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Oncoplastic breast conservation occupies a niche between standard breast conservation and mastectomy – A population-based prospective audit in Scotland

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ABSTRACT

Introduction: The role of oncoplastic breast conservation (OBC) surgery is not fully defined in terms of whether it is equivalent to standard breast conservation (SBC), or more an alternative to mastectomy, or whether it occupies its own niche somewhere between the two. Therefore, we have carried out a population-based prospective audit of the current OBC practice in Scotland.

Methods: All patients diagnosed with breast cancer in the whole of Scotland between 01/01/2014 and 31/12/2015 were prospectively recorded within the National Managed Clinical Networks databases. Patients treated with OBC were compared to patients who had SBC, mastectomy and mastectomy with immediate reconstruction (MIR).

Results: 8075 patients were included (OBC:217(2.7%); SBC:5241(64.9%); mastectomy:1907(23.6%); MIR:710(8.8%)). OBC patients were younger than SBC or mastectomy, but older than MIR ($p < 0.0001$). OBC patients were between SBC and mastectomy patients in terms of clinical and pathological tumour size (all $p < 0.001$), rates of lobular cancers (v.SBC:$p = 0.015$ and v.mastectomy:$p < 0.001$), high-grade tumours (v.SBC:$p = 0.030$ and v.mastectomy:$p = 0.008$), ER negative (v.SBC: $p = 0.042$) and HER-2 positive (v.SBC: $p = 0.003$) tumours, and nodal metastasis (v.mastectomy: $p < 0.001$). More OBC patients received (neo)adjuvant chemo- and hormonal therapy ($p \leq 0.001$), adjuvant radiotherapy ($p = 0.005$), trastuzumab ($p < 0.001$) than SBC. More OBC patients presented through screening (v.mastectomy/MIR: $p < 0.0001$). Time to surgery from diagnosis was longer for OBC than SBC/mastectomy ($p < 0.0001$), but shorter than MIR ($p = 0.007$).

Conclusion: This national audit demonstrates that OBC occupies its own niche between SBC, mastectomy and MIR in the surgical treatment of breast cancer in Scotland. We recommend that OBC should be recorded separately in other national breast cancer registries.

Introduction

Oncoplastic techniques for breast conservation include various volume displacement and replacement techniques aiming to partially reconstruct the breast after tumour excision [1]. Increased experience with oncoplastic breast surgical techniques over the last two decades has permitted breast conserving surgery to be carried out for larger tumours, which previously would have required mastectomy [2,3]. In addition, oncoplastic techniques may provide an improved aesthetic outcome, which has been shown to be important in terms of the patients' psychosocial wellbeing and

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quality of life [4,5].

To date, practice and outcomes of oncoplastic breast conservation (OBC) have primarily been reported in the form of single institution case series with a significant proportion of those being retrospective studies with small patient numbers [3,6–17]. So far only one single national audit on OBC practice has been published despite the global application of the technique [2].

Traditionally, breast cancer national audits on surgical outcomes classify breast surgeries as breast conservation, mastectomy and mastectomy with immediate reconstruction [18,19]. As oncoplastic breast conservation (OBC) represent a further treatment option, it is important to collect robust comparative nationwide data.

Existing comparative studies of OBC generally compare outcomes to those in SBC [3,7,8,20–24]. While a few comparative studies with mastectomy have also been published, the role of OBC is not fully defined in terms of whether it is equivalent to SBC, but rather an alternative to mastectomy, or whether it occupies its own niche somewhere between the two [3,12,20,25,26].

Therefore, we have carried out a population-based prospective audit of current OBC practice in comparison to SBC, mastectomy and mastectomy with immediate reconstruction (MIR) based on the cancer registry database of the National Managed Clinical Network in Scotland. We have focused on comparative analysis of tumour and patient characteristics, adjuvant and neoadjuvant treatments, time to surgery from diagnosis and time to adjuvant treatment from surgery.

