Breast reconstruction after mastectomy for breast cancer

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Just as there have been improvements in the early detection and treatment of breast cancer, there have also been improvements in the techniques used for breast reconstruction after mastectomy. There are many reconstructive methods available, using either autologous tissue or implants,[1] each with its unique set of indications, contraindications, advantages, disadvantages and complications (Table 1). Breast reconstruction after mastectomy is oncologically safe[7,8] and is associated with high satisfaction and improved psychosocial outcomes.[9] Although the rates of major complications after immediate reconstruction (at the same time as mastectomy) are greater than after mastectomy alone, clinically significant delays in the receipt of adjuvant therapy after immediate reconstruction have not been found.[10,11] Despite the potential psychological benefits of breast reconstruction, few patients who have had a mastectomy undergo breast reconstruction.[12]

In this review, we examine rates of breast reconstruction, discuss the factors that influence its use and review the current evidence for incorporating immediate breast reconstruction into the care of patients with early stage breast cancer.

Literature review

We searched MEDLINE (1990–June 2011, week 5) and EMBASE (1990–2011, week 26) on July 8, 2011. We used the exploded medical subject headings "mammaplasty," "mastectomy," "breast reconstruction," "socioeconomic factors," "attitude to health," "education," "decision-making," "patient preference," "physician practice variation," "health knowledge, attitudes or perceptions," "geography," "cancer stage" and "radiation or chemotherapy," with combinations of multiple keywords and synonyms such as "utilization," "barriers," "income" and "referral." Our search was limited to English-language articles. We excluded studies that investigated only ductal carcinoma in situ or had a prognostic or psychosocial primary outcome. We excluded studies from before 1990 because outdated methods of reconstruction were used before that time. In total, we identified 1482 unique articles. Two independent reviewers screened all titles, abstracts and bibliographies of the retrieved articles for relevance. There were no disagreements between reviewers. We formally reviewed 85 articles.

How often is breast reconstruction performed after mastectomy?

Canadian rates of breast reconstruction have historically been low.[13,14] Two population-based studies have evaluated rates and trends (Table 2).[13,14] Using population-based data, Baxter and colleagues[14] found a reconstruction rate of 7.9% in 1994/95 in Ontario, a figure that had not changed since 1984/85. Barnsley and colleagues[13] examined patterns of care for breast reconstruction in Nova Scotia and found a rate of 3.8% between 1991 and 2001. There has not been a recent evaluation in Canada. We identified nine population-based and five hospital-based studies in the United States describing the care of patients from 1985 through 2007 (Table 2).[12,15–27] The rate of breast reconstruction increased from 3.4% in 1985–1990 to 42% in 1997–2002 in a network of tertiary cancer centres.[13,19]

We identified six studies from other jurisdictions, four of which were English-language publications (Table 3).[28–31] Australia, Denmark and England reported national rates of breast reconstruction of 9.9% (1982–2000), 14% (1999–2006) and 16.5% (2006–2009), respectively.[28–30] A study from a single institution in Shanghai, China, reported an increase in the rate of reconstruction from 1.3% in 1990 to 5.1% in 2005.[31] These authors reported the rate of breast reconstruction in China as a proportion of all patients with breast cancer, whereas the other studies included in this

Key points

- Breast reconstruction after mastectomy is an oncologically safe procedure that can improve psychosocial outcomes.
- Increased age, nonwhite ethnic background, low income and nonurban residence are associated with decreased rates of breast reconstruction.
- Physician perceptions and knowledge, as well as cancer stage, also influence the rate of this procedure.
- Mastectomy with immediate breast reconstruction should be presented to patients with in situ or early stage breast cancer as an option along with breast-conservation therapy and mastectomy alone.

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review reported the rate as a percentage of patients who had undergone mastectomy.

What factors influence the use of breast reconstruction?

We focused our review on three broad categories of factors that influence the use of breast reconstruction: patient-, cancer- and physician-related factors.

