Effects of Early Exercise on the Development of Lymphedema in Patients With Breast Cancer Treated With Axillary Lymph Node Dissection

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Abstract

Purpose: Despite advances in the treatment of breast cancer, there is little research examining the prevention of lymphedema after breast and/or axillary surgery. Currently, there are no national guidelines for activity restrictions; however, many medical providers recommend restricting activity of the surgically affected arm, which can create quality-of-life issues as well as future medical issues for patients with breast cancer.

Methods: A literature review of several current research articles was performed. This report reviews four studies evaluating the effects of restricted activity versus progressive exercise and stretching activities on development of lymphedema.

Results: The results show that there is no difference in the risk of developing lymphedema when following activity guidelines. All four of the studies reviewed report results of either a decrease in the development of lymphedema or no increased risk of development of lymphedema when early exercise regimens are incorporated into postoperative care.

Conclusion: The four research articles show promising results that support future change in practice guidelines. However, none of the studies report follow-up results beyond 2 years. Additionl evaluation to monitor long-term effects is warranted.

Introduction

Lymphedema is defined by the Susan G. Komen Breast Cancer Foundation (Dallas, TX) as a collection of lymph fluid in the arm, hand, fingers, chest, or back causing swelling. Reported incidence rates vary widely, from 5% to 50% 2 years after surgery, as a result of inconsistent definitions and the lack of a standard measurement system.[1] Lymphedema after lymph node dissection is typically defined as an increase of more than 2 cm in upper arm circumference when compared with the nonsurgical arm, when measured at two locations.[2] Risk factors for lymphedema include surgery such as axillary dissection, mastectomy, surgery on the dominant side, radiation therapy to the axilla, injury, infection, postsurgical drainage, and elevated body mass index. It can cause seriously impaired limb function resulting from extensive limb swelling and discomfort that is chronic, progressive, and incurable.[3,4]

Many medical providers recommend activity restriction for patients after axillary lymph node dissection. This typically includes restrictions in physical activity involving the affected arm, such as lifting and carrying children, groceries, handbags, and packages.[3] There are many problems associated with the restricted activity guidelines, in that they can lead to decreased muscle strength, chronic pain, weight gain, decreased shoulder function, decreased cardiorespiratory fitness, and decreased quality of life.[4] This is consistent with the proven theory that a sedentary lifestyle is a risk factor for many other diseases.

Medical providers must be diligent in screening for lymphedema development and implement early treatment to limit the extent of lymphedema as well as the limitations and adverse effects that come along with the condition. Patients and their caregivers should be thoroughly educated on the risks, symptoms, and adverse effects of lymphedema as well as preventive measures. These typically include avoidance of blood pressures, blood draws, injections, and intravenous infusions in the affected arm; the increased risk of infection associated with cuts, burns, and insect bites to the affected arm; and the risk associated with development of lymphedema when flying. However, there is no clear evidence supporting these limitations as effective preventive measures.

It is proposed that early progressive exercise including weight lifting and stretching of the surgically affected arm will not only prevent a majority of the adverse effects related to breast cancer surgery and treatment but also address the above-mentioned risk factors without increasing the risk of lymphedema. For this reason, this report will discuss the findings of four studies in which this alternative treatment after axillary node dissection was investigated.

Methods

A literature search was performed via databases including Cumulative Index to Nursing and Allied Health Literature/Nursing, PubMed Plus, and Ovid. The words and phrases lymphedema, breast surgery, lymphedema prevention, exercise and lymphedema, and breast cancer and lymphedema were searched. The following filters were added to advanced searches: humans, females, type of article (clinical trial and randomized control trial), English language, adults, and within 5 years. This search produced four research articles[2,4-6] that thoroughly explore the risks and benefits of limited movement versus active movement of the affected limb in patients with breast cancer who have undergone postsurgical axillary lymph node dissection.