Methods

All patients diagnosed with breast cancer in Scotland over a two year period (between 01/01/2014 and 31/12/2015) were identified from prospectively maintained databases within the National Managed Clinical Networks/Cancer Networks of the 3 Scottish regions covering the whole of Scotland (WOSCAN: West of Scotland Cancer Network, SCAN: East of Scotland Cancer Network and NOSCAN: North of Scotland Cancer Network [27]. Since 2014, therapeutic mammoplasty (OBC) has been coded separately as final surgical treatment within the National Minimal Core Dataset to Support the Introduction of Breast Quality Performance Indicators (Information Services Division of NHS National Services Scotland) [28]. Therefore, from this database we were able to identify patients who had undergone OBC, SBC, mastectomy, or MIR as their final definitive surgery in whole Scotland. From the same database, data was collected for each patient regarding patient age at diagnosis, tumour pathology, neoadjuvant treatment and adjuvant treatment including the dates on which this was commenced. Patients who had any other kind of procedure or who received non-operative treatment only were excluded. Approval for access to this data was granted by the Public Benefit and Privacy Panel for Health and Social care in Scotland. Caldicott guardian approval was gained for the study from the relevant Cancer Networks.

Patient and tumour characteristics were compared between the four groups. Pearson Chi square was used to compare categorical variables. Z-test was used to compare 2 population proportions. Mann-Whitney test was used to compare two medians. All tests were two sided. All analysis was carried out using IBM SPSS Statistics version 22 (IBM Corp, Armonk, NY).

Results

8075 patients were included in the study. The median age at diagnosis was 61.6 years (23–97). 217 (2.7%) patients had OBC as their definitive surgical procedure. 5241 (64.9%) had SBC, 710 (8.8%) had MIR and 1907 (23.6%) had mastectomy alone. Of all patients who underwent conservation surgery, OBC comprised 4.0% of these operations. When rates were analysed between the three geographical regions of Cancer Networks in Scotland, WOSCAN patients had the highest rates of OBC within the breast conservation group (WOSCAN: 120/2484, 4.8%; SCAN: 60/1695, 3.5%; NOSCAN: 37/1279, 2.9%; $p = 0.0032$). However, overall, SCAN had the highest rate of breast conservation from the three regions (SCAN: 1695/2229, 76.0%; NOSCAN: 1279/1983, 64.5%; WOSCAN: 2484/3863, 64.3%; $p < 0.0001$) (Table 1).

The median age of OBC patients was between that of SBC and mastectomy patients (OBC: 55 years (29–81) vs. SBC: 62 years (23–97), or vs. mastectomy: 70 years (25–96), both $p < 0.0001$) and MIR patients (50 years (24–78), $p < 0.0001$) (Table 2). OBC patients were more likely to present through screening than patients in either of the other two groups (both $p < 0.0001$) (Table 2). OBC patients had a higher proportion of lobular cancers and DCIS compared to SBC patients ($p = 0.015$), and had more DCIS but fewer lobular cancers compared to mastectomy patients ($p < 0.0001$). Interestingly, tumour subtypes were similar between OBC and MIR patients (Table 2). OBC patients had higher clinical T (cT) stage ($p < 0.001$) and larger pathological tumour size compared to SBC patients (median invasive tumour size (ITS) OBC: 20 mm (1-90) v SBC: 15 mm (0-95), $p < 0.001$; median whole tumour size (WTS) OBC: 25 mm (1–120) v SBC: 17 mm (0–123), $p < 0.001$) (Table 2). Conversely, OBC patients had lower cT stage ($p < 0.001$) and smaller pathological tumour size compared to mastectomy (median ITS mastectomy: 27 mm (0–190), $p < 0.001$; median WTS mastectomy: 33 mm (0–190), $p < 0.001$). cT stage was similar in patients treated with OBC and MIR ($p = 0.121$), but ITS and WTS was, again, smaller in OBC in comparison to MIR patients (median ITS MIR: 21 mm (0–180), $p = 0.030$; median WTS MIR: 35 mm (1–246), $p < 0.001$) (Table 2). Tumour grade of patients treated with OBC was between the SBC and mastectomy groups, with more high-grade tumours in the SBC group ($p = 0.030$) and more lower grade cancers compared to the mastectomy group ($p = 0.008$) (Table 2). There were more ER negative ($p = 0.042$) and HER-2 positive ($p = 0.003$) patients in the OBC group than in the SBC group and fewer node positive cases in OBC patients when compared to mastectomy ($p < 0.001$) or MIR patients ($p = 0.006$) (Table 2).

