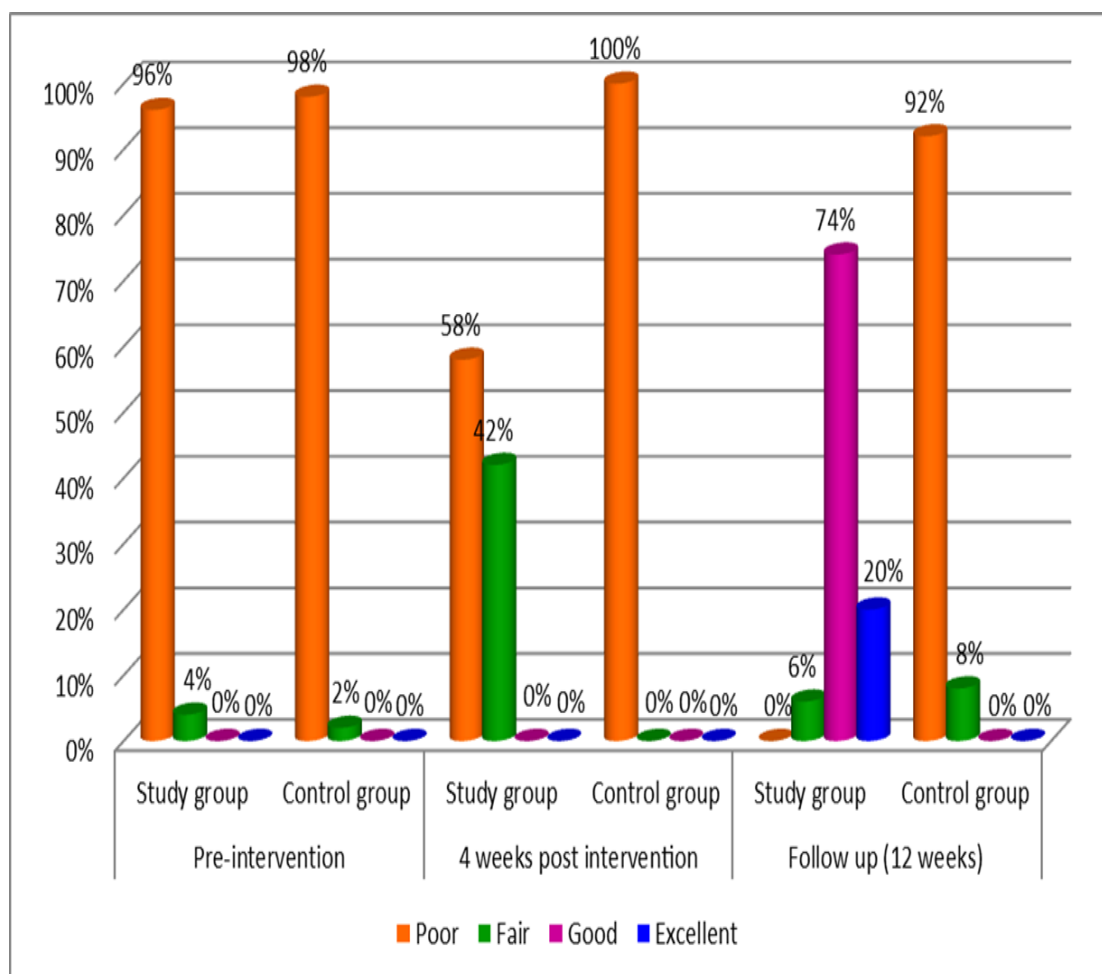
Discussion

In recent years, the incidence of breast cancer is increasing; patients often need radiotherapy after surgery, which requires high-quality evidence based nursing intervention to improve the therapeutic effect of patients. Postoperative radiotherapy for breast cancer patients will cause pain and edema in the affected limb which adversely affects the recovery of the upper limb (Zhang et al., 2023).

Shoulder function in relation to intervention throughout the study period among studied groups.

The present study finding revealed that at post intervention, patients of study group had highly significantly better improvement in the shoulder function, shoulder strength, pain, active forward flection and patient satisfaction than control group. All these improvements led to highly significantly improved total shoulder function (UCLA) score among study group than control group four weeks post intervention and at follow up (after12 weeks). The result of the current study was in the same line with Min et al., (2024) who studied the" Early implementation of exercise to facilitate recovery after breast cancer surgery" at South Korea demonstrated that a combined supervised and home-based exercise program improved both short- and long-term shoulder Range Of Motion (ROM) and strength. Also Lin et al., (2023) who studied "Effect of exercise on rehabilitation of breast cancer surgery" at China reported that aerobic exercise reduced the intensity of the shoulder pain, improved shoulder flexion and internal rotation range, lessened upper limb dysfunction and improved muscle strength during flexion.

Moreover Zhang et al., (2023) who studied "Application of evidence-based nursing in post-operative radiotherapy care for breast cancer" in China demonstrated that evidence-based nursing models can effectively improve patients' shoulder joint and elbow joint function, and improve patient satisfaction. Also Zhu et al., (2023) reported that functional exercise of the upper limb based on mirror therapy was helpful to the recovery of upper limb function in breast cancer patients. The results of this study showed that there was no statistically significant difference in pain, activity of daily living (ADL), ROM and upper limb function scores between both groups before intervention while obvious difference was observed regarding these parameters between both groups at four or eight weeks post intervention The results of the current study supported the study hypotheses which showed that patients in study group who implemented rehabilitative therapy had an improvement in shoulder functions than patients of control group. **From the researcher's point of view** arm exercises can help to keep full movement of arm and shoulder that enhancing circulation this leads to reduction of arm swelling by improving venous drainage. Also it can relieve pain and stiffness of the arm by encouraging muscle contraction and relaxation.

Conclusion

- Rehabilitative therapy had significant effect on improving shoulder functions among study group than control group.

Recommendations

Recommendations for nurses

- Nursing staff at radiotherapy unit should be encouraged about the use of rehabilitative therapy (rehabilitative exercises and swedish massage) for breast cancer patients before, during and after radiotherapy to improve shoulder functions and prevent further complications.
- A colored illustrative booklet should be distributed to all breast cancer patients undergoing radiotherapy to be oriented about everything concerning radiotherapy and its complications and how to overcome.
- Further research should be done to investigate the long-term effects of rehabilitative therapy on the prognosis and outcomes of patients with breast cancer.
- A similar study can be replicated at different settings and on large probability samples to allow for greater generalization of the findings.

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