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Exercise in the Management of Breast Cancer–Related Lymphedema

Chronic arm edema that follows breast cancer surgery requires adoption of an independent, long-term management program. To be successful, the program must be "user friendly" and not hamper the return to a full and active lifestyle despite lymphedema. Education about exercise as part of a treatment program requires an understanding of the normal physiology of fluid balance and of the unique pathophysiology of breast cancer lymphedema. Rather than restricting activity, encouraging participation in an exercise program gives women with lymphedema a tool to address all possible aspects of the condition, including the lymphatic, venous, and arterial components.

Key Words
breast cancer
exercise
lymphedema
rehabilitation

What appears to be new may in fact be familiar. What appears to be familiar may in fact be new. So question what you know because you may not really know at all. USA Today, September 23, 1996

Upper-extremity lymphedema following breast cancer surgery is often a chronic condition that must be self-managed to minimize pain, debilitation, and risk of recurrent infection. Often overwhelmed and frustrated by the amount of attention that must be paid to the swollen limb, many women feel they need to choose between managing the condition and living a "normal" life. It has been suggested that the most significant reasons for a less successful outcome with lymphedema treatment are disenchantment with the treatment regimen and the resultant failure to comply.[1,2] However, the fault of noncompliance may not lie entirely with the woman with edema.

The most widely accepted model of lymphedema management, an intensive daily regimen developed in the 1930s by Emil Vodder,[3] has remained relatively unchallenged but has not been sufficiently adapted to the changing lifestyles of women and the increasingly stringent reimbursement practices of insurance companies. Additionally, deeper examination of the etiology and pathophysiology of breast cancer–related lymphedema has led the medical community to question whether it is a breed of its own and thus should be managed differently from other lymphedemas. A better understanding of breast cancer–related lymphedema can, in fact, lead to the development of more "user-friendly" treatments that will enjoy better compliance and, ultimately, better results.

One very important component of a comprehensive treatment plan for breast cancer–related lymphedema is exercise.[4,5] Participation in a program consisting of flexibility, strengthening, and aerobic exercises is critical in addressing the well-documented causes and consequences of edema formation after treatment for breast cancer and gives women a more active role in their own lymphedema management.

Normal Physiology of Tissue Microcirculation

Tissue fluid balance is normally maintained by three interrelated systems: blood vessels, proteolytic cells, and the lymphatics.[6,7] These systems help maintain tissue-fluid balance in a state of dynamic equilibrium, with fluid and proteins being shuttled into and out of the interstitium in response to homeostatic mechanisms such as Starling's hypothesis, which states that fluid and protein in the interstitium will always equal fluid and protein in the hematologic vasculature.[8]

The blood microcirculatory system consists of arterioles and postcapillary venules. The function of the arteriole is to bring blood and its nutrients, including oxygen, into the tissue. Ninety percent of the fluid brought into the tissue by the blood is returned to the heart via the venous system. The venous system also is responsible for returning the smaller proteins back to the blood system. The remaining 10%, along with the larger proteins, is returned to the blood system via the lymphatic system.[9]

Protein molecules transport oxygen and other nutrients to the cells of the tissues. However, if excess unused protein is allowed to accumulate in the tissue, edema forms because protein is hydrophilic, that is, it attracts water. Therefore, large protein molecules are broken down by proteolytic cells (macrophages, fibroblasts, etc) in the tissue into more manageable sizes to be used or more easily transported.[6] This breakdown of protein by the proteolytic cells and the transport of the fluid and unused proteins from the interstitium back to the heart are critical in maintaining fluid balance and preventing edema.

Lymphatic and venous return is influenced by variations in total tissue pressure. These variations can occur through muscular contraction, movement, changes in external pressure, and respiration. It is through its effects on these normal physiologic mechanisms that exercise can be used to reduce and maintain the appropriate limb size.