Time to first surgery from diagnosis was significantly longer for patients treated with OBC compared to SBC (median 43 days (11–133) vs 29 days (4–176); $p < 0.0001$) or mastectomy (32 (4–178); $p < 0.0001$), but it was shorter than MIR (51 days (8–175); $p < 0.0001$) (Table 3). Similarly, time to final surgery was longer when patients were treated with OBC compared to SBC (median 49 days (11–133) vs 33 days (4–176); $p < 0.0001$) or mastectomy (34.5 (4–178); $p < 0.0001$), but it was shorter than MIR (59 days (11–175); $p = 0.0001$) (Table 3).

Neoadjuvant chemotherapy rate in patients treated with OBC was significantly higher when compared to SBC (15.3% v 7.3%, $p < 0.001$) (Table 4). Similarly, the neoadjuvant hormonal treatment rate before OBC was significantly higher than for SBC (10.2% v 4.6%, $p < 0.001$) (Table 4). Neoadjuvant chemo- and hormonal treatment

Table 1
Regional differences in type of breast cancer surgeries in Scotland.

	WOSCAN n (%)	SCAN n (%)	NOSCAN n (%)	Totals n (%)
OBC	120 (3.1)	60 (2.7)	37 (1.9)	217 (2.7)
SBC	2364 (61.2)	1635 (73.4)	1242 (62.6)	5241 (64.9)
Mastectomy	1018 (26.4)	362 (16.2)	527 (26.6)	1907 (23.6)
MIR	361 (9.3)	172 (7.7)	177 (8.9)	710 (8.8)
	3863	2229	1983	8075

OBC: oncoplastic breast conservation; SBC: standard breast conservation; MIR: Mastectomy with immediate reconstruction SCAN: East of Scotland Cancer Network; NOSCAN: North of Scotland Cancer Network; WOSCAN: West of Scotland Cancer Network.

Table 2
Clinicopathological characteristics of patients in each surgical group.