Patient-related factors

Several patient factors affect the use of breast reconstruction after mastectomy. These include age, socioeconomic status, ethnic background and location. The contribution of patient preference to these factors is unclear.

Age

The most consistent negative predictor of breast reconstruction is age greater than 50 years.[12,13,16,17,18,20–28,30] This is in part because of concern about increased complication rates with age and comorbidities. In an attempt to identify predictors of breast reconstruction using the hospital-based national sample of inpatients from 1999–2003, Reuben and colleagues[27] found that the association between age and breast reconstruction remained significant after controlling for comorbidities. In contrast, August and colleagues[32]

Table 1: Characteristics of common procedures for breast reconstruction

Type	Example	Indications	Contraindications	Advantages	Disadvantages	Complication rates
Implant-based[2–4]	• Tissue expander or implant under the pectoralis major muscle	• Small breasts with minimal ptosis • Insufficient donor tissue (e.g., from the abdomen) • Patient preference	• Previous or anticipated radiation therapy	• No morbidity at the donor site • Short operation, admission and recovery	• Long-term complications related to implant (e.g., capsular contracture, implant malposition) • Multiple visits for tissue expansion and a second surgery to replace expander with implant • Worse outcomes for patients who require radiation therapy	• Explantation: 2.7%–3.8% • Major complications:*‡ 4%–30.4% • Total complications: 5.8%–49%
Autologous[2–5]	• Pedicled: transverse rectus abdominus muscle • Free: transverse rectus abdominus muscle, deep inferior epigastric artery perforator • Other: gluteal flaps, thigh flaps	• Redundant tissue at the donor site • Patient preference	• Severe comorbidity that precludes safe tolerance of prolonged general anesthetic • Lack of redundant donor tissue	• More natural in appearance and feel (v. implant) • Better symmetry to contralateral native breast • Better outcomes for patients requiring radiation therapy (v. implant)	• Longer operation, admission and recovery (v. implant) • Increased blood loss (v. implant) • Complications at the donor site • Potential for partial or total loss of tissue flap	• Total flap loss: < 1–4% • Major complications:†‡ 7.7%–28.3% • Total complications: 22.6%–44.3%
Combination[6]	• Pedicled latissimus dorsi flap plus implant	• Not a candidate for autologous reconstruction alone (e.g., lack of redundant donor tissue) • Previous radiation therapy • Patient preference	• Atrophic or absent latissimus dorsi muscle (e.g., denervation or congenital absence)	• More natural appearance and feel than implant alone • Latissimus dorsi muscle provides additional vascularity and protection against radiation	• Morbidity at the donor site • More invasive than implant-based surgery	• Explantation: 3.5% • Major complications:‡ 7% • Total complications: 29.8%

*Includes implant extrusion, premature removal, capsular contracture, migration and device failure.
†Includes total or partial flap failure, fat necrosis and donor site morbidity.
‡Includes hematoma, infection, mastectomy flap necrosis, pulmonary embolism, pneumothorax and pneumonia.

observed fewer complications following implant-based breast reconstruction among women aged greater than 60 years compared with those less than 60. Although this finding may be related to patient selection, this study highlighted that age alone is not a contraindication for reconstruction.

Socioeconomic status

Income disparity has been linked to the different rates of breast reconstruction in the US. In a study involving 223 811 patients who underwent mastectomy from 1985 to 1990 and from 1994 to 1995, women with a family income of more than $40 000 were twice as likely to undergo reconstruction than women whose family income was less than $40 000.[12] Similarly, Christian and colleagues found lower rates of reconstruction in the two lowest quartiles of median household income (< $45 245).[25] In Western Australia, England and Denmark, studies that used area code or level of education as proxies for social deprivation found that increased deprivation was significantly associated with lower rates of breast reconstruction.[28–30] In contrast, household income did not influence the rate of breast reconstruction in Nova Scotia.[13]

Table 2: Canadian and US studies evaluating the rates of breast reconstruction following mastectomy