In each study, research investigators obtained institutional review board approval and obtained informed consent from all participants. All four articles reviewed the effects of movement and exercise on the development of arm lymphedema com-

Table 1. Study Demographics

Study	Sample Size	Patient Age (years)	Site	Study Dates	Exercise Program
Ahmed et al[6]	Intervention group, 23; control group, 22	Average, 52	University of Minnesota; Park Nicollet Health Care System, Minneapolis, MI	October 2001-June 2002	Progressive weight training twice per week with fitness professional in groups of four for 3 months, then in pairs without trainer Nine exercises using resistance machines and weights to target muscles of arms, back, chest, legs, buttocks for 60 minutes
Sagen et al[4]	204 women	37-75	Ullevaal and Akershus Hospital, Oslo, Norway	1999-2003	Intervention group: progressive resistance two to three times per week with trainer for 45 minutes for 6 months; unrestricted activity of affected arm Control group: restricted activity of affected arm for 6 months with no lifting or carrying > 3 kg; standard care PROM exercises
Torres Lacomba et al[2]	102 women	Mean, 52.9	Príncipe de Asturias Hospital, Madrid, Spain	May 2005-June 2007	Intervention group: early physiotherapy, education; manual lymph drainage, progressive massage of scar, stretching, progressive AROM exercises three times per week Control group: education, stretching performed at home once per week
de Rezende et al[5]	60 women	Intervention group: mean, 54; control group: mean, 54.4	Center for Integral Attention to Women's Health, University of Campinas, Sao Paulo, Brazil	March 23, 2003-July 13, 2007	Intervention group: kinesiotherapy (flexion, extension, abduction, adduction, internal and external rotation) Exercises in sets of 10 repetitions with 60-second intervals between exercises Control group: biomechanical physiologic movements with no defined sequence or number of repetitions; all lasted 40 minutes, three times per week for 42 days

Abbreviations: PROM, passive range of motion; AROM, active range of motion.

pared with those of restricted arm activity. The study population of each trial is evaluated in Table 1. All four studies were single-center, blind, randomized control trials assigning participants to either instructed active movement and exercise of the surgically affected arm or restricted movement of the surgically affected arm (Table 1), with the exception of the study de Rezende et al,[5] in which patients in the control group were instructed to perform stretching movement of the surgical arm.

Ahmed et al[6] required patients to meet with a certified fitness professional to reinforce the exercise regimen and ensure that it was carried out accurately to prevent injury. A series of nine exercises were performed incorporating resistance machines and free weights. Exercises that targeted muscles of the upper body were initially performed using either no weights or .5-lb wrist weights. The weight was increased by the smallest possible increment at each session, provided that there were no signs or symptoms of lymphedema. After completing the initial 3-month period, participants continued to perform the instructed exercises, stretching with a study partner without the presence of a fitness trainer, but they still had access to the trainer if needed. Participants in this study who were randomly assigned to the control group did not receive weight training or stretching instruction. The article does not discuss the specific restriction instructions provided to the control group.

In the study by Sagen et al,[4] patients randomly assigned to the intervention group were instructed that there were no physical activity restrictions to the affected arm for a period of 6 months. The program began with .5-kg weights for the first 2 weeks; weight was gradually increased as tolerated. Each exercise was performed for 15 repetitions. Participants who were randomly assigned to the active restriction arm of the study were given instructions to "avoid heavy or strenuous physical activities".[4] These included aerobic activity, exercise classes, and carrying or lifting items that weighed more than 3 kg. Patients in the activity restriction arm of the study did participate in a standard of care physical therapy program that involved passive

manual stretching and light massage of the arm shoulder and scar on the surgically affected side. This program was conducted once per week at an outpatient clinic for 6 months for a total of 45 minutes of intervention.

The study by Torres Lacomba et al[2] incorporated several techniques performed by a physiotherapist. These consisted of manual lymph drainage of the arm, breast, and trunk on the surgical side; massage of the surgical scar; stretching of the shoulder, back, and chest muscles; shoulder rotation movements; and progressive active and assisted exercises of the shoulder. These were started simultaneously with functional activities and resistance-free neuromuscular facilitation exercises. This study provided educational instruction with printed handouts to both groups with information about the lymphatic system; descriptions of normal load versus overload of the lymph system; and causes, precipitating factors, and interventions to prevent the development of lymphedema. Instructions included the avoidance of trauma, injury, infection, and constriction of the surgically affected arm and use and exercise of the arm.

The study by de Rezende et al[5] implemented a program of kinesiotherapy, a technique of spontaneous exercises for flexion, extension, abduction, adduction, and internal and external rotation of the shoulder on the surgically affected side. The exercises began 48 hours after surgery, starting with three different exercises and gradually increasing to a total of 19. These were performed for 10 repetitions each, with a 60-second break in between each exercise. The control group also performed exercises; however, there was no preset number of repetitions or defined sequence. The exercise course in the control group depended on the personal ability and experience of each patient.