	OBC n (%)	SBC n (%)	Mastectomy n (%)	MIR n (%)	p value OBC v SBC	P value OBC v mastect.	P value OBC v MIR
Age					<0.0001	<0.0001	<0.0001
≤50years	66 (30.4)	882 (16.8)	319 (16.7)	361 (50.8)			
51-69 y≥≥ears	127 (58.5)	3130 (59.7)	802 (42.1)	325 (45.8)			
≥70 years	24 (11.1)	1229 (23.4)	786 (41.2)	24 (3.4)			
Mode of referral					0.074	<0.0001	<0.0001
Screening service	92 (42.4)	2468 (47.1)	387 (20.3)	175 (24.7)			
Other screening (eg. review/FH clinic)	4 (1.8)	189 (3.6)	127 (6.7)	66 (9.3)			
Symptomatic	119 (54.8)	2569 (49.0)	1380 (72.4)	464 (65.4)			
Other	2 (0.9)	15 (0.3)	13 (0.7)	4 (0.6			
Tumour type					0.015	<0.0001	0.078
DCIS	29 (13.4)	524 (10.0)	107 (5.6)	114 (16.1)			
Ductal/NST	153 (70.5)	3814 (72.8)	1308 (68.6)	437 (61.5)			
Lobular	27 (12.4)	426 (8.1)	339 (17.8)	101 (14.2)			
Mucinous/Medullary/Tubular	5 (2.3)	231 (4.4)	46 (2.4)	21 (3.0)			
Mixed/other invasive	2 (0.9)	175 (3.3)	102 (5.3)	34 (4.8)			
Other	1 (0.5)	67 (1.3)	5 (0.3)	3 (0.4)			
cT stage					<0.0001	<0.0001	0.121
cT0	0 (0)	64 (1.3)	12 (0.7)	13 (2.0)			
cTis	35 (18.8)	553 (11.6)	134 (7.8)	136 (21.2)			
cT1	61 (32.8)	2887 (60.4)	501 (29.1)	215 (33.4)			
cT2	76 (40.9)	1177 (24.6)	733 (42.6)	212 (33.0)			
cT3	8 (4.3)	42 (0.9)	179 (10.4)	47 (7.3)			
cT4	6 (3.2)	60 (1.3)	163 (9.5)	20 (3.1)			
ITS					<0.0001	<0.0001	0.030
≤20 mm	94 (51.9)	3272 (72.5)	581 (33.5)	265 (47.7)			
21–50 mm	76 (42.0)	1201 (26.6)	899 (51.8)	216 (38.9)			
>50 mm	11 (6.1)	42 (0.9)	255 (14.7)	74 (13.3)			
WTS					<0.0001	<0.0001	<0.0001
≤20 mm	69 (33.0)	3295 (65.1)	390 (21.2)	166 (24.8)			
21–50 mm	113 (54.1)	1690 (33.4)	1032 (56.2)	314 (46.9)			
>50 mm	27 (12.9)	79 (1.6)	414 (22.5)	189 (28.3)			
Grade					0.030	0.008	0.645
I	17 (9.2)	745 (16.2)	87 (5.0)	50 (8.9)			
II	97 (52.7)	2344 (51.1)	836 (47.7)	318 (56.6)			
III	70 (38.0)	1502 (32.7)	831 (47.4)	194 (34.5)			
ER status					0.042	0.323	0.232
Negative	40 (20.2)	716 (14.9)	423 (23.3)	104 (16.5)			
Positive	158 (79.8)	4087 (85.1)	1391 (76.7)	526 (83.5)			
HER2 status					0.003	0.144	0.197
Positive	34 (18.3)	509 (11.1)	338 (19.0)	102 (17.4)			
Negative	151 (81.2)	4083 (88.8)	1437 (80.9)	484 (82.6)			
Inconclusive	1 (0.5)	5 (0.1)	1 (0.1)	0 (0)			
Nodal status					0.211	<0.0001	0.006
Negative	141 (74.2)	3609 (78.0)	947 (51.4)	431 (63.5)			
Positive	49 (25.8)	1015 (22.0)	897 (48.6)	248 (36.5)			

OBC: oncoplastic breast conservation; SBC: standard breast conservation; mastect.: mastectomy; MIR: mastectomy with immediate reconstruction; *c*T stage: clinical tumour stage; ITS: invasive tumour size; WTS: whole tumour size; ER: oestrogen receptor.

Table 3
Time to surgery from diagnosis by type of surgery.

	OBC n (%)	SBC n (%)	Mastectomy n (%)	MIR n (%)	p OBC v SBC	p OBC v mastect	p OBC v MIR
Time to first breast surgery from diagnosis					<0.0001	<0.0001	0.007
1–30 days	18 (16.4)	1731 (52.5)	520 (46.4)	58 (16.5)			
31–60 days	70 (63.6)	1397 (42.4)	516 (46.0)	167 (47.6)			
61–90 days	16 (14.5)	131 (4.0)	60 (5.4)	107 (30.5)			
90 days	6 (5.5)	37 (1.1)	25 (2.2)	19 (5.4)			
Time to final breast surgery from diagnosis					<0.0001	<0.0001	0.002
1–30 days	14 (12.7)	1478 (44.5)	448 (39.8)	27 (7.6)			
31–60 days	57 (51.8)	1428 (42.9)	483 (42.9)	139 (38.9)			
61–90 days	29 (26.4)	315 (9.5)	123 (10.9)	106 (29.7)			
90 days	10 (9.1)	104 (3.1)	72 (6.4)	85 (23.8)			