Edema Formation After Breast Cancer Treatment

Despite considerable focus on the lymphatic system, evidence shows that there are two potential sources of breast cancer edema formation: lymph drainage failure and hemodynamic imbalance. Although most authors suggest that arm edema is primarily a result of impaired lymphatic circulation,[10,11] failure to acknowledge the contribution of both mechanisms can lead to a limited view of possible treatment options.

Lymphatic Drainage Failure

Lymphedema has been defined as an accumulation of high-protein fluid resulting from impairment of lymphatic vessels. Figure 1 illustrates how the medical management of breast cancer can ultimately lead to secondary lymphedema.

Treatment for breast cancer consists of the obliteration of lymphatics through the surgical removal of lymph nodes and administration of radiation therapy (if applicable) and the obstruction of lymphatics with the resultant scar tissue that occurs from the aforementioned treatments. These factors put any woman who has undergone breast cancer treatment at risk of developing lymphedema. When the lymphatic system becomes impaired, it becomes sluggish and has a diminished capacity to transport the extra 10% of fluid from the tissue that is not handled by the venous system.[1,4,5] With longstanding edema, there is an accumulation of macromolecules (ie, proteins, lipids) and changes in the tissues, such as fibrosis and pitting.[12] These changes in tissue texture reflect the unhealthy nature of a limb at risk of infection.

Hemodynamic Imbalance

Since as early as 1938, evidence has demonstrated that a blood flow imbalance exists in women who develop swelling after treatment for breast cancer.[13] There is a 42% to 68% incidence of increased arterial inflow found in the swollen limb of women with breast cancer–related lymphedema.[10,14] Some theorize that this increase in limb blood flow leads to increased capillary filtration and ultimately more edema.

Other evidence demonstrates that there is decreased venous return or "venous flow abnormalities" in 14.5% to 70% of the swollen limbs presenting with breast cancer–related lymphedema. This suggests that these venous outflow obstructions and subsequent venous congestion may be an important part of the pathophysiology of arm edema.[10,11]

Some researchers hypothesize that the hemodynamic imbalances found in the swollen limbs of women with breast cancer–related lymphedema may contribute to the *cause* of the swelling, whereas others hypothesize that the imbalances of blood flow are more likely a *consequence* of the edema.[10,11] Regardless of which hypothesis is correct, these imbalances must be treated.

Role of Exercise in the Management of Lymphedema

There has been little research to date regarding the effects of exercise on lymphedema, and even less regarding the intensity at which exercise can be safely performed once a woman has developed swelling. Without any supporting data, intensive exercise has been viewed as contraindicated in the

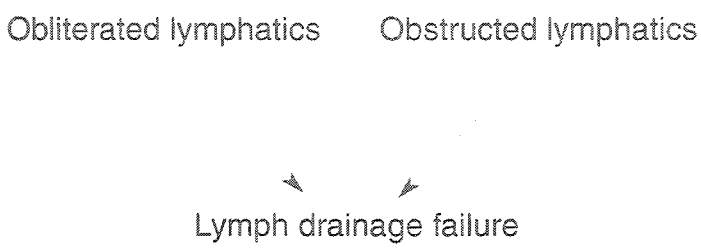


Figure 1.—Lymphatic obliteration due to lymph node excision and radiation therapy and obstruction due to scar tissue formation can impede lymphatic drainage, increasing risk of lymphedema.

management of breast cancer lymphedema. Many "do's and don'ts" lists caution against "overdoing it" and advocate more remedial activities. However, a recent study[15] demonstrated no significant difference in the incidence of lymphedema between women who, following axillary dissection for breast cancer, had returned to full activity (including sports) and those who, fearing lymphedema, did not. The authors concluded that the medical community needed to reexamine guidelines given to women after axillary dissection regarding return to activity and lymphedema prevention. Furthermore, it has been shown that women undergoing breast cancer treatment who exercise demonstrate improved cardiorespiratory capacity.[16] Because resistive and aerobic exercise has not been shown to be harmful to women who have developed breast cancer–related lymphedema and, indeed, may be helpful in the cancer recovery process, it should become a mainstay of lymphedema management.

