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ORIGINAL ARTICLE

Surgical options for Chinese patients with early invasive breast cancer: Data from the Hong Kong Breast Cancer Registry

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Summary *Background:* Breast conserving surgery (BCS) is preferred for suitable candidates, while mastectomy (MTX) with reconstruction (MTX + R) is considered a better option for patients requiring MTX. In Hong Kong, the rates of BCS and breast reconstruction are relatively low. This paper aims to study the surgical options and their predictors among Hong Kong breast cancer patients.
Methods: Data is retrieved from the Hong Kong Breast Cancer Registry (HKBCR) from 2007 to 2013. A total of 4519 Stage I–II breast cancer patients who had surgical treatments were included in this retrospective study.
Results: Our multivariate logistic regression shows that people who were younger (age < 40 years: OR, 1.5; 95% CI, 1.1–2.1; $p = 0.010$), more educated (undergraduate/postgraduate: OR, 2.8; 95% CI, 1.7–4.4; $p < 0.0001$), never married (OR, 1.5; 95% CI, 1.1–1.9; $p = 0.002$), had regular mammography screening (OR, 1.5; 95% CI, 1.3–1.8; $p < 0.0001$), had screen-detected cancers (OR, 1.3; 95% CI, 1.0–1.6; $p = 0.031$), and who underwent surgery at a private medical service facility (OR, 1.8; 95% CI, 1.6–2.2; $p < 0.0001$) were more likely to receive BCS. In addition, people who were younger (age < 40 years: OR, 15.9; 95% CI, 6.5–39.2; $p < 0.0001$), more educated (undergraduate/postgraduate: OR, 26.8; 95% CI, 3.6–201.4; $p = 0.001$), had regular mammography screening (OR, 1.6; 95% CI, 1.1–2.3; $p = 0.008$), had screen-detected cancers (OR, 2.1; 95% CI, 1.4–3.3; $p = 0.001$), and had smaller tumor (≤ 2.0 cm: OR, 0.39; 95% CI, 0.20–0.76; $p = 0.005$) were more likely to have reconstruction after MTX.

Conflicts of interest: All contributing authors declare no conflicts of interest.

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Conclusion: Chinese patients have lower BCS and breast reconstruction rate. Besides cultural difference, patient-related factors such as age, education, marital status, mammography screening, the use of private medical facilities, and clinical characteristics including smaller tumor size and peripherally located tumor were significant predictors for type of surgical treatments in Chinese women with early breast cancer.

1. Introduction

Over the last decade, breast cancer surgeries have evolved from radical mastectomy (MTX) to less aggressive surgical options. The development of breast conservation therapy has allowed doctors to have better control of the treatment process and improved cosmetic outcomes. A number of randomized trials have shown that breast conserving surgery (BCS) and modified radical MTX for women with early-stage breast cancer yield equal surgical outcomes.[1–5] Indeed, the National Institutes of Health in the US has recommended breast conservation therapy as an appropriate method of primary therapy for women with early-stage breast cancer.[6] In the 21st century, multidisciplinary management and personalized therapy of breast cancer emphasized both the survival outcome and the importance of functional recovery, with the ability to preserve and restore body shape and function, as well as psychosocial recovery and quality of life becoming an integral part of breast cancer management. Oncoplastic breast surgeries offering different reconstructive options have become important in modern breast cancer management.

Despite the availability of different surgical options for women with early-stage breast cancer, there are large geographical differences and institutional variations in the rates of breast conservation therapy and breast reconstructive surgeries.[7] According to the Hong Kong Hospital Authority's "6th Report of the Surgical Outcome Monitoring and Improvement Program", the rates of BCS and breast reconstruction in Hong Kong were 22.9% and 11%, respectively, among patients who had undergone MTX.[8] These rates are low compared to other countries. Meanwhile, studies in other countries have shown that surgical options for breast cancer are associated with age, education, ethnic groups, involvement of patients in decision making, and clinical pathological factors.[9–12] In a similar vein, we conducted a retrospective study using data extracted from the Hong Kong Breast Cancer Registry (HKBCR) to study the choices of surgical treatment in Hong Kong and to explore the influence of patient-related factors including age and level of education, clinical characteristics such as tumor size and medical service facilities factors on surgical choices for breast cancer treatment.

