Factors Influencing the Rate of Post-Mastectomy Breast Reconstruction in a Canadian Teaching Hospital

Les facteurs qui influent sur le taux de reconstructions mammaires postmastectomie dans un hôpital universitaire canadien

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Abstract

Background: Post-mastectomy breast reconstruction (PMBR) improves psychosocial well-being, quality of life, and body image. Reconstruction rates vary widely (up to 42% in the United States), but the few Canadian studies available report rates of 3.8% to 7.9%. We sought to evaluate the current state of breast reconstruction in 1 Canadian teaching hospital and factors determining patients' access to reconstruction. **Methods:** We performed a retrospective chart review of all patients with breast cancer undergoing mastectomy alone or mastectomy and reconstruction at a Canadian hospital between 2010 and 2013. We calculated rates of breast reconstruction and compared patient characteristics between the 2 groups, and then performed a multiple logistic regression to determine factors increasing the odds of receiving breast reconstruction. **Results:** A total of 152 patients underwent 154 total or modified radical mastectomies. We obtained a rate of PMBR of 21%, 14% immediate reconstruction, and 8% delayed. Statistical analysis showed that compared to patients with mastectomy alone, patients who received PMBR were significantly younger, with a larger percentage having bilateral mastectomies, non-invasive breast cancer, and residing further from the hospital. Patients less than 50 years old and those with bilateral mastectomies had significantly greater odds of having a reconstruction. **Conclusions:** Our Canadian tertiary care institution has a high volume of breast surgery and an active breast reconstruction team. However, the rate of immediate reconstruction remains low compared to similar centers in the United States. We recommend a united effort to increase awareness regarding PMBR and address common misconceptions hindering patients' access to breast reconstruction. **Level of Evidence:** Epidemiologic study, Level III

Résumé

Historique : La reconstruction mammaire postmastectomie (RMPM) améliore le bien-être psychosocial, la qualité de vie et l'image corporelle. Le taux de reconstructions varie considérablement (jusqu'à 42 % aux États-Unis), mais les quelques études canadiennes signalent un taux de 3,8 % à 7,9 %. Les auteurs ont cherché à évaluer la situation relative aux reconstructions mammaires dans un hôpital universitaire canadien et les facteurs déterminant l'accès à la reconstruction. **Méthodologie :** Les chercheurs ont procédé à une analyse rétrospective des dossiers de toutes les patientes atteintes d'un cancer du sein qui avaient subi une simple mastectomie ou une mastectomie suivie d'une reconstruction dans un hôpital canadien entre 2010 et 2013. Ils ont calculé le taux de reconstructions mammaires et comparé les caractéristiques des patientes des deux groupes, puis ont procédé à une régression logistique multiple pour déterminer les facteurs qui accroissaient la probabilité de reconstruction mammaire. **Résultats :** Au total, 152 patientes ont subi 154 mastectomies radicales totales ou modifiées. Les chercheurs ont obtenu un taux de RMPM de 21 %, soit 14 % de reconstructions immédiates et 8 % de reconstructions tardives. L'analyse statistique a révélé que, par rapport aux patientes qui avaient subi une simple mastectomie, celles qui avaient reçu une RMPM étaient considérablement

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plus jeunes, et un plus fort pourcentage avait subi une mastectomie bilatérale, était atteint d'un cancer du sein non invasif et habitait loin de l'hôpital. Les patientes de moins de 50 ans et celles qui avaient subi une mastectomie bilatérale couraient une plus grande chance de subir une reconstruction. **Conclusions :** Notre établissement de soins tertiaires canadien effectue un fort volume de chirurgies du sein et dispose d'une équipe de reconstruction mammaire active. Cependant, le taux de reconstructions immédiates demeure faible par rapport à celui de centres similaires aux États-Unis. Nous recommandons d'adopter un front uni pour mieux faire connaître la RMPM et calmer les erreurs courantes qui empêchent les patients d'avoir accès à la reconstruction mammaire. Qualité des preuves : Étude épidémiologique, niveau III.

