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Comparison of clinicopathologic, cosmetic and quality of life outcomes in 700 oncoplastic and conventional breast-conserving surgery cases: A single-centre retrospective study

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ABSTRACT

Introduction: Limited data is available from studies that directly compare oncoplastic breast surgery and conventional breast-conserving surgery (CBCS) procedures. The aim of this study was to compare three volume displacement oncoplastic breast-conserving surgery (OBCS) techniques to CBCS procedures, providing more evidence and facilitating the standardization of OBCS techniques.

Patients and methods: A retrospective single-centre comparative study was performed between January 2010 and January 2017 involving 758 breast cancer patients. The endpoints for comparison were oncological safety, frequency of complications, initiation time of adjuvant therapy, aesthetic outcome, quality of life and operation time. To compare data, statistical analyses were performed.

Results: The mean follow-up time was 51 months for the OBCS group and 52 months for the CBCS group. The excised weight of the specimens was significantly larger in the OBCS group than in the CBCS group (90 g vs. 63 g). The overall complication rate (5.7% vs. 6.6%), the initiation time of adjuvant therapy (4.2 weeks vs. 4.1 weeks) and the local recurrence rate (2.0% vs. 3.7%) did not differ significantly. Scores for the aesthetic outcome were significantly higher in the OBCS group; however, required longer operation time.

Conclusion: The investigated OBCS procedures allowed the removal of large volumes of breast tissue with improved cosmetic outcomes without delay in adjuvant therapies, maintaining the oncological safety. However, OBCS required longer operation time. Furthermore, the extended radicality of the OBCS could reduce the rate of re-excision and completion mastectomy, although it may result in the over-treatment of some breast cancer patients.

Introduction

In the last decade, sophisticated oncoplastic breast surgery has been developed that could allow maximal radicality in breast-conserving surgery (BCS), resulting in good or excellent cosmetic outcomes while still providing oncologic safety and resulting in low

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Abbreviations

ALND	axillary lymph node dissection
BCS	breast-conserving surgery
BMI	body mass index
CBCS	conventional breast-conserving surgery
DCIS	ductal carcinoma in situ
DFS	disease free survival
EORTC-QLQ	European Organisation for Research and Treatment of Cancer-Quality of Life Questionnaire
ER	estrogen receptor
ESMO	European Society of Medical Oncology
HER-2	human epidermal growth factor 2
IDC	invasive ductal carcinoma
ILC	invasive lobular carcinoma
LR	local recurrence
LRR	locoregional recurrence
NAC	nipple-areolar complex
NS	not significant
OBCS	oncoplastic breast-conserving surgery
OS	overall survival
PgR	Progesteron receptor
ROLL	radio-guided occult lesion localization
RT	radiotherapy
SLNB	sentinel lymph node biopsy
TNM	classification of malignant tumours
TM	therapeutic mammaplasty

morbidity [1–14].

However, high level evidence to support the oncological safety and improved aesthetic outcome of OBCS is still lacking due to the fact that most of the current publications were retrospective and multicentric, using non-standardized OBCS techniques with low numbers of enrolled patients and short follow-up times. Furthermore, due to its complexity, limited data is available from studies that directly compared OBCS and CBCS procedures, hindering the standardization of OBCS techniques [6,15–19].

The aim of this study was to compare three locally standardized volume displacement OBCS techniques to CBCS procedures, providing more evidence and facilitating the standardization of OBCS techniques.

The study was a single-centre retrospective comparative analysis using a prospectively administered institutional database and focusing on the following five clinico-oncological parameters: 1. the oncological safety (the rates of microscopically positive surgical margins and local and locoregional recurrence, disease free survival [DFS] and overall survival [OS]), 2. early postoperative complications, 3. the initiation time of adjuvant therapy, 4. the aesthetic outcomes and quality of life, and 5. the length of the operation.

Patients and methods

A single-centre retrospective comparative study was performed between January 2010 and January 2017 at the National Institute of Oncology in Budapest, Hungary. The study was approved by the institutional research ethics committee and involved 756 patients with stage 0-III breast cancer.

