# Breast lymphedema after breast conserving surgery

## Prospective surveillance, evaluation and diagnosis

By Cheryl Brunelle

After breast-conserving surgery for breast cancer treatment, patients may experience breast lymphedema. Symptoms can range from mild to severe, and include pain, and increased breast heaviness and volume. Pitting, peau d'orange, thickening and color changes in the nipple areolar complex, and erythema of the breast may be evident.[1]

### How common is breast lymphedema after breast conserving surgery?

Breast lymphedema incidence is quite high after breast-conserving surgery, with wide ranges up to 94% reported in the literature.[2] In a well-designed prospective study, Karin Johansson and her team screened sixty-five patients for two years after breast conserving surgery. They found breast lymphedema was present postoperatively, even before radiation treatment. The largest proportions of patients with breast lymphedema were found at three- and six-months post-radiation (63%) and the smallest proportions at two years post-radiation (28%). Large, long-term studies are lacking, and, despite a high incidence long after breast surgery and radiation, breast lymphedema has received limited attention in the clinical and research world.

### Who is most at risk for breast lymphedema?

Risk factors for breast lymphedema are not well understood, as it is diagnosed differently across studies, often using methods such as self-report or clinical exam alone. Some studies have identified the following as potential risk factors for breast lymphedema after breast conserving surgery: large tumor size,[1] elevated body mass index,[3] incision location,[3] prior surgical biopsy,[3] oncoplastic surgery,[1] axillary lymph node dissection (ALND),[1,4,5] radiation (locoregional radiotherapy,[1] boost;[1] hypofractionation[6,7]) and chemotherapy [1,4]. However, risk factors are yet to be well-defined in a large, prospective study with objective measurement.

### How is breast lymphedema evaluated?

**Symptoms:** Assessment of symptoms should include a subjective history and may incorporate patient-reported outcome measures. The clinician should actively elicit symptom experiences from the patient, asking about heaviness, increased breast size, swelling, or discomfort. In addition to the subjective history, the clinician may utilize valid and reliable patient-reported outcome measures to screen for presence of breast lymphedema symptoms over time or monitor changes with treatment. Such outcome measures may include the Breast-Q, a comprehensive outcome measure analyzing six domains: satisfaction with breasts, overall outcome, process of care, and psychosocial, physical, and sexual well-being. The domains are assessed within several independently validated subscales which may be administered in a stand-alone fashion.[8,9] The Breast-Q analyzes symptoms including pain, throbbing, tightness, pulling, tenderness, aching, and increased skin thickness in the breast. The Breast Cancer Treatment Outcomes Scale, a validated, 12-item questionnaire assesses symptoms including breast shape, breast swelling, tenderness, and sensitivity, as well as aesthetics.[10]

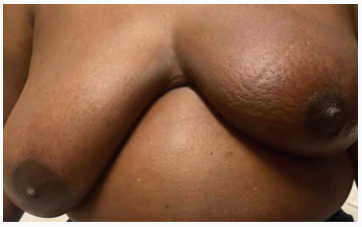

FIGURE 1
Breast lymphedema characterized by asymmetry, pitting edema from the patient's bra, darkening and thickening of the nipple-areolar complex, peau d'orange and erythema associated with radiation and edema.

**Clinical examination:** Clinical examination methods for breast lymphedema are outlined in the literature,[11] and characteristics are illustrated in Figure 1. Patients should ideally be examined both sitting and supine. In the seated position, breast asymmetry is readily apparent in moderate to severe breast lymphedema. However, it should be noted that breast symmetry should not be the expectation in women who have undergone breast conserving surgery, given that there has been removal of breast tissue on the affected side. The examiner may note a thickened nipple areolar complex (NAC) which may be paler or darker than the NAC on the opposite breast. Pitting edema caused by the patient's bra and peau d'orange may be present. Peau d'orange can be better seen by compressing the breast tissue between the fingers and utilizing a tangential light across the breast.[11] The clinician may seek permission to weigh the breast by lifting both breasts with their fingers, looking for

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heaviness in the affected breast.[11] The Stemmer sign may be positive in the presence of breast lymphedema; the skin cannot be pinched away from the subcutaneous tissue in the affected area as compared to the unaffected side.[11] Finally, there may be breast erythema secondary to radiation, previous cellulitis, or uncomfortable breast edema. In milder cases of breast lymphedema, the only finding may be peau d'orange in the lower quadrants of the breast, which is best examined with the patient in the supine position.[11]

FIGURE 2
Tissue dielectric constant (TDC) measurement of the upper outer quadrant of the left breast, measuring 52% percent water content (PWC) of the tissue.