2. Methods

The HKBCR is the most comprehensive and representative registry on breast cancer in Hong Kong. The population-wide registry, established in 2007 by Hong Kong Breast Cancer Foundation (HKBCF), collects over 300 data items from each local breast cancer case, including risk exposures, treatments, clinical outcomes, and survival rates. The research and the analyses give patients, medical professionals, and policy makers a better understanding of breast cancer in Hong Kong and help to improve the prevention, detection, and treatment of breast cancer as well as care for patients.

From 2007 to 2013, as many as 6278 breast cancer patients had given their consent to be registered with the HKBCR. Our retrospective observation study examined the data of 4519 of these patients who were diagnosed with invasive breast cancer Stage I–II and who had surgical treatments for breast cancer. Data on patient factors such as demographics, clinical pathologic variables, and the use of public medical service facilities were extracted from the HKBCR and analyzed retrospectively.

The relationship between surgical treatments for breast cancer and patient characteristics, sociodemographic data, screening habits, clinical and pathologic variables, and medical service facilities factors were examined using univariate analysis. Binary logistics regression was employed to construct a predictive model to explain what factors had effects on outcome of BCS with reference to all MTX or what factor influenced the outcome of MTX with reconstruction (MTX + R) with reference to MTX alone. In univariate analysis, explanatory variables with $p < 0.1$ were included in the final multivariable analysis with backward stepwise regression. The explanatory variables in the final model with $p < 0.05$ were considered as significant predictors. All statistical analyses were performed by SPSS software version 18.0 (SPSS Inc., Chicago, IL, USA).

3. Results

A total of 4620 tumors were reported in the 4519 breast cancer patients we examined retrospectively, with 43.2% and 56.8% of the tumors diagnosed as Stage I and Stage II invasive breast cancer, respectively. Among the patients, 40.5% of them underwent BCS, 51.5% had MTX, and 8.0% underwent MTX + R. The laterality of tumors was similar in both breasts: 2274 (49.2%) patients had cancer in their left breasts, 2188 (47.4%) in their right breasts, and 79 (1.7%) had bilateral breast cancers.

3.1. Patient characteristics

The mean ages of patients who underwent BCS, MTX, and MTX + R were 48.4 years, 52.6 years, and 44.4 years,

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Table 1 Demographic and patient characteristics in patients undergoing breast conserving surgery, mastectomy, and mastectomy with reconstruction.

