

# Breast reconstruction and radiation therapy: A Canadian perspective

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**BACKGROUND:** When and how best to perform breast reconstruction in the setting of radiation therapy is a much debated topic.

**OBJECTIVE:** To investigate the approaches that Canadian plastic surgeons are taking to breast reconstruction in patients who require or may require radiation therapy.

**METHODS:** In April 2009, a survey invitation was sent to Canadian plastic surgeons via e-mail. Survey responses were collected over a two-month period.

**RESULTS:** Of the 307 invitees, 90 surgeons responded, of whom 76 met the inclusion criteria. Most surgeons (66%) do not perform immediate reconstruction in patients who require postmastectomy radiation. Most respondents (64%) perform immediate reconstructions for patients whose need for radiation is uncertain at the time of mastectomy. Expander and implants is their preferred option, followed by free transverse rectus abdominis myocutaneous (TRAM) flap. Thirty-five per cent use the delayed immediate technique in these cases. Twenty-one per cent are unfamiliar with the delayed-immediate technique. For delayed reconstruction of the irradiated patient, the pedicled TRAM is the most common choice.

**CONCLUSIONS:** The reconstructive options are increasing for patients who may need postmastectomy radiation. The use of the delayed immediate technique could increase as physicians gain more knowledge of the technique.

**Key Words:** Breast reconstruction; Clinical practice survey; Radiation therapy

Radiation therapy is increasingly used to treat breast cancer. Plastic surgeons are, therefore, faced with the challenges of timing breast reconstruction in these patients. Postmastectomy radiation therapy is currently indicated for patients with T3 or stage III tumours, and those with four or greater positive axillary nodes (1,2). However, the role of radiation therapy for patients with T1 and T2 tumours is being investigated in clinical trials, underscoring the rapidly evolving nature of this area of oncology (2).

Mastectomy followed by immediate reconstruction is a favourable option because the breast shape and skin envelope are maintained, resulting in a better aesthetic result (3,4). However, postreconstruction radiation increases complications such as contracture and necrosis (3,4). The risks are especially high when implants are chosen over native tissue (5,6). Furthermore, the reconstructed breast may act as a mechanical barrier to adequate delivery of radiation to the inframammary nodes and result in unnecessary radiation of the lungs and the heart (6).

Reconstruction in a radiated tissue bed can also be difficult if skin flaps are not sufficiently pliable to stretch over implants. The skin flaps are also susceptible to necrosis (4). In this situation, autologous reconstruction has been shown to limit complication rates.

Particularly challenging is how to approach breast reconstruction in a patient whose need for radiation therapy is unknown at time of mastectomy. In these patients, weighing the benefits of immediate reconstruction against the risks of a reconstructed breast possibly receiving radiation mandates a well-thought-out treatment plan. The aim of the present study was to investigate the approaches that Canadian plastic surgeons are taking to this area of reconstruction.

## La reconstruction mammaire et la radiothérapie : une perspective canadienne

**HISTORIQUE :** Le moment et la manière de procéder à une reconstruction mammaire en présence de radiothérapie constituent un sujet controversé.

**OBJECTIF :** Explorer les approches qu'adoptent les plasticiens canadiens en matière de reconstruction mammaire chez les patientes qui ont besoin ou sont susceptibles d'avoir besoin de radiothérapie.

**MÉTHODOLOGIE :** En avril 2009, les chercheurs ont invité par courriel les plasticiens du Canada à participer à un sondage et ont colligé leurs réponses sur une période de deux mois.

**RÉSULTATS :** Quarante-vingt-dix chirurgiens ont répondu aux 307 invitations, et 76 respectaient les critères d'inclusion. La plupart des chirurgiens (66 %) ne procèdent pas à une reconstruction immédiate chez les patientes qui ont besoin d'une radiothérapie après une mastectomie. La plupart des répondants (64 %) procèdent toutefois à une reconstruction immédiate chez les patientes dont on ne connaît pas les besoins en radiothérapie au moment de la mastectomie. Lespanseurs et les implants sont la solution favorisée, suivis d'un lambeau du grand droit abdominal. Trente-cinq pour cent utilisent alors la technique immédiate différée, mais 21 % ne la connaissent pas. En cas de reconstruction différée des patientes irradiées, le lambeau du grand droit abdominal pédiculé est le choix le plus courant.

