

### Editor's key points

- ▶ Breast cancer continues to be the most common form of cancer affecting women in Canada (1 in 9 women), but diagnostic and treatment improvements have increased survival to 87%. Breast reconstruction can improve quality of life for patients who undergo mastectomy, but rates of reconstruction in Canada continue to be low. Many effective options are available for reconstruction, making almost all patients who require mastectomy candidates.
- ▶ Cancer Care Ontario recommends that all women diagnosed with operable breast cancer requiring mastectomy be referred to a plastic surgeon to discuss reconstructive options before their scheduled mastectomies.
- ▶ This article outlines the options for reconstruction, outcomes, and complications, and provides guidance that can be used to help patients decide among the various options. While some women will choose not to undergo breast reconstruction, all women should receive the appropriate education and support to allow for informed decision making.

# Breast reconstruction

## Updated overview for primary care physicians

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### Abstract

**Objective** To offer primary care providers a comprehensive summary of breast reconstruction options and complications.

**Quality of evidence** A literature search was conducted in PubMed with no time restriction using the search terms *breast reconstruction, summary, review, complications*, and *options*. Levels of evidence range from I to III.

**Main message** As breast cancer survival rates increase, the focus of breast cancer management must shift to include the restoration of a patient's quality of life after cancer. Breast reconstruction plays a crucial role in the restoration of normality for these women. Women who undergo mastectomy often suffer from challenges related to body image, self-esteem, and a decrease in quality of life scores. Cancer Care Ontario's Breast Cancer Treatment Pathway Map mandates that all women diagnosed with breast cancer who might require mastectomy be referred to a plastic surgeon to discuss reconstructive options before surgery.

**Conclusion** The knowledge and guidance of primary care providers is critical to effectively guiding and supporting patients who might undergo breast reconstruction in their decision-making processes. A thorough understanding of patient selection factors, modern options for breast reconstruction, and expected outcomes is essential.

**B**reast cancer continues to be the most common form of cancer affecting women in Canada (1 in 9 women).<sup>1</sup> Certain women (with genetic mutations like *BRCA1*, *BRCA2*, and *TP53*) have a greater likelihood of developing the disease. Diagnostic and treatment improvements have increased survival to 87%,<sup>2,3</sup> leading to a need to focus on restoration of quality of life after cancer. Studies show that women who undergo mastectomy often suffer from challenges related to body image, self-esteem, and a decrease in quality-of-life scores.<sup>4,5</sup> Postmastectomy breast reconstruction can offset or reverse these negative sequelae of prophylactic or oncologic mastectomies. It has been shown to be one of the most important determinants of functional and psychosocial well-being, long-term health, and patient satisfaction compared with patients who have undergone mastectomy without reconstruction.<sup>6,7</sup> However, rates of breast reconstruction in Canada continue to be low, approaching 2.7% to 18.5%.<sup>8</sup> While not all women will be candidates or have a desire to undergo breast reconstruction, 100% of women should be given the option and feel that they were appropriately counseled to make a confident decision. The key to this lofty goal is complete engagement of the entire health care team.

In 2015, Cancer Care Ontario (CCO) released a Breast Cancer Treatment Pathway Map,<sup>9</sup> which mandated that all women diagnosed with operable breast cancer requiring mastectomy be referred to a plastic surgeon to discuss reconstructive options before their scheduled mastectomies. The algorithm also outlines appropriate treatment and reconstructive options for individual patients.

## Quality of evidence

A PubMed literature search was conducted with no time restriction using *breast reconstruction, summary, review, complications, and options*. Guidelines published by national cancer-related organizations were also reviewed. A supplemental search of references from selected articles and reference lists of guidelines was also performed. Finally, expert experience from key opinion leaders in Canadian breast reconstruction was included to provide the most up-to-date and comprehensive review of modern options for reconstruction. Levels of evidence range from I to III.

