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Original Article

Scapular dyskinesis in patients with breast cancer

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Abstract

Aim: To determine the incidence of scapular dyskinesis in breast cancer patients, to compare it with controls, and to investigate the triggering factors, analyzing restriction, pain and function of the shoulder, lymphedema, time after surgery, radiotherapy, chemotherapy, number of removed lymph nodes. Scapular dyskinesis is one of the complications after breast cancer treatment, without a consensual incidence ratio. Only a few studies in literature mention the incidence of scapula alata which is advanced form of scapular dyskinesis in patients with breast cancer, most of which insufficiently assess the required parameters and with discordant results.

Material and Methods: The study sample comprised forty-nine patients who had undergone axillar dissection and forty-nine healthy individuals as controls. Scapular dyskinesis, shoulder mobility, pain, lymphedema and function of shoulder were evaluated with lateral scapular slide test, goniometer, visual analogue scale, circumference measurement and Disabilities of the Arm, Shoulder and Hand Questionnaire, respectively.

Results: The incidence of scapular dyskinesis was 53.06 % in patients with breast cancer and significantly higher than the control group (p= 0.007). None of the parameters investigated have a significant relationship with scapular dyskinesis statistically (p>0.05).

Conclusion: The results indicate that the incidence of scapular dyskinesis is significantly higher in breast cancer therefore it will be beneficial that scapular dyskinesis is included in and thoroughly scrutinized during the clinical assessments; and medical practitioners dealing with breast cancer patients are informed of a potential scapular dyskinesis should need be.

Keywords: Axillar dissection; breast cancer; scapular dyskinesis; winged scapula

INTRODUCTION

Breast cancer (BCa) is the most commonly diagnosed cancer type in women (1). The incidence of BCa has been reported as 27% in Turkey (2). While the rate of mortality has decreased with developments in early diagnosis and treatment, the rate of morbidity related to the disease has increased (3). BCa and its treatment cause some complications such as shoulder restriction, lymphedema and dysfunction, etc. One of these complications is scapular dyskinesis (SD).

SD is currently defined as an alteration of normal scapular kinematics (4,5). It has been associated with shoulder injury, and several studies have reported differences in scapular kinematics among people with instability, rotator cuff tears, and impingement syndrome when they were compared with healthy shoulders (6,7). It can be caused by several factors: bone (thoracic kyphosis or clavicle diseases), joint (instability or arthrosis), nervous system (cervical radiculopathy or nerve palsy), soft tissue (tightness or stiffness of the pectoralis minor and posterior capsule), and muscular imbalance (between the upper trapezius and serratus anterior) (8,9).

One of the causes of SD in patients with BCa is serratus anterior paralysis due to thoracic nerve injury. The compensatory muscular activity is necessary to increase shoulder stability, which in turn triggers secondary pain and spasm. Thus, muscle imbalance occurs and tendinitis around the shoulder joint forms (10).

Also, surgical scarring and fibrosis associated with radiotherapy and surgery, may affect the biomechanics of the shoulder. A previous study demonstrated decreased muscle activity in four key muscles controlling scapular movement (serratus anterior, upper trapezius, pectoralis major and rhomboid) in patients with BCa (11). Although SD in BCa patients may arise from axillar dissection, it may also be observed in populations without BCa as a result of postural insufficiency. For this reason, it was necessary to eliminate postural insufficiency from the complications of BCa surgery. Moreover to date no previous study has ever studied the incidence of SD in BCa patients with respect to a healthy control group.

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Although there are few studies present in the literature providing incidence ratio for scapula alata (SA) which is the advanced form of SD, in patients with BCa (12-19), there is no study investigating SD in patients with BCa according to our knowledge.

No consensus was present among these studies examining SA, regarding the parameters assessed for the diagnosis or the incidence ratios presented after the assessments. The extraordinarily high variance of the incidence ratios reported for SA (1.5-74 %) was highlighted in a review conducted by Mastrella (20). While a previous study demonstrated that the incidence of SA was low in BCa patients (8 %) and decreased over post-operative time (18); another study showed that SA was relatively common after breast surgery with an incidence rate of 73.3% (13). Although limited in number, studies exploring the relationship between SA and breast cancer are still available in literature. However, to our knowledge none of the few studies addressing the incidence of SD investigate its correlation with BCa.