Keywords

breast reconstruction, autologous breast reconstruction, rate of breast reconstruction, breast cancer, quality of life, prosthetic breast reconstruction

Introduction

Post-mastectomy breast reconstruction (PMBR) is a procedure that can improve many dimensions of a patients' quality of life.¹⁻³ Undergoing a mastectomy is a traumatic experience compounded by its effects on the patients' appearance, social interactions, and sexual life. Patients who receive PMBR are more satisfied with their appearance, have improved psychosocial and sexual well-being, and experience less pain and fewer functional limitations.²

A variety of factors have been shown to influence patients' accessibility and receipt of PMBR. There are characteristics specific to the breast surgeon, racial/ethnic disparities, socioeconomic factors, patient's age, characteristics of the patient's residential area, and access to health insurance (particularly in the United States), which invariably influence rates of breast reconstruction.⁴⁻⁷ Furthermore, a literature review conducted by Platt and colleagues demonstrated large variations across different countries and regions: 9.9% in Australia (1982-2000), 14% in Denmark (1999-2006), 16.5% in England (2006-2009), and up to 42% in a network of tertiary care centers in the United States (1997-2002).⁸

Post-mastectomy breast reconstruction is covered under provincial health insurance policies across Canada. Therefore, high rates of breast reconstruction are expected, given the clear benefits and affordability for the patient. Breast reconstruction is an essential component in the multidisciplinary approach to breast cancer care and can be considered a marker of quality of care. Breast reconstruction is not an essential service for breast cancer treatment with respect to survival, but it requires resources, accessibility, and a dedicated plastic surgery department.⁹ Unfortunately, there is scarce evidence regarding the rates of breast reconstruction in Canada. The province of Nova Scotia had an overall rate reported at 3.8% from 1991 to 2001, whereas in Ontario, the rate was marginally higher at 7.9% (1984/1985) and 7.7% (1995-1996).^{10,11} A more recent population-based study by Zhong and colleagues described an age-adjusted immediate breast reconstruction rate of 8.7 per 100 000 adult women in Ontario and further emphasized the discrepancies, whereby patients with higher median incomes being treated at a teaching hospital, or a hospital with more plastic surgeons, and patients willing to travel farther, were more likely to receive a

reconstruction.¹² The comparatively low rates raise questions with regard to the factors influencing access and receipt of breast reconstruction in Canada.

Presently, there is a scarcity of literature examining the state of breast reconstruction in the province of Quebec. As such, hospital- and population-based studies are necessary to determine the rates of breast reconstruction, to identify areas of weakness in breast reconstruction awareness, to determine the quality of care with regard to breast reconstruction for patients with breast cancer, and to improve access for all patients with breast cancer. Using a hospital-based retrospective chart review, we sought to identify the rates and predictive factors for breast reconstruction in one teaching hospital serving a large basin of Montreal and the province of Quebec.

Materials and Methods

Study Design and Setting

We conducted a hospital-based retrospective chart review at Maisonneuve-Rosemont Hospital according to a protocol approved by the hospital's research ethics review board. The hospital archivist identified a total of 814 patients undergoing 845 mastectomies over the proposed study period of January 1, 2010, to December 31, 2012.

Maisonneuve-Rosemont Hospital is a tertiary care hospital affiliated to the University of Montreal, involved in the training of medical students and residents across a large variety of specialties (Rapport annuel de gestion 2013-2014, Maisonneuve-Rosemont Hospital).

Study Population

We included patients that were aged 18 and older with a diagnosis of breast cancer (ductal carcinoma in situ, phyllodes tumour, or invasive ductal or lobular carcinomas), undergoing a total mastectomy and/or modified radical mastectomy for the treatment or prevention of future breast cancer, between January 1, 2010, and December 31, 2012, at Maisonneuve-Rosemont Hospital. We excluded patients who underwent mastectomies for treatment other than breast cancer treatment or prevention, including breast-conserving surgeries.

Main Measurements

Five individuals, including the primary author, extracted the data from the hospital charts over a period of 6 months. We extracted information on age, body mass index (BMI; calculated using measures of height and weight), smoking status, laterality of breast surgery (unilateral vs bilateral), and a diagnosis of diabetes. We classified radiotherapy and chemotherapy into the following categories: none, or if patient received neo-adjuvant (prior to mastectomy) or adjuvant (after mastectomy) therapy. We used the pathology report from the mastectomy specimen to classify patients into 2 groups under breast cancer status: non-invasive (no disease or in situ disease) or invasive disease (phyllodes tumour, infiltrating ductal, or lobular carcinoma). Although we included patients receiving prophylactic surgery for a positive BRCA status, they were not separately analyzed and were categorized in the non-invasive group for breast cancer status. The software calculator at GPS Visualizer (<http://www.gpsvisualizer.com/calculators>) calculated the great circle distance between the address of the patient at the time of the mastectomy and the hospital to provide a hospital-to-home distance.