A comprehensive exercise program should consist of flexibility, strengthening, and aerobic exercises. (Figure 2, pages 104–105, shows examples of flexibility and strengthening exercises). If the limb is used as a barometer of response to the activity and proper steps are taken while exercising, there is no reason why a woman cannot have a full, active lifestyle once lymphedema has developed after breast cancer. In fact, such exercises can be beneficial in the treatment of breast cancer–related lymphedema because they actually affect the lymphatic and arterial/venous components of the condition.

Flexibility Exercise

Because many women with swelling also have impaired venous return, muscle and tissue tightness of the axilla and chest wall may further complicate the edema. Flexibility exercises of the shoulder girdle to decrease pectoral tightness can help alleviate compression of the vessels of the thoracic outlet that may hamper the normal venous drainage of the limb. Furthermore, range-of-motion exercises help to restore normal, functional use of the arm.

Strengthening Exercise

Progressive resistive training, again using the limb as a barometer of tolerance, not only prepares the woman for return to functional activity but has also been shown to accelerate lymphatic and venous flow. Muscle contraction causes the change in tissue pressure required for lymphatic vessels to propel lymphatic fluid and for veins to propel blood back to the heart.[5,7,12] Prior research has shown that repeated muscle contractions of the hand with the limb bandaged results in increased resorption of protein and enhanced lymphatic flow.[18] Therefore, it is recommended that women wear compression bandages on the limb while they perform their exercise program to facilitate the muscle pump force on the venous and lymphatic systems and to prevent excess filtration of fluids into the tissues of the arm during the exercise. It has also been demonstrated that any increased arterial inflow found in an edematous limb is decreased after circumferential bandaging for 4 hours.[10] Performing exercises while wearing compression bandages assists in both lymphatic and venous return and helps diminish the increased arterial inflow that occurs in some lymphedemas following breast cancer.

The resistive exercise program should progress gradually, beginning with light weights (1–2 pounds) and increasing both the weight and the number of repetitions depending on the limb's tolerance. The limb must be monitored for any increases in swelling. If an increase does not resolve within 24 hours, the weights and the number of repetitions must be reduced accordingly. If, after the exercise, the limb size and the tissue texture remain unchanged, the activity has been well tolerated and may be increased. It is important that all muscle groups of the arm be used, especially the larger groups, including those of the shoulder girdle and elbow.

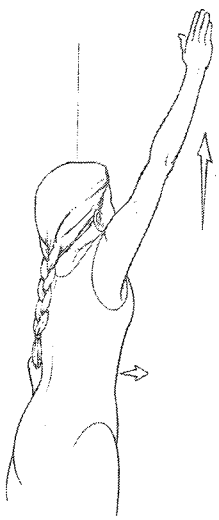
Aerobic Exercise

Aerobic exercise can also be used to enhance the lymphatic and venous flow. Under normal physiologic conditions, there is a negative pressure build-up in the thorax with each breath taken. This negative pressure creates a vacuum effect, enhancing both venous and lymphatic uptake.[7,8,12]

Persistent fatigue is a common complaint of many women who have undergone treatment for breast cancer. The cardiorespiratory capacity of the cancer patient is greatly diminished after treatment. However, it has been demonstrated that women who perform aerobic exercise during treatment for breast cancer are able to better combat the effect that cancer treatment has on their cardiorespiratory systems.[16] In addition to enhancing the normal mechanisms of fluid return and fluid balance, performing aerobic exercises with the limb bandaged can also help the woman regain some of the cardiorespiratory function that may have been lost during her cancer treatment.

Conclusions

Teaching a woman with breast cancer–related lymphedema an exercise program appropriate and effective for her condition requires a basic under-



Passive Shoulder Flexion

Purpose

This exercise stretches the axilla and the muscles in the back of the arm. When tight, these muscles can prevent full overhead reach. When you perform this exercise correctly, you will feel a stretch in the axilla and along the back of your arm from the shoulder to the elbow.

