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Effects of lymphedema on posture, upper extremity functions, and quality of life in patients with unilateral breast cancer

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Abstract

Study aim: This study aimed to examine the effects of lymphedema on upper extremity function, posture and quality of life in patients with upper extremity lymphedema after unilateral breast cancer.

Material and methods: Twenty-seven women (46.65 ± 3.44 years) were included in this study. Upper extremity circumference and range of motion measurements were performed on the unaffected and affected sides. New York Posture Analysis (NYPA) was used for posture evaluation. Upper extremity functions and quality of life were assessed by the Disabilities of the Arm, Shoulder and Hand (DASH) and the Lymphedema Functionality, Disability and Health Questionnaire (Lymph-ICF), Upper Extremity Lymphedema-27 (ULL-27) and Quality of Life Measure for Limb Lymphedema – Arm (LYMQOL-Arm), respectively.

Results: The results showed a significant positive correlation between the DASH and Lymph-ICF, ULL-27, and LYMQOL-Arm ($r = 0.618$, $r = 0.637$, $r = 0.529$, $p < 0.05$). Furthermore, there was a significant correlation between ULL-27 and LYMQOL-Arm ($r = 0.557$, $p < 0.05$). No significant correlation between posture and upper extremity functions (DASH, Lymph-ICF) and quality of life was found (ULL-27, LYMQOL-Arm) ($r = –0.205$, $r = –0.087$, $r = –0.238$, $r = –0.122$, $p > 0.05$).

Conclusions: Upper extremity lymphedema can affect upper extremity functions and quality of life. Addressing lymphedema-specific quality of life and related measures is essential for the management of lymphedema.

Keywords: Breast cancer – Lymphedema – Posture – Upper extremity functions – Quality of life

Introduction

Breast cancer poses a significant global threat to women's lives. It occurs due to the uncontrolled proliferation of cells in the breast tissue [43].

Cancer-related incidence and mortality rates, especially in breast cancer, have increased for 50 years [15]. In the United States, 15.0% of all newly diagnosed cancers in 2022 were female breast cancer [42]. In 2020, breast cancer overtook lung cancer to become the most commonly diagnosed cancer worldwide, despite lung cancer typically being ranked first in global cancer incidence. Approximately 1 in 4 of all cancer cases occurring in women are breast cancer. It is common in both developed and developing countries [33]. Although its incidence is high, especially in developed countries, it has been observed that survival rates have been higher in recent years [17].

Breast cancer most commonly occurs in middle-aged women and is most commonly diagnosed in women between 40 and 55 [42]. The increasing survival times after treatments have caused health complications in the long term in patients depending on the treatments. Following breast cancer treatment, individuals may experience secondary pathologies such as pain in the upper extremity, limited joint movements, reduced functional capacity, swelling, stiffness, increased risk of infection, and loss of sensation. These include decreased quality of life and loss of upper extremity functions. In addition, some impairments can occur due to breast cancer treatment. One of these impairments is lymphedema.

Lymphedema is characterized by a generalized or localized accumulation of protein-rich interstitial fluid resulting from impaired lymphatic circulation due to some congenital or acquired causes [8, 9].

The most frequent reason for secondary lymphedema is filariasis in developing countries; acquired lymphedema

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in developed countries is usually related to cancer treatment [46]. Lymphedema is a typical impairment and complication of cancer treatment and is an important issue of survival reported by women after breast cancer [41].

The high prevalence of acquired lymphedema, which develops as a sequela of cancer treatment, is due to the increase in advanced examination methods and increased awareness of patients and physicians. Breast cancer is associated with a significant lymphedema risk. Cancer-associated lymphedema may develop immediately after cancer treatment or even months or years later [31]. Every woman undergoing cancer treatment has a lifetime risk of developing lymphedema. Therefore, early diagnosis of secondary lymphedema is required for effective treatment [12].

In women with lymphedema, pain, pressure, heaviness and fullness, numbness, increased warmth in the lymphedema arm, redness, edema, limitation in physical activity, and skin changes can be seen. High body mass index, obesity, nodal radiation, mastectomy, chemotherapy, low physical activity, blood sampling and blood pressure measurement from the affected arm, exposure to extreme temperatures, and plane travel increase the risk of lymphedema [2, 14, 32].