We examined all patients who met the inclusion criteria for any breast reconstructive procedures which they may have subsequently received at Maisonneuve-Rosemont Hospital up until July 31, 2014. We classified the reconstructive procedures based on the timing (immediate vs delayed) and the type of reconstruction (implant, autologous, or combined).

Statistical Analysis

We performed all of the statistical analysis using SPSS (Version 22, IBM) and verified the methodology with a trained biostatistician. We calculated the total rate of reconstruction as the number of reconstructions (immediate + delayed) divided by the number of total and/or modified radical mastectomies. We considered a bilateral mastectomy as a single procedure. The rate of delayed breast reconstruction was defined as the number of delayed reconstructions divided by the number of patients eligible for a reconstruction (total mastectomies—mastectomies with immediate breast reconstruction).

We divided patients into mastectomy alone versus mastectomy + reconstruction for comparative reasons to try and identify factors that may influence the rates and access to breast reconstruction. We then performed a subgroup analysis for patients that received breast reconstruction and examined for differences between patients undergoing immediate versus delayed reconstruction. We assessed for normality of all continuous variables using the Shapiro-Wilk test and calculated means and 95% confidence intervals for all variables following a Gaussian distribution. We provided medians and ranges for non-normally distributed variables and calculated frequencies and percentages were for all categorical variables.

We used independent samples Student t-test for comparison of means and Levene test for equality of variance to assess for homogeneity of variances. We used a Mann-Whitney *U* test to

Table 1. Hospital Statistics for Mastectomies and Reconstructions from 2010 to 2012.

	Yearly			Total	
	2010	2011	2012	# Mastectomies	BR, n (%)
# of TM	25	24	14	63	15 (24)
# of MRM	17	28	22	67	5 (7.5)
# of BM	10	7	7	24	12 (50)
Total	52	59	43	154	—
BR, n (%)					
Total	12 (23)	10 (17)	10 (23)	32 (21)	—
Immediate	8 (15)	6 (10)	7 (16)	21 (14)	—
Delayed	4 (9.1)	4 (7.5)	3 (8.3)	11 (8.3)	—

Abbreviations: BM, bilateral mastectomies; BR, breast reconstructions; MRM, modified radical mastectomies; TM, total mastectomies.

compare non-normally distributed continuous variables. We compared categorical variables using a χ^2 test or a Fisher exact test when there were only 2 categories in each variable and when there were one or more expected cell frequencies <5.

We created a multiple logistic regression model to determine whether there were patient characteristics that can predict the probability of receiving a breast reconstruction. We measured the statistical significance of the model using a χ^2 test, a Hosmer-Lemeshow test for goodness-of-fit, and the Nagelkerke's R-square for the model's ability to explain the variation in the dependent variable. We reported the percentage accuracy in classification for the prediction model. We employed a Wald test to determine the statistical significance for each of the independent variables and reported the odds ratios alongside their 95% confidence intervals. Statistical significance was considered as *P* value <.05.

Results

Hospital Statistics for Mastectomies and Reconstructions

Once we reviewed the initial database and applied the exclusion criteria, we identified 656 patients undergoing 743 mastectomies (breast conserving surgery, total mastectomy, and modified radical mastectomy) for the treatment or the prevention of future breast cancer. After excluding breast-conserving mastectomies, 152 patients undergoing 154 total mastectomies and/or modified radical mastectomies (20.7% of all mastectomies) were included in the study. We present the hospital statistics for mastectomies and breast reconstruction in Table 1. The total rate of reconstruction was 21% with 14% of patients receiving an immediate breast reconstruction and while 8% of eligible patients underwent a delayed breast reconstruction at the same institution.

