

INFLUENCE OF LYMPHEDEMA ON GRIP STRENGTH AND PAIN OF HAND IN FEMALES HAVING BREAST CANCER: A CLINICAL STUDY

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ABSTRACT

Background: literature data is scarce concerning the hand function evaluation including hand grip strength, pain, and swelling in subjects with breast cancer-related lymphedema (BCRL) of the upper extremity following the treatment of breast cancer.

Aim: The present study was done to evaluate the hand lymphedema impact on hand grip strength and pain in females having breast cancer to further assess the impact of hand lymphedema severity on them.

Methods: The study included 120 females having upper limb lymphedema following the treatment for breast cancer. The included subjects were divided into two groups comprising 60 subjects each based on the hand edema presence Group I had 60 subjects having hand edema (HE+) and Group II included 60 subjects without hand edema (HE-). Grip strength and pain were assessed in all the subjects.

Results: median strength difference was 4 (5.3-1) in Group I study subjects compared to Group II where the median was 2 (4-1). These findings showed that the strength difference was significantly lesser for Group I subjects having hand lymphedema compared to group II subjects who did not have hand lymphedema with $p=0.04$. Concerning the pain difference, it was seen that the median value for pain in Group I was 6 (7.73-3.23) which was significantly higher than in Group II where the pain difference was 3.5 (5-1.73) with a p -value of 0.001. It was seen that pain was significantly higher for subjects with hand lymphedema compared to subjects with no hand lymphedema.

Conclusion: The limb having lymphedema following breast cancer management is weaker concerning the handgrip strength and is weaker with more pain intensity and edema.

Keywords: Breast cancer-related lymphedema, grip strength, hand lymphedema, pain, hand edema.

INTRODUCTION

BCRL (Breast cancer-related lymphedema) is a debilitating disease affecting a largely female population globally with a reported incidence of every 5 females having breast cancer. The main cause of Breast cancer-related lymphedema is a lymphatic channel injury to the prevention of adequate fluid drainage leading to swelling in the breast, trunk, or upper extremities on the side involved with the breast carcinoma.¹

The appearance of this swelling can be attributed to interstitial fluid accumulation and alteration in the tissues owing to insufficient lymphatic drainage. This swelling usually

appears gradually and can range from mild to the severe form. The primary risk factor for Breast cancer-related lymphedema is the removal of the axillary lymph nodes which can significantly increase after postoperative radiation therapy.²

Axillary lymph nodes are removed during the breast carcinoma surgery for local disease control, staging, and to evaluate the adjuvant treatment. The risk of developing lymphedema following the surgery is largely governed by the axillary surgery type. Both the SLNB (sentinel lymph node biopsy) which is a less invasive procedure and ALND (axillary lymph node dissection) expose subjects to the life-long risk of developing lymphedema following the removal of a few sentinel lymph nodes during SNLB or various axillary lymph nodes during ALND.³ A recent study for assessing the incidence of Breast cancer-related lymphedema in subjects with unilateral breast cancer suggest that the incidence of lymphedema is 4 folds higher compared in subjects managed with ALND compared to subjects who undergo SLNB with a reported incidence of nearly 20% and 5% respectively.⁴

Lymphedema is clinically diagnosed by measuring arm volume or circumference. Measuring the circumference using tape is the most commonly used technique in clinical diagnosis. The figure of eight method is employed when the hand is swelled and the circumference is not measured.⁵ In nearly 60%-70% of subjects hand swelling is seen in upper extremity lymphedema cases after treating them for breast cancer. This can negatively affect the functional mobility, daily activities, strength, and sensation of the affected hand. However, literature data is scarce concerning hand function evaluation in subjects with lymphedema of the upper extremity.⁶

In hand edema subjects, excessive fluid accumulates and expands in the subcutaneous tissues until it reaches the maximum capacity, and muscle action, joint movement, and tissue spaces are fluid filled causing inefficient muscle force production and joint mobility reduction.⁷ Lymphedema can limit physical arm function and limited motion range along with the feeling of numbness, heaviness, and pain in the upper extremity which further affect the quality of life. In survivors of breast cancer, decongestion does not reduce the fluid volume in the arm. Previous literature data shows that upper arm pain can also be due to nerve damage during treatment including radiotherapy, chemotherapy, or surgery.⁸

Limited shoulder movement can make subjects do wrist hyperextension during basic activities. This wrist hyperextension repeatedly may stress the extensor tendon and cause lateral epicondylitis causing weakness in the hands.⁹ Hence, the present study was done to evaluate the hand lymphedema impact on hand grip strength and pain in females having breast cancer to further assess the impact of hand lymphedema severity on them.

MATERIALS AND METHODS

The present cross-sectional prospective clinical study was done to evaluate the hand lymphedema impact on hand grip strength and pain in females having breast cancer to further assess the impact of hand lymphedema severity on them. The study population was comprised of females from the Department of Orthopaedics, Basaveshwara Medical College and Hospital, Chitradurga, Karnataka. After explaining the detailed study design, informed consent was taken from all the subjects in both written and verbal format.

