

Quick Summary of Section

Lymph nodes

- Lymph nodes are part of the lymphatic and immune system, which protects your body against infection and disease.

Lymphatic System

- The lymph system is a network of lymph vessels, tissues, and organs that carry lymph throughout the body.

Anatomy of lymphatic system

- When the lymph system is working as it should, lymph flows through the body and is returned to the bloodstream.

Lymphedema and Cancer

- Lymphedema can occur after any cancer or treatment that affects the flow of lymph through the lymph nodes, such as removal of lymph nodes.

Stages of Lymphedema

- **Stage 0:** A subclinical state where swelling is not evident despite impaired lymph transport..
- **Stage I or Reversible:** The limb (arm or leg) is swollen and feels heavy. Pressing on the swollen area leaves a pit (dent).
- **Stage II or Spontaneous irreversible:** The limb is swollen and feels spongy. Pressing on the swollen area does not leave a pit.
- **Stage III or Lymphostatic elephantiasis:** This is the most advanced stage. The swollen limb may be very large.

Possible Signs of Lymphedema

- Other conditions may cause the same symptoms. A doctor should be consulted if any of the following problems occur

Preventative Measures

- Skin care
- Avoid blocking fluids/pooling.

Treatment

- Pressure garments
- Exercise
- Bandaging
- Complete Decongestive Therapy (CDT) or Combined therapy
- Massage therapy
- Compression device

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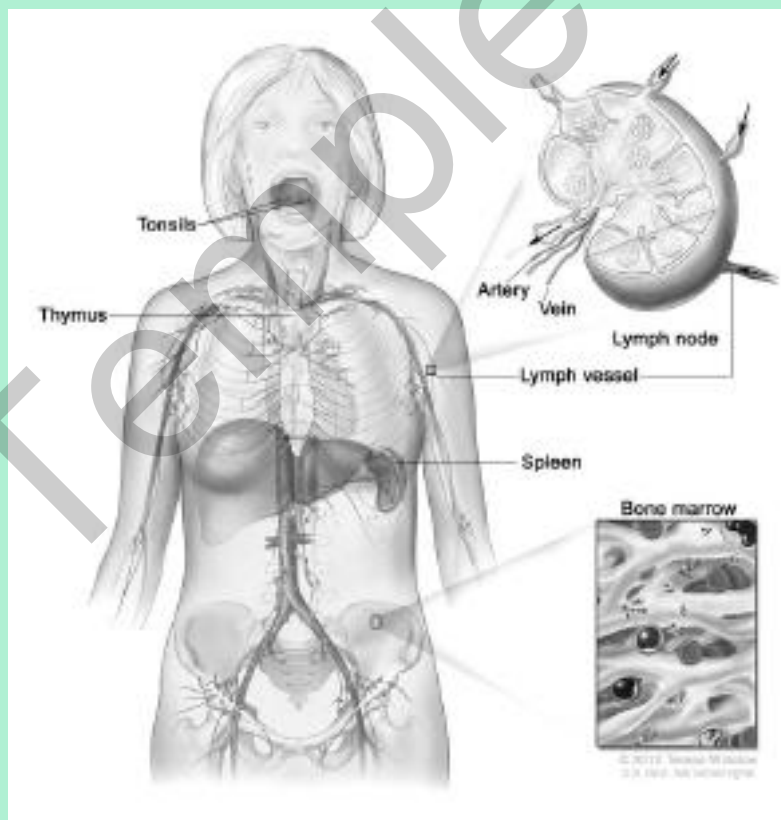
Lymph nodes

Lymph nodes are part of the lymphatic and immune system, which protects your body against infection and disease.

- Lymph nodes are small, round organs that are clustered in many areas of the body, such as the underarm.
- It consists of a network of vessels and organs that contains lymph, a clear fluid that carries infection-fighting white blood cells as well as fluid and waste products from the body's cells and tissues.
- Cancer cells can spread to lymph nodes and other parts of the body through lymph vessels. In a person with cancer, lymph can also carry cancer cells that have broken off from the main tumor.
- Once lymph nodes are removed, they will be checked for cancer. Knowing whether cancer is in the underarm lymph nodes can help the doctor decide if you need any treatment in addition to surgery.