In the investigated period, 378 patients underwent OBCS procedures (the OBCS group). As a control group, patients treated with CBCS (the CBCS group) were randomly selected during the same period.

All the preoperative drawings and operations were performed by two qualified (European Board of Surgical Qualification) breast surgeons according to the decisions made by the multidisciplinary team.

In the retrospective processing, the exclusion criteria were as follows: oncologic follow-up of the patients was performed at another institute, the patients did not participate in the evaluation of the cosmetic and quality of life outcome measurements, the patient had a history of BCS and/or radiation therapy (RT), or the patient received immediate contralateral breast symmetrisation with therapeutic surgery.

In cases with breasts that were of moderate or large volume (cup size B/C and greater) or ptotic (Regnault classification type II-III), a therapeutic mammaplasty (superior, central or inferior pedicle Wise-pattern) OBCS was performed. In cases with medium or smaller sized (bra cup size B/C) or slightly ptotic breasts (Regnault classification Type I-II, pseudoptosis, parenchymal maldistribution) a dermoglandular rotation (medial, lateral mammoplasty) or peri-areolar (bra cup size A and greater, Regnault classification normal or Type I) (round block, omega) OBCS was performed (Fig. 1a-i). Considering Clough's recommendations, all three aforementioned volume displacement OBCS techniques allowed level I or level II excision if it was necessary [20].

The diagnosis of breast cancer, additional staging examinations and the follow-up of the patients were performed according to the institutional protocol based on that of the European Society of Medical Oncology (ESMO) [21].

At the time of the study, a minimum of a 1-mm tumour-free resection margin was considered a microscopically intact surgical margin (for invasive and in situ cancers as well), with the exception of the posterior and anterior margins if the surgery was performed with the maximum allowed radicality. After January 2015, the minimum surgical margin for invasive tumours was modified to “no cell on the inked surface”, but the 2-mm safety margin remained unmodified for ductal carcinoma in situ (DCIS) [21].

The removal of non-palpable tumours was performed with radioguided occult lesion localization (ROLL) supplemented by intraoperative specimen mammography examination.

Intraoperative frozen section procedures were not applied routinely in cases of palpable tumours. In cases of sentinel lymph node biopsy (SLNB), intraoperative imprint cytology was applied.

Level I-III axillary lymph node dissection (ALND) was performed for patients with metastatic SLN on imprint cytology and for patients with unidentified SLN and clinically node positive cases. After the first of January 2015, ALND was omitted for limited axillary metastases according to the study criteria of ACOSOG Z0011 [22] and OTOASOR [23]. In selected cases, patients with metastatic axillary SLN were treated with axillary and supraclavicular RT.

All the analysed cases underwent whole-breast RT, with an overall dose of 50/2 or 40.05/2.67 Gy (external beam, 6-MV photon irradiation) and additional tumour bed boost irradiation (16/2 or 10/2.5 Gy) and/or axilla and supraclavicular irradiation if it was necessary.

Antibiotics for prophylaxis were not administered routinely during the surgeries.

The database included each patient's age, body mass index (BMI), smoking habits, diabetic comorbidity, cup size, surgical technique (wide excision or quadrantectomy), type of OBCS techniques, type of axillary surgery, specimen weight, rate and type of completion surgery and operation time. The database also included the clinical and pathological TNM stage, histological type of the