**Objective measures:** Historically, clinicians and researchers have relied upon clinical examination or self-report alone to diagnose breast lymphedema, given notable absence of validated objective measurement tools. In the past several years, however, tools such as ultrasound and tissue dielectric constant (TDC), and more recently indocyanine green (ICG) lymphography, have been evolving as potential real-time measurement tools for breast lymphedema.

## Tissue Dielectric Constant

The handheld TDC device (MoistureMeter-D Compact, Delfin Technologies, Finland), illustrated in Figure 2, transmits an ultra-high-frequency electromagnetic wave through its probe which is in contact with the skin. A proportion of this wave is reflected from the tissues, influenced by the amount of water through which the wave passes. The reflected wave is analyzed and the TDC is displayed, which ranges from 1 (zero tissue water) to 78.5 (pure water).[12,13] Two studies in particular have shown the utility of TDC in breast lymphedema measurement: Johansson et al prospectively screened patients for breast lymphedema for two years after radiation completion.6,7 They measured mean whole breast TDC values and calculated a diagnostic threshold of TDC ratio ≥ 1.40 of the affected to unaffected breast. TDC values were elevated at the beginning of radiation, and remained elevated, with a significantly higher TDC value in the affected breast at every timepoint. Incidence of breast lymphedema was 29% prior to radiation, 63% at 3- and 6-month post-radiation, declining to 28% at 24 months.

## TDC and Indocyanine Green Lymphography

Heydon-White et al. published the first study using TDC with ICG lymphography to not only identify breast lymphedema but to map the lymphatic drainage pathways of the breast after breast conserving surgery.[14] As in Johansson et al's study, breast lymphedema was defined as a whole breast TDC ratio ≥ 1.40. The lower quadrants of the affected breast displayed significantly higher tissue water content than the upper quadrants ($p < 0.05$). Five of seven patients with whole breast dermal backflow via ICG lymphography (reflecting lymphatic impairment), had TDC ≥ 1.40. In the other cases, although TDC ratios were ≤ 1.40, localized dermal backflow was evident.[14] This study illustrates the potential utility of incorporating direct lymphatic imaging, such as ICG lymphography, to characterize breast lymphedema.

## Ultrasound

Ultrasound has been utilized in several research studies to characterize increased skin thickness associated with breast edema.[15-23] Measurement protocols are available which outline ultrasound settings. Measurements are typically taken using a high frequency linear probe with a thick gel layer, incorporating standardized probe and patient positioning, and minimizing probe pressure to avoid compression of the skin,[19,20] as illustrated in Figure 3. In one small study, dermal thickness measurements with ultrasound demonstrated high inter-image, intra- and inter-rater reliability.[19]

Diagnostic thresholds for skin thickness associated with breast lymphedema have been suggested in small studies. Dylke et al.[19] established dermal thickness thresholds of >1.6 mm in the superior and lateral quadrants and >2.0 mm in the medial and inferior quadrants to diagnose breast lymphedema in a small study of 38 women. Riches et al.[22] utilized ROC analysis to establish diagnostic skin thickness thresholds for each quadrant, showing low positive predictive value (44-58%) but high negative predictive value (87-99%) of their suggested thresholds. Further research is required to build upon these foundational studies to definitively establish diagnostic thresholds for skin thickness measured by ultrasound to diagnose breast lymphedema.

## Imaging as part of routine breast cancer follow-up

When compared to the non-operated side, skin thickness increases in the operated breast may be found in routine mammography (Figures 4A and 4B) or breast ultrasound images taken for staging or workup (Figure 4C).

FIGURE 3
Portable linear high frequency ultrasound measurement of skin thickness on the inner upper quadrant of the left breast.