NIH NCI (11) and NIH NCI (13)

Lymphatic System – National Cancer Institute

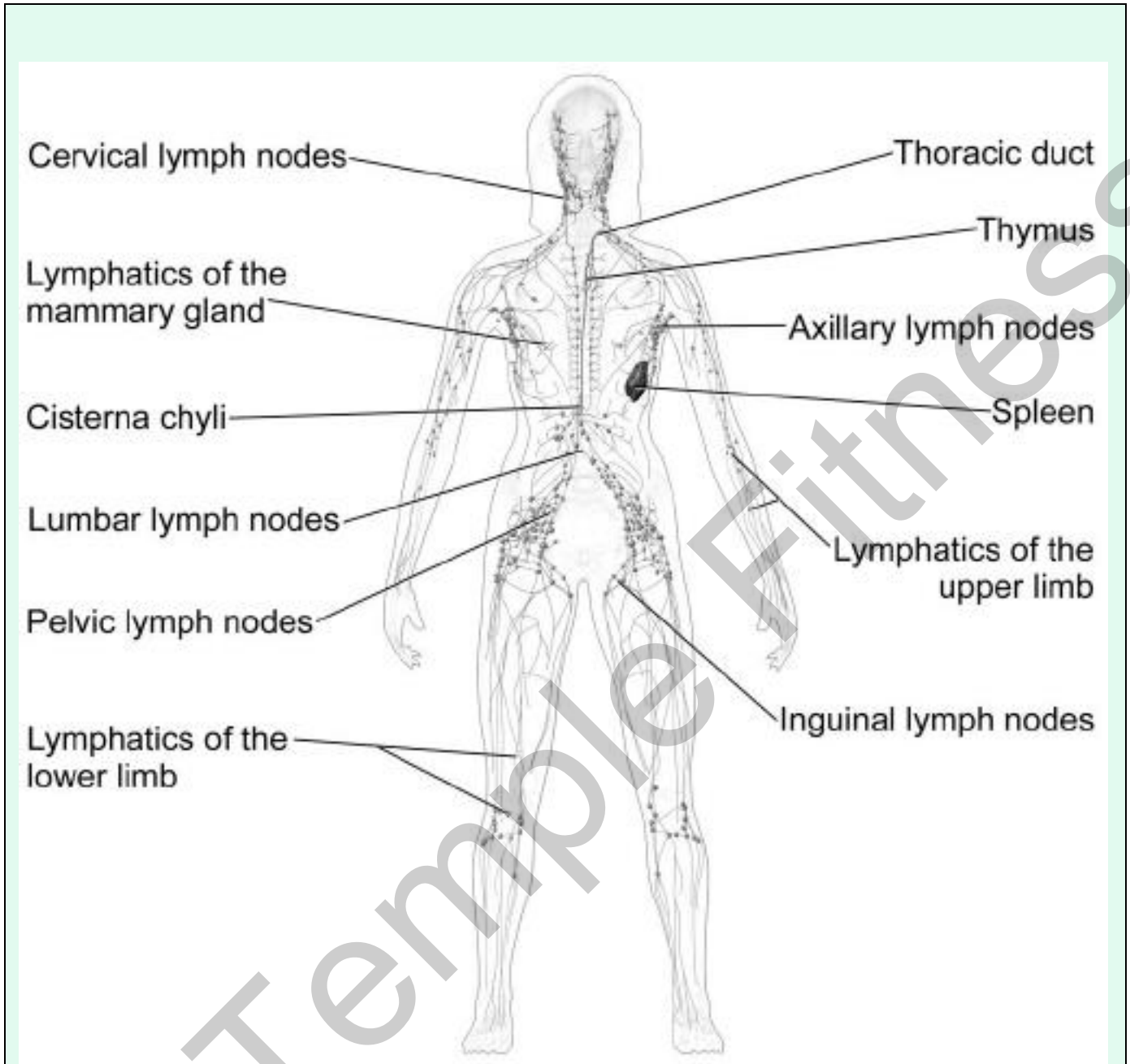


NIH NCI (12) <https://www.cancer.gov/about-cancer/treatment/side-effects/lymphedema/lymphedema-pdq>