The study included 120 females having upper limb lymphedema following the treatment for breast cancer. The inclusion criteria for the study were subjects willing to participate in the

study, having mild to severe unilateral lymphedema, having signed the informed consent, and subjects who underwent breast cancer treatment including chemotherapy, radiotherapy, or surgery a minimum of 3 months before the study commencement. The exclusion criteria were subjects having conditions affecting study participation as dementia, severe axillary pain, joint or muscle disorders, cancer recurrence, and previous history of contralateral breast disease. All included subjects had arm lymphedema after breast cancer treatment.

The included subjects were divided into two groups comprising 60 subjects each based on the hand edema presence Group I had 60 subjects having hand edema (HE+) and Group II included 60 subjects without hand edema (HE-). All the measurements for all the subjects were done during a single session. The severity of the lymphedema in the arms was assessed along with hand size for both arms, hand grip strength, and pain. Before testing the subjects, after final inclusion, detailed medical history was recorded for all the subjects followed by a clinical examination. Demographics including affected hand, dominant hand, profession, BMI (body mass index), weight, height, gender, and age of all the subjects along with the disease characteristics including previous infection, lymphedema duration, adjuvant systemic treatment, radiotherapy technique, positive lymph nodes, number of tumors, excised axillary lymph node number, and side and type of surgery. Arm edema was evaluated by measuring the circumference using 1-inch-wide tape in an interval of 5 cm starting from the third phalanx nail fold and going proximally to 45 cm. All measurements were assessed in centimeters for both arms.

A modified version of American Physical Therapy Association criteria was used to classify the severity of the lymphedema which divides it into mild, moderate, and severe for arm circumference of 3, 3-5, and >5cm respectively. The figure of eight measurements was done with the same tape as for circumference in sitting position with abducted arms rotated externally to 90°, abducted thumb, extended and abducted fingers, natural wrist, and elbows fixed at 90° and all measurements were taken twice for both the hands and in centimeters (\pm 0.1 cm).

The pain was assessed in a 100 mm VAS (visual analog scale) to determine the pain severity in the hands. Subjects were asked to rate their pain on a VAS scale of 0 to 10 where 0 showed no pain and 10 depicted severe pain. The pain was divided into 3 categories depending on the baseline scores mild for <4, moderate for 4-6, and severe for >6. A hydraulic hand Dynamometer was used to assess the hand grip strength and gross grasp as per the American Society of Hand Therapists guidelines. Throughout the test, the dynamometer was placed at the hand position setting. The subjects were asked to press against the device as much as possible. The peak forces were recorded at each trial and the mean average was taken to get the maximum average force which was compared to another normal side of each participant.

The data collected were assessed statistically using logistic regression and multivariate statistical techniques. The data were presented in tabulated and descriptive formats. SPSS version 22.0, 2013, Armonk, NY: IBM Corp and chi-square and Man Whitney U-test test were utilized. The data were expressed as mean and standard deviations and as percentages and numbers with a 0.05% significance level.

RESULTS

The present cross-sectional prospective clinical study was done to evaluate the hand lymphedema impact on hand grip strength and pain in females having breast cancer to further assess the impact of hand lymphedema severity on them. The included subjects were divided into two groups comprising 60 subjects each based on the hand edema presence Group I had 60 subjects having hand edema (HE+) and Group II included 60 subjects without hand edema (HE-). The demographic data of the study participants are listed in Table 1. All 60 subjects of both groups were females. The mean age of the study subjects of group I was 32.6 ± 4.2 years and for Group II study subjects was 33.1 ± 4.4 years respectively which was statistically comparable between the two groups with $p > 0.05$. The age range was 19-68 years for Group I and 21-59 years for Group II respectively which was non-statistical between the two study groups. The management of breast carcinoma was done by surgery in 40% ($n=24$), radiotherapy in 36.6% ($n=22$) subjects, and chemotherapy in 23.3% ($n=14$) study subjects respectively for Group I. For Group II, surgery, radiotherapy, and chemotherapy was given to 38.3% ($n=23$), 41.6% ($n=25$), and 20% ($n=12$) study subjects respectively. 31.6% ($n=19$) subjects had mild, 35% ($n=21$) subjects had moderate, and 33.3% ($n=20$) subjects had severe hand lymphedema in group I participants as shown in Table 1.

For the assessment of the post-operative parameters in the two groups of study subjects, it was seen that the median strength difference was 4 (5.3-1) in Group I study subjects compared to Group II where the median was 2 (4-1). These findings showed that the strength difference was significantly lesser for Group I subjects having hand lymphedema compared to group II subjects who did not have hand lymphedema with $p=0.04$. Concerning the pain difference, it was seen that the median value for pain in Group I was 6 (7.73-3.23) which was significantly higher than in Group II where the pain difference was 3.5 (5-1.73) with a p-value of 0.001. It was seen that pain was significantly higher for subjects with hand lymphedema compared to subjects with no hand lymphedema as summarized in Table 2.