Identification of the risk factors associated with SD is necessary for preventative rehabilitation programs in order to avoid injury that may occur after BCa treatment. Early postoperative diagnosis might prove useful in facilitating early management, in turn accelerating functional recovery and reducing surgical procedure-related complications. Although the presence of SD and risk factors have been investigated in different diseases (21-23) and different sports (24, 25), the relationship between various SD types/degrees and functional parameters such as shoulder pain or shoulder mobility in patients with BCa has not been clarified in the literature. While few studies have investigated some of the possible risk factors for scapular abnormalities such as BMI, age, type of surgery, number of lymph nodes removed, radiotherapy, chemotherapy, shoulder restriction (12-19), there is no study investigating the association of SD with lymphedema and function of shoulder according to our knowledge.

The objectives of the present study were to evaluate the incidence of SD in patients with BCa, to compare it with healthy controls and to analyze the risk factors that could affect SD.

MATERIAL and METHODS

The present study was conducted at Gazi University Hospital and included forty-nine patients in the study group and forty-nine healthy individuals in the control group. All the participants in the study group had axillary dissection. Home exercise program was given to all patients participating in the study. The exercise protocol included one set with 10 repetitions of active UL exercises.

Ethical approval was obtained from the research ethics committee of Gazi University (number 25901600 on 22.12.2015). The inclusion criteria for the study group were being older than 18 years, being diagnosed with BCa and having received axillary dissection. Patients with neurological or orthopedic disorders that limited motor functions had severe cardiac abnormalities; presented cognitive impairment that may influence the cooperation of the patient; had undergone bilateral axillary surgery or immediate breast reconstruction with the latissimus dorsi flap or the rectus abdominis muscle and the ones who refused to participate were excluded from the study (18).

The sample size, the required number of people to be employed in the study was determined by a pilot study using the PASS 11 program. It was determined that at least 83 participants (the patient and healthy group combined) were needed to achieve 80% power.

Outcome measurements

Age and Body Mass Index (BMI) scores were calculated for all participants.

The presence of SD was evaluated by lateral scapular slide test (LSST). Kibler described this test to measure static scapular positions (26). LSST involves measuring the distance from the inferior angle of the scapula to the nearest vertebral spinous process using a tape measure or goniometer in three positions of the shoulder: at neutral, at 40-45 degrees of coronal plane abduction with hands resting on hips, and at 90 degrees abduction with the arms in full internal rotation. Kibler contends that the injured or deficient side would exhibit the greater distance between the scapula and columna vertebralis. The difference between the distance of the injured and normal side was calculated and compared. The abnormality threshold was determined to be 1.5 cm (Figure 1).

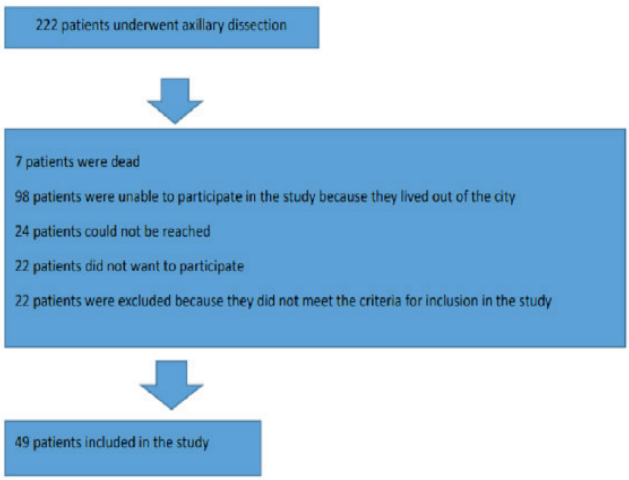

Figure 1. A Flow chart of patients enrolled in the study

Assessment of patients with BCa is described below

A visual analogue scale (VAS) was used to evaluate the pain intensity. The patients were asked to score their pain severity on a 10 cm horizontal line with a scale between 0 (0: no pain) and 10 (10: maximum, unbearable pain) (27). Scores at 1 and above were defined as painful (28).

The range of motion (ROM) in the shoulder (flexion, abduction, external and internal rotation) was evaluated with a universal goniometer following the protocol described by Kendall and McCreary (29).

The ROM was measured in all planes while the patients were lying in a supine position. Flexion was assessed in the sagittal plane with the arm at the side and the hand pronated, whereas the shoulder abduction was measured in the frontal plane with the arm at the side and the shoulder externally rotated to obtain maximum abduction. External and internal rotation of the shoulder were measured in the transverse plane while the arm was abducted to 90°, the elbow flexed to 90°, the hand pronated, and forearm perpendicular to the floor. Ten and higher degrees of ROM were accepted as a shoulder restriction (30).

The circumference of both arms was measured, starting from the styloid process of the ulna, with repeated measurements at every 4 cm proximally to the axilla to determine the lymphedema volume. The results were recorded in centimeters and then volume estimation was done using the Kuhnke model (31).

