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ORIGINAL ARTICLE

Trends in Post-Mastectomy Reconstruction in an Asian Population: A 12-Year Institutional Review

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■ **Abstract:** Post-mastectomy breast reconstruction is an integral component of breast cancer treatment. It is often perceived that women in Asian countries have a lower rate of post-mastectomy reconstruction than Western populations. This study describes trends in timing and types of breast reconstruction performed in the largest healthcare provider in Singapore, over a period of 12 years. It also reports on the oncological outcomes and surgical safety. A retrospective review of all patients who underwent post-mastectomy reconstruction from January 2001 to December 2012 at the National Cancer Centre Singapore and Singapore General Hospital was performed. Six hundred and twenty post-mastectomy reconstructions were performed in 579 patients. The proportion of reconstructions increased from 4% in 2001 to 18% in 2012. Younger patients (<50 years old) and those with early stage cancer were more likely to undergo reconstruction. Immediate breast reconstruction was favored by more than 90% of patients. Postoperatively, 9% developed acute surgical complications that were treated surgically; 6% had additional surgery for late complications. Only 4% had delay of adjuvant chemotherapy. At median follow-up of 63 months (range 3–166), loco-regional recurrence was 4%, and distant metastases 8%. Post-mastectomy reconstruction for breast cancer is increasingly performed in our institution. Both younger age and lower stage disease were associated with choice for reconstruction in our study. Low rates of delay to adjuvant therapy were noted, and it may safely be offered to suitable women undergoing mastectomy. ■

Key Words: Asian, breast cancer, breast reconstruction, mastectomy, post-mastectomy reconstruction

Post-mastectomy breast reconstruction has become an integral component of breast cancer treatment. It improves the psychosocial well-being of patients who have had a mastectomy and may be performed at the time of mastectomy or at a later date (1,2). Skin-sparing, and nipple-sparing mastectomies have been shown to be oncologically safe (3,4). Advances in autologous flap techniques and breast prostheses have also considerably expanded a woman's options for post-mastectomy reconstruction.

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The reported rates of post-mastectomy reconstructions range from 17% to as high as 60% in Western populations (5–7). This is considerably lower, at 2.6–18% in Asian countries (8,9). Possible reasons for this discrepancy include a conservative culture which places less importance on esthetics, inadequate awareness of the procedure and its oncological safety, and paucity of access to expertise (9–11).

Singapore has the highest incidence of breast cancer in Asia, with one in 16 women developing breast cancer in her lifetime (12). It is unique as it has a predominantly Asian population, largely Western lifestyle, and first-world healthcare system. This study reports the use of post-mastectomy reconstruction within the largest healthcare cluster in Singapore over the past

decade. It describes trends in timing and types of breast reconstruction, identifies the clinicopathological characteristics for women who had breast reconstruction, and reports on outcomes of the procedure.

MATERIALS AND METHODS

All women who had immediate or delayed post-mastectomy reconstruction between January 2001 to December 2012 at the Singapore General Hospital (SGH) and National Cancer Centre Singapore were included in this study. Immediate reconstructions were performed at the time of mastectomy while delayed reconstructions had an initial mastectomy prior to a second surgery for reconstruction, with no stipulated time interval. Clinicopathological information, details of surgery, surgical and oncological outcomes were retrospectively reviewed from electronic databases and clinical records.

Early complications occurred within 30 days of breast reconstruction surgery and were considered as major if readmission and/or a second operation was needed. Late complications occurred at least 30 days after breast reconstruction. Adjuvant chemotherapy was considered delayed if it was administered more than 60 days after the primary operation (13). We arbitrarily divided the study period into two time periods—the first 6 years (2001-2006) and the last 6 years (2007–2012) to better appreciate broad trends.

Categorical variables were described by proportions and compared using the Chi square test. Continuous variables were expressed in medians and compared using the Mann–Whitney test. For comparisons, $p < 0.05$ was considered as statistically significant.

The study had Institutional Ethics Review Board approval.