Study	Study period	Database; jurisdiction	Rate of use
Canada, population-based			
Baxter et al.[14]	1984–1985, 1995–1996	Canadian Institute for Health Information; Ontario	7.9% in 1984/85 and 7.7% in 1995/96
Barnsley et al.[13]	1991–2001	Medical Services Insurance and Canadian Institute for Health Information; Nova Scotia	3.8%
US, population-based			
Polednak[15]†	1988–1995	Surveillance, Epidemiology and End Results registries; US	Overall 8.1% (4.3% in 1988, 10.8% in 1995)
Alderman et al.[16]†	1998	Surveillance, Epidemiology and End Results registries; US	15%
Polednak[17]†	1988–1995	Connecticut Tumor Registry (part of Surveillance, End Results and Epidemiology); US	9.1% in 1988, 8.5% in 1995
Polednak[18]*	1992–1997	Connecticut Tumour Registry (part of Surveillance, Epidemiology and End Results) and hospital discharge database; US	12.5%
Alderman et al.[19]†	1998–2002	Surveillance, Epidemiology and End Results registries; US	16.5%
Joslyn[20]	1998–2000	Surveillance, Epidemiology and End Results registries; US	17%‡
Rosson et al.[21]†	1995–2004	Maryland hospital discharge database; US	27.9%
Tseng et al.[22]†	2000–2006	Greater Sacramento Surveillance, End Results and Epidemiology; US	20.2%
Kruper et al.[23]*	2003–2007	Office of Statewide Health Planning and Development hospital discharge database, California; US	24.8% in 2003, 29.2% in 2007
US, hospital-based			
Morrow et al.[12]†	1985–1990, 1994–1995	National Cancer Database; US	3.4% in 1985–1990, 8.3% in 1994–1995
Desch et al.[24]*	1989–1991	Virginia Cancer Registry (linked to Blue Cross and Blue Shield); US	16% in 1989–1991
Christian et al.[25]*	1997–2002	Eight national Comprehensive Cancer Network centers; US	42% (95% were immediate breast reconstructions)
Tseng et al.[26]†	2001–2002	M.D. Anderson Breast Surgery database; US	37.5%
Reuben et al.[27]†	1998–2003	Nationwide inpatient sample; US	23.6%

*Breast reconstruction and delayed breast reconstruction.
†Early (within four months of mastectomy) and immediate breast reconstruction only.
‡We calculated the rate manually using age data because the rate was not reported explicitly in this study.

Ethnic background

Ethnic background has been found to influence the rate of breast reconstruction in the US, with the highest rate observed among white people.[12,16,19,20–23,26,27,33] In a population-based study by Morrow and colleagues[34] involving 1844 women with breast cancer, the authors found that, after controlling for age, stage of disease and level of education, black women underwent breast reconstruction less frequently than white women.

Location

Geographic variation in the rate of breast reconstruction has been found in Canadian and US studies.[15,16,19,20,21,27] In Ontario, breast reconstruction occurred at twice the frequency in the Toronto area (10 reconstructions per 100 mastectomies) compared with the rest of the province (4.3 reconstructions per 100 mastectomies).[14] In Nova Scotia, there was a 4.8% rate of reconstruction among women living in urban locations and a 3.7% rate among women in rural areas.[13] Regional variation was also observed in England, where reconstruction rates were between 8.4% and 31.9% depending on region.[30]

Patient preference

The underlying cause for the association between patient-related factors and breast reconstruction is unknown. Factors associated with decreased use have been shown not to be associated with reduced benefit from the procedure. The degree to which patient preference influences the rate of breast reconstruction is also unknown. Several surveys of patients with breast cancer who have undergone mastectomy investigated the influence of patient preferences on breast reconstruction. Older patients were found to be more likely to choose mastectomy alone than reconstruction.[35] Provider bias, however, may also be a contributing factor: older and nonwhite patients were less likely than younger women and white women to receive information about breast reconstruction,[36] and nonwhite women are more likely than white women to be discouraged from breast reconstruction.[33,34]

Cancer-related factors

The stage of cancer and adjuvant therapies, such as radiation therapy, affect the rate of reconstruction after mastectomy.