**CONCLUSIONS :** Les options de reconstruction augmentent pour les patientes qui peuvent avoir besoin d'une radiothérapie après une mastectomie. Le recours à la technique immédiate différée pourrait augmenter à mesure que les médecins la connaîtront mieux.

## METHODS

### Development and distribution of a clinical practice survey

Approval for the present study was obtained from the Capital District Health Authority Research Ethics Board, Halifax, Nova Scotia.

A nine-question clinical practice survey was developed for distribution to a target population of Canadian plastic surgeons (Figure 1). The survey was created based on the results of a literature review as well as the clinical experience of two plastic surgeons (DL and JW). The survey presented three clinical scenarios: a patient who at time of mastectomy is known to need radiation therapy; a patient requiring sentinel lymph node biopsy to determine whether radiation is needed; and a patient who has had radiation therapy and presents for delayed reconstruction. The surgeons were given four commonly used breast reconstruction options to offer these patients – autogenous free tissue transfer in the form of a transverse rectus abdominis myocutaneous (TRAM) flap or deep inferior epigastric perforator (DIEP) flap; pedicled TRAM; latissimus dorsi (LD) with or without implant; and purely prosthetic reconstruction. Delayed-immediate reconstruction was another option for the second scenario.

Surgeons were also asked about common complications encountered in the radiated patient. Finally, they were given an opportunity to add comments in a free text section of the survey.

The survey was distributed electronically to 307 plastic surgeon members of the Canadian Society of Plastic Surgery using 'Opinio', Dalhousie's University (Halifax, Nova Scotia) online survey tool, in April 2009. Reminders were sent via e-mail two weeks after the initial invitation.

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Please place an [X] beside the appropriate answer.

- Location**
  - Western Canada: B.C., Alberta
  - Prairies: Saskatchewan, Manitoba
  - Ontario
  - Quebec
  - Atlantic: Newfoundland, Nova Scotia, New Brunswick, P.E.I
- Nature of Practice**
  - Primary care
  - Secondary care
  - Tertiary care
- Is the majority of your clinical practice in Canada?**
  - Yes – please continue to Question #4
  - No – please do not continue survey
- Do you perform breast reconstructions in adult patients?**
  - Yes – please continue to Question #5
  - No – please do not continue survey
- a) **Do you routinely perform immediate breast reconstructions on patients who will require post mastectomy radiation treatment?**
  - yes
  - no
  - I don't perform immediate reconstructions
- b) **If you answered "yes," which of the following options would you offer these patients?**
  - free TRAM/DIEP
  - pedicled TRAM
  - LD+/- expander/implants
  - tissue expander/implants
- a) **Would you routinely perform immediate reconstructions on patients who MAY require radiation post mastectomy (i.e. will not be decided until the final pathology is available)?**
  - Yes
  - No
  - I don't perform immediate reconstructions
- b) **If you answered "yes," what form(s) of reconstruction would you usually offer?**
  - free TRAM/DIEP
  - pedicled TRAM
  - LD+/- expander/implants
  - tissue expander/implants
- c) **Do you use the technique of delayed-immediate reconstruction in these cases?**
  - yes
  - no
  - I am not familiar with that technique.
- a) **For delayed reconstruction in patients who have already undergone radiation therapy, which reconstructive option(s) would you usually offer?**
  - free TRAM/DIEP
  - pedicled TRAM
  - LD+/- expander/implants
  - tissue expander/implants
- b) **What is the amount of time that you would ideally wait between radiation treatment and reconstruction?**
  - 0-3 months
  - 3-6 months
  - 6-12 months
  - >12 months
  - other \_\_\_\_\_
- In your experience, what is/are the most common reason(s) for revision/rescue surgery in patients who have had their breast reconstructions radiated?**
  - Severe capsular contracture
  - Implant extrusion
  - Asymmetry secondary to flap contracture
  - Implant malposition
  - Fat necrosis
  - Other \_\_\_\_\_
- Please provide any additional comments that would help us understand your approach to breast reconstruction in patients who have had or will need radiation.**

**Figure 1)** Postmastectomy reconstruction and radiation therapy clinical practice survey. BC British Columbia; DIEP Deep inferior epigastric perforator; LD Latissimus dorsi; PEI Prince Edward Island; TRAM Transverse rectus abdominis myocutaneous

Surgeons were excluded from the study if the majority of their practice was outside of Canada or if they did not perform breast reconstructions in adult patients.