In all four of the articles[2,4-6] reviewed, arm circumference was measured at various time points throughout the studies to monitor for changes and possible development of lymphedema. Ahmed et al[6] measured arm circumference of both arms at baseline and 6 months. Measurements were taken 48 hours after exercise and between 6:30 and 11:00 AM in the morning. Patients were instructed to fast for 12 hours before being measured, and a mean of two measurements was used. Measurements were taken between 5 and 11 days after start of the menstrual cycle. Staff members performed the measurements under blinded conditions. Measurements were taken at four locations along both arms, at the metacarpophalangeal joint, distal to the ulnar styloid process, 10 cm distal to the midpoint of the lateral epicondyle, and 10 cm proximal to the midpoint of the lateral epicondyle. Patients were lying prone with their arms straight by their sides. Those who wore compression garments had measurements taken 1 hour after the garments were removed. Participants self-reported lymphedema symptoms or lymphedema diagnosis, defined as a difference in arm circumference greater than 2 cm. The time period for these reports was the last 3 months of the program through a validated survey measure, which had a specificity of 0.9 and sensitivity of 0.86 to 0.92 for diagnosing lymphedema. Lymphedema symptoms were reported as a mild, moderate, or severe increase in size of the hand or lower or upper arm of the affected arm compared with the nonaffected arm. Other symptoms included changes in fine motor function, puffiness, and pain or swelling of the hand or arm. Ahmed et al also incorporated the Baecke questionnaire to measure the physical activity of study participants outside of the interventional program.

Sagen et al[4] measured outcomes on the basis of the difference between the volume of the affected arm and the volume of the control arm (vol diff) using the simplified water displacement instrument in milliliters. This study used a vol diff of greater than 200 mL as a limit to identify risk factors for the development of lymphedema and a 10% increase in vol diff between a participant's surgically affected arm and nonaffected arm to measure the incidence of lymphedema. The authors also used a visual analog scale to measure the sensation of heaviness and pain in the surgical arm. A questionnaire was used to document the intensity, duration, and frequency of surgical arm activity while at work, while at home performing housework, and during leisure time.

Torres Lacomba et al[2] measured arm circumference at 4 weeks, 3 and 6 months, and 1 year after surgery. Measurements were taken with a 1-cm wide tailor tape measure starting at the elbow fold at 5-cm increments along the length of both arms while participants were seated with both arms on a table, with forearms in maximum supination and shoulders neutral in 45-degree flexion.

De Rezende et al[5] performed arm circumference measurements using a universal tape measure at 7.5 cm above and 7.5 cm below the humeroradial joint, at the wrist at the ulnar styloid process, and at the metacarpophalangeal joint. Their report did not discuss positioning of the patients during the measurements or frequency of the measurements.

Results

The results of the four studies[2,4-6] reviewed (summarized in Table 2) support the implementation of early exercise and activity as opposed to restriction after axillary lymph node dissection. Ahmed et al[6] report that the weight training regimen implemented did not increase the development or exacerbate the symptoms of lymphedema in the patient population studied. Of the 23 women randomly assigned to the intervention group, 22 attended at least 80% of the exercise sessions, showing a strong adherence to protocol. Self-reported incidence of lymphedema and increase in lymphedema symptoms was not statistically significant (intervention group, $P = .4$; control group, $P = .22$). The measurements showed differences from 0.36 to 1.43 cm for arm circumference of the surgically affected arm and 0.28 to 0.71 cm for the difference between the surgically affected arm and nonaffected arm. The authors report that a change of 2 cm was clinically relevant.