OBC: oncoplastic breast conservation; SBC: standard breast conservation; mastect.: mastectomy; MIR: mastectomy with immediate reconstruction. Patients with neodjuvant treatment, M1 stage and time over 6 months to surgery from diagnosis were excluded.

rates were comparable between OBC, mastectomy and MIR patients. A significantly higher rate of OBC patients in comparison to SBC received adjuvant chemotherapy (34.1% v 21.5%, $p < 0.001$), radiotherapy (96.8% v 91.4%, $p = 0.005$), hormonal treatment (54.6% v 65.3%, $p = 0.001$) and trastuzumab (13.9% v 6.8%, $p < 0.001$) (Table 4). Adjuvant treatment rates of OBC, mastectomy and MIR patients were comparable except for radiotherapy, as expected.

1859 patients received adjuvant chemotherapy (67 OBC, 1034 SBC, 555 mastectomy and 203 MIR) (Table 5). The median time to adjuvant chemotherapy from final surgery for OBC patients was 42

Table 4
Adjuvant and neoadjuvant treatment by type of surgery.

	OBC n (%)	SBC n (%)	Mastectomy n (%)	MIR n (%)	p OBC v SBC	P OBC v mastec.	P OBC v MIR
Neoadjuvant chemotherapy					<0.0001	0.181	0.247
Yes	33 (15.3)	381 (7.3)	228 (12.2)	140 (20.0)			
No/NA	183 (84.7)	4811 (92.7)	1636 (87.8)	560 (80.0)			
Neoadjuvant hormonal treatment					<0.0001	0.088	0.277
Yes	22 (10.2)	241 (4.6)	123 (6.6)	44 (6.3)			
No/NA	194 (89.8)	4951 (95.4)	1741 (93.4)	656 (93.7)			
Adjuvant chemotherapy					<0.0001	0.462	0.941
Yes	72 (34.1)	1072 (21.5)	583 (31.6)	237 (34.4)			
No/NA	139 (65.9)	3918 (78.5)	1260 (68.4)	452 (65.6)			
Adjuvant radiotherapy					0.005	<0.0001	<0.0001
Yes	209 (96.8)	4744 (91.4)	852 (45.7)	264 (37.7)			
No/NA	7 (3.2)	448 (8.6)	1012 (54.3)	436 (62.3)			
Adjuvant hormonal treatment					0.001	0.111	0.641
Yes	118 (54.6)	3391 (65.3)	1123 (60.2)	395 (56.4)			
No/NA	98 (45.4)	1801 (34.7)	741 (39.8)	305 (43.6)			
Adjuvant trastuzumab treatment					<0.0001	0.233	0.536
Yes	30 (13.9)	351 (6.8)	208 (11.2)	86 (12.3)			
No/NA	186 (86.1)	4841 (93.2)	1656 (88.8)	614 (87.7)			

OBC: oncoplastic breast conservation; SBC: standard breast conservation; MIR: mastectomy with immediate reconstruction. Patients with M1 stage were excluded.

Table 5
Time from cancer surgery to start of adjuvant chemotherapy and radiotherapy by type of surgery.

Time from surgery to adjuvant chemotherapy	OBC n(%)	SBC n(%)	Mastectomy n(%)	MIR n(%)	p value OBC v SBC	p value OBC v mastect	p value OBC v MIR
0–31 days	10 (14.9)	225 (21.9)	87 (15.8)	22 (10.8)	0.585	0.673	0.217
32–60 days	50 (74.6)	691 (67.3)	378 (68.5)	138 (68.0)			
61–90 days	6 (9.0)	96 (9.3)	78 (14.1)	40 (19.7)			
>90 days	1 (1.5)	15 (1.5)	9 (1.6)	3 (1.5)			
Altogether	67	1027	552	203			
Time from surgery to adjuvant radiotherapy	OBC n(%)	SBC n(%)	Mastectomy n(%)	MIR n(%)	p value OBC v SBC	p value OBC v mastect.	p value OBC v MIR
0–31 days	0	27 (0.8)	3 (0.7)	0	0.088	0.626	0.747
32–60 days	81 (62.8)	2394 (69.5)	273 (60.9)	75 (58.6)			
61–90 days	41 (31.8)	786 (22.8)	137 (30.6)	44 (34.4)			
>90 days	7 (5.4)	239 (6.9)	35 (7.8)	9 (7.0)			
Total	129	3446	448	128			