## RESULTS

Ninety plastic surgeons responded to the survey (29% response rate), and 76 met the inclusion criteria. Five surgeons could not be reached via e-mail. The majority of surgeons practiced in Ontario

**TABLE 1**  
**Geographical distribution of survey respondents**

Region	Surgeons, n (%)
Ontario	26 (34)
Western Canada	25 (33)
Atlantic Canada	11 (14)
Prairies	8 (10)
Quebec	6 (8)

and Western Canada (Table 1). There was near equal representation of both community (43%) and academic (54%) practice.

### Scenario 1. Do you routinely perform immediate breast reconstructions on patients who will require postmastectomy radiation treatment?

Most surgeons (66%) did not perform any form of immediate reconstruction on patients who were known to require postmastectomy radiation therapy. Only 30% of surgeons (n=23) performed immediate reconstruction in these patients. In this latter group of surgeons, prosthetic reconstruction was the most commonly offered option (Figure 2), followed by free TRAM, LD, then pedicled TRAM. Four per cent (n=3) of surgeons do not perform immediate reconstruction for any patient requiring breast reconstruction.

### Scenario 2. Would you routinely perform immediate reconstructions on patients who MAY require radiation postmastectomy (ie, will not be decided until the final pathology is available)?

Thirty-four per cent (n=26) of surgeons would not perform an immediate reconstruction for patients whose need for radiation was uncertain at the time of surgery, and 64% (n=49) would. In the group that would operate, expander/implant reconstruction was the preferred option. This would be considered by 35 of the 49 physicians (71%). Either pedicled (43%) or free (40%) TRAM would also be offered (Figure 3).

For this scenario, 35% of surgeons (n=27) would use the delayed-immediate method of reconstruction. Forty-two per cent of surgeons (n=32) would not use this method. A minority of physicians (21%) were unfamiliar with delayed-immediate approach. One physician did not answer the question.

### Scenario 3. For delayed reconstruction in patients who have already undergone radiation therapy, which reconstructive option(s) would you usually offer?

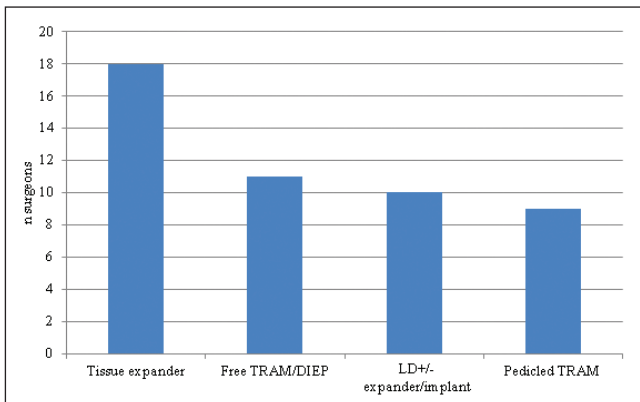
Pedicled TRAM was the most commonly offered option for breast reconstruction with 60% (n=45) of surgeons considering it (Figure 4). LD and free TRAM were nearly equally popular, and were offered by 56% (n=42) and 52% (n=39) of surgeons, respectively. Expander/implant reconstruction was less favoured for this group of patients – only 36% (n=27) of surgeons presented it as a choice to patients.

The preferred wait time between radiation therapy and breast reconstruction was six to 12 months.