RESULTS

Incidence and Trends in Breast Reconstruction

A total of 4,884 mastectomies were performed between 1 January 2001 to 31 December 2012, and 620 (13%) post-mastectomy breast reconstructions were done for 579 patients. 596 (96%) were posttherapeutic mastectomies, whereas 24 (4%) were reconstructions after a risk-reducing mastectomy. An increase in incidence of breast reconstructions were noted over the years from 16 (4%) in 2001 to 73 (18%) patients in 2012 (Fig. 1). This was statistically significant when considered in the context of the early (2001–2006) and late (2007–2012) years (7% versus 17%, $p < 0.01$). Immediate breast reconstructions (IBR) were generally favored, making up 580 (94%) reconstructions. This proportion remained in excess of 90% across the years with no discernable variation (Fig. 1). Among those who had IBR, 498 (86%) had a skin-sparing mastectomy (SSM) and 75 (13%) had a nipple-sparing mastectomy (NSM). Significantly more NSM were performed in recent years (0.9% in 2001–2006 versus 18% in 2007–2012, $p < 0.01$). Forty patients had delayed reconstruction, of which eight of them had a contralateral IBR. The median time to breast reconstruction was 29 (range 6–323) months after initial mastectomy.

Autologous tissue transfers were utilized for 540 (87%) of the reconstructions, whereas implant-based reconstructions made up the remaining 80 (13%). Notably, there was a significant increase in implant reconstructions from 4% in the first 6 years to 18% in the later period ($p < 0.01$; Fig. 2). Among autologous flap reconstructions, 415 (77%) were abdominally based flaps using either the transverse rectus

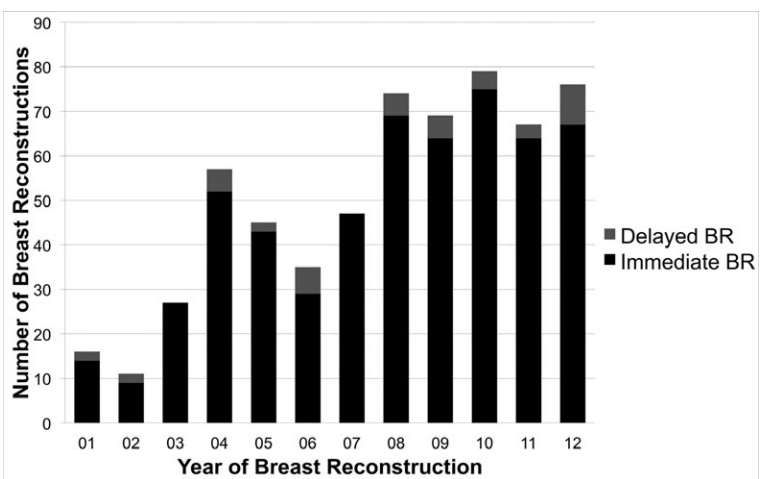

Figure 1. Incidence and timing (immediate versus delayed) of breast reconstruction from 2001 to 2012.

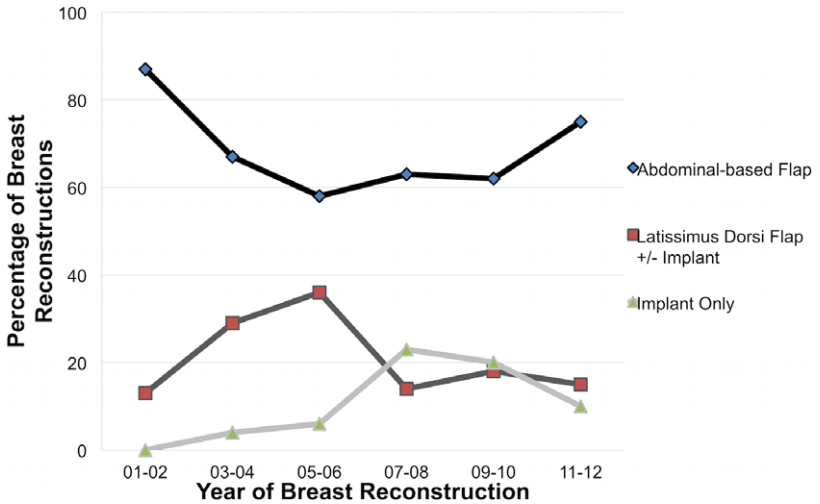

Figure 2. Trends in type of post-mastectomy breast reconstruction (%).

abdominis myocutaneous (TRAM) flap (pedicled or free) or deep inferior epigastric perforator (DIEP) flap. The latissimus dorsi (LD) myocutaneous flap was used in 125 (23%) reconstructions, of which 41 (33%) had a concurrent implant placement. Timing of reconstruction was not significantly associated with any particular reconstruction type.