Cancer stage

The most predictive clinical factor associated with the rate of reconstruction in the US is stage of disease. Patients with ductal carcinoma in situ or American Joint Committee on Cancer stage 1 disease are more likely to undergo breast reconstruction than patients with more advanced disease.[16–18,20,22,25] Canadian data are limited, but Barnsley and colleagues[13] found that an advanced stage of disease was significantly associated with a lower rate of reconstruction in Nova Scotia. In a US study involving more than 200 000 women with breast cancer, women with ductal carcinoma in situ or stage 1 disease made up only 42.1% of the study population but accounted for 87.6% of all breast reconstruction surgeries.[12] Similar trends were identified in other US studies.[12,16–18,20,25,26] Although higher stage disease is not a contraindication for breast reconstruction, women or their physicians, or both, may not perceive this restorative procedure as a high priority compared with treatment.[37] Even in the context of delayed reconstruction after patients have completed treatment, the rate of breast reconstruction is still lower among those

Table 3: International studies evaluating the rate of breast reconstruction following mastectomy

Study	Study period	Database; jurisdiction	Rate of use
Population-based			
Hall et al.[28]*	1982–2000	Western Australia Record Linkage Project; Australia	9.9%†
Hvilsom et al.[29]	1999–2006	Danish Breast Cancer Cooperative; Denmark	Immediate reconstruction: 1% Delayed reconstruction: 13%
Jeevan et al.[30]*	2006–2009	Hospital Episodes Statistics, Database of the National Health Service; England	16.5%
Hospital-based			
Yu et al.[31]*	1990–2005	Institutional database, Shanghai Cancer Hospital, Shanghai; China	1.3% in 1990–2005 5.1% in 2005‡

*Early (within four months of mastectomy) and Immediate breast reduction only or for index or subsequent episode.
†We calculated the rate manually because the rate was not reported explicitly in this study.
‡Rate of breast reconstruction after mastectomy as a proportion of all patients with breast cancer.

with more advanced disease.[38] It is unclear whether this is because of provider bias or patient preference.

Radiation therapy

Decreased rates of breast reconstruction among patients with more aggressive disease may be confounded by factors related to cancer stage, such as the likelihood that the patient will require radiation therapy after mastectomy.[1] In a population-based study involving women in Sacramento, California, the need for radiation therapy was strongly associated with decreased odds of breast reconstruction.[22]

Physician-related factors

The use of breast reconstruction after mastectomy can be affected by factors related to the referring physician, including practice setting and physician attitude.

Physician characteristics and practice setting

In a cross-sectional survey involving 1844 patients identified between 2001 and 2003, Alderman and colleagues[39] found that only 33% of patients recalled discussing breast reconstruction with their general surgeons during the surgical decision-making process. The authors also surveyed general surgeons who performed breast cancer surgeries for this cohort of patients and found that general surgeons with high rates of referral for breast reconstruction were most likely to be women, have higher volumes of breast surgery and work in cancer centres.[37] Other registry studies in the US have also reported higher rates of breast reconstruction in cancer centres, as well as in urban centres with higher volumes of breast oncology surgeries.[12,20,22,23,27,37] and a greater concentration of surgeons performing reconstructive surgery.

Knowledge and attitudes

General surgeons with high rates of referral for breast reconstruction and those with low rates of referral have been reported to have different attitudes and perceptions about women's preferences for reconstruction.[37] Surgeons with low referral rates were more likely than those with high rates to identify barriers to access to reconstruction in their practice.[37] In 2002, Wanzel and colleagues performed a needs assessment of referring physicians to understand the reasons for the low rates of breast reconstruction in Canada.[40] They found that 35.2% of general surgeons, 31.1% of oncologists and 45.3% of family physicians felt that inadequate knowledge about breast reconstruction negatively influenced their decisions to refer patients to plastic surgeons.