Functionality of the shoulder was evaluated by using the Turkish version of the Disability of Arm, Shoulder, Hand questionnaire (DASH) (32). It is a 30-item patient self-report questionnaire designed to measure physical function and symptoms in patients with several musculoskeletal disorders of the upper limbs (33).

Statistical analysis

Data obtained from patients in both groups were evaluated using SPSS 23 statistical software. The categorical data was reported as the number samples in each group and their percentage values; while the numerical variables were shown as descriptive statistics with mean and standard deviation. The normality test of numerical variables was examined by Shapiro Wilk Test. The relationship between two independent categorical variables was examined by Chi-square test. As there were non-normal distributions, the relationship between independent numerical valuables were analyzed with spearman correlation test. Statistical significance level was taken as $p<0.05$.

RESULTS

Ninety-eight participants were enrolled in the study. Table-1 shows ranges for the age and BMI scores for each group, respectively. No significant differences were found in age (p:0.52) and BMI scores (p:0.59) in both groups (Table 1).

Table 1. Age and BMI for patient and control groups

		Mean ± Standard deviation	MedianMinimum-Maximum	p
Age (year)	Study	50.18 ± 9.10	51 (32-67)	0.529
	Control	49.18 ± 9.69	48 (29-73)	
BMI (kg/m²)	Study	26.51 ± 5.28	26 (17-43)	
	Control	27.22 ± 5.99	26 (16-46)	0.591

BMI, body mass index

42.9% of the patient group was in their first year after the surgery. The number of lymph nodes removed was more than 10 in most of the patients (85.7%). The number of patients operated on the left side (42.9%) was close to that of patients operated on the right side (57.1%). 55.1% of patients had received radiotherapy and 77.6% had undergone chemotherapy.

Pains during movement (65.3%) and at night (59.2%) were more common than pain at rest (20.4%). Shoulder restriction in the direction of abduction was observed in 46.9% of the patients and was more common than the other directions. SD was positive in more than half of the patients (53.1%) and 71.4 % of patients did not have lymphedema. While functional status was slightly affected in 65% of patients, only 4% were severely affected. The characteristics of the study group are shown in Table 2.

Table 2. Distribution according to patients's characteristics

			n	%
Time after surgery	≤1 year		21	42.9
	>1 year		28	57.1
Operated side	Right		28	57.1
	Left		21	42.9
Dominant side of the body	Right		48	98
	Left		1	2
Scapular dyskinesis		Positive	26	53.1
		Negative	23	46.9
	Rest	Positive	10	20.4
		Negative	39	79.6
Pain	Movement	Positive	32	65.3
		Negative	17	34.7
	Night	Positive	29	59.2
		Negative	20	40.8
	Flexion	Restricted	18	36.7
		Full	31	63.3

Shoulder Mobility	Abduction	Restricted	23	46.9
		Full	26	53.1
	Internal Rotation	Restricted	8	16.3
		Full	41	83.7
	External Rotation	Restricted	14	28.6
		Full	35	71.4
Lymphedema	Absent		35	71.4
	Mild		8	16.3
	Moderate		2	4.1
	Serious		4	8.2
DASH	Mild		32	65.3
	Moderate		15	30.6
	Serious		2	4.1
Number of lymph nodes removed	≤10		7	14.3
	>10		42	85.7
Radiotherapy		Positive	27	55.1
		Negative	22	44.9
Chemotherapy		Positive	38	77.6
		Negative	11	22.4

DASH Disability of arm, shoulder and hand

Table 3. The correlation of scapular dyskinesis with probable risk factors in BCa patients

			Scapular dyskinesis					
			Positive		Negative		Chi	p
			n	percent	n	percent	square	
Time after surgery		≤1 year	10	38.5	11	47.8	0.138	0.572
		>1 year	16	61.5	12	52.2		
Shoulder mobility	Flexion	restricted	12	46.2	6	26.1	2.115	0.146
		full	14	53.8	17	73.9		
	Abduction	restricted	15	57.7	8	34.8	2.572	0.109
		full	11	42.3	15	65.2		
	Internal rotation	restricted	6	23.1	2	8.7	0.945	0.254
		full	20	76.9	21	91.3		
	External rotation	restricted	9	34.6	5	21.7	0.991	0.319
		full	17	65.4	18	78.3		
Pain	rest	positive	7	26.9	3	13.0	0.719	0.299
		negative	19	73.1	20	87.0		
	movement	positive	18	69.2	14	60.9	0.377	0.539
		negative	8	30.8	9	39.1		
	night	positive	14	53.8	15	65.2	0.653	0.419
		negative	12	46.2	8	34.8		
Lymphedema		positive	5	19.2	9	39.1	2.368	0.124
		negative	21	80.8	14	60.9		
DASH		mild	16	61.5	16	69.6	0.347	0.556
		Moderate/ serious	10	38.5	7	30.4		
BMI		≤30	19	73.1	16	69.6	0.074	0.786
		>30	7	26.9	7	30.4		
Age		≤50	13	50.0	10	43.5	0.208	0.648
		>50	13	50.0	13	56.5		
Number of lymph nodes removed		10 and less than 10	5	19.2	2	8.7	0.413	0.424
		More than 10	21	80.8	21	91.3		
Radiotheraphy		positive	13	50.0	14	60.9	0.583	0.445
		negative	13	50.0	9	39.1		
Chemotheraphy		positive	22	84.6	16	69.6	1.588	0.208
		negative	4	15.4	7	30.4		