	BCS ($n = 1849$)	MTX ($n = 2310$)	MTX + R ($n = 360$)	p
Age group (y)				
< 40	271 (14.7%)	175 (7.6%)	88 (24.4%)	BCS vs. MTX, $p < 0.001$; MTX vs. MTX + R, $p < 0.001$
40–49	769 (41.6%)	791 (34.2%)	178 (49.4%)	
50–59	526 (28.4%)	794 (34.4%)	67 (18.6%)	
≥ 60	198 (10.7%)	500 (21.6%)	9 (2.5%)	
Unknown	85 (4.6%)	50 (2.2%)	18 (5.0%)	
Education level				
No schooling/kindergarten	37 (2.0%)	171 (7.4%)	1 (0.3%)	BCS vs. MTX, $p < 0.001$; MTX vs. MTX + R, $p < 0.001$
Primary school	289 (15.6%)	717 (31.0%)	32 (8.9%)	
Secondary school	942 (50.9%)	1072 (46.4%)	169 (46.9%)	
Matriculation	160 (8.7%)	108 (4.7%)	43 (11.9%)	
Undergraduate/ postgraduate	316 (17.1%)	156 (6.8%)	99 (27.5%)	
Unknown	105 (5.7%)	86 (3.7%)	16 (4.4%)	
Occupation				
Professional/clerical	723 (39.1%)	502 (21.7%)	180 (50.0%)	BCS vs. MTX, $p < 0.001$
Non-clerical/labor	268 (14.5%)	591 (25.6%)	56 (15.6%)	MTX vs. MTX + R, $p < 0.001$
Housewife	518 (28.0%)	825 (35.7%)	66 (18.3%)	
Self-employed	66 (3.6%)	57 (2.5%)	15 (4.2%)	
Retired/unemployed	135 (7.3%)	229 (9.9%)	14 (3.9%)	
Unknown	139 (7.5%)	106 (4.6%)	29 (8.1%)	
Marital status				
Never married	274 (14.8%)	206 (8.9%)	60 (16.7%)	BCS vs. MTX, $p < 0.001$; MTX vs. MTX + R, $p < 0.001$
Married	1338 (72.4%)	1824 (79.0%)	252 (70.0%)	
Widowed/divorced/ cohabitating	156 (8.4%)	225 (9.7%)	32 (8.9%)	
Unknown	81 (4.4%)	55 (2.4%)	16 (4.4%)	
Smoking before BC diagnosis				
No	1683 (91.0%)	2143 (92.8%)	328 (91.1%)	NS
Yes	80 (4.3%)	94 (4.1%)	17 (4.7%)	
Unknown	86 (4.7%)	73 (3.2%)	15 (4.2%)	
Previous breast diseases				
No	1481 (80.1%)	1942 (84.1%)	289 (80.3%)	NS
Yes	253 (13.7%)	299 (12.9%)	52 (14.4%)	
Unknown	115 (6.2%)	69 (3.0%)	19 (5.3%)	
Self-reported significant past health				
Good	1208 (65.3%)	1593 (69.0%)	257 (71.4%)	BCS vs. MTX, $p < 0.001$; MTX vs. MTX + R, $p < 0.001$
Minor	424 (22.9%)	427 (18.5%)	68 (18.9%)	
Major	91 (4.9%)	185 (8.0%)	4 (1.1%)	
Unknown	126 (6.8%)	105 (4.5%)	31 (8.6%)	
Reproductive history				
No	372 (20.1%)	320 (13.9%)	86 (23.9%)	BCS vs. MTX, $p < 0.001$; MTX vs. MTX + R, $p < 0.001$
Yes	1258 (68.0%)	1857 (80.4%)	230 (63.9%)	
Unknown	219 (11.8%)	133 (5.8%)	44 (12.2%)	
Breast self-examination				
Never	554 (30.0%)	1006 (43.5%)	89 (24.7%)	BCS vs. MTX, $p < 0.001$; MTX vs. MTX + R, $p < 0.001$
Occasional	719 (38.9%)	734 (31.8%)	174 (48.3%)	
Regular	440 (23.8%)	473 (20.5%)	75 (20.8%)	
Unknown	136 (7.4%)	97 (4.2%)	22 (6.1%)	
Clinical breast examination				
Never	565 (30.6%)	1184 (51.3%)	99 (27.5%)	BCS vs. MTX, $p < 0.001$; MTX vs. MTX + R, $p < 0.001$
Occasional	240 (13.0%)	230 (10.0%)	45 (12.5%)	
Regular	911 (49.3%)	805 (34.8%)	196 (54.4%)	
Unknown	133 (7.2%)	91 (3.9%)	20 (5.6%)	

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Table 1 (*continued*)

	BCS (n = 1849)	MTX (n = 2310)	MTX + R (n = 360)	p
Screening mammography				
Never	985 (53.3%)	1666 (72.1%)	197 (54.7%)	BCS vs. MTX, $p < 0.001$; MTX vs. MTX + R, $p < 0.001$
Occasional	193 (10.4%)	171 (7.4%)	35 (9.7%)	
Regular	530 (28.7%)	372 (16.1%)	106 (29.4%)	
Unknown	141 (7.6%)	101 (4.4%)	22 (6.1%)	
Average monthly household income				
< HK$10,000	182 (9.8%)	345 (14.9%)	23 (6.4%)	BCS vs. MTX, $p < 0.001$; MTX vs. MTX + R, $p < 0.001$
HK$10,000–29,999	496 (26.8%)	613 (26.5%)	89 (24.7%)	
≥ HK$30,000	543 (29.4%)	293 (12.7%)	141 (39.2%)	
Unknown	628 (34.0%)	1059 (45.8%)	107 (29.7%)	