OBC: oncoplastic breast conservation; SBCS: standard breast conservation; mastect: mastectomy; MIR: mastectomy with immediate reconstruction. M1 patients excluded were excluded. Patients who received adjuvant chemotherapy were excluded when time to adjuvant radiotherapy compared.

days (26–161), which was similar to the other cohorts (SBC: 40 days (11–407); mastectomy: 43 days (9–171); MIR: 44 days (23–247)). In particular, a similar proportion of patients in each group started adjuvant chemotherapy within 31 days (OBC: 14.9% v. SBC: 22.1%, $p = 0.171$; mastectomy: 16.2%, $p = 0.787$; MIR: 10.8%, $p = 0.386$) (Table 5). 4200 patients received adjuvant radiotherapy but no adjuvant chemotherapy (129 OBC, 3474 SBC, 469 mastectomy and 128 MIR). There was no significant difference in median time from final surgery to adjuvant radiotherapy when OBC was compared to the other three groups (OBC: 51 days (35–125), SBC: 50 days (10–447), mastectomy: 55 days (26–428), MIR: 56 days (33–122)) (Table 5).

Discussion

This study has found that, despite increasing experience with OBC, these operations only made up 2.7% of operations for breast cancer and 4% of breast conserving operations in Scotland in 2014 and 2015. There were, however, significant regional differences in the country in OBC rates ranging from 2.9% to 4.8% of breast conserving cases (Table 1). The rate of OBCS in our study is markedly below that reported by large, tertiary referral centres, e.g. the MD Anderson Cancer Centre which has reported an increase from 4% of breast cancer operations in 2007 to 15% in 2014, making up 33% of breast conservation operations [29]. However, uniquely we describe here a real-life population scenario in this audit which has not been previously studied. It is likely that, as all newly appointed breast surgeons in the UK are now required to be competent in mammoplastic techniques as a condition of their completion of training, this rate will rise over the coming decade in Scotland. Further, we have shown previously that the absolute numbers of OBCs are increasing in Scotland, and more frequent application of OBC surgery may result in a reduction in mastectomy rate [2]. Therefore, we are following up our current 2014–2015 dataset in the subsequent years and relevant national data request from the Information Services Division/NHS National Services Scotland is underway.

The average tumour size in the OBC cohort of our study (median ITS 20 mm, median WTS 25 mm) is comparable to the initial results of the UK-wide TeaM study that reported a median ITS of 19 mm and median WTS 24 mm in OBC patients [30] (Table 2). The finding that tumour size occupies a middle ground between SBC patients and mastectomy patients is not particularly surprising given that one of the main aims of OBC surgery is to conserve the breast with acceptable aesthetic outcome in cases which previously would have required mastectomy. However, these findings are not entirely consistent with the existing literature. A number of studies have found tumour size to be similar to those who undergo SBC [21,31–33] and we previously found tumour characteristics to be similar to mastectomy patients in breast units in Glasgow [3,12]. Other studies have reported larger tumours in OBC patients compared to SBC but did not compare to mastectomy [7,34–37].

Further differences found in pathology include tumour grade, which was between SBC and mastectomy for patients treated with OBC, more ER negative and HER-2 positive patients in the OBC group than in the SBC and fewer node positive cases in OBC patients when compared to mastectomy or MIR patients (Table 2). The difference in age between the groups probably reflects differences in the extensiveness of the surgery with OBC being more extensive than SBC or mastectomy, but less of an undertaking than post-mastectomy breast reconstruction. More OBC patients received neoadjuvant chemo-, hormonal therapy as well as adjuvant chemo-, radio-, hormonal therapy and trastuzumab than patients treated with SBC (Table 4). These differences mirror the findings of previously published single centre results, but confirm them with a national database [3,7,8,12].