Although lymphedema is not life-threatening, it negatively affects lifestyle and quality of life. Due to cosmetic appearance, people's concerns about body image increase. Anxiety and depression are examples of psychological problems that can arise. In addition, this situation affects the daily life activities of individuals. It causes limitations in upper extremity movements. The patient's ability to use the affected arm is reduced, especially if the arm is the patient's dominant arm.

Abbasi et al. reported that lymphedema can cause pathological changes not only in the lymphatic system but also in the musculoskeletal system. Such problems are accompanied by mood problems, depression, decreased belief in recovery and feeling inadequate due to decreased physical activity. These conditions significantly reduce their quality of life [1, 16].

In addition, Taghian et al. found that breast cancer patients who developed lymphedema generally avoided using their arms. This situation causes complications such as limitation of movement in the upper extremity and increased edema. As a result, the patient's quality of life decreases [44].

Upper extremity function problems are a common side effect of breast cancer treatment and affect the patient's daily life. It has been reported that there is a decrease in the joint's range of motion depending on lymphedema in the upper extremity, which often occurs in shoulder movements. Therefore, patients experience severe losses in upper extremity functions [5]. In a study conducted after breast cancer, body asymmetry in the arm, lymphedema, and complications have been shown to affect spinal posture and whole-body balance [19].

To the best of our knowledge, no detailed study has examined the relationship between multiple parameters such as upper extremity function, posture and quality of life in individuals who develop lymphedema. Although studies in the literature have examined these parameters, there is a lack of clarity regarding the duration and stages of lymphedema in patients. Furthermore, current research on the topic is limited, highlighting the need for a consensus among studies. For these reasons, the objective of this study is to investigate how upper extremity lymphedema affects posture, upper extremity function, and quality of life in patients who develop the condition following unilateral breast cancer.

Materials and methods

The sample of the study consisted of patients who applied to a Special Hospital in Istanbul and were diagnosed with upper extremity lymphedema after unilateral breast cancer by the doctor.

Patients who developed upper extremity lymphedema at least one year after breast cancer treatment and those without metastases were included in this study. Volunteering to participate in the study, being between the ages of 18–50, having had unilateral breast cancer, being at least one year after breast cancer treatment, and active metastasis were inclusion criteria, while arthritis, fibromyalgia syndrome, neurological diseases, mental diseases, myopathic diseases, bilateral upper extremity lymphedema, inadequate communication and cooperation, presence of any orthopedic disease in the affected upper extremity, scoliosis, and cognitive problems were exclusion criteria.

Subjects

The program G*Power 3.1 was used to determine the sample size. Based on the percentage measurement values related to the methods to be studied in the literature [19], the total sample size found using the G*Power 3.1 program with an effect size of 0.5, a power of 0.9 and a margin of error of 0.05 was found to be n = 30, consisting of 15 experimental subjects and 15 control subjects. Thirty people were included in the study. Three people were excluded from the study due to the exclusion criteria. Therefore, the study was carried out on 27 subjects, all women, age 39–50, mean age 46.65 ± 3.44.

This study was designed as a descriptive cross-sectional study and simultaneously investigated the cause-effect relationship between the variables in a certain period. Ethical approval: University Ethical Committee, 10.06.2022 and E.83321821-050.01.04-2906.

Study protocol

Written informed consent was obtained by explaining the aim and plan of the study to the participants. Afterwards, the patients were evaluated for approximately 45–60 minutes. First, sociodemographic information about age, height, weight, and detailed medical histories were recorded. The researcher made upper extremity range of motion (ROM) and upper extremity circumference measurements on both sides of the participants. Participants were asked to answer questionnaires for upper extremity functions and quality of life assessments. Upper extremity functions were evaluated with DASH and Lymph-ICF, and the ULL-27 and LYMQOL-Arm questionnaires assessed the quality of life. Finally, the postures of the study group who completed the questionnaires were evaluated with the New York Posture Analysis.