BC = breast cancer; BCS = breast conserving treatment; MTX = mastectomy alone; MTX + R = mastectomy with reconstruction; NS: non-significance.

respectively. Patients who had BCS or MTX + R were significantly younger than those who had MTX. Compared with the patients who only had MTX, those who underwent BCS or MTX + R had a higher level of education (BCS 17.1% and MTX + R 27.5% vs. MTX 6.8%; all $p < 0.001$). Patients who had BCS or MTX + R were also more likely to have a professional occupation than patients with MTX (BCS 39.1% and MTX + R 50.0% vs. MTX 21.7%; all $p < 0.001$). The percentage of patients who were never married was higher in the BCS or MTX + R group than the MTX group (BCS 14.8% and MTX + R 16.7% vs. MTX 8.9%; all $p < 0.001$). The BCS or MTX + R group also had a higher household income than the MTX group (BCS 29.4% and MTX + R 39.2% vs. MTX 12.7%; all $p < 0.001$) (Table 1).

3.2. Clinical characteristics

Table 2 presents the clinical and pathological characteristics by type of surgical treatments. Patients who had BCS were more likely to have smaller tumors than those who had MTX (62.6% vs. 43.7%, $p < 0.001$). However, the patients who underwent MTX + R were more likely to have larger tumors than the MTX group (7.8% vs. 2.6%, $p < 0.001$). The location of the breast tumor has been found to be significantly associated with the type of surgical treatments. The BCS group had fewer central breast tumors than the MTX group (3.7% vs. 6.8%, $p < 0.001$), while the percentage of central breast tumors was significantly higher in the MTX + R group compared to the MTX group (15.6% vs. 6.8%, $p < 0.001$). Patients who underwent BCS had fewer multifocal and multicentric breast tumors than those who had MTX (all $p < 0.001$). By contrast, patients who underwent MTX + R had more multifocal and multicentric breast tumors than the MTX group (all $p < 0.001$). Significantly more patients in the BCS group had estrogen receptor (ER) positive or progesterone receptor (PR) positive cancers than in the MTX group, and significantly fewer patients in the BCS group were c-erbB2 positive than in the MTX group (all $p < 0.001$). These differences were absent between the MTX group and the MTX + R group.

3.3. Breast screening habits

The percentage of patients who had regular mammography screening was higher in the BCS group than in the MTX group (28.7% vs. 16.1%, $p < 0.001$). This observation was also found in the MTX + R group when compared with the MTX group (29.4% vs. 16.1%, $p < 0.001$) (Table 1).

3.4. Surgical treatment at private and public medical facilities

Of the 4620 invasive breast tumor cases, 2825 (61.1%) were treated surgically in a private medical facility, and the rest, 1795 (38.9%), in a public medical facility. Patients who had BCS were more likely to receive surgical treatment in a private medical facility compared with those who underwent MTX (73.4% vs. 50.5%, $p < 0.001$). Patients who had MTX + R were also more likely to opt for a private hospital than the MTX group (67.1% vs. 50.5%, $p < 0.001$) (Table 2).

3.5. Factors associated with BCS vs. MTX

Using multivariate logistic regression, significant predictive factors for BCS included younger age (age < 40 years: OR, 1.5; 95% CI, 1.1–2.1; $p = 0.010$; age 40–49 years: OR, 1.6; 95% CI, 1.2–2.0; $p < 0.0001$), higher education level (secondary school: OR, 2.2; 95% CI, 1.4–3.3; $p < 0.0001$; matriculation: OR, 2.6; 95% CI, 1.5–4.2; $p < 0.0001$; undergraduate/postgraduate: OR, 2.8; 95% CI, 1.7–4.4; $p < 0.0001$), never married (OR, 1.5; 95% CI, 1.1–1.9; $p = 0.002$), minor significant past health (OR, 1.2; 95% CI, 1.0–1.5; $p = 0.019$), regular mammography screening (occasional screening: OR, 1.5; 95% CI, 1.2–1.9; $p = 0.001$; regular screening: OR, 1.5; 95% CI, 1.3–1.8; $p < 0.0001$), method of first detection (screen-detected: OR, 1.3; 95% CI, 1.0–1.6; $p = 0.031$), smaller tumor size (tumor size ≤ 2.0 cm: OR, 13.4; 95% CI, 6.0–30.1; $p < 0.0001$; tumor size 2.01–5.0 cm: OR, 6.2; 95% CI, 2.8–14.0; $p < 0.0001$), tumor in the central region (OR, 0.43; 95% CI, 0.31–0.61; $p < 0.0001$), and private medical service facility (OR, 1.8; 95% CI, 1.6–2.2; $p < 0.0001$) (Table 3).