## Main message

The knowledge and guidance of the primary care physician (PCP) is critical during the time of diagnosis and decision making. As one of the patient's most valuable resources during the journey through breast cancer treatment, the PCP must understand and support decision making around modern reconstructive options. Unfortunately, the most recent comprehensive review we found written specifically with PCPs in mind comes from more than 35 years ago<sup>10</sup> and much has changed. The purpose of this review is to provide a modern update on reconstructive options that offers PCPs a framework for discussion with and support of women who are candidates for breast reconstruction.

**Dispelling false beliefs.** An unfortunate number of patient and health care provider beliefs around breast reconstruction are outdated and false. Patients often think they are too old,<sup>11</sup> feel vanity in their desire to undergo reconstruction, worry that reconstruction will interfere with cancer treatment, or believe that breast reconstruction is dangerous and fraught with complications.

The reality is that there are no absolute contraindications to breast reconstruction. Certainly, the patients' general health and the type and grade of malignancy must be considered. Certain factors such as morbid obesity and smoking considerably limit options. In most cases, however, health- and tumour-related factors will influence the type and timing of reconstruction but not whether or not reconstruction is an option. Breast reconstruction itself does not lead to an increase in recurrence nor increased difficulty in surveillance.

**Timing of breast reconstruction.** Immediate breast reconstruction, performed during the same procedure as oncologic resection, has the distinct advantages of decreasing the total number of surgeries, providing improved psychological benefit, and preserving much of the native breast skin and potentially the nipple. Delayed reconstruction might be recommended for patients with advanced disease, those for whom there are uncertainties about disease control, or those not interested in or prepared to make a reconstructive decision at the time of their oncologic procedure (**Table 1**).

**Mastectomy incisions.** Before deciding on a reconstructive technique, a decision about which type of mastectomy is appropriate is made by the general surgeon, if possible in consultation with the plastic surgeon. When immediate reconstruction is not planned, a horizontal incision is made to remove excess skin with the mastectomy specimen and allow the remaining skin to close neatly, flat against the chest wall. When immediate reconstruction is planned, the incision is modified to preserve as much breast skin as possible. Traditionally, "skin-sparing" mastectomy involves nipple and areolar excision as an ellipse, leaving a horizontal scar and

**Table 1. Timing of breast reconstruction: Immediate versus delayed.**

TIMING	DEFINITION	IDEAL CANDIDATE	ADVANTAGES	DISADVANTAGES
Immediate	Reconstructive procedure is started during the same operation as the mastectomy or lumpectomy	<ul style="list-style-type: none"> <li>• Healthy</li> <li>• Low-grade cancer</li> <li>• Less likely to require postsurgical radiotherapy</li> <li>• In more advanced or unknown breast cancer stages, part of the breast reconstruction can start immediately</li> </ul>	<ul style="list-style-type: none"> <li>• Preservation of native skin and possibly nipple</li> <li>• Fewer procedures</li> <li>• Considerable psychological benefit (avoids breast deformity)</li> </ul>	<ul style="list-style-type: none"> <li>• Longer surgery</li> <li>• Longer recovery</li> <li>• Unknown tumour biology with variability in the need for postoperative adjuvant therapy</li> </ul>
Delayed	Reconstructive procedure occurs months to years after mastectomy or lumpectomy	<ul style="list-style-type: none"> <li>• Cannot tolerate a longer surgical procedure and recovery</li> <li>• Requires radiotherapy postoperatively</li> <li>• Multiple important risk factors (smoking, diabetes, vascular disease, etc)</li> </ul>	<ul style="list-style-type: none"> <li>• Increased time to make reconstructive decisions</li> <li>• Decisions can be based on final tumour pathology</li> <li>• More time to prepare for recovery</li> </ul>	<ul style="list-style-type: none"> <li>• Need for multiple operations</li> <li>• More complicated operations (owing to missing skin envelope and possibly nipple)</li> <li>• Psychological effects of breast deformity until reconstruction is performed</li> </ul>

most native breast skin behind. Today, in appropriate patients, a “nipple-sparing” approach can be used. In these cases, surgeons will decide where to make the access incision for removal of the underlying breast tissue while preserving all overlying skin, nipple, and areola. A nipple-sparing approach can often be considered if these criteria are met:

- the tumour does not involve the area around the nipple;
- the patient has small- or medium-sized breasts (generally, A to a small C cup size); and
- the patient has good native nipple position (minimal ptosis).