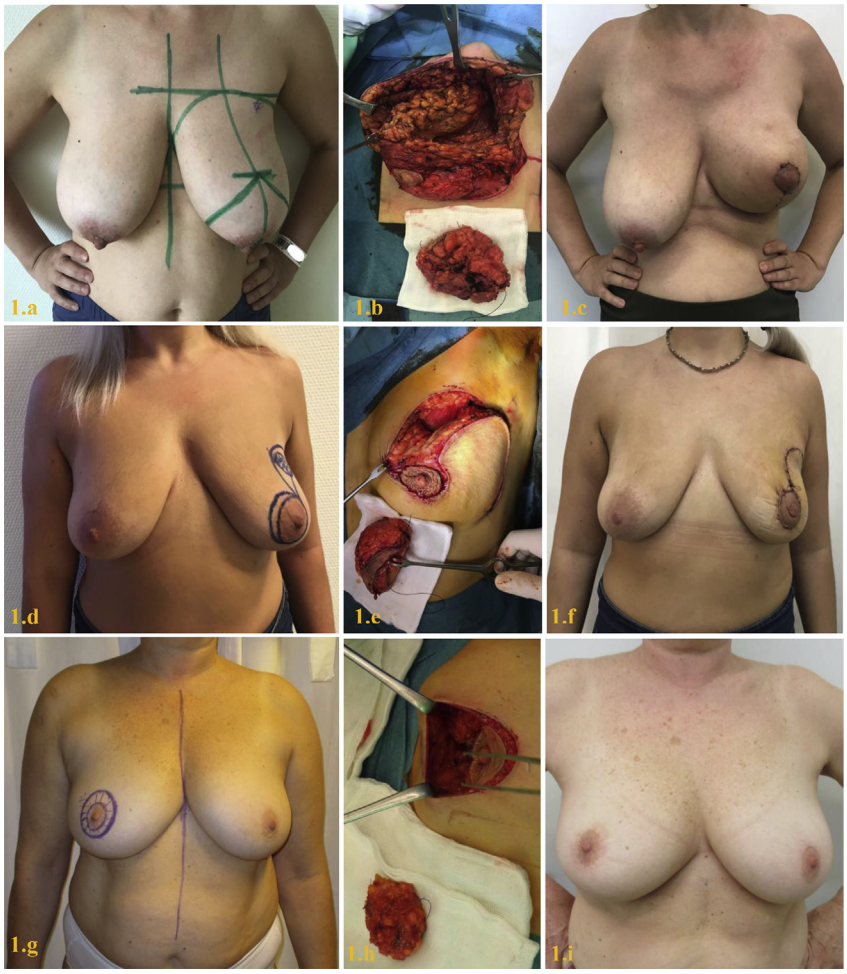

Fig. 1. Illustrating the three investigated volume displacement OBCS techniques
Fig. 1a-c.: *Pre-, intra- and postoperative photos illustrating a left-sided oncoplastic therapeutic mammaplasty (inferior pedicle Wise-pattern) due to a pT2pN0(sn)M0 ductal invasive carcinoma (ER: 100%, PR: 100%, HER-2: neg.)*
Fig. 1d-f.: *Pre-, intra- and postoperative photos illustrating a left-sided (lateral) dermoglandular rotation oncoplastic surgery due to a pT2pN0(sn)M0 ductal invasive carcinoma (ER: 80%, PR: 90%, HER-2: neg.)*
Fig. 1g-i.: *Pre-, intra- and postoperative photos illustrating a right-sided periareolar (round block) oncoplastic surgery due to a pT1cpN0(sn)M0 ductal invasive carcinoma (ER: 95%, PR: 80%, HER-2: neg.).*

tumour, hormone receptor status, HER-2 receptor status, grade, Ki67 value, molecular subtype and nature of the microscopical surgical margin. Furthermore, the timing of the initiation of the adjuvant treatment in relation to the time of surgery, the types of adjuvant treatments used, the follow-up time from the time of the surgery, and the oncologic status of the patient were assessed.

Postoperative complications were divided into two categories. Minor complications included infection treated with antibiotics, haematoma, seroma, and partial skin/nipple-areola complex (NAC) necrosis that healed spontaneously. Complications requiring surgical intervention were classified as major complications and included haematoma, chronic infection and seroma (lasting for more than 2 weeks following the removal of the surgical drain), fat necrosis, and partial skin/NAC necrosis.

To assess the aesthetic results, a 5-point Likert scale [24,25] (score: 1, strongly disagree; 2, disagree; 3, undecided; 4, agree; 5, strongly agree) was used to judge the statement, “this case has an excellent aesthetic outcome”. The evaluation was performed by a committee of 3 breast surgeons who gave a single score for each case at the first postoperative year.

The EORTC-QLQ (European Organisation for Research and Treatment of Cancer- Quality of Life Questionnaire) was applied to measure the quality of life of breast cancer patients at the first postoperative year. Selected scales were used in the QLQ-C30 and the QLQ-BR23 questionnaires such as the social functioning, emotional functioning and body image. Potential scores ranged from 0 to 100, with a higher score indicating a higher prevalence [26].