## DISCUSSION

### Breast reconstruction in the patient requiring radiation therapy

There is substantial risk to the reconstructed breast undergoing radiation (7-10). In autologous reconstruction, flaps can shrink and develop contour abnormalities. Partial flap loss has also been noted. In a landmark study performed at the MD Anderson Centre (Texas, USA), patients who had radiation therapy following immediate breast reconstruction with free TRAM flaps demonstrated a significantly higher rate of late complications such as fat necrosis, volume loss and flap contracture than did those patients who received radiation therapy before free TRAM reconstruction (8). Twenty-eight per cent of the flaps required a second flap to address the consequences of radiation. Rogers and Allen (10) reported similar findings in DIEP flap breast



**Figure 2)** Reconstructive options offered to patients requiring radiation therapy. DIEP Deep inferior epigastric perforator; LD Latissimus dorsi; TRAM Transverse rectus abdominis myocutaneous

reconstruction. Reconstructed breasts subjected to radiation showed significantly higher rates of fat necrosis, fibrosis, shrinkage and contracture, as well as lower aesthetic scores when compared with non-radiated patients (10).

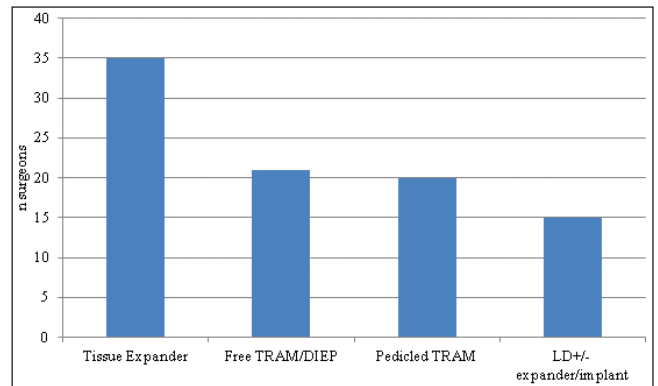
Evans et al (9) reported a significantly increased risk of capsular contracture, complications, and need for implant removal in prosthetic reconstruction both before and after radiation therapy. Covering the implant with autogenous tissue did not change outcomes. Spear and Onyewu (11) made similar conclusions in their study of two-stage saline implant reconstruction in radiated patients. Complications were more common in the radiated group, with the latter demonstrating a 32.5% capsular contracture rate, whereas there were no contractures in the nonradiated group (11). They reported that covering the implant with an LD flap was protective. Nonetheless, 19 of 40 patients (47.5%) required flap salvage compared with 10% of patients in the nonradiated group.

Although there are several reports of successful immediate reconstructions that have been irradiated, this seems to be the exception and not the rule. It is, therefore, reasonable that the majority of physicians surveyed in the present study would not offer immediate reconstruction to patients requiring radiation. For the minority of physicians who would offer immediate reconstruction to such patients, prosthetic reconstruction was a favoured option. This may be due to the relative ease and convenience of prosthetic reconstruction in comparison with autogenous reconstruction. Notably, however, the second most commonly offered choice was robust autogenous reconstruction in the form of a free TRAM flap. Free flaps have been shown to better withstand the effects of radiation than prosthetic reconstruction (12,13). Although revision surgery may be needed, the reconstruction can often be salvaged.

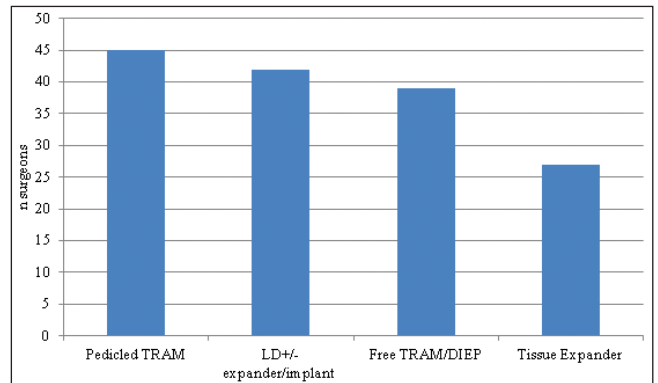
**Reconstruction of the patient who may require radiation and the role of the delayed-immediate technique**

Nearly one-half (46%) of surgeons would offer prosthetic reconstruction to patients whose need for radiation was unknown at the time of surgery. Possible explanations were provided by physician comments in the free-text section of the survey. Several surgeons noted that they used the implants either as a final reconstruction method or as a skin envelope preserver while the patient awaited the final pathology result. Another surgeon commented that using a prosthesis allows the patient more time to consider her reconstructive options and perhaps proceed to autologous reconstruction after receiving the pathology result.