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Table 2 Clinical characteristics in patients undergoing breast conserving surgery, mastectomy and mastectomy with reconstruction.

	BCS ($n = 1871$)	MTX ($n = 2378$)	MTX + R ($n = 371$)	p
Surgery in medical facility				
Private hospital	1374 (73.4%)	1202 (50.5%)	249 (67.1%)	BCS vs. MTX, $p < 0.001$; MTX vs. MTX + R, $p < 0.001$
Public hospital	497 (26.6%)	1176 (49.5%)	122 (32.9%)	
Method of first detection				
Accidental discovery	1473 (78.7%)	1950 (82.0%)	289 (77.9%)	BCS vs. MTX, $p < 0.001$; MTX vs. MTX + R, $p < 0.001$
Screen-detected	247 (13.2%)	158 (6.6%)	48 (12.9%)	
Unknown	151 (8.1%)	270 (11.4%)	34 (9.2%)	
Largest tumor size (cm)[a]				
≤ 2.00	1171 (62.6%)	1039 (43.7%)	111 (29.9%)	BCS vs. MTX, $p < 0.001$; MTX vs. MTX + R, $p < 0.001$
2.01–5.00	658 (35.2%)	1206 (50.7%)	217 (58.5%)	
> 5.00	12 (0.6%)	61 (2.6%)	29 (7.8%)	
Unknown	30 (1.6%)	72 (3.0%)	14 (3.8%)	
Upper outer quadrant (UOQ)				
No	994 (53.1%)	1254 (52.7%)	215 (58.0%)	NS
Yes	877 (46.9%)	1124 (47.3%)	156 (42.0%)	
Upper inner quadrant (UIQ)				
No	1458 (77.9%)	1934 (81.3%)	293 (79.0%)	BCS vs. MTX, $p = 0.006$; MTX vs. MTX + R, NS
Yes	413 (22.1%)	444 (18.7%)	78 (21.0%)	
Lower outer quadrant (LOQ)				
No	1605 (85.8%)	2035 (85.6%)	325 (87.6%)	NS
Yes	266 (14.2%)	343 (14.4%)	46 (12.4%)	
Lower inner quadrant (LIQ)				
No	1696 (90.6%)	2181 (91.7%)	335 (90.3%)	NS
Yes	175 (9.4%)	197 (8.3%)	36 (9.7%)	
Central				
No	1801 (96.3%)	2217 (93.2%)	313 (84.4%)	BCS vs. MTX, $p < 0.001$; MTX vs. MTX + R, $p < 0.001$
Yes	70 (3.7%)	161 (6.8%)	58 (15.6%)	
Multifocality				
No	1085 (58.0%)	1172 (49.3%)	175 (47.2%)	BCS vs. MTX, $p < 0.001$
Yes	148 (7.9%)	313 (13.2%)	110 (29.7%)	MTX vs. MTX + R, $p < 0.001$
Unknown	638 (34.1%)	893 (37.5%)	86 (23.2%)	
Multicentricity				
No	1202 (64.2%)	1349 (56.7%)	229 (61.7%)	BCS vs. MTX, $p < 0.001$
Yes	11 (0.6%)	78 (3.3%)	42 (11.3%)	MTX vs. MTX + R, $p < 0.001$
Unknown	658 (35.2%)	951 (40.0%)	100 (27.0%)	
ER positive				
No	367 (19.6%)	596 (25.1%)	92 (24.8%)	BCS vs. MTX, $p < 0.001$; MTX vs. MTX + R, NS
Yes	1458 (77.9%)	1708 (71.8%)	261 (70.4%)	
Unknown	46 (2.5%)	74 (3.1%)	18 (4.9%)	
PR positive				
No	591 (31.6%)	846 (35.6%)	146 (39.4%)	BCS vs. MTX, $p = 0.002$; MTX vs. MTX + R, NS
Yes	1232 (65.8%)	1443 (60.7%)	204 (55.0%)	
Unknown	48 (2.6%)	89 (3.7%)	21 (5.7%)	
cerbB positive				
No	1206 (64.5%)	1265 (53.2%)	194 (52.3%)	BCS vs. MTX, $p < 0.001$; MTX vs. MTX + R, NS
Yes	307 (16.4%)	528 (22.2%)	103 (27.8%)	
Unknown	358 (19.1%)	585 (24.6%)	74 (19.9%)	