The collected data were analysed using Statistica 12.0 software. To compare the data between the OBCS and CBCS groups, the following statistical methods were used: in cases of categorical variables, Chi-square tests or Fisher's exact tests were used, while data showing non-normal distributions were analysed by Mann-Whitney U tests. Survival intervals were analysed using the Kaplan-Meier method and log-rank statistics. Statistical significance was determined when p values were <0.05.

Results

Fifty-six patients were lost to follow-up. The oncologic follow-up of 16 patients was performed in another institute, 14 patients did not want to participate in the evaluation of the cosmetic and

quality of life outcome measurements and in 26 patients, an immediate breast symmetrisation was performed with the therapeutic surgery. In total, 350 breast cancer patients were in the OBCS group, and 350 patients were in the CBCS group.

The mean follow-up time was 51 months (range: 12–95 months) for the OBCS group and 52 months (range:12–96 months) for the CBCS group.

Patient and tumour characteristics

The patient characteristics are summarized in Table 1. The groups were homogenous in terms of age, BMI, active smoking status and diabetic comorbidity, while the cup sizes were significantly larger ($p = 0.001$) in the OBCS group than in the CBCS group.

The tumour characteristics are detailed in Table 2. According to the data in Table 2, there were no significant differences between the two groups in terms of the pathological tumour size, tumour grade or invasive pathological subtype.

Compared to the CBCS group, the OBCS group had significantly more patients with pathological Stage II tumours ($p = 0.035$) and more patients with pN1 status ($p = 0.011$).

The number of patients with triple negative ($p = 0.004$) and/or highly proliferative tumours (Ki67 $\geq$ 20%) was significantly higher ($p = 0.001$) in the OBCS group than in the CBCS group.

Significantly more patients underwent neoadjuvant chemotherapy ($p = 0.001$) in the OBCS group than in the CBCS group.

The rates of adjuvant chemo- and biological therapy, RT and endocrine therapy were 40.6%, 100% and 82.9% in the OBCS group and 23.1%, 100% and 87.4% in the CBCS group. There was a significant difference in the number of patients who underwent chemo- and biological therapy between the two groups ($p = 0.002$).

Type of surgery, operation time

The techniques of the OBCS procedures are summarized in Table 3.

Significantly more quadrantectomies were performed in the OBCS group ($p = 0.001$) than in the CBCS group ($n = 265$ vs. $n = 159$), resulting a statistically significant difference ($p = 0.002$) in the number of wide excisions ($n = 85$ vs. $n = 191$), which was the most common technique in standard BCS cases. However, there was no significant difference ($p = 0.25$) between the two groups in the number of ROLL techniques. In the OBCS group, ALND was performed in total of 72 cases, while in the CBCS group, only 18 patients were treated with ALND. Thus, the difference was statistically significant ($p = 0.001$).

In relation to the operative times, the OBCS procedures required significantly longer operation times ($p < 0.01$) than the CBCS techniques. The average operation time was 68 min for the OBCS group and 58 min for the CBCS group.

Table 1
Patients' characteristics.

Variable	OBCS group (n = 350)	CBCS group (n = 350)	p-value
	n (%)	n (%)	
Patients' characteristics			
mean age	58 (31–85)	59 (29–86)	NS
BMI	23.3 (17.1–30.4)	22.9 (16.9–31.3)	NS
active smoking	37 (10.6)	41 (11.7)	NS
diabetic co-morbidity	16 (4.6)	20 (5.7)	NS
Cup size			
A-B	116 (33.1)	237 (67.7)	0.001
C-F	234 (66.9)	113 (32.3)	0.001

Table 2
Pathological findings and comparison of the tumour characteristics of the OBCS and the CBCS groups.