MI body mass index, DASH Disability of arm, shoulder and han

The chi square analysis between SD and probable risk factors in BCa patients are presented in Table 3. Results suggest no statistically significant relationship between SD and the parameters tested (p>0.05).

SD frequencies of breast cancer patients and the control group are given in Table 4. According to the results, SD was significantly more common in breast cancer patients than it was in the control group (p = 0.007).

Table 4. The comparison of patient and control groups about scapular dyskinesis

			Group		Total	Chi square	p
			patient	control			
Scapular dyskinesis	Positive	n	26	13	39	7.198	0.007
		percentage	53.1	26.5	39.8		
	Negative	n	23	36	59		
		percentage	46.9	73.5	60.2		
Total		n	49	49	98		
		percentage	100.0	100.0	100.0		

p<0.05

DISCUSSION

The novelty of the present study was the investigation of the incidence of SD in patients with BCa; which was found to be 53.1 %. The limited number of studies available in literature which explore the relationship between SA (which is advanced form of SD) and BCa report discordant results regarding incidence of SA; 1.5-74% (20). No consensus was present among these studies regarding the parameters assessed for the diagnosis or the incidence ratios presented after the assessment. Since SA is the much more advanced form of SD, its diagnosis is much easier due to its explicit symptoms. On the other hand, early diagnosis of SD is very important for preventing progression of the shoulder disease which leads to major manifestations such as shoulder impingement syndrome, rotator cuff tendinopathy and multidirectional impairments (8,34,35). SD diagnosis might easily be missed especially among the major systemic symptoms of BCa. Since BCa patients are already facing a distressing life with respectively low prognosis; they are the actual population that will benefit most from even the slight physical improvements that would improve the quality of their life. Therefore, we aimed to focus on SD in BCa patients with axillary dissection. In addition; to our knowledge the present study is unique in investigating the incidence of SD in patients with BCa in comparison to healthy controls.

The incidence of SA in patients with BCa after axillar dissection has been reported in some previous studies (1.5-74 %), however none of these studies compared its incidence with healthy controls. In the present study, incidence of SD in the BCa group and the control group was found to be 53.1 % and 26.5 %, respectively. Significantly higher incidence of SD in the BCa group (p=0.007) suggests cancer and cancer treatments (such as axillar dissection) as important factors in the development of SD.

Present study also sought to evaluate SD risk factors such as restriction of the shoulder; no significant relationship was observed between SD and shoulder restriction statistically (p>0.05). To our knowledge, there are only two studies in the literature investigating the relationship between restriction and SA in patients with BCa (15,18). One of these two studies reported that SA was associated with greater shoulder morbidity for flexion, abduction and adduction (18), while the other was unable to present any statistically significant correlation (15). On the other hand, a different study conducted on other patient populations (without axillar surgery) evaluated the restricted shoulder (especially restricted abduction) with scapular winging or weakness of serratus anterior (36).

Likewise, the relationship between pain and SD was not seen to be statistically significant. Partial damage of the long thoracic nerve was suggested to cause some weakness without paralysis. It is also known that less pain is experienced when the load on the compensating muscles is less and no spasms are experienced in partially injured patients. While a previous systematic review and meta-analysis reported that asymptomatic athletes with SD have an increased risk of future shoulder pain by 43% (37); the single study present in the literature examining patients with BCa has obtained results similar to the results of the current study (18). Further studies with a longitudinal follow-up are needed to determine whether the presence of SD predisposes BCa patients to developing shoulder symptoms.

According to our knowledge no previous study has investigated the relationship between lymphedema and SA or SD after BCa treatment. It is appreciated that there is a great variance in the severity of the lymphedema cases observed; and more severe lymphedema is expected to participate in the development of SD. Yet, in the present study, only 4 of the patients were diagnosed with serious lymphedema impeding a statistically significant result. Further studies with larger sample size would be needed to conclusively address this question.