Comparison of Patients Who Received a Mastectomy Alone Versus Mastectomy and Reconstruction

We compared patients undergoing mastectomy alone or mastectomy and reconstruction, and the results are presented

Table 2. Comparison of Patients Undergoing Mastectomy Alone to Patients With a Mastectomy and Reconstruction.

	n	MA	n	MR	P Value
Age, years ^a	122	66 (26-93)	32	48 (33-75)	< .0005
BMI, kg/m ^{2a}	118	27.33 (10.76-58.77)	31	24.75 (18.56-36.73)	.068
Diabetes ^b					
Non-diabetic, n (%)	122	108 (88.5)	32	31 (96.9)	.198
Smoking status ^b					
Ex- or Never, n (%)	122	101 (82.8)	32	27 (84.4)	.831
Laterality ^b					
bilateral, n (%)	122	12 (9.8)	32	12 (37.5)	< .0001
Radiotherapy ^b					
none, n (%)	122	55 (45.1)	31	20 (64.5)	.053
Chemotherapy ^b					
none, n (%)	122	61 (50.0)	31	19 (61.3)	.261
Breast cancer status ^b					
Non-invasive, n (%)	122	19 (23.0)	31	9 (51.6)	.002
Hospital-to-home distance, ^b n (%)					
0-20 km	122	112 (91.8)	32	24 (75)	.014
>20 km		10 (8.2)		8 (25)	

Note: Bold text indicates variables that are statistically significant.

Abbreviations: BMI, body mass index; MA, mastectomy alone; MR, mastectomy and reconstruction.

^aThe median and range were provided for non-normally distributed continuous variables, and the Mann Whitney *U* test was used to compare the distributions.

^b χ^2 or Fisher exact test (2×2 , with expected cell counts less than 5) was used to measure associations between frequencies.

P value < .05 was considered statistically significant.

in Table 2. Patients who received breast reconstructions were significantly younger (48 years mastectomy and reconstruction vs 66 years mastectomy alone, $P < .0005$) and had a higher percentage of bilateral mastectomies (37.5% mastectomy + reconstruction vs 9.8% mastectomy alone, $P < .0001$). More patients who had breast reconstruction had non-invasive disease (51.6% mastectomy and reconstruction vs 23.0% mastectomy alone, $P < .002$) and resided further from the hospital (25% mastectomy and reconstruction vs 8.2% mastectomy alone for distance >20 km, $P < .014$). We did not identify a difference between groups for the remaining variables.

Predicting Odds of Receiving Breast Reconstruction Post-Mastectomy

We created a multiple logistic regression model to determine whether there were variables capable of predicting the odds of receiving a breast reconstruction, and the results are presented in Table 3. Patients under 50 years of age (odds ratio [OR]: 5.71, 95% confidence interval [CI]: 2.02-16.2) or undergoing a bilateral mastectomy (OR: 5.04, 95% CI: 1.54-16.5) had significantly higher odds of receiving a breast reconstruction. Patients with non-invasive disease (OR: 2.56, 95% CI: 0.972-6.75) demonstrated higher odds but the adjusted OR did not reach significance.

Comparison of Patients Undergoing Immediate versus Delayed Breast Reconstruction

A subgroup analysis comparing immediate breast reconstruction versus delayed breast reconstruction is presented in Table 4. Patients who had immediate breast reconstruction

had significantly smaller body mass index (BMIs; 22.70 vs 28.73, $P < .001$) and a lower percentage of patients receiving radiotherapy (15.0% vs 72.7%, $P = .004$) and chemotherapy (20% vs 72.7%, $P = .007$). The results for the type of breast reconstruction are presented in Table 5. The majority of immediate breast reconstruction was implant-based (85.7%), whereas for delayed breast reconstruction, the majority were done with autologous tissue (63.7%).