The various incisions types are shown in **Figure 1**.

**Options for breast reconstruction.** Options for breast reconstruction are divided into alloplastic (implant-based) or autologous (tissue-based) reconstruction (**Table 2**). Implant-based reconstruction is currently the most common type of breast reconstruction performed in North America.<sup>12</sup> Substantial improvements made in both implant technology and techniques have allowed for aesthetically pleasing, efficient, and safe reconstruction in most breast cancer patients. Likewise, advances, particularly in the field of microsurgery, have provided options for transfer of tissue from various body areas with minimal donor-site morbidity. Both categories of breast reconstruction can be performed in an immediate or delayed fashion.

**Alloplastic implant-based reconstruction:** Alloplastic reconstruction (**Figure 2**) is traditionally performed in 2 stages involving insertion of a tissue expander followed by implant exchange. A “direct-to-implant” approach

allows reconstruction with the permanent implant at time of mastectomy. **Table 3** provides guidance for deciding between these approaches. Alloplastic reconstruction involves shorter surgeries with easier recovery but with the possible need for ongoing implant monitoring or adjustment in the future. Surgery can take 1 to 2 hours per side, and return to normal activity is expected within 2 to 3 weeks. Exercise and heavy lifting are restricted for 6 weeks.

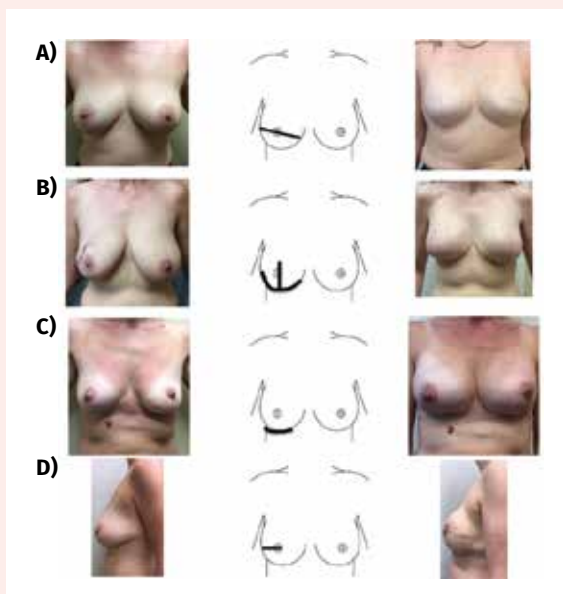
**Autologous tissue reconstruction:** Autologous reconstruction (**Figure 3**) uses the patient's own skin, fat, and muscle to reconstruct the breast mound. Broadly, autologous reconstruction is divided into pedicled versus free flap. The advantages and disadvantages of each are described in **Table 4**. Pedicled flaps originate from tissue close to the breast and use native blood supply to vascularize the breast mound. Examples of pedicled flaps include the latissimus dorsi flap and the pedicled TRAM (transverse rectus abdominis myocutaneous) flap. Alternatively, free flaps can be taken from close or remote areas. They are disconnected from their native blood supply and reconnected in the breast area via specialized microvascular techniques. The most commonly used example is the DIEP (deep inferior epigastric artery perforator) flap, which uses skin and subcutaneous tissue of the abdomen supplied by the DIEP blood vessels to create the breast mound. Common autologous breast reconstruction types are described in **Table 5**.

Autologous reconstruction involves longer surgery with donor- and recipient-site involvement. For this reason, return to sedentary activity (eg, walking or sitting for prolonged duration) is usually 2 weeks, but with restriction in many activities for up to 8 weeks. A hospital stay of 1 to 4 days is generally required.