Variable	OBCS group (n = 350)	CBCS group (n = 350)	p-value
	n (%)	n (%)	
pT			
pTis	22 (6.3)	30 (8.6)	NS
pT1a-c	210 (60.0)	226 (64.6)	NS
pT2	88 (25.1)	91 (26.0)	NS
pT3	2 (0.6)	1 (0.3)	NS
pT4	1 (0.3)	1 (0.3)	NS
ypT0	15 (4.3)	0 (0.0)	0.001
ypT1a	9 (2.6)	1 (0.3)	0.001
ypT1c	2 (0.6)	0 (0.0)	NS
ypT2	1 (0.3)	0 (0.0)	NS
pN			
pN0	237 (67.7)	317 (90.6)	0.013
pN1	67 (19.2)	25 (7.1)	0.011
pN2	16 (4.6)	6 (1.7)	NS
pN3	3 (0.9)	1 (0.3)	NS
ypN0	17 (4.9)	0 (0.0)	0.001
ypN1	7 (2.0)	1 (0.3)	NS
ypN2a	3 (0.9)	0 (0.0)	NS
Histological type			
IDC	271 (77.4)	277 (79.1)	NS
ILC	35 (10)	21 (6.0)	NS
Other	22 (6.3)	22 (6.3)	NS
In situ component	170 (48.6)	124 (35.4)	0.012
Immunhistology			
ER+	271 (77.4)	303 (86.6)	NS
PgR+	119 (34.0)	143 (40.9)	NS
HER-2+	19 (5.4)	5 (1.4)	NS
Triple negative	38 (10.9)	12 (3.4)	0.004
Ki67 $\geq$ 20%	130 (37.1)	79 (22.6)	0.001
Grade			
I	107 (30.6)	94 (26.9)	NS
II	127 (36.3)	139 (39.7)	NS
III	89 (25.4)	87 (24.9)	NS
pStage			
0	27 (7.7)	30 (8.6)	NS
I	165 (47.1)	211 (60.3)	0.02
II	137 (39.1)	100 (28.6)	0.035
III	21 (6.0)	9 (2.6)	NS

NS: not significant; IDC: invasive ductal carcinoma; ILC: invasive lobular carcinoma; ER: estrogen receptor; PgR: Progesteron receptor; HER-2: human epidermal growth factor receptor-2.

Table 3
Techniques of the OBCS procedures.

Oncoplastic techniques	n
Therapeutic mammaplasty (superior, central, inferior pedicle Wise-pattern)	143
Dermoglandular rotation (medial, lateral mammoplasty)	159
Periareolar (round block, omega)	48
Total	350

Volume of the specimens and tumour margins

The median weight of the excised specimens in the OBCS group was 90 g (range: 4–529 g), while in the CBCS group, it was found to be 63 g (range: 1.5–878 g) Thus, a significantly larger volume of breast tissue was excised during OBCS than during standard BCS ($p = 0.001$). In the OBCS group, the median microscopically tumour-free surgical margin was 8 mm (range: 0–21 mm), while in the CBCS group, it was 4.5 mm (range: 0–17 mm), resulting significantly wider clear surgical margins in OBCS group than in the CBCS group ($p = 0.010$).

Due to positive or close surgical margins, 28 (8%) completion surgeries were performed (19 [5.4%] re-excisions and 9 [2.6%] mastectomies) in the OBCS group, whereas in the CBCS group, 38 (10.9%) patients required re-excision and 20 (5.7%) patients needed

mastectomies, resulting in a total of 58 (16.6%) reoperations. The rate of completion surgery was significantly higher in the CBCS group than in the OBCS group ($p = 0.001$).

Complication and initiation time of adjuvant therapy

There were 11 minor complications (3.1%) and 9 major complications (2.6%) requiring surgical intervention in the OBCS group, resulting in a total of 20 complications (5.7%).

In the CBCS group, 23 (6.6%) complications were identified, of which 11 (3.1%) were minor and 12 (3.4%) were classified as major. The complications in both groups are summarized in Table 4.

The median time to the initiation of the adjuvant treatment was 4.2 weeks (range: 4–12 weeks) in the OBCS group and 4.1 weeks (4–12 weeks) in the CBCS group. In terms of complication rate and the initiation time of adjuvant therapy, significant differences were not observed between the two groups ($p = 0.31$).