Discussion

Maisonnette-Rosemont Hospital is a high-volume breast surgery center with an immediate breast reconstruction rate of 14%. The majority of immediate breast reconstructions were implant based, whereas autologous tissue comprised a larger percentage of delayed breast reconstructions. Although this rate of breast reconstruction is higher in comparison to the rates reported in 2 Canadian population-based studies on breast reconstruction (3.8%-7.9%), these rates are still substantially lower than that of tertiary care centers in the United States, where the rate of breast reconstruction is up to 42%.^{10,11,13} Our findings indicate that patients receiving breast reconstruction are significantly younger and are more likely to have bilateral mastectomies, less invasive disease, and greater hospital-to-home distance. In fact, patients with a younger age and a bilateral mastectomy had 5 times the odds of receiving a breast reconstruction according to our findings. This confirms findings in the literature regarding factors influencing rates and access to breast reconstruction, and there is a growing body of evidence addressing the underlying reasons responsible for the contrast between these 2 patient populations.¹⁰⁻¹²

Table 3. Multiple Logistic Regression Model Predicting Probability of Breast Reconstruction Based on Patients' Characteristics at the Moment of the Hospital Admission.

	Adjusted ^a			Unadjusted		
	OR	95% CI	P Value	OR	95% CI	P Value
Age, years						
≤50	5.71	2.02-16.2	0.001	5.86	2.55-13.5	<.0001
>50	1.0	Referent		1.0	Referent	
BMI, kg/m ²						
≤25	1.71	0.649-4.51	0.277	2.04	0.918-4.54	.080
>25	1.0	Referent		1.0	Referent	
Laterality						
Unilateral	1.0	Referent	0.008	5.50	2.167-13.957	<.0005
Bilateral	5.04	1.54-16.5		1.0	Referent	
Smoking status						
Ex or Non-Smoker	0.603	0.166-2.19	0.443	1.123	0.388-3.25	.831
Current	1.0	Referent		1.0	Referent	
Diabetes						
No	1.99	0.225-17.63	0.536	4.019	0.508-31.8	.187
Yes	1.0	Referent		1.0	Referent	
Radiotherapy						
No	2.36	0.760-7.32	0.138	2.22	0.978-5.02	.057
Yes	1.0	Referent		1.0	Referent	
Chemotherapy						
No	1.09	0.366-3.24	0.879	1.58	0.708-3.54	.263
Yes	1.0	Referent		1.0	Referent	
Breast cancer status						
Non-invasive	2.56	0.972-6.75	0.057	3.15	1.19-8.32	0.021
Invasive	1.0	Referent		1.0	Referent	

Note: Bold text indicates variables that are statistically significant.

Abbreviations: BMI, body mass index; CI, confidence interval; OR, odds ratio.

^aThe χ^2 for the model (8) = 36.471, *P* value < .0001. The coefficient of determination (Nagelkerke R^2) = 0.344. The Hosmer-Lemeshow goodness of fit test was not significant (χ^2 = 5.9787, *P* value = .665). The percentage accuracy in classification was 84.5%. A *P* value <.05 was considered statistically significant.

Age older than 50 years has been shown to be the most consistent negative predictor for breast reconstruction.⁸ Our findings are in line with this, as patients in our study that were younger than 50 years of age had 5.71 times the odds of having a breast reconstruction than patients over age 50. It is commonly perceived that older patients are less likely to desire breast reconstruction and are more at risk from complications. However, recent evidence from 2 large-scale studies have demonstrated that older age is not associated with increased risk of 30-day postoperative complications for tissue-expander immediate breast reconstruction when compared to patients undergoing mastectomy alone or when patients >65 years old were compared to patients <65 years old in a cohort of patients that received breast reconstruction.^{14,15} Patients who have had a breast reconstruction overwhelmingly (91.8%) report that age should not be considered when offering the option for breast reconstruction.¹⁵

The high percentage of bilateral mastectomy patients undergoing breast reconstruction is in line with the prophylactic nature of the surgery, with patients more inclined to be informed and seek prospective reconstructive options.¹⁶ Nonetheless, we feel that all patients with breast cancer should be provided with the choice of undergoing a breast reconstruction and be referred to a plastic surgeon, as the

benefits are universal. Ultimately, this would enable all patients to make an informed decision regarding their breast cancer treatment.

The presence of a larger proportion of patients with a breast reconstruction traveling further distances may be indicative of referral patterns, more advanced disease requiring specialized services or the desire of the patient to obtain both a mastectomy and reconstruction at the same institution or in institutions thought to deliver better care. This raises questions regarding centralization of care to optimize resources and efficiency. However, the current evidence do not provide us any evidence regarding reasons explaining this pattern of behaviour.