**Fat grafting in breast reconstruction:** Autologous fat grafting (**Figure 4**) involves harvesting fat from a remote body area via liposuction followed by injection with small cannulas into the breast area. Most commonly, it is used for refinement and optimization, as an adjunct for both types of breast reconstruction,<sup>13</sup> or to fill partial mastectomy defects.<sup>14</sup> It is currently being used in select cases as the primary method for whole-breast reconstruction. As a filler material it is favourable owing to its availability, ease of harvest, and biocompatibility.<sup>13</sup> The abundance of adipose-derived stem cells within the transferred fat also gives the fat great potential to repair breast tissues damaged from surgical trauma or radiation. This technique has extended the options of reconstruction in many patients who would have previously been poor candidates. It has been shown in many studies to be safe and compatible with surveillance imaging<sup>15</sup> and it does not influence the risk of cancer recurrence.<sup>16,17</sup>

**Lumpectomy defect reconstruction:** As an alternative to mastectomy, many women undergo breast conservation therapy (BCT). Breast conservation therapy includes

**Figure 1. Types of mastectomy incisions:** A) Horizontal (skin-sparing mastectomy), B) skin-reducing, C) nipple-sparing, inframammary, and D) nipple-sparing, radial incision.



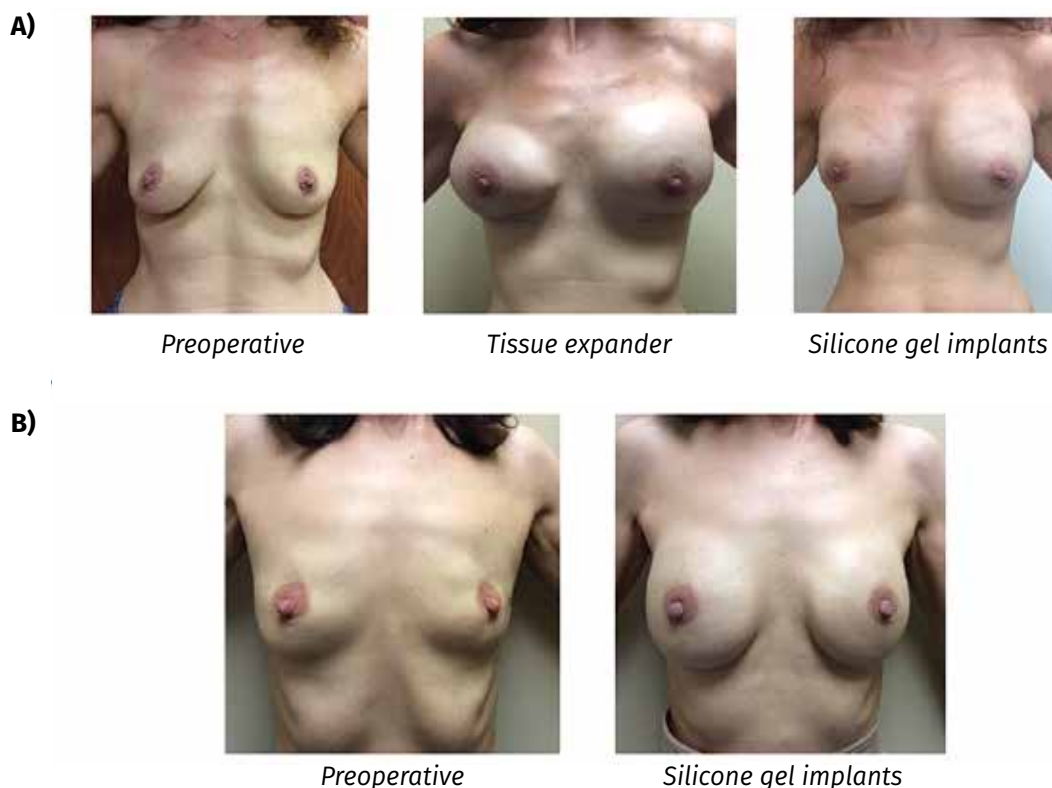
lumpectomy followed by radiation and provides equivalent long-term survival compared with mastectomy.<sup>18,19</sup> While this approach leaves most of the breast intact, up to 40% of patients can have unsightly and deforming breast abnormalities following BCT.<sup>20-23</sup> The new field of oncoplastic surgery combines the lumpectomy

with immediate rearrangement of adjacent tissues to preserve the ideal breast shape. In many cases, the contralateral breast will be balanced at the same time through breast reduction or lift (**Figure 5**). Although possible through autologous fat grafting, transfer of autologous tissue flaps, or local tissue rearrangement,<sup>24</sup>