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Lymphatic System	<p>The lymph system is a network of lymph vessels, tissues, and organs that carry lymph throughout the body.</p> <ul style="list-style-type: none">• The parts of the lymph system that play a direct part in lymphedema include the following:<ul style="list-style-type: none">○ Lymph: Colorless, watery fluid that travels through the lymph vessels and carries T and B lymphocytes.<ul style="list-style-type: none">▪ Lymphocytes are a type of white blood cell.○ Lymph vessels: A network of thin tubes that collect lymph from different parts of the body and return it to the bloodstream.○ Lymph nodes: Small, bean-shaped structures that filter lymph and store white blood cells that help fight infection and disease.<ul style="list-style-type: none">▪ Lymph nodes are found along a network of lymph vessels throughout the body.▪ Groups of lymph nodes are found in the neck, underarm, mediastinum, abdomen, pelvis, and groin..• Lymph (clear fluid) and lymphocytes travel through the lymph vessels and into the lymph nodes where the lymphocytes destroy harmful substances. The lymph enters the blood through a large vein near the heart.• The spleen, thymus, tonsils, and bone marrow are also part of the lymph system but do not play a direct part in lymphedema. <p><i>NIH NCI (12)</i></p>
Anatomy of lymphatic system	<p>When the lymph system is working as it should, lymph flows through the body and is returned to the bloodstream.</p> <ul style="list-style-type: none">• Fluid and plasma leak out of the capillaries (smallest blood vessels) and flow around body tissues so the cells can take up nutrients and oxygen.• Some of this fluid goes back into the bloodstream. The rest of the fluid enters the lymph system through tiny lymph vessels.<ul style="list-style-type: none">○ These lymph vessels pick up the lymph and move it toward the heart.○ The lymph is slowly moved through larger and larger lymph vessels and passes through lymph nodes where waste is filtered from the lymph.• The lymph keeps moving through the lymph system and collects near the neck, then flows into one of two large ducts:<ul style="list-style-type: none">○ The right lymph duct collects lymph from the right arm and the right side of the head and chest.○ The left lymph duct collects lymph from both legs, the left arm, and the left side of the head and chest.• These large ducts empty into veins under the collarbones, which carry the lymph to the heart, where it is returned to the bloodstream. <ul style="list-style-type: none">➤ When part of the lymph system is damaged or blocked, fluid cannot drain from nearby body tissues.➤ Fluid builds up in the tissues and causes swelling/edema. <p><i>NIH NCI (12)</i></p>

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Lymphedema

Lymphedema is swelling caused by excess protein-rich lymph trapped within the interstitium and subcutaneous tissues. This is caused by dysfunction of the lymphatic system or pathology.

Lymphedema occurs when the lymph system is damaged or blocked. Fluid builds up in soft body tissues and causes swelling. It is a common problem that may be caused by cancer and cancer treatment. Lymphedema usually affects an arm or leg, but it can also affect other parts of the body. Lymphedema can cause long-term physical, psychological, and social problems for patients.