In the literature there was no previous study exploring the relationship between the function of the shoulder and SA or SD in patients with BCa to our knowledge. This correlation was only investigated in swimmers

and a previous study conducted on 661 elite swimmers was unable to demonstrate any statistically significant relationship between SD and DASH scores (38). Similar to the previous results with healthy swimmers, no significant relationship was found between SD and function of the shoulder in patients with BCa which was assessed by DASH scores in this study. It can be anticipated for patients with SD to compensate the disability on the operated side by the muscle activity on the non-operated side. Furthermore, 43% of patients were operated from the non-dominant side which might have hampered the function of these patients less than a possible operation on the dominant side; additionally accounting for the absence of a significant correlation.

No correlation was found between SD and BMI similar to the previous studies reported by Mastrella and Teixeira (14,16). On the other hand, there are also other studies reporting SA to be more common in patients with a body mass index of less than 25 kg/m2 (15,17). Since high-fat tissue in the scapular area masks the physical signs, as previously suggested by Teixiera et al. for SA, we believe that clinically a high body mass would impede the diagnosis of SD; possibly accounting for the absence of a significant correlation.

One of the factors that we investigated in relation to SD was age which was found not to be associated with the presence of SD, in parallel with some previous studies (13,16).On the other hand in another three previous studies; younger age was also reported as a significant risk factor for SA without obvious explanation (14,15,17). Further studies with larger sample size might prove useful in resolving these discrepancies in the literature.

As with previous studies, the present study found no statistical difference between patients with and without SD in relation to the number of lymph nodes removed (14,16,17). Therefore, it is anticipated that, the axillary surgery procedure may have a major role on the development of SD independently of the number of positive lymph nodes.

Radiotherapy and SD were found not to be correlated in the current study group, similar to the results reported in a previous study (16). However two previous studies reported that radiation could cause long thoracic nerve injury (15,39). Conflicting results may be due to the differences in dose and the number of radiotherapy sessions.

While chemotherapy was not suggested as a predisposing factor for SA in previous studies (14,16), certain chemotherapeutic agents are long been known to have neurological side effects due to their toxicity; i.e. docetaxel and cisplatin causing neuropathy (40). Therefore, we wanted to scrutinize its correlation with SD. Yet, chemotherapy and SD were found not to be correlated.

Our study uniquely investigates the incidence of SD in BCa patients in comparison to a control group. The presence of SD was found significantly higher in patients after BCa treatment. This result suggests that presence of SD is a condition that should strongly be considered in rehabilitation. Medical practitioners dealing with BCa patients should be aware of the possibility of SD, and every patient after axillary dissection should be evaluated by a physiotherapist using standardized tools in order to reveal the function of the serratus muscle. Early postoperative diagnosis might prove useful in facilitating early management, in turn accelerating functional recovery and reducing surgical procedure-related complications.

This study is relevant in the sense that it sheds light on the incidence and the predisposing factors of SD in the literature. Although none of the parameters investigated have a significant relationship with SD statistically, the incidence of SD was 53.06 % in patients with BCa and significantly higher than the control group. SD can be a consequence of the surgical treatment for BCa which requires attention According to our knowledge, this was the first study to investigate the relationship between lymphedema and shoulder function with SD. Although the results in the present study needs affirmation by further studies with larger sample size, the result of the present study may have great impact, for demonstrating what risk factors are significantly associated with SD after treatment for BCa.

We acknowledge that there were some limitations in this study. Patients with axillary lymph node dissection were included; so, these results could not be generalized to patients with selective node biopsy. LSST which is used to evaluate SD is a clinical test, and thus evaluator dependent. While ROM, shoulder function and pain were investigated for possible correlation with SD, patients' quality of life was not.

Yet, future research with a larger population size outperforming the certain limitations in this study would provide comprehensive understanding regarding the predisposing factors of SD in BCa patients with axillary dissection. A preoperative evaluation would facilitate the comparison of pre- and postoperative results. In addition, periodical follow-up examinations after the surgery would shed light on prognosis of SD. Electromyography assessments of the serratus anterior muscle would be useful in confirming the thoracic long nerve relatively.

CONCLUSION

SD is a not infrequent sequela of axillary lymph node dissection in Bca patient. It is usually underestimated and overlooked. This result suggests that presence of SD is a condition that should be emphasized in rehabilitation.

There is no association between age, BMI, restriction, pain and function of the shoulder, lymphedema, time after surgery, radiotherapy, chemotherapy, number of removed lymph nodes statistically according to the results of present study. There is a need for further study in this regard.

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