**Table 2. Types of breast reconstruction: Alloplastic versus autologous.**

TYPE	IDEAL CANDIDATE	ADVANTAGES	DISADVANTAGES	COMPLICATIONS
Alloplastic (implant-based)	<ul style="list-style-type: none"> <li>• Average to thin body habitus (no excess tissue for autologous)</li> </ul>	<ul style="list-style-type: none"> <li>• No donor site</li> <li>• Shorter surgery</li> <li>• Fewer short-term complications</li> <li>• Fewer scars</li> <li>• Faster recovery</li> </ul>	<ul style="list-style-type: none"> <li>• Often multistage endeavour</li> <li>• Longer timeline to completion</li> <li>• Difficult to achieve symmetry in unilateral cases</li> <li>• Requires implant maintenance and exchange</li> </ul>	<ul style="list-style-type: none"> <li>• Capsular contracture</li> <li>• Malposition</li> <li>• Rupture</li> <li>• Implant rippling or visibility</li> <li>• Less natural look and feel</li> </ul>
Autologous (tissue-based)	<ul style="list-style-type: none"> <li>• Requires adequate excess soft tissue at donor site</li> <li>• Minimal major comorbidities</li> <li>• Not obese</li> </ul>	<ul style="list-style-type: none"> <li>• Use of own tissue</li> <li>• Natural look and feel that changes with patient over time</li> <li>• Easier symmetry in unilateral cases</li> </ul>	<ul style="list-style-type: none"> <li>• Large donor site</li> <li>• Longer, more technically challenging procedure</li> <li>• Longer recovery</li> <li>• More short-term complications</li> </ul>	<ul style="list-style-type: none"> <li>• Partial or complete flap failure</li> <li>• Donor-site morbidity including wound dehiscence, weakness, hernia, or bulge</li> </ul>

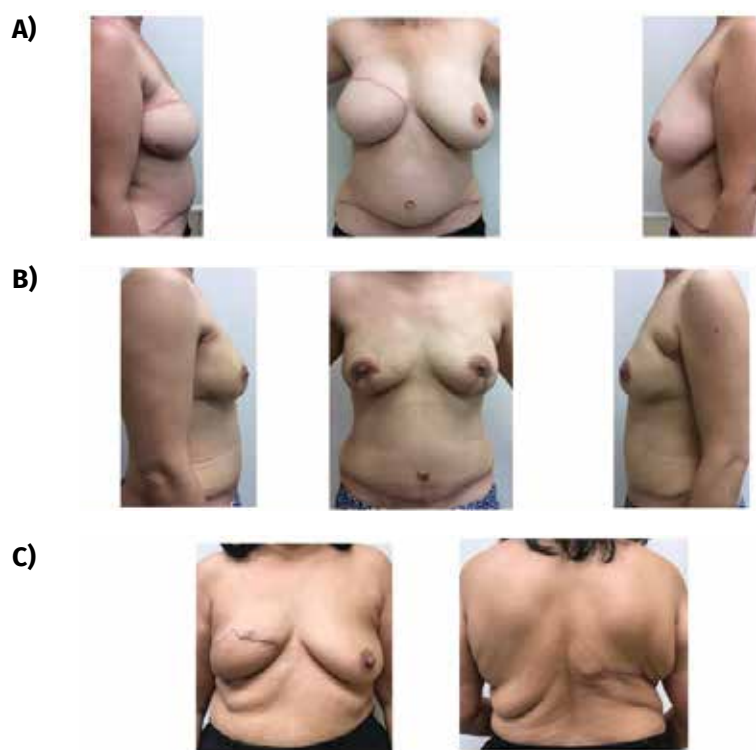
**Figure 2. Types of alloplastic implant-based reconstruction: A) Two-stage reconstruction; B) direct-to-implant reconstruction.**