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<p>Lymphedema and Cancer</p>	<p>Lymphedema can occur after any cancer or treatment that affects the flow of lymph through the lymph nodes, such as removal of lymph nodes. It may develop within days or many years after treatment. Most lymphedema develops within three years of surgery.</p> <p>Risk factors for lymphedema include the following:</p> <ul style="list-style-type: none"> • Removal and/or radiation of lymph nodes in the underarm, groin, pelvis, or neck. <ul style="list-style-type: none"> ○ The risk of lymphedema increases with the number of lymph nodes affected. ○ There is less risk with the removal of only the sentinel lymph node (the first lymph node in a group of lymph nodes to receive lymphatic drainage from the primary tumor). • Being overweight or obese. • Slow healing of the skin after surgery. • A tumor that affects or blocks the left lymph duct or lymph nodes or vessels in the neck, chest, underarm, pelvis, or abdomen. • Scar tissue in the lymph ducts under the collarbones, caused by surgery or radiation therapy. • Lymphedema often occurs in breast cancer patients who had all or part of their breast removed and axillary (underarm) lymph nodes removed. <i>(See below)</i> • Lymphedema in the legs may occur after surgery for uterine cancer, prostate cancer, lymphoma, or melanoma. It may also occur with vulvar cancer or ovarian cancer. Lymphedema occurs frequently in patients with cancers of the head and neck due to high-dose radiation therapy and combined surgery. <p><i>NIH NCI (12)</i></p>
<p>Lymphedema and Breast Cancer</p>	<p>Lymphedema is swelling caused by a build-up of lymph. You may have this type of swelling in the hand, arm, chest, or back on the side of your body where lymph nodes were removed by breast cancer surgery or damaged by radiation therapy.</p> <p>Some important facts to know about lymphedema are:</p> <ul style="list-style-type: none"> • Lymphedema can show up soon after surgery. • Lymphedema can show up months or years after cancer treatment is over. • Lymphedema might develop after an insect bite, minor injury, or burn on the arm where lymph nodes were removed or damaged. • Lymphedema can cause pain and other problems. <p><i>NIH NCI (11)</i></p>
<p>Stages of Lymphedema</p>	<ul style="list-style-type: none"> • Stage 0: A subclinical state where swelling is not evident despite impaired lymph transport. This stage may exist for months or years before edema becomes evident. • Stage I or Reversible: The limb (arm or leg) is swollen and feels heavy. Pressing on the swollen area leaves a pit (dent). <ul style="list-style-type: none"> ○ This stage of lymphedema may diminish with elevation. ○ Subjective complaints are common. • Stage II or Spontaneous irreversible: The limb is swollen and feels spongy. Pressing on the swollen area does not leave a pit. <ul style="list-style-type: none"> ○ A condition called tissue fibrosis may develop and cause the limb to feel hard. • Stage III or Lymphostatic elephantiasis: This is the most advanced stage. The swollen limb may be very large. <ul style="list-style-type: none"> ○ Stage III lymphedema rarely occurs in breast cancer patients. <p><i>NIH NCI (12) and other</i></p>

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<p>Possible Signs of Lymphedema</p>	<p>Other conditions may cause the same symptoms. A doctor should be consulted if any of the following problems occur:</p> <ul style="list-style-type: none"> • Swelling of an arm or leg, which may include fingers and toes. • A full or heavy feeling in an arm or leg. • A tight feeling in the skin. • Trouble moving a joint in the arm or leg. • Thickening of the skin, with or without skin changes such as blisters or warts. • A feeling of tightness when wearing clothing, shoes, bracelets, watches, or rings. • Itching of the legs or toes. • A burning feeling in the legs. • Trouble sleeping. • Loss of hair. <p><i>NIH NCI (12)</i></p>
<p>PREVENTATIVE MEASURES</p>	<p>Tell your doctor right away if you have any of the above symptoms. The chance of improving the condition is better if treatment begins early. Untreated lymphedema can lead to problems that cannot be reversed. <i>NIH NCI (12)</i></p>
<p>Skin Care</p>	<ul style="list-style-type: none"> • Keep skin and nails clean and cared for, to prevent infection. • Bacteria can enter the body through a cut, scratch, insect bite, or other skin injury. • Fluid that is trapped in body tissues by lymphedema makes it easy for bacteria to grow and cause infection. • Look for signs of infection, such as redness, pain, swelling, heat, fever, or red streaks below the surface of the skin. • Call your doctor right away if any of these signs appear. <p>Careful skin and nail care helps prevent infection:</p> <ul style="list-style-type: none"> • Use cream or lotion to keep the skin moist. • Treat small cuts or breaks in the skin with an antibacterial ointment. • Avoid needle sticks of any type into the limb (arm or leg) with lymphedema. This includes shots or blood tests. • Use a thimble for sewing. • Avoid testing bath or cooking water using the limb with lymphedema. There may be less feeling (touch, temperature, pain) in the affected arm or leg, and skin might burn in water that is too hot. • Wear gloves when gardening and cooking. • Wear sunscreen and shoes when outdoors. • Cut toenails straight across. See a podiatrist (foot doctor) as needed to prevent ingrown nails and infections. • Keep feet clean and dry and wear cotton socks. <p><i>NIH NCI (12)</i></p>