BCS = breast conserving treatment; MTX = mastectomy alone; MTX + R = mastectomy with reconstruction; ER = estrogen receptor; PR = progesterone receptor; NS = non-significance.

[a] Largest tumor size is used for analysis if there is more than one tumor in the same breast.

3.6. Factors associated with MTX + R versus MTX

Table 3 shows that significant explanatory factors for MTX + R in the multivariate logistic regression model included younger age (age < 40 years: OR, 15.9; 95% CI, 6.5–39.2; $p < 0.0001$; age 40–49: OR, 9.3; 95% CI, 3.9–21.8; $p < 0.0001$; age 50–59 years: OR, 4.2; 95% CI, 1.8–10.1; $p = 0.001$), higher education level (secondary

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Table 3 Multivariate regression on likelihood of breast surgery for invasive breast cancer cases.

	BCS (all MTX: reference)	*p*	MTX + R (MTX: reference)	*p*
	Adjusted OR (95% CI)		Adjusted OR (95% CI)	
Age group	Reference: > 60 y.o.			
< 40	1.5 (1.1–2.1)	0.010	15.9 (6.5–39.2)	< 0.0001
40–49	1.6 (1.2–2.0)	< 0.0001	9.3 (3.9–21.8)	< 0.0001
50–59	1.2 (0.97–1.6)	0.082	4.2 (1.8–10.1)	0.001
Education level	Reference: no schooling/kindergarten			
Primary school	1.5 (0.98–2.3)	0.060	4.1 (0.54–30.8)	0.174
Secondary school	2.2 (1.4–3.3)	< 0.0001	8.5 (1.2–62.9)	0.035
Matriculation	2.6 (1.5–4.2)	< 0.0001	17.7 (2.3–136.2)	0.006
Undergraduate/postgraduate	2.8 (1.7–4.4)	< 0.0001	26.8 (3.6–201.4)	0.001
Marital status	Reference: married			
Never married	1.5 (1.1–1.9)	0.002	1.1 (0.72–1.7)	0.618
Divorced/separated/cohabitating	1.1 (0.88–1.5)	0.339	1.9 (1.2–3.1)	0.010
Self-reported significant past health	Reference: good			
Minor	1.2 (1.0–1.5)	0.019	1.0 (0.72–1.5)	0.837
Major	1.0 (0.77–1.4)	0.801	0.22 (0.07–0.71)	0.011
Screening mammography	Reference: never			
Occasional	1.5 (1.2–1.9)	0.001	1.4 (0.84–2.3)	0.207
Regular	1.5 (1.3–1.8)	< 0.0001	1.6 (1.1–2.3)	0.008
Method of first detection	Reference: accidental discovery			
Screen-detected	1.3 (1.0–1.6)	0.031	2.1 (1.4–3.3)	0.001
Largest tumor size (cm)	Reference: > 5.00 cm			
≤ 2.0	13.4 (6.0–30.1)	< 0.0001	0.39 (0.20–0.76)	0.005
2.01-5.00	6.2 (2.8–14.0)	< 0.0001	0.69 (0.36–1.3)	0.258
Tumor at central region	0.43 (0.31–0.61)	< 0.0001	2.2 (1.4–3.4)	0.001
Surgical operation location	Reference: public hospital			
Private hospital	1.8 (1.6–2.2)	< 0.0001	––	