Clinicopathological Characteristics

The characteristics of the patients who underwent post-mastectomy reconstruction are summarized in Table 1. The median age was 46 (range 22–70) years old. Patients of Chinese ethnicity, premenopausal women, and married women were more likely to have a breast reconstruction. Among those who had a therapeutic mastectomy, the majority (83%) had early, stage I or II breast cancer. The timing (i.e., immediate or delayed) of reconstruction was not significantly associated with stage of disease ($p = 0.4$). These characteristics did not differ between the study periods. There was an increase in the number of patients who had risk-reducing mastectomy with reconstruction in the later period (0.4% versus 6%, $p < 0.01$) (Tables 2 and 3).

Table 1. Characteristics of Patients Who Underwent Post-Mastectomy Breast Reconstruction (*n* = 579)

Characteristics (%)			
Period of study, N = Mastectomies performed	2001–2006 (*N* = 2,331)	2007–2012 (*N* = 2,302)	Total
Rate of BR (%)	203 (9%)	376 (16%)	579 (12%)
Ethnicity			
Chinese	178 (88%)	311 (83%)	489 (84.5%)
Malay	13 (6%)	22 (6%)	35 (6%)
Indian	5 (2%)	9 (2%)	14 (2.5%)
Others	7 (4%)	34 (9%)	41 (7%)
Nationality			
Singaporean	190 (94%)	329 (88%)	519 (90%)
Others	13 (6%)	47 (12%)	60 (10%)
Median age (range)	47 (22–69)	46 (25–70)	46 (22–70)
Menopausal status			
Premenopausal	143 (70%)	258 (69%)	401 (69%)
Postmenopausal	60 (30%)	118 (31%)	178 (31%)
Marital status			
Single	30 (15%)	62 (16%)	92 (16%)
Married	148 (73%)	279 (74%)	427 (74%)
Divorced/Widowed	7 (3%)	6 (2%)	13 (2%)
Unrecorded	18 (9%)	29 (8%)	47 (8%)
Personal history of breast/ovarian cancer	22 (11%)	42 (11%)	64 (11%)
Family history of breast/ovarian cancer	19 (9%)	63 (17%)	82 (14%)

Outcomes

The mean length of hospitalization stay was 10 days (range 2–39). It was 10 days (range 3–39) for autologous reconstructions, and 6 days (range 2–16) for implant-based reconstructions. The total complication rate was 20%. Ninety (15%) of the 620 reconstructions had early complications, whereas 39 (6%) developed late complications (Table 4). Donor site morbidity significantly decreased in the later years from 4% to 1% ($p = 0.01$). The rate of surgical complications was not affected by timing of breast reconstruction, with 104 (18%) occurring in patients who

Table 2. Clincopathological Characteristics of the Breast Tumors in Our Study Population

Characteristics (%)	2001–2006 (*n* = 211)	2007–2012 (*n* = 409)	Total (*n* = 620)	p
Median size, mm (range)	20 (1–80)	20 (1–130)	20 (1–130)	
Histologic subtype				
Carcinoma in situ	54 (25.5%)	90 (22%)	144 (23%)	<0.01
Invasive ductal carcinoma	146 (69%)	277 (68%)	423 (68%)	
Invasive lobular carcinoma	10 (5%)	19 (5%)	29 (5%)	
Prophylactic	1 (0.5%)	23 (5%)	24 (4%)	
Nodal status	*n* = 210	*n* = 386	*n* = 596	
Positive	63 (30%)	115 (30%)	178 (30%)	
Negative	147 (70%)	271 (70%)	418 (70%)	
Stage of tumor	*n* = 210	*n* = 386	*n* = 596	
0	54 (26%)	90 (23%)	144 (24%)	
I	57 (27%)	118 (31%)	175 (30%)	
II	65 (31%)	109 (28%)	174 (29%)	
III	33 (15.5%)	64 (17%)	97 (16%)	
IV	1 (0.5%)	5 (1%)	6 (1%)	
Neo-adjuvant chemotherapy	10 (5%)	28 (7%)	38 (6%)	0.29
Adjuvant therapy				
Chemotherapy	103 (49%)	202 (52%)	305 (51%)	0.93
Radiotherapy	66 (31%)	126 (33%)	192 (32%)	0.92
Hormonal therapy	98 (47%)	228 (59%)	326 (55%)	0.03
Targeted therapy	1 (0.5%)	51 (13%)	52 (9%)	<0.01