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<p>Avoid blocking fluids and pooling in Affected Limb</p>	<p>Avoid blocking the flow of fluids through the body. It is important to keep body fluids moving, especially through an affected limb or in areas where lymphedema may develop.</p> <ul style="list-style-type: none"> • Do not cross legs while sitting. • Change sitting position at least every 30 minutes. • Wear only loose jewelry and clothes without tight bands or elastic. • Do not carry handbags on the arm with lymphedema. • Do not use a blood pressure cuff on the arm with lymphedema. • Do not use elastic bandages or stockings with tight bands. <p>Keep blood from pooling in the affected limb.</p> <ul style="list-style-type: none"> • Keep the limb with lymphedema raised higher than the heart when possible. • Do not swing the limb quickly in circles or let the limb hang down. This makes blood and fluid collect in the lower part of the arm or leg. • Do not apply heat to the limb. <p><i>NIH NCI (12)</i></p>
<p>TREATMENT</p>	<ul style="list-style-type: none"> • Damage to the lymph system cannot be repaired. • Treatment is given to control the swelling caused by lymphedema and keep other problems from developing or getting worse. • Physical (non-drug) therapies are the standard treatment. • Treatment may be a combination of several of the physical methods. • The goal of these treatments is to help patients continue with activities of daily living, to decrease pain, and to improve the ability to move and use the limb (arm or leg) with lymphedema. • Drugs are not usually used for long-term treatment of lymphedema. <p><i>NIH NCI (12)</i></p>
<p>Complete Decongestive Therapy or combined therapy</p>	<p>Combined physical therapy or complete decongestive therapy is a program managed by a certified lymphedema therapist to include:</p> <ul style="list-style-type: none"> • Manual lymphatic drainage • Compression bandaging • Exercise • Skin care – <i>see skin care above</i> • Patient education <ul style="list-style-type: none"> • At the beginning of the program, the therapist gives many treatments over a short time to decrease most of the swelling in the limb with lymphedema. • The patient then continues the program at home to keep the swelling down. <p><i>NIH NCI (12)</i></p>

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Manual Lymphatic Drainage	<ul style="list-style-type: none">• MLD (manual therapy) for lymphedema should begin with someone specially trained in treating lymphedema.• In this type of massage, the soft tissues of the body are lightly rubbed, tapped, and stroked. It is a very light touch, almost like a brushing.
MLD	<ul style="list-style-type: none">• MLD may help move lymph out of the swollen area into an area with working lymph vessels.• Patients can be taught to do this type of massage therapy themselves by a certified lymphatic therapist. <p><i>NIH NCI (12)</i></p> <p>Effects:</p> <ul style="list-style-type: none">• Increases reabsorption of protein rich fluid• Increases lymphatic activity• Promotes relaxation• Creates and analgesic effect <p><i>(Klose Education)</i></p> <p>When done correctly, massage therapy does not cause medical problems. Massage should not be done on any of the following:</p> <ul style="list-style-type: none">• Open wounds, bruises, or areas of broken skin.• Tumors that can be seen on the skin surface.• Areas with deep vein thrombosis (blood clot in a vein).• Sensitive soft tissue where the skin was treated with radiation therapy. <p><i>NIH NCI (12)</i></p> <p>Contraindications:</p> <ul style="list-style-type: none">• Acute infections, such as cellulitis• Untreated congestive heart failure (CHF)• Malignant disease – cancer• Renal dysfunction• Acute undiagnosed DVT <p><i>(Klose education)</i></p>