**Table 3. Types of alloplastic (implant-based) reconstruction**

TYPE	DEFINITION	TECHNICAL DETAILS	ADVANTAGES	DISADVANTAGES
Two stage	<p>Performed in 2 stages:</p> <ul style="list-style-type: none"> <li>• Stage 1—tissue expander inserted under pectoralis muscle</li> <li>• Stage 2—expander exchanged for implant with or without fat grafting and with or without nipple reconstruction</li> </ul>	<ul style="list-style-type: none"> <li>• Expander is filled (via transcutaneous injections) every 1-2 wk until appropriate volume is achieved (<b>Figure 4</b>)</li> <li>• Fat grafting is used for lumpectomy defect reconstruction</li> </ul>	<ul style="list-style-type: none"> <li>• Patient provides constant input on size desired</li> <li>• Second stage allows for refinement and adjustment or adjunctive procedures (nipple areolar reconstruction, fat grafting, pocket adjustment for symmetry, etc)</li> </ul>	<ul style="list-style-type: none"> <li>• Multiple surgeries</li> </ul>
Direct to implant	<p>Final implant inserted at time of mastectomy</p>	<ul style="list-style-type: none"> <li>• Robust, healthy skin required at time of mastectomy</li> <li>• Internal scaffold (acellular dermal matrix or synthetic mesh) is placed within mastectomy site to help support implant</li> <li>• Appropriate for small or medium breasts with minimal ptosis only</li> </ul>	<ul style="list-style-type: none"> <li>• No weekly saline injections</li> </ul>	<ul style="list-style-type: none"> <li>• Technically challenging</li> <li>• Might still require second operation (for contouring, symmetry, nipple-areolar reconstruction, etc)</li> </ul>

**Figure 3. Autologous breast reconstruction: A) and B) abdominal-based reconstruction; and C) latissimus dorsi reconstruction.**



reconstructing these defects in a delayed manner is far more difficult. This highlights the need to consider plastic surgery involvement early in the decision to undergo BCT when a large defect is possible.

**Nipple-areolar reconstruction:** Reconstruction of the nipple-areolar complex (NAC) (**Figure 6**) is the last step of breast reconstruction and is usually undertaken when the breast mound has healed and settled in its final position. Restoration of the NAC includes reconstruction of the projecting nipple and pigmentation. For nipple reconstruction, local skin flaps can be designed and folded to produce a projecting nipple, a graft can be harvested from the contralateral nipple, or a 3-dimensional tattoo can be used to give the illusion of a projecting nipple. Pigmentation of the NAC can be obtained via tattoo or skin graft.<sup>25,26</sup> Patients are generally very satisfied with NAC reconstruction, although a lack of long-term nipple projection is a common problem.<sup>27</sup> These

procedures are often completed under local anesthesia in an outpatient setting.

**Adjunct procedures:** For many women, secondary procedures such as fat grafting, implant adjustments or replacements, or skin tightening procedures are required over time. In unilateral cases, balancing procedures such as contralateral breast reduction, augmentation, or mastopexy can be performed in the immediate or delayed setting to achieve appropriate symmetry.

### Outcomes and complications

**Outcomes:** Many recent studies have looked at outcomes, complications, and satisfaction rates after breast reconstruction. Regardless of procedure type, most women find an improvement in quality of life and psychological and emotional well-being, with an improvement in body image, symmetry, and balance. Studies repeatedly demonstrate that, when asked,

**Table 4. Advantages and disadvantages of autologous breast reconstruction: Pedicled versus free flap.**

AUTOLOGOUS BREAST RECONSTRUCTION	ADVANTAGES	DISADVANTAGES
Pedicled flap	<ul style="list-style-type: none"> <li>• Technically simpler</li> <li>• Shorter operative times</li> <li>• Lower risk of partial or complete flap failure</li> </ul>	<ul style="list-style-type: none"> <li>• Potential loss of function due to sacrifice of muscle:               <ul style="list-style-type: none"> <li>-Pedicled TRAM—loss of abdominal strength and higher rate of abdominal hernia</li> <li>-Latissimus dorsi—decreased range of movement and strength of upper extremity; feels “tighter”</li> </ul> </li> </ul>
Free flap	<ul style="list-style-type: none"> <li>• Ability to harvest larger amount of tissue</li> <li>• No sacrifice of underlying muscle</li> </ul>	<ul style="list-style-type: none"> <li>• Technically complex</li> <li>• Longer operative times</li> <li>• Longer hospital stays</li> <li>• Higher risk of flap failure</li> </ul>

TRAM—transverse rectus abdominis myocutaneous.