What is the role of immediate breast reconstruction in the treatment of early stage breast cancer?

Immediate reconstruction (at the same time as mastectomy) offers the benefits of breast reconstruction on body image and quality of life with little interruption.[41,42] In the past, immediate breast reconstruction was an unpopular concept because of concerns that the surgical resection or detection of local recurrence could be compromised.[43] This has not been found in practice, and these concerns are no longer barriers to immediate reconstruction.[7,8,41,42] Box 1 presents a comparison of immediate and delayed reconstruction (any time after mastectomy) in terms of clinical and psychosocial advantages and disadvantages.

For women who have the option of breast-conserving therapy or mastectomy, the selection of mastectomy with reconstruction may be preferred by those who want to avoid radiation and the stigmata associated with having a mastectomy defect.[12] Because of the recommendations by the Commission on Cancer of the American College of Surgeons in 2001 to incorporate immediate reconstruction in the treatment of

Box 1: Comparison of immediate and delayed breast reconstruction[1,2,10,11]

Immediate breast reconstruction

- Indicated for patients with early stage breast cancer who are not expected to require radiation therapy after mastectomy
- Preserves key anatomic landmarks (e.g., inframammary fold)
- Preserves the quality and quantity of the native mastectomy skin flap when a skin-sparing mastectomy is performed
- Single operation for mastectomy and first stage of reconstruction
- Increased postoperative complications compared with delayed reconstruction
- Clinically nonsignificant delay in the delivery of chemotherapy

Delayed breast reconstruction

- Indicated for patients with locally advanced breast cancer who are expected to require radiation therapy after mastectomy. Reconstruction usually takes place a minimum of six months following completion of radiation.
- Results in the loss of important anatomic landmarks
- Decreased quality and quantity of the native mastectomy skin flap
- At least two operations for mastectomy and initial stage of reconstruction

early stage breast cancer, there has been a shift from delayed to immediate breast reconstruction in the US.[22,23,26,27] Although this study reported a rate of immediate or early breast reconstruction (within four months of mastectomy) of 3.4% in 1985–1990,[12] the most recent multicentre study involving the National Comprehensive Cancer Network reported a rate of 40% in 1997–2002.[25] The higher rate of immediate reconstruction reflects a shifting pattern of practice being led by specialized cancer centres in the US. In contrast, in Canada, only 1.1% of patients who had a mastectomy underwent immediate reconstruction in Nova Scotia in 2001.[13] Current rates of immediate reconstruction in Ontario are unknown. For patients with in situ or early stage breast cancer, mastectomy with immediate breast reconstruction should be presented as an option along with breast-conservation therapy and mastectomy alone. Box 2 provides a fictional example of how to apply this review in clinical practice.

Gaps in knowledge

In Canada, little is known about the factors that influence the rate of breast reconstruction or the reasons for its underuse. The optimal rate of breast reconstruction is not currently known for any jurisdiction, and the absence of such a benchmark limits useful research in this area. However, given the broad array of factors that influence the rate of breast reconstruction and the low rate of breast reconstruction in Canada compared with other jurisdictions, it is unlikely that our current practice has achieved an optimal rate. An important step to address these knowledge gaps is to acquire a better understanding of the current rates and timing of breast reconstruction and the different factors that influence access to breast reconstruction in Canada.

Box 2: Applying the results of this review in clinical practice (fictional case)

A 60-year-old woman has a 2-cm invasive ductal carcinoma in the upper lateral quadrant of her right breast diagnosed by means of ultrasound-guided needle biopsy. There are no abnormalities in the other breast. She has no family history of breast cancer and is otherwise in good health. On physical examination, she has relatively symmetric B-cup breasts with minimal ptosis and a moderate amount of redundant lower abdominal tissue with a scar from a cesarean section.