Evaluations

Structured questionnaire

The structured questionnaire prepared by the researcher applied face-to-face interviews. The questionnaire included the age, weight, height, body mass index (BMI), lymphedema duration, lymphedema stage, dominant side, affected side, and orthopedic disease of subjects.

Upper extremity circumference measurement

Circumference measurements were evaluated for both upper extremities. Markings were made every 4 cm, assuming the wrist pivot point. Upper extremity circumference measurements were made at 4 cm intervals up to the axilla. The difference between the affected and unaffected sides was determined.

Goniometric measurements

The active range of motion (ROM) of both upper extremities (affected and healthy) was measured with a goniometer. Flexion and abduction were measured in the supine position and extension in the prone position. Internal and external rotations were measured in the supine position with the shoulder 90° abducted and the elbow 90° flexion. A difference of ≥20° between the affected and unaffected sides was considered a limitation in the ROM of the affected side.

Evaluation of posture

Posture is the optimal form of all body parts about the whole body and the adjacent segment. The study participants' postures were evaluated using the New York Posture Analysis (NYPA). Posture analysis is done in an upright standing position.

This assessment test evaluates posture disorders that occur in 13 different body regions. The scoring of the test is as follows: A score of 5 is given if the person has a proper posture, 3 points if there is a moderate impairment, and 1 point if there is a severe disorder. The maximum score obtained at the end of the test is 65, and the minimum is 13. The standard evaluation criteria used for the test are as follows for the total score: ≥45: very good, 40–44: good, 30–39: medium, 20–29: weak, ≤19: bad.

Assessment of upper extremity functions

Disabilities of the arm, shoulder, and hand (DASH) questionnaire. It is a disability/symptom scoring system based on a self-report system of 30 items developed to evaluate upper extremity-specific physical functions and symptoms. The DASH questionnaire contains 30 questions. Questions are scored from 1 to 5 (1: no difficulty, 2: mild difficulty, 3: medium difficulty, 4: extreme difficulty, 5: none at all). The total score range is 0–100. The DASH score is calculated using the formula:

$$[\text{sum of answers}/n - 1] \times 25$$

(n = number of questions answered). The Turkish validity and reliability were determined by Düger et al. [16, 21]

Lymphedema functionality, disability, and health questionnaire (Lymph-ICF). Lymph-ICF, a descriptive and evaluation tool, consists of 29 questions about the functional impairments, activity limitations, and participation restrictions reported by patients with breast cancer-related lymphedema. Physical function, mental function,

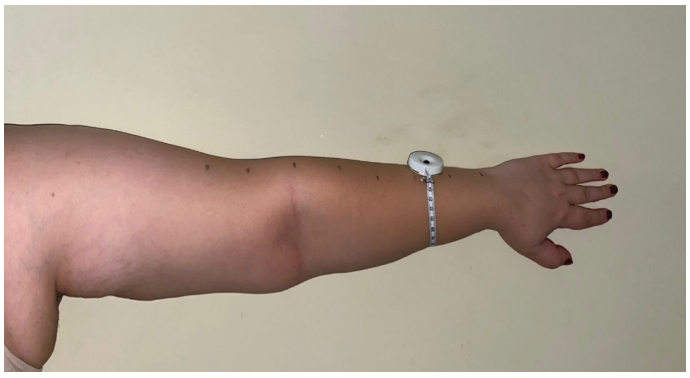

Figure 1. Upper extremity circumference measurement

Figure 2. Goniometric measurements

home activities, mobility activities, and life and social activities are the five main components into which the questionnaire is subdivided. A visual analogue scale is next to each question, and patients mark the answer that best suits them. A high score indicates that the effect on the quality of life is high. The Turkish validity and reliability study was performed by Kostanoğlu et al. in 2016 [12, 26].