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Bandages	<ul style="list-style-type: none">• Once the lymph fluid is moved out of a swollen limb, bandaging (wrapping) can help prevent the area from refilling with fluid.• Bandages also increase the ability of the lymph vessels to move lymph along.• Lymphedema that has not improved with other treatments is sometimes helped with bandaging. <p><i>NIH NCI (12)</i></p> <p>INDICATIONS:</p> <ul style="list-style-type: none">• Lymphedema• Chronic venous insufficiency (CVI)• Combination venous and lymphatic edema• Lipedema• Post-traumatic edema• Post-surgical edema• Acute DVT (<i>with physician dx</i>) <p>CONTRAINDICATION:</p> <ul style="list-style-type: none">• Acute infections (MD must clear patient)• Arterial wounds• Arterial disease (ABI 0.8 or below)• Acute DVT (<i>without physician dx</i>)• Cardiac edema (untreated CHF)• Acute trauma without diagnosis <p>PRECAUTIONS</p> <ul style="list-style-type: none">• Sensory deficits• Malignancy• Diabetes<ul style="list-style-type: none">– Small vessel (arteriole) and sensory deficits– Toe bandaging may be contraindicated• Paralysis• Poor cognition or altered mental status• Sensitivity to the products used for bandaging <p><i>(Klose Education)</i></p>
Pressure garments	<ul style="list-style-type: none">• Pressure garments are made of fabric that puts a controlled amount of pressure on different parts of the arm or leg to help move fluid and keep it from building up.• Some patients may need to have these garments custom-made for a correct fit.• Wearing a pressure garment during exercise may help prevent more swelling in an affected limb.• It is important to use pressure garments during air travel, because lymphedema can become worse at high altitudes.• Pressure garments are also called compression sleeves and lymphedema sleeves or stockings. <p><i>NIH NCI (12)</i></p>

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<p>Compression device</p>	<ul style="list-style-type: none"> • Compression devices are pumps connected to a sleeve that wraps around the arm or leg and applies pressure on and off. The sleeve is inflated and deflated on a timed cycle. • This pumping action may help move fluid through lymph vessels and veins and keep fluid from building up in the arm or leg. • Compression devices may be helpful when added to complete decongestive therapy. • The use of these devices should be supervised by a trained professional because too much pressure can damage lymph vessels near the surface of the skin. <p>NIH NCI (12)</p>
<p>Exercise</p> <p><i>(also see Exercise and Breast Cancer)</i></p>	<p>Both light exercise and aerobic exercise (physical activity that causes the heart and lungs to work harder) help the lymph vessels move lymph out of the affected limb and decrease swelling.</p> <ul style="list-style-type: none"> • Talk with a certified lymphedema therapist before beginning exercise. <ul style="list-style-type: none"> ○ Patients who have lymphedema or who are at risk for lymphedema should talk with a certified lymphedema therapist before beginning an exercise routine. <ul style="list-style-type: none"> ▪ <i>(See the Lymphology Association of North America (https://www.clt-lana.org/) web site for a list of certified lymphedema therapists in the US)</i> • Wear a pressure garment if lymphedema has developed. <ul style="list-style-type: none"> ○ Patients who have lymphedema should always wear a well-fitting pressure garment during all exercise that uses the affected limb or body part. ○ When it is not known for sure if a woman has lymphedema, upper-body exercise without a garment may be more helpful than no exercise at all. ○ Patients who do not have lymphedema do not need to wear a pressure garment during exercise. • Breast cancer survivors should begin with light upper-body exercise and increase it slowly. <ul style="list-style-type: none"> ○ Some studies with breast cancer survivors show that upper-body exercise is safe in women who have lymphedema or who are at risk for lymphedema. ○ Weight-lifting that is slowly increased may keep lymphedema from getting worse. ○ Exercise should start at a very low level, increase slowly over time, and be overseen by the lymphedema therapist. ○ If exercise is stopped for a week or longer, it should be started again at a low level and increased slowly. ○ If symptoms (such as swelling or heaviness in the limb) change or increase for a week or longer, talk with the lymphedema therapist. ○ It is likely that exercising at a low level and slowly increasing it again over time is better for the affected limb than stopping the exercise completely. • More studies are needed to find out if weight-lifting is safe for cancer survivors with lymphedema in the legs. <p>NIH NCI (12)</p>
<p>Other Treatments</p>	<p>Weight loss</p> <ul style="list-style-type: none"> • In patients who are overweight, lymphedema related to breast cancer may improve with weight loss. <p>Laser therapy</p> <ul style="list-style-type: none"> • Laser therapy may help decrease lymphedema swelling and skin hardness after a mastectomy. A hand-held, battery-powered device is used to aim low-level laser beams at the area with lymphedema. <p>Drug therapy</p> <ul style="list-style-type: none"> • Lymphedema is not usually treated with drugs. Antibiotics may be used to treat and prevent infections. Other types of drugs, such as diuretics or anticoagulants (blood thinners), is usually not helpful and may make the lymphedema worse. <p>Surgery</p> <p>Lymphedema caused by cancer is rarely treated with surgery.</p> <p>NIH NCI (12)</p>

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Axillary Reverse Mapping (ARM)

Axillary Reverse Mapping (ARM)

The axillary reverse mapping (ARM) technique has been developed to map and preserve arm lymphatic drainage during ALND and/or SLNB, thereby minimizing arm lymphedema. However, the success of ARM in reducing lymphedema has not been exactly determined. If ARM can be confirmed to be both effective and oncologically safe in preventing lymphedema, this technique should be recommended in the management of breast cancer treatment.