Based on this clinical picture, this woman is a candidate for breast-conservation therapy, mastectomy alone or skin-sparing mastectomy with immediate breast reconstruction. Her age is not a contraindication for breast reconstruction.

When discussing the surgical approach, her general surgeon points out that all three treatment options have equivalent survival rates. Because the decision will need to incorporate the patient's personal values, priorities and expectations, the surgeon spends some time discussing these with the patient. In addition, the surgeon offers an urgent referral to a reconstructive surgeon and a radiation oncologist to discuss the details of these treatment options.

The reconstructive surgeon explains that the patient is a candidate for either implant-based reconstruction or reconstruction with an autologous tissue flap using the deep inferior epigastric perforator flap composed of her redundant lower abdominal tissue. Either of these two options can be performed at the same time as the mastectomy.

After speaking with the reconstructive surgeon, the patient chooses to undergo skin-sparing mastectomy with immediate breast reconstruction using an autologous tissue flap.

Limitations

The rates of breast reconstruction discussed in this review were obtained from large administrative databases that may not accurately capture all important predictor variables.[12,13–31] Clinical factors such as smoking, obesity and comorbidities were not routinely captured, and sociodemographic factors such as income were estimated from area code and census data. Coding misclassification (of breast cancer diagnosis and receipt of mastectomy with or without reconstruction) and the inability to capture outpatient mastectomy in some databases may misrepresent the true rates. The Surveillance, Epidemiology and End Results database (a frequent source of data for US studies) is the most representative registry for breast cancer in the US. However, it captures only reconstruction performed within the first course of treatment, thus leaving gaps in information for delayed reconstruction. National hospital-based studies as in Table 2 may not reflect patterns of care in the general population. Although patient and provider preferences undoubtedly influence the rate of reconstruction, the influence of such factors could not be assessed in most pattern-of-care studies and would be better addressed through qualitative or survey designs.[33–37,39,40,44,45] The findings of our review are generalizable primarily to high-income, English-speaking countries because cultural differences in other parts of the world will have a tremendous impact on patients' decisions to undergo breast reconstruction.

Other factors such as public policy or the media may also influence the rates of breast reconstruction. For example, in 1998, the Women's Health and Cancer Rights Act was passed in the US in favour of mandatory insurance coverage for breast reconstruction.[46] More recently, a bill in New York State was passed that mandated physicians to discuss the option of breast reconstruction with their patients before surgery for treatment of breast cancer.[47] An external factor that may have had a negative influence on the rate of breast reconstruction after 1992 in the US is the moratorium by the Food and Drug Administration on the use of silicone implants.

Women who underwent implant reconstruction before 1992 have expressed significant anxiety and regret about their decision. However, no study has specifically investigated the influence that this policy has had on rate of implant reconstruction.[48]

There is a paucity of useful guidelines in the US and Canada outlining the role of breast reconstruction in the management of breast cancer. It is plausible that the lack of formal guidelines may be an important barrier to reconstruction in Canada. As a result, the current approach to integrate breast reconstruction in the delivery of multidisciplinary care varies by institution.[14,16] In contrast, in the United Kingdom, the Scottish Intercollegiate Guidelines Network and the National Institute for Health and Clinical Excellence have guidelines for breast cancer management,[49,50] which recommend that general surgeons discuss breast reconstruction with their patients before oncologic surgery and offer immediate reconstruction when indicated.

Summary

The decision to proceed with breast reconstruction following mastectomy for breast cancer is a complex one. In general, we found that patient-related factors such as increased age, nonwhite ethnic background, low income and nonurban location of residence, and cancer-related factors such as advanced stage and anticipated need for radiation therapy are associated with decreased rates of breast reconstruction.[12,13–27] Furthermore, modifiable barriers to breast reconstruction in Canada include knowledge gaps and misperceptions held by referring physicians and patients.[40] Addressing these gaps in knowledge may increase the rate of breast reconstruction in Canada.

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