Assessment of Quality of Life

Upper extremity lymphedema-27 (ULL-27). ULL-27 is a quality-of-life questionnaire evaluating upper extremity lymphedema as three components. The scale deals with physical, psychological and social components and consists of 27 questions. The first 15 questions evaluate the physical component, questions 16–22 evaluate the psychological component, and questions 23–27 evaluate the social component. A 5-point Likert score (1 = strongly disagree, 5 = strongly agree) is used in the scale. The lowest score is 27, and the highest score is 135. A high score on the scale indicates that lymphedema negatively affects the quality of life. The physical score consists of a total of fifteen questions, and this score of the person is between 15 and 75. The psychological score consists of seven questions, with a minimum of 7 and a maximum of 35 points. There are five questions for the social score, with a minimum of 5 and a maximum of 25 points. For a total score of 27 questions, 1 in all questions will receive a minimum of 27 points, and a person choosing 5 in all questions will receive a maximum of 135 points [24, 27].

Quality of life measure for limb lymphedema-arm (LYMQOL-Arm). The LYMQOL-Arm, primarily a self-assessment report questionnaire, assesses the symptoms of lymphedema in the upper extremity and the ability to perform functional activities in patients with breast cancer-associated lymphedema [25]. There are five subsections in the 21-question survey. These are upper extremity function (questions 1a-h,2,3), appearance (questions 4–8), symptoms (questions 9–14), emotional state (questions 15–20), and general quality of life (21st question). High scores for the first 20 questions and low scores for the 21st question indicate poor quality of life [4].

Statistical analysis

All statistical analyses were conducted using the program IBM SPSS Statistics for statistical analysis. The Shapiro-Wilk test was used to test the numerical variables for normality. The summary of numerical data showed mean ± standard deviation, and ratio n (%) was used for categorical data. Spearman's correlation test was performed to evaluate results for non-parametric data. The Mann-Whitney U test was used to compare the non-parametric data. The statistical significance level was set at $p < 0.05$.

Table 1. Demographic characteristics and distribution of clinical characteristics of the study group

N = 27		Mean ± SD	
Age [years]		46.65 ± 3.44	
Weight [kg]		71.07 ± 13.80	
Height [cm]		164.54 ± 7.51	
BMI [kg/m^2]		26.38 ± 5.52	
		N	%
Affected side	Dominant	18	66.7
	Nondominant	9	33.3
Lymphedema duration	1–5 years	27	100
Lymphedema staging	Stage 1	15	55.6
	Stage 2	12	44.4

Data expressed as mean ± standard deviation; N: Patient number.

Results

The study group's demographic characteristics (age, weight, height and body mass index (BMI)) are presented in Table 1. Additionally, in the study group, the dominant side was affected in eighteen participants, and the non-dominant side was affected in nine participants. The study group included lymphedema patients who were diagnosed between 1 to 5 years, and according to the International Society of Lymphology (ISL), the staging of lymphedema patients. The clinical characteristics of the study group are shown in Table 1.

The range of motion (ROM) of the shoulder, elbow, and wrist joints was evaluated for the unaffected and affected sides. Since the data were not normally distributed, the Wilcoxon signed-rank test was used to compare the shoulder, elbow, and wrist joint range of motion (ROM)

Table 2. Measurement values of the shoulder, elbow and wrist joint range of motion (ROM) of the unaffected and affected side of the study group

	Affected side Mean ± SD	Unaffected side Mean ± SD	p-value z	Min-max Median values for affected side	Min-max Median values for unaffected side
Shoulder flexion [°]	133.26 ± 17.31	173.88 ± 6.55	p: 0.00 z: –4.468	90–150 140	160–180 175
Shoulder extension [°]	35.96 ± 12.16	55.55±5.60	p: 0.00 z: –4.21	10–60 40	40–60 55
Shoulder abduction [°]	134.61 ± 22.13	173.33 ± 6.79	p: 0.00 z: –4.341	90–180 130	160–180 175
Shoulder internal rotation [°]	46.92 ± 13.49	64.44 ± 4.23	p: 0.00 z: –4.151	15–70 47.5	55–70 65
Shoulder external rotation [°]	59.80 ± 17.40	82.03 ± 5.59	p: 0.00 z: –4.192	10–90 60	75–90 80
Elbow flexion [°]	116.34 ± 23.43	143.14 ± 6.22	p: 0.00 z: –4.161	30–150 120	130–150 145
Forearm supination [°]	55.00 ± 11.48	75.55 ± 4.23	p: 0.00 z: –4.387	20–80 57.5	70–80 75
Forearm pronation [°]	55.38 ± 11.65	75.37 ± 4.14	p: 0.00 z: –4.40	20–80 60	70–80 75
Wrist flexion [°]	58.26 ± 15.48	75.55 ± 4.23	p: 0.00 z: –3.954	25–80 60	70–80 75
Wrist extension [°]	54.23 ± 18.36	65.55 ± 4.23	p: 0.012 z: –2.509	15–75 60	60–70 65
Wrist radial deviation [°]	16.15 ± 4.22	17.51 ± 2.56	p: 0.406 z: –0.831	5–20 16.5	10–20 17.5
Wrist ulnar deviation [°]	16.84 ± 5.36	23.66 ± 4.55	p: 0.00 z: –3.932	10–30 15.5	14–30 25