Table 3. Oncologic Breast and Reconstructive Surgery

Type of surgery (%)	2001–2006 (*n* = 211)	2007–2012 (*n* = 409)	Total (*n* = 620)	p
Timing of reconstruction				
Delayed	17 (8%)	23 (6%)	40 (6%)	0.3
Immediate	194 (92%)	386 (94%)	580 (94%)	
Type of mastectomy				
Skin-sparing mastectomy	187 (87%)	311 (76%)	498 (80%)	0.07
Nipple-sparing mastectomy	2 (1%)	73 (18%)	75 (12%)	<0.01
Type of reconstruction				
Autologous	203 (96%)	337 (82%)	540 (87%)	<0.01
Abdomen-based*	143	272		
Latissimus dorsi†	60	65		
Implant	8 (4%)	72 (18%)	80 (13%)	
Nipple areola reconstruction (NAC)	51 (24%)	78 (19%)	129 (21%)	0.14

*Inclusive of TRAM, DIEP flaps etc.
†Inclusive of LD with or w/o implant reconstruction.

had IBR and six (15%) developing in delayed post-mastectomy reconstructions (p = 0.83).

Neo-adjuvant chemotherapy was administered to 38 (6%) patients. There was no association between having neo-adjuvant chemotherapy and developing surgical complications (p = 0.84). Adjuvant chemotherapy was administered to 305 (53%) patients and the median time to chemotherapy was 41 days (range 22–219 days). Twenty-six (4%) patients had delay in chemotherapy administration, of which 19 were because of surgical-site complications. Three hundred and twenty (56%) patients received hormonal therapy. Targeted therapy (Herceptin) was introduced in our institution in 2006 and 52 (9%) patients received it. Adjuvant radiotherapy was administered to 192 (33%) of our patients.

The overall median follow-up was 63 months (range 3–166). It was 63 months (range 3–166) for the IBR group and 67 months (range 3–150) for the delayed reconstruction group. Loco-regional recurrence in IBR and delayed reconstruction occurred in 23 (4%) and 2 (5%) patients, respectively (p = 0.67). Among patients who had IBR, 22 (4%) of 498 who had SSM and 1 (1%) of 75 who had NSM developed loco-regional recurrence. Distant metastases developed in 48 (8%) [45 (8%) IBR, 3 (8%) delayed reconstruction] patients, with no difference between the time of reconstruction (p = 1). At the end of the study, 43 (7%) [40 (7%) IBR, 3 (8%) delayed reconstruction] patients had breast cancer-related deaths. The 2-year and 5-year survival rate is 98% and 94%, respectively.

DISCUSSION

The detection of earlier stage breast cancer with screening programs and advances in adjuvant therapies have effected good long-term survival for patients with breast cancer. Consequently, psychosocial and cosmetic outcomes have an increasingly important role in breast cancer management. Current clinical guidelines recommend that breast reconstruction be offered to all suitable women choosing or requiring a mastectomy (14,15).

We have reported the trends in post-mastectomy reconstruction over the past decade in Singapore—the country with the highest rate of breast cancers in Asia that has a predominantly ethnic Asian population with Western mores. In this review, several major trends were identified. Firstly, we observed a significant increase in post-mastectomy breast reconstruction over the years. The rate was 4% in 2001 and this increased to 18% in 2012. When the results are considered in two time periods–2001 to 2006 versus 2007 to 2012, the rate was 7% versus 17% and this increase was statistically significant. That more

Table 4. Surgical and Oncological Outcomes

Number (%)	2001–2006 (*n* = 211)	2007–2012 (*n* = 409)	Total (*n* = 620)	p
Number of reconstructions with complications	40 (19%)	70 (17%)	110 (18%)	0.58
Early			90 (15%)	
Number of surgical complications*				
Minor (treated conservatively)	7 (3%)	20 (5%)	27 (4%)	0.41
Skin envelop infection	4	12		
Donor site infection	2	2		
Seroma/Hematoma	1	6		
Major (requiring surgical intervention)	15 (7%)	43 (11%)	58 (9%)	0.11
Skin envelop necrosis	0	4	4	
Flap necrosis, partial loss	8	19	27	
Flap necrosis, total loss	1	6	7	
Infection leading to implant removal	1	3	4	
Seroma/Hematoma evacuation	3	4	7	
Abdominal wound dehiscence	2	7	9	
Number of nonsurgical complications	2 (0.9%)	3 (0.7%)	5 (0.8%)	1
Deep vein thrombosis	1	1	2	
Pulmonary embolism	1	1	2	
Intestinal obstruction	0	1	1	
Late (surgical management)			39 (6%)	
Reconstructed breast	13 (6%)	13 (3%)	26 (4%)	0.09
Fat necrosis, infection	8	6	14	
Fat necrosis mimic recurrent cancer	5	6	11	
Implant contracture necessitating removal	0	1	1	
Donor site	9 (4%)	4 (1%)	13 (2%)	0.01
Hernia	8	4	12	
Abdominal wall abscess	1	0	1	