school: OR, 8.5; 95% CI, 1.2–62.9; $p = 0.035$; matriculation: OR, 17.7; 95% CI, 2.3–136.2; $p = 0.006$; undergraduate/postgraduate: OR, 26.8; 95% CI, 3.6–201.4; $p = 0.001$), having divorced (OR, 1.9; 95% CI, 1.2–3.1; $p = 0.010$), major significant past health (OR, 0.22; 95% CI, 0.07–0.71; $p = 0.011$), regular mammography screening (OR, 1.6; 95% CI, 1.1–2.3; $p = 0.008$), method of first detection (screen-detected: OR, 2.1; 95% CI, 1.4–3.3; $p = 0.001$), smaller tumor size (tumor size ≤ 2.0 cm: OR, 0.39; 95% CI, 0.20–0.76; $p = 0.005$), and tumor at central region (OR, 2.2; 95% CI, 1.4–3.4; $p = 0.001$) (Table 3).

Receiver operating characteristic curves were constructed to indicate how well the prediction models for BCS and breast reconstruction were. Area under the curve (AUC) ranging from 0.7 to 0.8 was considered as fair, while one ranging from 0.8 to 0.9 was deemed as good. Figures 1A and 1B showed that AUCs were 0.711 for BCS and 0.818 for MTX + R, indicating that the models produced fairly good predictions for the outcomes of interest.

4. Discussion

In Hong Kong, the incidence of breast cancers has increased over time, with the latest reported incidence being over 3500 cases in 2012, indicating an increasing need for surgical treatment for breast cancer patients.[13] Compared with other countries, Hong Kong has a lower rate of BCS and reconstructive surgery. The difference may be attributable to cultural difference[14] or patient-related factors.[15–17]

Our study shows that 40.5% of Chinese women patients have had BCS, which is higher than what was reported in Hong Kong Hospital Authority's Surgical Outcome Monitoring and Improvement Program (SOMIP).[8] The main reason for the difference is SOMIP only included patients from public hospitals, which have a lower rate of BCS. However, our study reports that 8.0% underwent MTX + R and the rate is low when compared to western countries, where the rate of BCS was 61.4% and the rate of MTX + R was 70%.[18,19] Asian/Pacific Islanders were more likely to undergo MTX[18] and Asian and black women were less likely to undergo MTX + R as compared to white women.[19] This might be attributed to a generally more conservative attitude of Chinese patients. According to our findings, younger women and/or those who have a higher education level or who are more knowledgeable were more likely to have BCS and breast reconstruction. The results were in agreement with previous studies.[20–24] It is possible that patients who are more educated feel more empowered to be involved in choosing the type of surgical treatment they are to undergo. Healthcare professionals and patients should note that patient education on BCS and breast reconstruction can influence the surgical option. While marital status was not a significant predictor for breast conserving treatment

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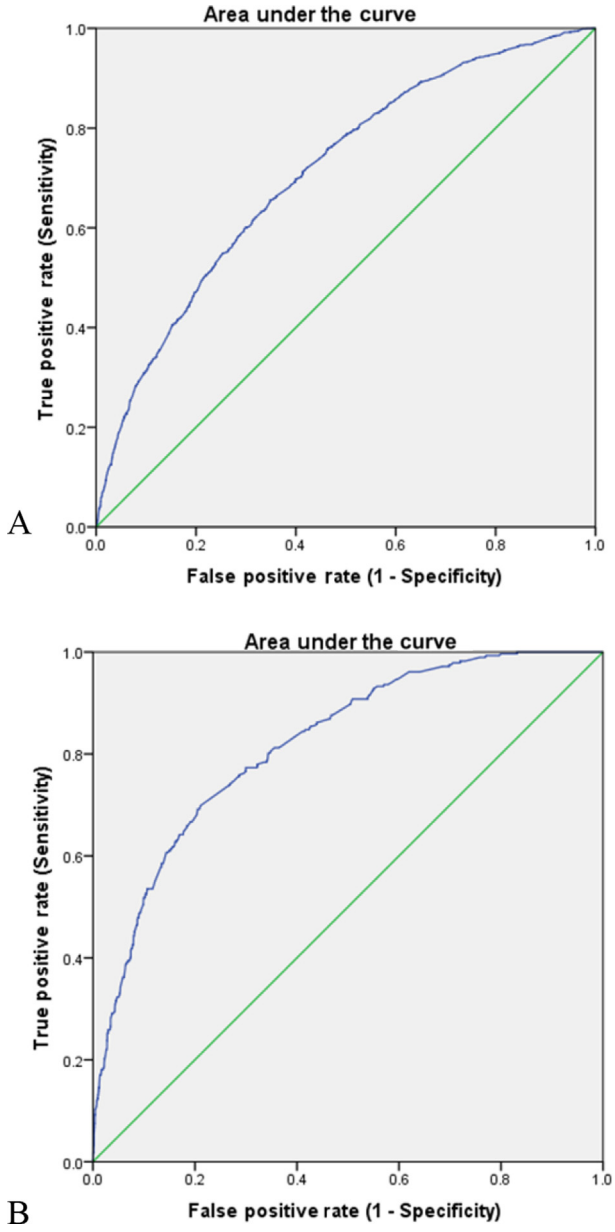