NIH – National Library of Medicine. Axillary Reverse Mapping (ARM): Where to Go

- Lymphedema is a major chronic morbidity that occurs in patients undergoing treatment for breast cancer (BC). Surgery for BC includes axillary surgery with either sentinel lymph node biopsy (SLNB) or axillary lymph node dissection (ALND).
- Lymphedema occurs due to removal or disruption of lymphatic drainage of the arm that overlaps with drainage of the breast. The risk of lymphedema increases significantly with adjuvant radiation.
- Axillary reverse mapping (ARM) is a technique where blue dye is injected into the upper arm at surgery, allowing direct visualization of arm lymphatics and nodes during either SLNB or ALND. This allows preservation of arm lymphatics unless there is suspicion of metastatic disease in ARM lymphatics or if the ARM node is/are also the sentinel lymph node.
- Studies to date have largely been observational cohort studies, and mainly with low risk patients undergoing SLNB only. There is only one published randomized controlled trial, and this included only patients undergoing modified radical mastectomy.

NIH – National Library of Medicine. Axillary Reverse Mapping (ARM) Technique (ARM)

- Traditionally, the rates of arm swelling after sentinel node biopsy range from 3-8%¹ and from 13-40%² after axillary dissection surgery. The studies that looked at ARM show a lymphedema rate that is lower, around 1-3% for the sentinel node surgery and 4-9%³ for the axillary dissection surgery.
- Sometimes, it is not always possible to do ARM, and the surgeon needs to inject the blue dye in the breast to help identify the correct lymph nodes. This may be the case if you have had previous chemotherapy in the breast, or if the lymph nodes are not accurately found with other methods.
- Additionally, it is possible that the blue lymph nodes and the channels that are identified to drain the arm need to be removed to treat your cancer safely. If this is the case, you may be placed in a special group to watch your arm swelling closely, or even have the option of having these channels reconnected. This is usually done by surgeons well experienced in lymphatic surgery, and may include plastic surgeons also.

Summit Education: Oncology Rehab Dec 12, 2019

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American Cancer Society - Lymph Node Surgery for Breast Cancer <https://www.cancer.org/cancer/breast-cancer/treatment/surgery-for-breast-cancer/lymph-node-surgery-for-breast-cancer.html>

Medical gallery of Blausen Medical 2014". WikiJournal of Medicine

NIH NCI (11) <https://www.cancer.gov/types/breast/surgery-choices/lymphedema>

NIH NCI (12) <https://www.cancer.gov/about-cancer/treatment/side-effects/lymphedema/lymphedema-pdq>

NIH NCI (13) <https://www.cancer.gov/about-cancer/diagnosis-staging/staging/sentinel-node-biopsy-fact-sheet>

NIH – National Library of Medicine. Axillary Reverse Mapping (ARM): Where to Go

<https://pubmed.ncbi.nlm.nih.gov/29961238/>

NIH – National Library of Medicine. Axillary Reverse Mapping (ARM) Technique (ARM)

<https://clinicaltrials.gov/ct2/show/NCT03109522>

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UPMC Axillary Lymph Node Dissection <https://www.upmc.com/locations/hospitals/magee/services/magee-womens-cancers/breast-cancer-program/treatment/breast-cancer-surgery/axillary-lymph-node>

Wikipedia – Axillary Lymph Nodes - https://en.wikipedia.org/wiki/Axillary_lymph_nodes

Wiki McMaster: Breast Cancer https://wiki.mcmaster.ca/LIFESCI_4M03/_detail/screen_shot_2017-10-02_at_5.51.59_pm.png?id=group_1_presentation_1_-_breast_cancer

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