Regarding the invasiveness of the breast cancer on the rate of breast reconstruction, our findings appear to be in line with the literature from the United States. The stage of the disease is the most predictive clinical factor associated with the rate of reconstruction, with advanced disease having a strong negative predictive value.⁸ Advanced disease is likely to require adjuvant therapy, and there are concerns on compromising oncological safety when performing breast reconstruction. However, it has been shown that there is no increased frequency of local breast cancer recurrence with immediate breast reconstruction in advanced disease compared with mastectomy alone.¹⁷ Presently, the need to proceed with adjuvant therapy is not

Table 4. Comparison of Patients Undergoing Immediate Versus Delayed Breast Reconstruction.

	Immediate Reconstruction (n = 21)	Delayed Reconstruction (n = 11)	P Value
Age, years ^a	49.65 ± 1.89 (39-69)	52.82 ± 3.81 (33-75)	.466
BMI kg/m ^{2b}	22.70 (18.56-34.60)	28.73 (22.15-36.73)	.001
Diabetes ^c			
Non-diabetic, n (%)	21 (95.2)	11 (1.00)	1.00
Smoking status ^c			
Ex- or Never, n (%)	18 (85.7)	9 (81.8)	1.00
Laterality ^c			
Unilateral, n (%)	12 (57.1)	8 (72.7)	.465
Radiotherapy ^c			
None, n (%)	17 (85.0)	3 (27.3)	.004
Chemotherapy ^c			
None, n (%)	16 (80.0)	3 (27.3)	.007

Note: Bold text indicates variables that are statistically significant.

^aIndependent samples Student's *t* test was performed to compare means for normally distributed variables. Means, standard deviation, and range were provided for continuous variables.

^bThe median and range were provided for non-normally distributed continuous variables, and the Mann-Whitney *U* test was used to compare the distributions.

^c χ^2 or Fisher exact test (2×2 , with expected cell counts less than 5) was used to measure associations between frequencies. *P* value <.05 was considered statistically significant.

Table 5. Type of Reconstruction for Immediate Versus Delayed Breast Reconstruction.

	Immediate Reconstruction (n = 21)	Delayed Reconstruction (n = 11)
Type of Reconstruction, n (%)		
Prosthetic	18 (85.7)	2 (18.2)
Autologous	2 (9.5)	7 (63.6)
Combined	1 (4.8)	2 (18.2)

considered a contraindication for immediate breast reconstruction, and reconstructive options are available to optimize outcomes. However, higher level of evidence studies are necessary to confirm the effect of immediate breast reconstruction on the timing of adjuvant therapy and subsequent outcomes. Whether immediate reconstruction causes a delay in beginning adjuvant therapy and any potential significance of this delay remains to be ascertained. The significantly lower percentage of patients requiring adjunctive radiotherapy and chemotherapy in the immediate breast reconstruction group likely reflect breast surgeons' preference to refer patient with less aggressive disease for reconstruction.

Our study illustrates the state of breast cancer care within 1 university teaching hospital. Given that Maisonneuve-Rosemont Hospital is a well-known and respected tertiary care center in a large urban city, there is a patient selection bias, and

breast reconstruction rates are expected to be higher than that of the provincial average. This is supported by the fact that our reconstruction rates are higher than the rates of breast reconstruction reported in 2 previous Canadian population-based studies.^{10,13} Furthermore, despite the clear distinction between patients who received a mastectomy and reconstruction and those that had a mastectomy alone, the design of the study does not allow us to assess whether these patterns are secondary to physician or patient preferences. However, hospital-based studies provide an important overview of region-specific quality of care. They serve as benchmarks for comparison and help guide local and regional health care policy-making. Future research endeavours should focus on physician attitudes and patient preferences to identify the current shortfalls in PMBR.

Conclusion

Post-mastectomy breast reconstruction is essential to the multidisciplinary approach to breast cancer care and given the low rates demonstrated in a high volume breast surgery center in Quebec, the medical community should maintain a continued effort to increase awareness in the general population and amongst colleagues in health care. Furthermore, they must focus on invalidating longstanding misconceptions with respect to risks of immediate breast reconstruction in older patients, safety, and outcomes of breast reconstruction in patients with advanced disease that require adjuvant treatment, as these are the factors that appear to greatly influence access and rates of breast reconstruction.

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