Data expressed as mean ± standard deviation. ROM: Range of Motion.

Table 3. The relationship between upper extremity functions, posture, and quality of life parameters of the study group

	DASH	Lymph-ICF	NYPA	ULL-27	LYMQOL-Arm
DASH					
r_s	1.000	0.618	–0.205	0.637	0.529
p		0.001	0.314	0.000	0.005
Lymph-ICF					
r_s		1.000	–0.087	0.651	0.867
p			0.671	0.000	0.000
NYPA					
r_s			1.000	–0.238	–0.122
p				0.241	0.552
ULL-27					
r_s				1.000	0.557
p					0.003
LYMQOL-Arm					
r_s					1.000
p					

DASH: Disabilities of the arm, shoulder and hand questionnaire, Lymph-ICF: Lymphedema functionality, disability and health questionnaire, NYPA: New York Posture Analysis, ULL-27: Upper Extremity Lymphedema-27, LYMQOL-Arm: Quality of Life Measure for Limb Lymphedema-Arm, P: p-value, r_s: Spearman's correlation coefficient.

Table 4. The relationship between disabilities of the arm, shoulder and hand (DASH) score and its components scores of the study group

DASH	Total score	Function	Symptoms
Total score r_s	1.000	0.128	0.302
p		0.524	0.126
Function r_s		1.000	–0.048
p			0.812
Symptoms r_s			1.000
p			

P: p-value, r_s: Spearman's correlation coefficient.

between the study group's unaffected and the affected side. A statistically significant difference was found between the unaffected and affected sides' range of motion measurements in all parameters except wrist radial deviation ($p < 0.05$). These findings are presented in Table 2.

The study investigated a relationship between posture, upper extremity functions (DASH and Lymph-ICF), and quality of life (ULL-27 and LYMQOL-Arm). These findings showed a significant positive correlation between the DASH and Lymph-ICF, ULL-27, and LYMQOL-Arm ($r = 0.618$, $r = 0.637$, $r = 0.529$, $p < 0.05$). However, there was no relationship between the DASH and NYPA ($r = –0.205$, $p > 0.05$). Also, there was no correlation between NYPA and Lymph-ICF, ULL-27, and LYMQOL-Arm ($r = –0.087$, $r = –0.238$, $r = –0.122$, $p > 0.05$). The results showed a significant positive correlation between Lymph-ICF and ULL-27, LYMQOL-Arm ($r = 0.651$, $r = 0.867$, $p < 0.05$). There was a significant correlation between ULL-27 and LYMQOL-Arm ($r = 0.557$, $p < 0.05$, Table 3).

The relationship between the DASH total score and its function and symptoms components was not statistically significant ($r = 0.128$, $r = 0.302$, $p > 0.05$). Also, there was no correlation between function and symptom components ($r = –0.048$, $p > 0.05$, Table 4).

There was a significant correlation between physical and mental, mobility, and life and social activities components ($r = 0.657$, $r = 0.632$, $r = 0.809$, $p < 0.05$). However, there was no correlation between physical and household activity components ($r = 0.367$, $p > 0.05$). There was a significant positive correlation between mental and household, mobility, and life and social activities components ($r = 0.651$, $r = 0.698$, $r = 0.755$, $p < 0.05$). Also, there was a moderate correlation between household and mobility, life and social activities components ($r = 0.448$, $r = 0.523$, $p < 0.05$). Furthermore, a significant correlation was found between mobility and life and social activities components ($r = 0.575$, $p < 0.05$, Table 5).