## Screening and diagnosis

Prospective surveillance for breast cancer-related lymphedema of the arm after axillary lymph node removal is recommended by the Lymphology Association of North America, the National Comprehensive Cancer Network, the National Lymphedema Network, and the International Society for Lymphology, to name a few. Research in this area is solid, and screening is emerging as standard of care for women treated for breast cancer.[24-27] Screening for lymphedema of the breast, however, has not received nearly the same attention.

Women who have undergone breast conserving surgery for breast cancer, with or without radiation, should ideally be screened for breast lymphedema, in addition to arm lymphedema. This screening can include symptoms assessment, clinical examination, and objective measures if they are available. Patients should be educated regarding the incidence of breast lymphedema after breast conserving surgery, potential signs and symptoms, and how to reach out for diagnosis and referral. Given that there is no current gold standard for breast lymphedema diagnosis, a combination of symptoms, clinical examination and objective measurements may be best to ensure timely diagnosis and management. Until diagnostic criteria are better defined, diagnosis may be made using any or all of these approaches. If objective measurement tools are available (such as TDC, ultrasound or review of routine breast imaging via mammography or ultrasound), it may be prudent to include these, applying available diagnostic thresholds.

## Treatment

There are no current evidence-based guidelines for treatment for breast lymphedema, and currently, treatment tends to encompass a multi-modal approach. Treatment methods are summarized in several publications and a useful summary is available by Lesli Bell in the Spring 2023 *Pathways* edition.[28-32] Treatment may include manual lymphatic drainage of the breast and trunk, consistent wear of compression bras or vests (Figure 5), chip bags or quilted pads inside the bra over the area of swelling (Figure 5),

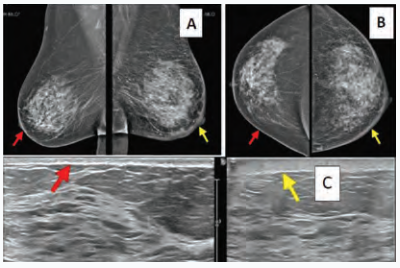


FIGURE 4
Imaging findings of breast lymphedema. A Bilateral lateral medial-oblique mammogram showing skin thickening on the left side (yellow arrow) versus right side (red arrow), B Bilateral craniocaudal mammogram showing skin thickening on the left side (yellow arrow) versus right side (red arrow), C Thickened skin on left (yellow arrow) versus right side (red arrow) on routine breast ultrasound.
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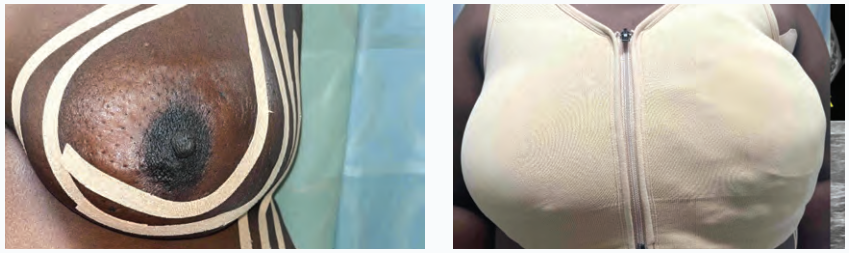
FIGURE 5



Kinesiotaping for drainage of the left breast to the ipsilateral axillary lymph nodes (left) and compression bra wear over quilted breast pad (right).

manual therapy including scar management, and kinesiotaping (Figure 5). Stretching and strengthening should be included in the plan of care for every patient who has been treated for breast cancer.

## Summary/future directions

Incidence of breast lymphedema is high after breast conserving surgery, with some patients experiencing severe symptoms. Breast lymphedema is treatable, and treatment is imperative for those whose symptoms are impacting their daily activities and quality of life; these patients should not be left to suffer from a treatable side effect of their breast conserving treatment.

Awareness of breast lymphedema after breast conserving surgery is important amongst patients at risk and their providers, to ensure timely diagnosis and referral for treatment. Prospective surveillance for breast lymphedema can be easily added to that for lymphedema of the arm, and I would suggest this should be standard of care. Patient education, symptom monitoring and clinical examination may be incorporated into screening programs. Further research is required to establish risk factors for breast lymphedema after breast conserving surgery, definitive diagnostic thresholds utilizing objective measurements (such as ultrasound and TDC measurement), and treatment guidelines. LP

**References can be found at https://canadalymph.ca/pathways-references**

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