The results of the study by Sagen et al[4] showed no statistically significant difference between the intervention group and control group in arm volume, vol diff, or lymphedema at 3 and 6 months or 2 years after surgery. A mean vol diff of 79 mL was used for power analysis. The number of participants was set at 207 to account for those who were noncompliant or lost to follow-up and to be certain that there was an adequate sample to

Table 2. Study Findings

Study	Results
Ahmed et al[6]	No variation in incidence of lymphedema or onset of lymphedema symptoms in intervention *v* control group
Sagen et al[4]	No significant difference in arm volume, vol diff, or arm lymphedema at 3, 6, or 24 months
	Arm volume and arm lymphedema increased with time in both groups ($P = .05$)
	Home physical exercise was significantly higher at 3 and 6 months in intervention group ($P < .001$) but did not differ at 2 years
Torres Lacomba et al[2]	Diagnosis of lymphedema was significantly higher in control (14 cases [25%]) *v* intervention group (4 cases [7%]; $P = .010$)
	12−month follow-up volume ratio between arms increased 5.1% in control and 1.6% in intervention group ($P = .0065$)
	Lymphedema developed four times faster in control group (HR, 0.26; $P = .010$)
de Rezende et al[5]	13.83 sessions performed in intervention *v* 13.19 in control group
	No statistically significant difference in groups in relation to arm circumference
	Statistically significant increase in circumference 7.5 cm above humeroradial joint in control group ($P = .332$)

Abbreviation: vol diff, difference in volume between affected arm and control arm; HR, hazard ratio.

detect the minimal clinically relevant vol diff of 50 mL between the intervention and control groups. Sagen et al report an adherence percentage of 83% in the intervention group and 89% in the control group. Over the course of the study, there was a significant increase in arm volume and lymphedema in the surgical arm in both groups from 3 to 6 months and also from 6 months to 2 years after surgery ($P < .001$). Analysis included the comparison of the differences between the two groups at 3 months, 6 months, and 2 years; differences in characteristics between the study participants; and risk factors for the development of lymphedema at 2 years. There were 35 patients with a vol diff of more than 200 mL; therefore, four independent factors (10%) were included in the analysis: body mass index of more than 25 before surgery, vol diff of more than 0 before surgery, pain of more than 0 mm at 3 months after surgery, and sensation of heaviness of more than 0 mm at 3 months after surgery.

In their study, Torres Lacomba et al[2] found that there was a significantly higher incidence of lymphedema in the control group (14 [25%] of 57 patients) compared with the intervention group (four [7%] of 59 patients; $P = .01$). At the 1-year follow-up, arm volume of the surgically affected side was 5.1% greater than that of the nonaffected side in the control group and 1.6% greater in the intervention group, a statistically significant difference ($P = .0065$). A larger maximum difference between two adjacent points in the control group compared with the intervention group (1.15 *v* 0.68 cm; $P = .0207$) was reported. Lymphedema of the surgical arm developed four times more rapidly in the control group versus the intervention group. Analysis of the control and intervention groups compared the incidence of lymphedema and variables "maximum difference in arm circumference between two adjacent locations" and "change in volume ratio."[2] Survival analysis was also performed.

The study by de Rezende et al[5] did not demonstrate a statistically significant difference in lymphedema or arm circumference between the intervention and control groups. However, there was a statistically significant increase in the measurement of arm circumference 7.5 cm above the humeroradial joint in the control group ($P = .332$). Analyses of demographics, type of surgery, staging of disease, and chemotherapy regimen were performed. Evaluation of data and verification on trends in physiotherapy movements of flexion, extension, abduction, adduction, and internal and external rotation and comparison of time spent performing exercises for the intervention and control groups were also performed.

Discussion

The four research articles[2,4-6] reviewed show promising results that support future change in practice guidelines. Although current recommendations limit activity of the surgical arm, there does not seem to be an increase in incidence of lymphedema or exacerbation of lymphedema symptoms when progressive weight training or resistance exercises are implemented postoperatively. Current restrictions can result in considerable changes in quality of life for patients with breast cancer treated with axillary lymph node dissection.

In the longest study reviewed, patients were observed for a span of 2 years.[4] Patients in such a population now have a much longer potential life span as a result of advancing treatment options and diagnostic technologies. Therefore, long-term collection of information on whether early exercise intervention after axillary lymph node dissection affects the development of lymphedema when compared with activity restriction of the surgically affected arm is worth exploring.

Comparisons of different activity modalities such as resuming normal everyday activity, active stretching of the surgically affected arm, resistance exercises without weights, and weight training programs should be further evaluated in randomized control studies. It seems to be safe to change current recommendations and instruct patients to begin progressive exercise after breast cancer surgery with axillary lymph node dissection. Additional research of this issue will provide practitioners with more specific guidelines to provide to their patients.

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Author's Disclosures of Potential Conflicts of Interest

The author indicated no potential conflicts of interest.

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