Position

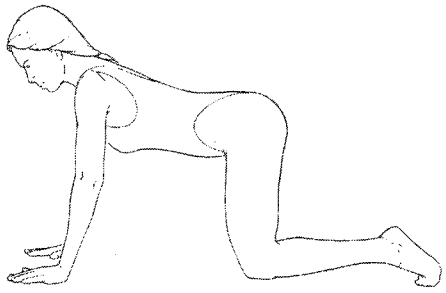
Stand facing a wall with your arm reaching up the wall as high as possible.

Motion

Lean forward and continue to reach until you feel a stretch in the axilla. Hold for 15 seconds.

As your motion improves, begin the stretch standing further away from the wall to increase the stretch.

Repeat 10 times.



Rocking for Shoulder Flexion*

Purpose

Using your body weight as a force can help make stretching easier. This exercise stretches the axilla and back of the arm.

Position

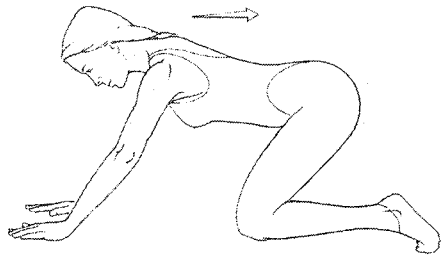
Rest on your hands and knees, with your hands positioned slightly in front of your shoulders. Place most of your weight on your legs and unaffected arm.

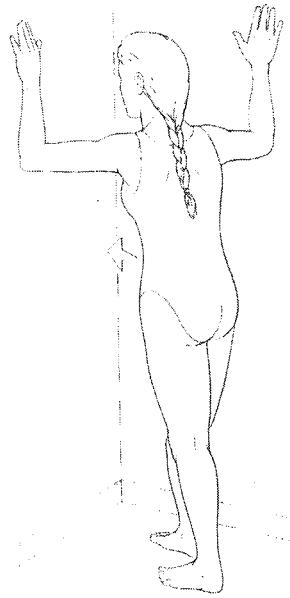
Motion

Slowly rock back to your heels until you begin to feel a stretch in your shoulders. Hold this position for 20 to 30 seconds, then return to starting position. As the stretch becomes easier, start with your arms further out in front of your body to increase the stretch.

Repeat 10 times.

*Do not perform this exercise if placing weight on your affected shoulder causes pain.





Pectoral Corner Stretch

Purpose

This exercise stretches the incision and skin across the chest wall as well as the pectoralis muscle. Tightness of the anterior chest or pectoralis muscle can affect your posture, pulling your shoulder forward and giving you a "round shoulder" appearance. It can also make reaching out to the side or behind more difficult.

When you perform this exercise correctly, you will feel a stretch along the front of your chest and shoulder.

Position

Stand facing a corner. Place your hands and forearms on the wall, with your elbows at shoulder level.

Motion

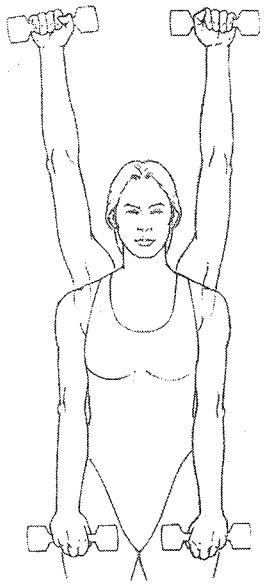
Slowly lean your chest into the corner. You will feel a stretch across your chest wall.

Hold this stretch for 15 seconds, then return to starting position.

Keep your forearms flat against the wall throughout the movement.

Repeat 10 times.

Figure 2.—Sample flexibility and strengthening exercises. (From Miller,[17] with permission.)



Bilateral Shoulder Flexion

Purpose

This exercise contracts a part of the deltoid muscle and other muscles that raise the arm overhead. The deltoid lymph pathway is an alternative route for lymph flow, and contracting the deltoid muscle helps facilitate lymph movement along this pathway. Raising the arms overhead opens up the axilla, helping to clear the pathway for lymph to flow.