**Table 5. Common types of autologous (tissue-based) breast reconstruction**

TYPES	DEFINITION	IDEAL CANDIDATE
Pedicled flap		
• Pedicled TRAM	<ul style="list-style-type: none"> <li>• Rectus abdominis muscle</li> <li>• Soft tissue from lower abdomen similar in colour, texture, and longevity</li> <li>• Underlying rectus abdominis muscle is separated from its attachment to the pubis and flipped up onto the breast area along with the overlying skin and subcutaneous tissues</li> </ul>	<ul style="list-style-type: none"> <li>• Healthy amount of excess abdominal tissue (not obese)</li> <li>• Unilateral</li> </ul>
• Latissimus dorsi	<ul style="list-style-type: none"> <li>• Versatile flap from back</li> <li>• Can be used with muscle alone or with overlying skin</li> <li>• Small amount of bulk</li> </ul>	<ul style="list-style-type: none"> <li>• Thin patient (inadequate abdominal tissue)</li> <li>• Generally has significant skin damage from radiotherapy</li> </ul>
Free flap		
• DIEP	<ul style="list-style-type: none"> <li>• Same tissue as pedicled TRAM but without sacrifice of underlying rectus muscle</li> <li>• Vessels dissected from muscle and microvascular anastomosis created to recipient vessels in chest</li> </ul>	<ul style="list-style-type: none"> <li>• Healthy patients</li> <li>• Bilateral cases</li> <li>• Desire to harvest larger amounts of tissue</li> </ul>
• SGAP	<ul style="list-style-type: none"> <li>• Skin and fat from upper buttock</li> </ul>	<ul style="list-style-type: none"> <li>• Reserved for unique cases (ie, inadequate abdominal tissue or previous failed abdominal tissue reconstruction)</li> </ul>
• TUG	<ul style="list-style-type: none"> <li>• Skin, fat, and small muscle from upper inner thigh</li> </ul>	

DIEP—deep inferior epigastric artery perforator, SGAP—superior gluteal artery perforator, TRAM—transverse rectus abdominis myocutaneous, TUG—transverse upper gracilis.

**Figure 4. Fat grafting for lumpectomy defect reconstruction**

women who have undergone breast reconstruction indicate they would make the same decision again and would recommend reconstruction to a friend who was facing this decision.<sup>4-7</sup>

**Complications:** Complications specific to breast reconstruction depend on the reconstructive option chosen (**Table 6**).<sup>28</sup> Complications of implant-based reconstruction include capsular contracture (hardening of the internal breast capsule), malposition (improper or changed positioning of the implant), implant rippling or edge visibility, and an unnatural look or feel. Complications more specific to autologous reconstruction include donor-site complications such as wound healing delay, abdominal bulge or hernia, and occasionally donor-site weakness. Difficulties in obtaining good shape, appropriate size, and good symmetry are problems with both implant- and tissue-based reconstruction.

**Surveillance following breast reconstruction.** There are no data to support the value of routine screening mammography after mastectomy and reconstruction. Further, there are no data to suggest breast reconstruction hides local recurrence or affects survival.<sup>29,30</sup> The goal of mastectomy is to remove all breast tissue, and if there is a small amount of residual breast tissue it is almost always under the breast skin. Therefore, local recurrences after mastectomy usually present as skin recurrence, as the skin is physically separated from the chest wall by breast reconstruction.<sup>31,32</sup> Clinical examination of the chest wall and reconstructed breast can detect skin recurrences and should be performed during breast cancer survivorship follow-up appointments.<sup>29,33</sup> Cancer Care Ontario recommends diagnostic imaging (such as mammography, ultrasound, and magnetic resonance imaging) primarily for reconstructed breasts of symptomatic patients.<sup>9,34</sup>