Regardless of the indications, the delayed-immediate reconstruction method of placing an expander temporarily at the time of mastectomy has been described by Kronowitz et al (14). In a 2004 study, the MD Anderson group presented this as a means of preserving the skin envelope until final pathology results of the breast specimen and lymph node biopsy were available. In the first stage, a tissue expander



**Figure 3)** Reconstructive options offered to patients whose need for radiation therapy is unknown at time of mastectomy. DIEP Deep inferior epigastric perforator; LD Latissimus dorsi; TRAM Transverse rectus abdominis myocutaneous



**Figure 4)** Delayed reconstructive options offered to patients who have received radiation. DIEP Deep inferior epigastric perforator; LD Latissimus dorsi; TRAM Transverse rectus abdominis myocutaneous

is placed submuscularly and filled to maximum volume at the time of the skin-sparing mastectomy (14,15). Final pathology is reviewed and the second stage occurs two weeks later. If radiation therapy is not indicated, the expanders are removed, the flaps and tissue are debrided as needed and definitive breast reconstruction is performed with either TRAM, superior gluteal artery perforator flap, LD with implants, or implants alone. If radiation is indicated, the expander is deflated before its administration to enable the best access to inframammary nodes and limit collateral damage to the lungs and the heart. Re-expansion is then performed after the completion of radiation therapy. Delayed reconstruction in the form of TRAM, superior gluteal artery perforator flap or LD with implants is then performed.

Kronowitz et al (14) reported success in nine patients who underwent both stages. Complications ranged from site seroma to microvascular thrombosis; however, no flap losses occurred.

Although the delayed-immediate technique is a relatively new approach, more than two-thirds of polled physicians were familiar with it. That more than 30% of surgeons would use it when applicable speaks of its acceptability as a means of preserving the benefits of immediate reconstruction without jeopardizing the aesthetic results via a radiated reconstruction.

**Breast reconstruction in the patient who has received radiation therapy**

Our survey surgeons expressed a strong preference for autologous reconstruction such as the TRAM flap for the patient with a radiated mastectomy site. This is consistent with recommendations presented in the literature (15). Several studies have noted fewer complications in TRAM reconstructions and concluded that the flap brought healthy tissue with reparative capabilities to a compromised wound

bed (12,13). Favouring a pedicled TRAM or an LD with implants over a free tissue transfer may be largely due to the relative ease of performing these surgeries. In addition, radiated recipient vessels are sometimes a problem. Temple et al (16) reported that 17 of 123 planned free TRAMs were converted to pedicled TRAMs because of unusable internal mammary artery recipient vessels in radiated patients (16).

A wait time of six to 12 months postradiation therapy was preferred by the surgeons in our study. Baumann et al (17) studied radiation-related complications in abdominal breast reconstructions, and reported that delayed reconstructions performed 12 months after radiation therapy had a significantly lower risk of reoperation rates for microvascular compromise as well as flap loss compared with reconstructions performed earlier than 12 months after radiation therapy.

#### Limitations

The present study was limited by its low response rate of 29%. However, many Canadian plastic surgeons do not perform breast reconstructions and would, therefore, not respond.

#### CONCLUSION

The results of the survey indicate that Canadian physicians are largely informed by the results in the literature. The deviations seen in the form of favouring prosthetic reconstruction may be due, in part, to the relative ease and convenience of this option as well as the ability to allow the surgeon to later proceed with autologous reconstruction if decided by the patient. The varied approaches presented underscore the complexity of approaching breast reconstruction in a patient requiring radiation therapy.

**DISCLOSURES:** The authors have no financial disclosures or conflicts of interest to declare.

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