*Surgical complications related to the reconstructed breast or donor site.

patients are choosing post-mastectomy reconstruction in recent years may reflect improved specialized breast care. Within this institution, the practice of breast cancer care has evolved over the past decade. In addition to formal multi-disciplinary breast cancer care, all patients are now seen by subspecialty breast surgeons who occupy a common clinic facility with breast reconstructive surgeons. These factors, and the availability of robust data on the oncological safety of SSM and NSM in recent years, likely contributed to an increase in patients being referred for post-mastectomy reconstructions (3,16–18). This parallels the observation that patients treated at specialized cancer centers, like those recognized by the National Cancer Institute in the USA, are reported to be 40% more likely to undergo reconstruction after mastectomy than patients treated at other institutions (19,20).

Secondly, in our population, IBR is preferred, with consistently more than 90% of patients undergoing IBR over the past decade. This differs from the majority reported series of post-mastectomy reconstruction where IBR makes up 1.7–83% of all post-mastectomy reconstructions (21–23). Common reasons cited for delayed reconstructions include the potential need for radiation therapy with consequent compromise of the flap, concern that major reconstructive surgery would delay administration of adjuvant therapy and in older series, the desire for a disease-free interval prior to major constructive surgery (24,25). It is likely the primary reason for our high proportion of IBR relates to physician selection for referral for reconstruction. Concerns with radiation therapy and delay of chemotherapy may have biased the referral pattern, and we see patients with early stage disease (stage 0–II) making up more than 80% of those who receive post-mastectomy reconstruction. These patients are therefore imminently suited to maximally benefit from IBR, including the psychological benefit of retaining a breast mound post-mastectomy, improved cosmesis from preservation of the native skin envelop with or without the nipple, and a single surgery (Fig. 3). In our series, the rate of early major surgical complications was low at 9%. Only 19 (3%) patients experienced a delay in the administration of adjuvant chemotherapy because of surgical-site complications, and the rate of LRR was low at 4% with no increased risk in those with NSM. There was also no significant difference in oncological outcomes between the IBR and delayed breast reconstruction group. These outcomes are comparable to those from other units (3,16–18). This audit reaffirms our practice that IBR is safe with regards to short-term surgical outcomes, with minimal resultant delays in adjuvant therapy, and good long-term oncological safety. Perhaps with the reported decrease in surgical complications in recent years and the demonstrated objective minimal numbers with delay to adjuvant chemotherapy, post-mastectomy reconstruction will be extended to patients with more advanced disease.

Another trend noted was the increase in use of implant-based reconstruction. This gradual increase trended toward, but did not reach statistical significance. One possible reason is due to the rise of contralateral risk-reducing mastectomy where patients may desire shorter surgery and better symmetry in instances of bilateral post-mastectomy reconstructions (26–28). Implant-based reconstructions would meet

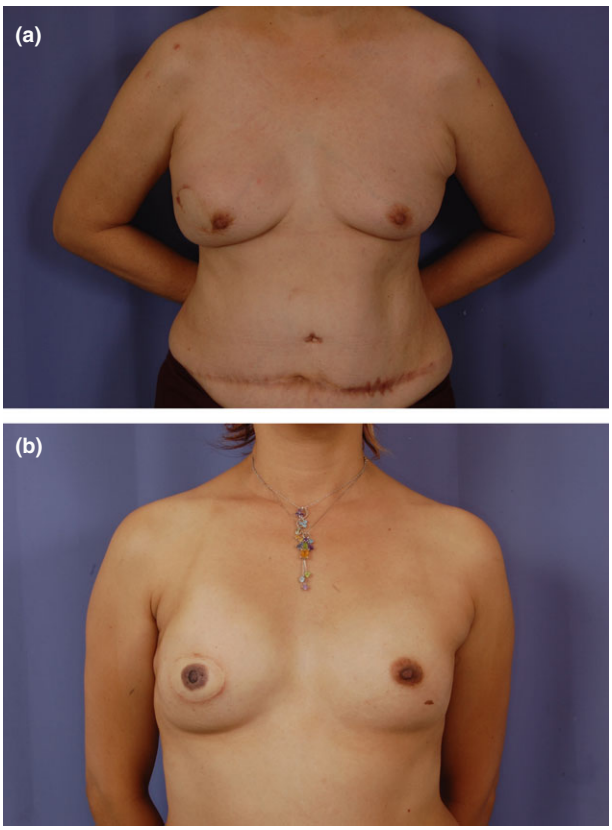

Figure 3. (a) Post-reconstruction photograph of a patient who received a right nipple-sparing mastectomy (NSM) with immediate transverse rectus abdominis myocutaneous (TRAM) flap reconstruction. (b) Post-reconstruction photograph of a patient who received a right skin-sparing mastectomy (SSM) with immediate TRAM flap reconstruction and delayed nipple-areolar construction (NAC).