The relationship between the ULL-27 total and component scores was statistically significant ($r = 0.899$, $r = 0.662$, $r = 0.705$, $p < 0.05$). There was a significant correlation between social, physical, and psychological components ($r = 0.519$, $r = 0.576$, $p < 0.05$). However, there was no correlation between the physical and psychological components ($r = 0.372$, $p > 0.05$, Table 6).

The correlation between the LYMQOL-Arm total and its components function, appearance, symptoms and

Table 5. The relationship between lymph-icf total score and its components scores of the study group

Lymph-ICF	TS	PF	MF	HA	MA	LSA
TS r_s	1.000	0.756	0.902	0.707	0.841	0.814
p		<0.001	<0.001	<0.001	<0.001	<0.001
PF r_s		1.000	0.657	0.367	0.632	0.809
p			<0.001	0.065	0.001	<0.001
MF r_s			1.000	0.651	0.698	0.755
p				<0.001	<0.001	<0.001
HA r_s				1.000	0.448	0.523
p					0.022	0.006
MA r_s					1.000	0.575
p						0.002
LSA r_s						1.000
p						

P: p-value, r_s: Spearman's correlation coefficient, Lymph-ICF: Lymphedema Functionality, Disability and Health Questionnaire, TS: Total Score, PF: Physical Function, MF: Mental Function, HA: Household Activities, MA: Mobility Activities, LSA: Life and Social Activities.

Table 6. The relationship between ULL-27 total score and its components scores of the study group

ULL-27	Total scores	Physically	Psychological	Social
Total Score r_s	1.000	0.899	0.662	0.705
p		<0.001	<0.001	<0.001
Physically r_s		1.000	0.372	0.519
p			0.061	0.007
Psychological r_s			1.000	0.576
p				0.002
Social r_s				1.000
p				

ULL-27: Upper Extremity Lymphedema-27, P: p-value, r_s: Spearman's correlation coefficient.

emotion scores was statistically significant ($r = 0.899$, $r = 0.824$, $r = 0.641$, $r = 0.451$, $p < 0.05$). Also, there was a negative and significant correlation between the LYMQOL-Arm total and the overall quality of life component scores ($r = –0.448$, $p < 0.05$). There was a significant correlation between function, appearance, and symptoms components ($r = 0.659$, $r = 0.556$, $p < 0.05$). However, there was no correlation between function and symptoms and overall quality of life components ($r = 0.274$, $r = –0.353$, $p > 0.05$). A significant negative correlation was found between appearance and overall quality of life ($r = –0.534$, $p < 0.05$). In addition, a significant correlation was found b etween appearance and symptoms components ($r = 0.396$, $p < 0.05$). However, there was no correlation between appearance and emotion components ($r = 0.316$, $p > 0.05$, Table 7).

Discussion

In both our country and the world, breast cancer is a severe life-threatening problem [43]. Middle-aged women are most likely to get female breast cancer. The age group of women diagnosed usually is 40 to 55 [43]. Lymphedema is a key survivorship issue that women with breast cancer report experiencing and is a prevalent disability and side effect of cancer treatment. Even months or years after cancer therapy, cancer-associated lymphedema can appear. Every woman receiving cancer treatment risks developing lymphedema during their lifetime [31]. Examining studies in the literature reveals that becoming older is one of the risk factors for lymphedema. In their research, Geller et al. [18] found that women under 50

Table 7. The relationship between LYMQOL-Arm total score and its components scores of the study group

LYMQOL-Arm	Total score	Function	Appearance	Symptoms	Emotion	Overall quality of life
Total score						
r_s	1.000	0.899	0.824	0.641	0.451	–0.448
p		<0.001	<0.001	<0.001	0.021	0.022
Function						
r_s		1.000	.659	0.556	0.274	–0.353
p			.000	0.003	0.176	0.077
Appearance						
r_s			1.000	0.396	0.316	–0.534
p				0.045	0.116	0.005
Symptoms						
r_s				1.000	0.554	–0.275
p					0.003	0.174
Emotion						
r_s					1.000	–0.431
p						0.028
Overall quality of life r_s						
p						1.000