Figure 1 (A) Receiver operating characteristic (ROC) curve for breast conserving surgery (AUC = 0.711), (B) ROC curve for mastectomy with reconstruction (AUC = 0.818).

in previous studies,[9,24,25], our study has found that it is one of the predictor factors for BCS and MTX + R. "Never married" was a significant determinant for BCS, whereas women who were divorced or widowed were more likely to have MTX + R compared to those who had MTX alone.

In Hong Kong, there is no population-based breast cancer screening; women can only access screening service in private sector. Our study also shows that mammography screening, screen-detected tumor, and smaller tumor size were associated with increased likelihood of BCS, a finding in line with previous studies that suggested breast cancer screening increases the rate of BCS.[26–28] Breast cancer screening not only saves lives,[29–35] but also retains breasts for cosmetic reasons, which improves the psychosocial being and quality of life of breast cancer patients. The HKBCF has long been an advocate of a population-wide mammography screening program in Hong Kong where such an initiative is yet to be in place. Our data show the benefits of breast screening and should be taken into account in the drawing up of local breast screening policy.

Meanwhile, the rate of breast conservation has been found to be lower in patients with centrally located tumor and larger tumor. These factors seem intrinsic, but with medical advances in oncoplastic surgery[36–39] and neoadjuvant chemotherapy,[40] it helped to extend BCS indication. Tumors considered too large or that are situated in an unfavorable location for breast conservation therapy should be evaluated with input from both the oncologists and surgeons with oncoplastic training. Education and training in techniques extending BCS indication as well as in various breast reconstruction options should enable surgeons to offer personalized surgical options for breast cancer patients.

It is noteworthy that more patients in private medical facilities underwent BCS compared with public medical facilities. In Hong Kong, all patients have free medical coverage by government including all surgical procedures in public hospitals. In this context, financial cost is unlikely affecting the choice of surgical options. Is the difference attributed to surgeon belief, the surgeon's technique, resources implication, or worry of re-excision? Based on the scientific clinical evidence published by the National Guideline Clearinghouse and the National Collaborating Centre for Cancer, surgical management of early-stage breast cancer and ductal carcinoma *in situ* for eligible candidates should be based on patient's preference, not the surgeon's preference.[41,42] However, patient preference may be affected by culture and informed consent process. Further studies are appreciated to delineate how these factors interact with the informed consent process and surgical choices.

Our study is the first study using more than 4000 patients' data extracted from the HKBCR to investigate the factors associated with surgical treatments for Chinese breast cancer patients in Hong Kong. However, our study is a study of retrospective data retrieval only. It does not include physician difference and it cannot capture data on patient's own decision factors.

In conclusion, this study has shown that patient-related factors such as age, education, marital status, mammography screening, the use of private medical facilities, and clinical characteristics including smaller tumor size and peripherally located tumor, were significant predictors for type of surgical treatments in Chinese women with early breast cancer. More works are to be done on patient education, surgical training, for example, neoadjuvant chemotherapy and oncoplastic surgery techniques, which increase surgical options for breast cancer patients. By promoting these aspects, we believe surgeons and patients themselves could make better surgical decisions for their surgical treatment of breast cancer.

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