these criteria. This trend of increase in implant-based reconstruction is also noted worldwide, primarily due to the availability of acellular dermal matrixes and various inferior pole support materials that allow for direct-to-implant reconstructions (23,29). As such surgeries become increasingly available in Singapore, the use of implant-based reconstructions may rise further. At present, reconstruction of the neo-breast with autologous tissue is the preferred choice. Eighty-seven percent of our reconstructions utilize autologous tissue transfers, with 77% being either a TRAM or DIEP flap and remaining 23% LD reconstruction (with or without an implant for volume). This predominant use of abdominal tissue may seem a surprise, given the relatively low body mass index (BMI) in Asian women compared to Caucasians. However, the corresponding smaller breast volume often means there is sufficient tissue for a matching reconstruction to the contralateral breast. Surgical techniques such as venous augmentation and free tissue transfer have also enabled us to harvest a larger flap. With the evolution of the reconstruction techniques and the introduction of muscle-sparing techniques, the incidence of abdominal hernia has been reduced significantly from 3% to 1% over the last 5 years in our centre. Similarly, Kim et al. have demonstrated that IBR with the TRAM flap is a viable option for patients with a low BMI (<18.5 kg/m^2) in a study of 564 patients with acceptable complications rates in an Asian centre (30, 31).

The median age of women who underwent post-mastectomy reconstruction was 46 years old, which was younger than the median age of 55–59 years old at diagnosis of breast cancer in Singapore (32). This younger age is consistent with reported series, with some suggesting that age is perhaps the most significant variable associated with post-mastectomy reconstruction (7,19,33–36). Younger patients may be more concerned with their body image and sexuality and hence opt for post-mastectomy reconstruction, and they usually have fewer concurrent medical problems, rendering them better surgical candidates. Lim et al. identified age and anticipated psychosocial morbidity as the most important patient factors in determining whether a referral to the plastic surgeon was made (37). Hequet et al. surveyed 81 women who declined reconstruction in their study population and 23% cited older age as the main deciding factor (38). Be that as it may, age per se is not a contraindication to reconstructive surgery. Our oldest patient was 70 years old. She was clinically fit and had a successful breast implant reconstruction. It is acknowledged that the optimal management of a breast cancer patient should not be determined solely upon age (39,40). This is an important consideration as our population starts to age.

This study was designed to explore the surgical and oncological outcomes of post-mastectomy breast reconstruction and identify trends over a decade of rapid advancement of breast cancer treatment. Being retrospective in nature, we were unable to determine the influence of factors such as personal choice, socioeconomic status, and physician bias—common factors that have been reported to determine the uptake of post-mastectomy reconstruction in other studies (6,7,9,19,36). These are important considerations. Several Asian studies have demonstrated that fear of additional surgery and complications, and a higher concern about survival over physical appearance have influenced the decision to not proceed with

reconstruction (10,11,41). The attitudes of Asian surgeons may also influence the decision to proceed with reconstruction. A nation-wide survey in Japan conducted by Takahashi et al. showed that 31.3% of surgeons did not give reconstruction-related information at all when explaining breast cancer management (42). Economic factors also likely contribute. In Singapore, post-mastectomy reconstruction is considered a medical procedure (not cosmetic) and surgical costs may be reimbursed by government subsidies and insurance claims. However, medical care in Singapore entails a copayment by the patient, and the costs of surgery conceivably contributes to the patients' decision making. For this study, details of patient admissions based on stratification of bed status (largely regarded as a reflection of availability of insurance coverage and magnitude of government subsidies) were not accessible, nor were details of patients' occupation available. These limitations preclude a deeper understanding of how patient and physician attitudes and economic issues influence the decision for post-mastectomy reconstruction. Future studies designed to explore patient reported outcome measures and attitudes toward breast reconstruction will go some way to more completely understand the Asian psyche toward breast reconstruction.

CONCLUSION

The rate of post-mastectomy reconstruction had increased steadily in our population, over the past decade. In our cohort, the patient who has post-mastectomy reconstruction is more likely to be young, premenopausal, married and have earlier stage disease. IBR is preferred, and the safety of this is supported by minimal delays to adjuvant therapy and good oncological outcomes. These results form an objective basis for extending the option of post-mastectomy breast reconstruction to future patients.