Concerning the assessment of the Pearson correlation between the hand lymphedema and independent study variables, it was seen that the spearman correlation for strength difference was 0.233 with a p-value of 0.24 showing that a non-significant correlation exists between strength difference and hand lymphedema. Similar results were seen for the pain intensity with non-significant results where the spearman correlation was -0.013 and the p-value was 0.91 as shown in Table 3.

DISCUSSION

The present cross-sectional prospective clinical study was done to evaluate the hand lymphedema impact on hand grip strength and pain in females having breast cancer to further assess the impact of hand lymphedema severity on them. The included subjects were divided into two groups comprising 60 subjects each based on the hand edema presence Group I had 60 subjects having hand edema (HE+) and Group II included 60 subjects without hand edema (HE-). The demographic data of the study participants are listed in Table 1. All 60 subjects of both groups were females. The mean age of the study subjects of group I was 32.6 ± 4.2 years and for Group II study subjects was 33.1 ± 4.4 years respectively which was statistically comparable between the two groups with $p > 0.05$. The age range was 19-68 years for Group I and 21-59 years for Group II respectively which was non-statistical between the two study

groups. The management of breast carcinoma was done by surgery in 40% (n=24), radiotherapy in 36.6% (n=22) subjects, and chemotherapy in 23.3% (n=14) study subjects respectively for Group I. For Group II, surgery, radiotherapy, and chemotherapy was given to 38.3% (n=23), 41.6% (n=25), and 20% (n=12) study subjects respectively. 31.6% (n=19) subjects had mild, 35% (n=21) subjects had moderate, and 33.3% (n=20) subjects had severe hand lymphedema in group I participants. These data were compared to the studies of Choi Y et al¹⁰ in 2013 and Reed MD et al¹¹ in 2014 where authors assessed female subjects with breast carcinoma having similar demographic and disease characteristics as in the present study.

On evaluating the post-operative parameters in the two groups of the study subjects, it was seen that the median strength difference was 4 (5.3-1) in Group I study subjects compared to Group II where the median was 2 (4-1). These findings showed that the strength difference was significantly lesser for Group I subjects having hand lymphedema compared to group II subjects who did not have hand lymphedema with p=0.04. Concerning the pain difference, it was seen that the median value for pain in Group I was 6 (7.73-3.23) which was significantly higher than in Group II where the pain difference was 3.5 (5-1.73) with a p-value of 0.001. It was seen that pain was significantly higher for subjects with hand lymphedema compared to subjects with no hand lymphedema. These results were consistent with the studies of Tereda M et al¹² in 2020 and Baran E et al¹³ in 2021 where authors reported significant lesser hand grip strength and pain intensity in subjects with hand lymphedema following treatment of breast cancer as seen in the results of the present study.

The study results showed that on assessment of Pearson correlation between the hand lymphedema and independent study variables, it was seen that spearman correlation for strength difference was 0.233 with the p-value of 0.24 showing that a non-significant correlation exists between strength difference and hand lymphedema. Similar results were seen for the pain intensity with non-significant results where the spearman correlation was -0.013 and the p-value was 0.91. These results were in agreement with the studies of Giray E et al¹⁴ in 2019 and Mistry S et al¹⁵ in 2021 where authors suggested a similar correlation between hand lymphedema, hand grip strength, and pain intensity in their respective studies

CONCLUSION

Considering its limitations, the present study concludes that the limb having lymphedema following breast cancer management is weaker concerning the handgrip strength and is weaker with more pain intensity and edema. However, an increase in the volume of edema is not associated with an increase in hand lymphedema symptoms including hand grip strength and pain. The limitations of this study were smaller considered population, shirt monitoring, and biased related to the geographic location warranting further long-term studies planned longitudinally.

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TABLES

	Characteristics	Group I		Group II	
		%	n=60	%	n=60
1.	Gender				
a)	Males	0	0	0	0
b)	Females	60	100	100	60
2.	Mean age (years)	32.6±4.2		33.1±4.4	
3.	Age range	19-68		21-59	
4.	Management				
a)	Surgery	40	24	38.3	23
b)	Radiotherapy	36.6	22	41.6	25
c)	Chemotherapy	23.3	14	20	12
5.	Lymphedema stage				
a)	Mild	31.6	19	-	-
b)	Moderate	35	21	-	-
c)	Severe	33.3	20	-	-

Table 1: Demographic and disease characteristics of the study subjects

S. No	Parameter	Group I Median (IQR)	Group II Median (IQR)	p-value
1.	Strength difference	4 (5.3-1)	2 (4-1)	0.04
2.	Pain difference	6 (7.73-3.23)	3.5 (5-1.73)	0.001

Table 2: Comparison of the strength difference and pain difference in the two groups of study subjects

S. No	Variable	Spearman correlation	p-value
1.	Strength difference	0.233	0.24
2.	Pain intensity	-0.013	0.91

Table 3: Pearson correlation between hand lymphedema to pain intensity and strength difference in the two groups of study subjects