Time to first and final surgery from diagnosis was significantly longer for patients treated with OBC compared to SBC and mastectomy, but it was shorter than MIR (Table 3). The differences probably represent mainly logistical issues such as availability of plastic or oncoplastic surgeons and relatively longer theatre time, but other factors such as regional differences, facilities and socio-economic factors may also play a role [38]. It is unknown whether the eleven- or fourteen-day delay in surgery when OBC is compared to mastectomy or SBC would affect prognosis, although *Eriksson* et al. recently suggested that a three week delay confers a 1.26-fold increased hazard rate of death, which was strongest in women with the largest tumors [39]. Hence, further studies are required to investigate the potential adverse affect on prognosis of delays in surgery in OBC patients.

This national audit suggests that OBC is a standalone option for the surgical treatment of breast cancer in Scotland, based on the differences found from SBC, mastectomy and MIR. OBC and MIR both improve aesthetic outcome for patients after breast conservation or mastectomy [5,40]. We and others demonstrated that OBC offers suitable women the option to avoid MIR while providing faster recovery [3,12,26]. *Kelsall* et al. showed in a case-matched study that better psychosocial and self-rated satisfaction with breast appearance could be achieved with OBC compared to MIR, regardless of the need for radiotherapy [26]. *Chand* et al. demonstrated that patients report long-lasting satisfaction after OBC and outcomes compare very favorably with those reported following MIR [41]. Therefore, OBC rate could be regarded as a performance indicator similarly to MIR rate in large national audits [18,19].

Our study did not demonstrate a difference between the surgical groups in terms of time to adjuvant therapy. Although there was a suggestion that OBC patients are less likely to start adjuvant therapy within the first 31 days of surgery this slight difference between the two breast conservation groups had disappeared by 60 days (Table 5). The question of whether OBC does genuinely lead to a delay in adjuvant therapy is a matter of debate. A few studies have reported a delay to adjuvant therapy in OBC [6,42–45]. However, the majority of studies – including ours – report no statistical delay to adjuvant treatment [13,20,22,46–49]. The studies which did show a delay are in the main older studies and it may be that, as experience with these techniques has increased, outcomes have improved. Many of the studies, both those reporting a delay and those who did not, are often limited by small patient numbers and, where there is no comparison arm, use variable definitions of 'delay'. Nevertheless, this is the only population based study which shows no significant difference in the start of adjuvant treatment in patients treated with OBC compared with SBC, mastectomy and MIR. The trend that patients treated with OBC or MIR start their adjuvant chemotherapy later in comparison to SBC or mastectomy patient requires follow-up in the datasets of the subsequent years.

The limitations of our study are primarily related to the data available within the prospectively collected MCN databases. We do not know details of the surgical technique used, incomplete excision rate in conservation surgery, postoperative complication rates, recurrence rates or patient reported outcomes. However, to our knowledge this is the first prospective national audit of oncoplastic breast conserving surgery, providing a 'real world' view of the current use of OBC in a comparatively large number of patients, with comparison groups from the three other major surgical treatment groups.

In conclusion, this national study demonstrated that OBC occupies its own niche between SBC and mastectomy in the surgical treatment of breast cancer in Scotland. We recommend that OBC should be recorded separately from SBC, mastectomy and MIR in other large national audits, and OBC rate could be regarded as a performance indicator similarly to MIR rate.

Conflict of interest statements

Elizabeth S Morrow – declares no conflict of interest. Sheila Stallard – declares no conflict of interest. Julie Doughty – declares no conflict of interest. Andy Malyon – declares no conflict of interest. Matthew Barber – declares no conflict of interest. J Michael Dixon - declares no conflict of interest. Laszlo Romics - declares no conflict of interest.

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