LYMQOL-Arm: Quality of life measure for limb Lymphedema-Arm; P: p-value; r_s: Spearman's correlation coefficient.

had a considerably higher risk of developing lymphedema. Richard et al. [36] investigated the relationship between lymphedema and patient age, and age at the time of diagnosis is an important determinant in the development of lymphedema. With increasing age (>65), the risk of developing lymphedema decreases due to decreased physical activity. Still, advanced age is a risk factor for lymphedema due to non-use, according to a study by Vrieze et al. [13] that examined the relationship between physical activity level and age in 185 breast cancer surgery patients. According to our demographic data, the participants in our study ranged in age from 39 to 50. As a result, according to the age range of the participants, our study is similar to the literature. As the lymphedema stage progresses, the symptoms increase [45]. In our study, no significant difference was found between the upper extremity functions, posture and quality of life of the participants according to the lymphedema stage (15 participants stage 1, 12 participants stage 2).

According to the literature, women with breast cancer may experience lymphedema if their BMI is high. Due to the proliferation of fat cells and enhanced functions such as the endocrine system, the increased fat mass caused by obesity will put more strain on the circulatory system and add to the load on the lymphatic and circulatory systems. In addition to the harm caused by breast cancer surgery, individuals may be more susceptible to developing lymphedema due to increased lymphatic fluid volume that exceeds their body's carrying capacity. There is increased awareness of high BMI as a risk factor for lymphedema. Recent research has revealed a strong link between lymphedema and a high BMI. Additionally, it has been discovered that a high BMI alters lymphatic function. According to Leray et al., lymphedema patients with a high BMI have a greater incidence of comorbidities [28]. According to Ridner et al., obese people have a 3.6-fold higher risk of developing lymphedema than normal-weight patients [39]. The participants' BMI ranged from 17.30 to 39.06. According to the BMI classification of this study, eight people had a healthy weight range body mass index. In comparison, the other eight people were overweight (>25), and eleven people had an obesity range body mass index (>30). As a result, our study is similar to the literature regarding the high BMI of most participants.

There has been limited research considering upper extremity functions when lymphedema is present on the dominant and non-dominant sides. Upper extremity functions may be impaired differently in those with afflicted dominant and non-dominant sides. Although it is controversial in the literature, Quiron [47] found that the severity of lymphedema increased if the dominant extremity was the side that was affected. However, no study has examined the effects on upper extremity functions, posture and quality of life according to the dominant and non-dominant sides. In the study group, the dominant side was affected in eighteen participants, and the non-dominant side was affected in nine participants. In our study, there was no statistically significant difference between upper

extremity function, posture and quality of life according to the affected side of the participants.

Belmonte et al. found that the joint ROM decline persists in the 5-year shoulder joint ROM examinations of patients with lymphedema [7]. In a study investigating the magnitude of the effects on shoulder functions, Levangie et al. found that the abduction and flexion movements of the shoulder were affected, and there was a 10–20 degree or 10% limitation of joint motion when compared to the contralateral side [29]. In the study of Isaksson et al., they found a 20-degree restriction in shoulder abduction and flexion after breast surgery [22]. Similarly, our study found a statistically significant difference between the unaffected and affected sides' range of motion measurements in all parameters except wrist radial deviation.

Women with post-mastectomy lymphedema were found to have asymmetries in posture in the study by Haddad et al. [19]. Babasaheb et al. observed that those with lymphedema following breast cancer had poor posture [3]. Our study is different from the literature in this regard. Our study also found that 15 participants had lymphedema at stage one only and 12 participants had stage two lymphedema, and the duration of the condition was in the range 1–5 years. In this relatively initial stage and time frame, no alterations of gross postural alignment were observed. However, it is crucial to understand that there may be no visible signs at this stage, but such signs might develop in the future considering that lymphedema is a progressive disease. Compensatory postural changes may develop from lymphedema through alteration of movement patterns in an attempt to minimize pain or swelling. These changes may not be so obvious for the first instance, but they have potential to alter the whole musculoskeletal system. For instance, body weight redistribution or changes in joint biomechanics because of edema may gradually cause postural dysfunctions and could have radical effects on spinal curves, pelvic tilt and alignment, curvatures of the thorax and a tilting of the head and face. However, according to the study findings there was no correlation between the quality of life, upper extremity functions, or posture.