Position

Stand, preferably in front of a mirror, with your arms down by your sides, holding weights.

Motion

Keeping your elbows straight, raise both arms up over your head evenly. Go only as high as your involved shoulder will go. Lower both arms slowly.

Perform this exercise in front of a mirror to make sure you are raising both arms evenly.

Repeat 10 times.

Weight: do not exceed 3 pounds.

Bilateral Shoulder Abduction (to 90°)

Purpose

This exercise contracts part of the deltoid muscle, helping to move lymph along the alternative pathway.

Position

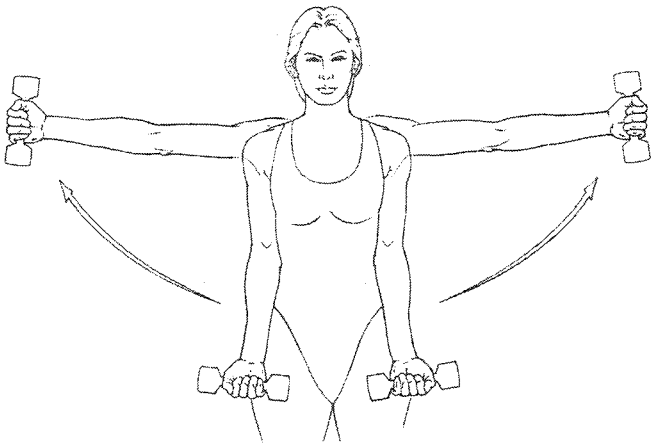
Stand with your arms by your sides.

Motion

Simultaneously raise both arms out to the side until your arms are parallel to the floor. Keep your palms facing forward throughout the movement.

Repeat 10 times.

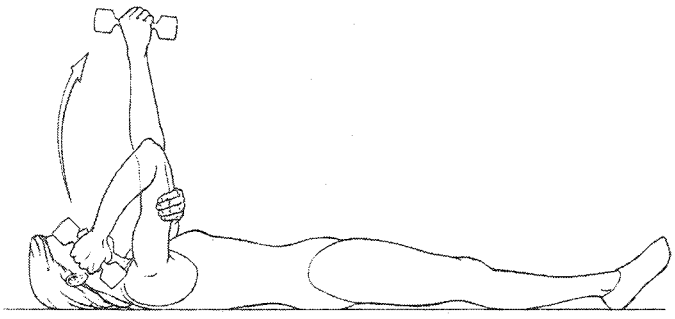
Weight: do not exceed 3 pounds.



Elbow Straightening (Elbow Extension)

Purpose

This exercise, which uses the triceps muscle to straighten the elbow, also helps to promote the flow of lymph trapped in the forearm.



Position

Lie on your back. Bend your arm so that your elbow points up toward the ceiling, with a weight in your hand (if appropriate). Hold your upper arm still with your opposite hand.

Motion

Slowly straighten your elbow until it is fully extended.

Slowly bend your elbow to return to start position.

Perform this exercise in front of a mirror to make sure you raise both arms slowly.

Repeat 10 times. Do one to two sets (as tolerated).

Figure 2. (cont)—Sample flexibility and strengthening exercises. (From Miller,[17] with permission.)

standing of normal microcirculation and fluid balance physiology. It also requires an appreciation of the pathophysiology specific to this kind of lymphedema. Rather than restricting the activity of the woman who has developed lymphedema after breast cancer, encouraging participation in a safe but active exercise program will give her the tools needed to address all possible aspects of the edema, including the lymphatic, venous, and arterial components. Evidence clearly indicates that breast cancer–related lymphedema is unique and thus requires a treatment program tailored to it.

Self-management of lymphedema is critical to maintain long-term reduction and control of the swelling. As part of a self-management program, exercise emphasizes what a woman *can* do rather than what she *cannot* do, so that she no longer is forced to choose between managing her arm and returning to a normal, active lifestyle.

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