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CONFLICT OF INTEREST

None.

REFERENCES

1. Ueda S, Tamaki Y, Yano K, *et al.* Cosmetic outcome and patient satisfaction after skin-sparing mastectomy for breast cancer with immediate reconstruction of the breast. *Surgery* 2008;143:414–25.

2. Nano MT, Gill PG, Kollias J, *et al.* Psychological impact and cosmetic outcome of surgical breast cancer strategies. *ANZ J Surg* 2005;75:940–7.

3. Adam H, Bygdeson M, Boniface JD. The oncological safety of nipple-sparing mastectomy – A Swedish matched cohort study. *Eur J Surg Oncol* 2014;40:1209–15.

4. Lanitis S, Tekkis PP, Sgourakis G, *et al.* Comparison of skin-sparing mastectomy versus non-skin-sparing mastectomy for breast cancer: a meta-analysis of observational studies. *Ann Surg* 2010;251:632–9.

5. Sue GR, Lannin DR, Au AF, *et al.* Factors associated with decision to pursue mastectomy and breast reconstruction for treatment of ductal carcinoma in situ of the breast. *Am J Surg* 2013;206:682–5.

6. Jagsi R, Jiang J, Momoh AO, *et al.* Trends and variation in use of breast reconstruction in patients with breast cancer undergoing mastectomy in the United States. *J Clin Oncol* 2014;32:919–26.

7. Brennan ME, Spillane AJ. Uptake and predictors of post-mastectomy reconstruction in women with breast malignancy – systematic review. *Eur J Surg Oncol* 2013;39:527–41.

8. Shaikh IA, Thomas H, Vidyadharan R, *et al.* Post mastectomy immediate breast reconstruction 13 years experience in a single centre. *Indian J Surg Oncol* 2010;1:250–5.

9. Oda A, Kuwabara H, Fushimi K. Disparities associated with breast reconstruction in Japan. *Plast Reconstr Surg* 2013;132: 1392–9.

10. Fang SY, Balneaves LG, Shu BC. "A struggle between vanity and life": the experience of receiving breast reconstruction in women of Taiwan. *Cancer Nurs* 2010;33:E1–11.

11. Shameem H, Yip CH, Fong E. Immediate breast reconstruction after mastectomy – why do women choose this option? *Asian Pac J Cancer Prev* 2008;9:409–12.

12. Singapore Cancer Registry. *Trends of Female Breast Cancer in Singapore 2006-2010*. National Registry of Diseases Office: Singapore, 2012.

13. Gagliato Dde M, Gonzalez-Angulo AM, Lei X, *et al.* Clinical impact of delaying initiation of adjuvant chemotherapy in patients with breast cancer. *J Clin Oncol* 2014;32:735–44.

14. National Institute for Health and Clinical Excellence. Early and locally advanced breast cancer:diagnosis and treatment. (Clinical guideline 80). London: NICE, 2009. Available at: www.nice.org.uk/CG80 (accessed January 1, 2015).

15. National Comprehensive Cancer Network. Breast Cancer. Clinical Practice Guidelines in Oncology Version 3.2014. Available at: www.nccn.org (accessed January 1, 2015).

16. Missana MC, Laurent I, Germain M, *et al.* Long-term oncological results after 400 skin-sparing mastectomies. *J Visc Surg* 2013;150:313–20.

17. Romics L Jr, Chew BK, Weiler-Mithoff E, *et al.* Ten-year follow-up of skin-sparing mastectomy followed by immediate breast reconstruction. *Br J Surg* 2012;99:799–806.

18. Agrawal A, Sibbering DM, Courtney CA. Skin-sparing mastectomy and immediate breast reconstruction: a review. *Eur J Surg Oncol* 2013;39:320–8.

19. Morrow M, Scott SK, Menck HR, *et al.* Factors influencing the use of breast reconstruction postmastectomy: a National Cancer Database study. *J Am Coll Surg* 2001;192:1–8.

20. Levine SM, Levine A, Raghubir J, *et al.* A 10-year review of breast reconstruction in a university-based public hospital. *Ann Plast Surg* 2012;69:376–9.

21. Lindford AJ, Siponen ET, Jahkola TA, *et al.* Effect of delayed autologous breast reconstruction on breast cancer recurrence and survival. *World J Surg* 2013;37:2872–82.