Patients with breast cancer who experience lymphedema typically avoid using their arms. Complications brought on by this condition include increased edema and restricted movement in the upper extremity. Lymphedema affects not only the lymphatic system but also the musculoskeletal system. When the dominant side is involved, it causes the individual to avoid using the affected side. According to the literature, the findings of our study suggest that patients with high DASH scores experience a decrease in upper extremity functions. Dawes et al., in a study on patients with lymphedema after breast cancer treatment, discovered that upper extremity functions were affected, and patients with lymphedema scored higher in DASH [11]. Çolak et al. found that women with lymphedema had higher DASH scores [10]. When Park et al. evaluated the upper extremity functions of individuals with lymphedema after breast cancer, they found that the upper extremities of those with lymphedema showed lower function [34]. In our study, the mean DASH score of individuals who developed lymphedema after breast cancer was 52.91 ± 14.88.

In cases when lymphedema is the focus point, it is advised to employ the Lymph-ICF questionnaire, according to Jamshidi et al. Additionally, this scale includes questions specific to all arm symptoms. On the visual analogue scale, all questions are responded to. Because of this, the findings have a wide range of scores and are highly sensitive [20]. Although lymphedema is not life-threatening, it can impact a patient's physical, social, domestic, occupational, and emotional life. It demonstrates that when used with the DASH questionnaire, it may be most helpful when patients with a range of upper extremity disorders, such as breast cancer survivors, are assessed in a clinical or research investigation [23]. According to a study, patients with upper extremity lymphedema related to treatment for unilateral breast cancer have a higher lymph-ICF score [6]. In Lymph-ICF components, a positive correlation was found between physical function, mobility and social-life activities. Our study corroborated these findings.

Lymphedema affects people's quality of life. The ULL-27 and LYMQOL-Arm for quality of life were the most popular and most thoroughly validated in the study by Lim et al. [30]. ULL-27 can be used in upper extremity lymphedema, according to Pusic et al. in a COSMIN criteria review [37]. It was found that the quality of life decreased as the total score increased. The components of ULL-27 showed a significant positive correlation between social, physical, and psychological components. While there was a relationship between ULL-27 and upper extremity functions, no relationship was found with posture. Upper extremity functions were evaluated with DASH and Lymph-ICF, and their relationship was significant.

The first 20 items in the LYMQOL-Arm questionnaire are about the quality of life, while the last question rates overall quality of life on a scale of 0 to 10. Park et al. found that breast cancer-related lymphedema negatively affects the quality of life and upper extremity function [34]. Passik et al. reported that quality of life decreased significantly in their study evaluating the quality of life with LYMQOL-Arm [35]. In the study, Rietman et al. found that upper extremity dysfunction, which may develop due to the treatment methods applied, causes difficulties in daily activities, and this situation negatively affects the quality of life of individuals [38]. In addition, Ridner et al. found that although breast cancer was treated, the swelling in the arm reminded patients of breast cancer, so uncertainty about the future and fear that cancer

would recur negatively affected the patients' lives [40]. The current results showed a significant relationship between overall quality of life and appearance and emotions. A positive correlation was found between LYMQOL-Arm and upper extremity functions (DASH, ULL-27).

Limitations

Participant recruitment was limited due to the COVID-19 pandemic. In addition, categorization of participants based on the degree of lymphedema was not feasible in our study about posture, quality of life, and upper extremity functions.

Conclusion

This study concluded that lymphedema extremities significantly affected upper extremity functioning and quality of life in individuals with unilateral breast cancer but not posture. Patients with lymphedema following unilateral breast cancer may experience a decline in quality of life and upper extremity functions. In addition, patients should be educated about eventualities such as postural problems, impairment in upper extremity functions, and decreased quality of life.

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