**Funding.** In Canada, most provinces offer postmastectomy breast reconstruction coverage. Refer to the relevant schedule of benefits for more information.<sup>35-43</sup>

**Figure 5. Oncoplastic breast reduction**

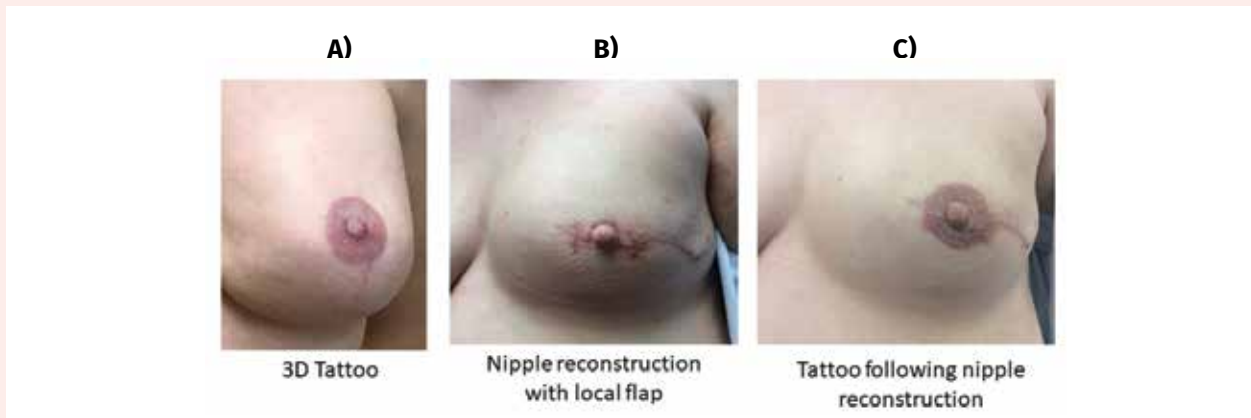
**Patient education.** Many educational resources exist to help patients better understand their options for breast reconstruction. Online and print resources are available from the CCO<sup>44</sup> and the Canadian Cancer Society<sup>45</sup> websites. An international campaign for breast reconstruction awareness takes place on the third Wednesday of October every year. Additionally, BRA (Breast Reconstruction Awareness) Day events are an excellent resource for patients to learn about options and improve access to breast reconstruction. Education and event information are available online.<sup>46</sup>

**Behavioural change.** Given that there are no absolute contraindications for breast reconstruction, surgical optimization can be achieved for women thinking about undergoing the procedure with the support of their PCPs. Strong examples in this realm include smoking cessation and weight loss.

## Conclusion

All breast cancer patients should receive education about breast reconstruction as soon as operative management is considered, as reflected in CCO's breast cancer treatment guidelines<sup>47</sup> and other similar guidelines worldwide. Currently, many effective options are available for breast reconstruction, making virtually all cancer patients candidates. These include both implant-based and tissue-based options that each can be performed in either the immediate or the delayed setting.

While some women will choose not to undergo breast reconstruction, all women should receive the appropriate education and support to allow for informed decision making. The PCP remains one of the most

**Figure 6. Nipple areolar reconstruction:** A) Three-dimensional tattoo, B) nipple reconstruction with local flap, and C) tattoo following nipple reconstruction.**Table 6. Complications associated with breast reconstruction**

COMPLICATION	ALLOPLASTIC	AUTOLOGOUS
Surgical site infections	0.37 times more likely	...
Hematoma or seroma formation	0.56 times more likely	...
Skin or soft tissue necrosis	...	2.79 times more likely
Wound dehiscence	No difference	No difference
Reconstructive failure	0.14 times more likely	...
Deep vein thrombosis	No difference	No difference
Pulmonary embolism	No difference	No difference

Data from Tsoi et al.<sup>28</sup>

valuable resources for women embarking on the breast cancer treatment journey. As such, it is important to stay up to date on the options available to these women. 🌿

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All authors contributed to the literature review and interpretation, and to preparing the manuscript for submission.

#### Competing interests

None declared

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