22. Morrow M, Li Y, Alderman AK, *et al.* Access to breast reconstruction after mastectomy and patient perspectives on reconstruction decision making. *JAMA Surg* 2014;149:1015–21.

23. Alderman AK, Storey AF, Nair NS, *et al.* Financial impact of breast reconstruction on an academic surgical practice. *Plast Reconstr Surg* 2009;123:1408–13.

24. Gurunluoglu R, Gurunluoglu A, Williams SA, *et al.* Current trends in breast reconstruction: survey of American Society of Plastics Surgeons 2010. *Ann Plast Surg* 2013;70:103–10.

25. Seth AK, Silver HR, Hirsch EM, *et al.* Comparison of delayed and immediate tissue expander breast reconstruction in the setting of postmastectomy radiation therapy. *Ann Plast Surg* 2015;75:503–7.

26. Sim Y, Tan VK, Ho GH, *et al.* Contralateral prophylactic mastectomy in an Asian population: a single institution review. *Breast* 2014;23:56–62.

27. Lin IC, Nelson JA, Wu LC, *et al.* Assessing surgical and medical complications in bilateral abdomen-based free flap breast reconstructions, compared with unilateral free flap breast reconstructions. *Ann Plast Surg* 2016;77:61–6.

28. Liu C, Zhuan Y, Momeni A, *et al.* Quality of life and patient satisfaction after microsurgical abdominal flap versus staged expander/implant breast reconstruction: a critical study of unilateral immediate breast reconstruction using patient-reported outcomes instrument BREAST-Q. *Breast Cancer Res Treat* 2014;146:117–26.

29. Albornoz CR, Bach PB, Mehrara BJ, *et al.* A paradigm shift in US breast reconstruction: increasing implant rates. *Plast Reconstr Surg* 2013;131:15–23.

30. Kim EK, Eom JS, Hwang CH, *et al.* Immediate transverse recuts abdominis musculocutaneous (TRAM) flap breast reconstruction in underweight Asian patients. *Breast Cancer* 2014;21:693–7.

31. Kim EK, Eom JS, Ahn SH, *et al.* Evolution of the pedicled TRAM flap: a prospective study of 500 consecutive cases by a single surgeon. *Ann Plast Surg* 2009;63:378–82.

32. Singapore Cancer Registry. Trends in Cancer Incidence in Singapore 2008-2012 [online]. Available at: http://www.hpb.gov.sg/HOPPortal/content/conn/HOPUCM/path/Contribution%20Folders/uploadedFiles/HPB_Online/Publications/Cancer_Trends_Report_08-12.pdf (accessed November 24, 2013).

33. Ananian P, Houenaeghel G, Protiere C, *et al.* Determinants of patients' choice of reconstruction with mastectomy for primary breast cancer. *Ann Surg Oncol* 2004;11:762–71.

34. Wolfswinkel EM, Lopez SN, Weathers WM, *et al.* Predictors of post-mastectomy reconstruction in an underserved population. *J Plast Reconstr Aesthet Surg* 2013;66:763–9.

35. Wei R, Lau SS, Cheung PS. Breast carcinoma in Chinese women: does age affect treatment choice and outcome? *Asian J Surg* 2010;33:97–102.

36. Greenberg CC, Schneider EC, Lipsitz SR, *et al.* Do variations in provider discussions explain socioeconomic disparities in postmastectomy breast reconstruction? *J Am Coll Surg* 2008;206:605–15.

37. Lim J, Low SC, Hoe M. Breast reconstruction after mastectomy: a survey of general surgeons in Singapore. *ANZ J Surg* 2001;71:207–11.

38. Hequet D, Zarca K, Dolbeault S, *et al.* Reasons of not having breast reconstruction: a historical cohort of 1937 breast cancer patients undergoing mastectomy. *Springerplus* 2013;18:325.

39. August DA, Wilkins E, Rea T. Breast reconstruction in older women. *Surgery* 1994;115:663–8.

40. Sisco M, Johnson DB, Wang C, *et al.* The quality-of-life benefits of breast reconstruction do not diminish with age. *J Surg Oncol* 2015;111:663–8.

41. Lam WW, Fielding R, Ho EY, Chan M, Or A. Surgeon's recommendation, perceived operative efficacy and age dictate treatment choice by Chinese women facing breast cancer surgery. *Psychooncology* 2005;14:585–93.

42. Takahashi M, Kai I, Hisata M, Higashi Y. The association between breast surgeons' attitudes towards breast reconstruction and their reconstruction-related information-giving behaviors: a nationwide survey in Japan. *Plast Reconstr Surg* 2006;118:1507–14.