Local and locoregional recurrence

During the follow-up period, there were 7 (2.0%) recurrences identified in the OBCS group, 4 (1.1%) of which were local recurrences (LRs) and 3 (0.9%) of which were locoregional recurrences (LRRs). In the CBCS group, 11 (3.1%) LRs and 2 (0.6%) LRRs with distant metastasis were identified, resulting in a total of 13 (3.7%) recurrences. There were no statistically significant differences between the OBCS and the CBCS groups regarding the rates of LR ($p = 0.29$), LRR ($p = 0.31$) and distant metastases ($p = 0.33$).

Two patients in the CBCS group were not alive at the time of the last follow-up due to the progression of the disease.

Aesthetic outcome and quality of life

The median values of the aesthetic outcome score were significantly different between the two groups, with 4.4 points (range: 3–5) in the OBCS group and 3.2 points (range: 1–5) in the CBCS group ($p = 0.001$).

In the OBCS group, the median value of the emotional functioning score was 91.6 (range: 50–100), whereas the median social functioning score was 83.4 (range: 33–100). The median body image score was 91.6 (range: 50–100).

In the CBCS group, the median value of the emotional functioning score was 83.4 (range: 50–100), whereas the median social functioning score was 75.0 (range: 50–100). The median body image score was 75.0 (range: 33–100). All the median scores of the aesthetic outcomes were significantly higher ($p < 0.01$) in the OBCS group than in the CBCS group.

Discussion

The first OBCS techniques were described more than two decades ago [27,28]. Since then, the emphasis on the aesthetic outcomes and quality of life after breast cancer surgery has resulted in the development of various OBCS techniques [20,29,30]. However, there is little standardization of OBCS, which makes the scientific comparison of the techniques among each other and to CBCS challenging [31].

In this retrospective analysis, the results of the therapeutic mammaplasty, the periareolar and the dermoglandular rotation OBCS procedures were compared to the outcomes of CBCS according to the following five clinico-oncological parameters.

Oncological safety

In this study, significant differences were not observed in the rates of LR and LRR between the OBCS and CBCS groups, which had total recurrence rates of 2.0% and 3.7%, respectively. Recent studies with follow-up intervals of 3, 3–5 and 5 years had mean LRs of 1.7, 3.7, and 6.0% and distant metastases rates of 3.8, 7.1, and 11.9%, respectively [12]. It should be noted that the mean follow-up time of 4 years may limit the accurate evaluation of the oncological results regarding the LR and LRR.

The main advantage of OBCS techniques seems to be the ability to perform wider excisions without compromising the aesthetic outcomes, while reducing the risk of positive margins [32]. Our results revealed that the excised weight of the specimens was significantly larger in the OBCS group than in the CBCS group (90 g vs. 63 g), even though there was no significant difference in pathological grade in the two groups. The explanation for the larger excised specimens in the OBCS group could be the significantly higher number of patients who underwent neoadjuvant chemotherapy with unfavourable biological tumour subtypes and larger initial clinical tumour sizes. Thus, the extended radicality of OBCS may result in the overtreatment of some breast cancer patients; however, in our study, significantly wider microscopically tumour-free margins (8 mm vs. 4.5 mm) and a lower rate of completion surgeries due to positive surgical margins were found in the OBCS group compared to the BCBS group ($n = 28$ [8.0%]) vs. $n = 58$ [16.6%]). The appropriate indication for OBCS and the ideal specimen volume that should be resected according to the clinical tumour size were determined in a recent publication by Pukancsik et al. When the predicted resected volume is more than 10% of the entire breast volume of the inner quadrants and more than 15–19% of the volume of the outer quadrants, CBCS may not result in an acceptable aesthetic outcome. In cases involving a predictably larger volume loss than discussed above, OBCS might be a better treatment choice than CBCS [14].

A recent publication by Carter et al. showed a lower rate (5.8%) of positive or close margins after OBCS than after CBCS (8.3%). Down et al. found a significantly lower need for re-excision after OBCS (37 patients) than after CBCS (121 patients) (5.4% vs. 28.9%) [10,33].

Among studies that reported oncologic outcome data for OBCS procedures, the crude OS and DFS rates were 95.0 and 90.0% [12]. In line with the international results, our findings showed an OS rate of 100.0% and a DFS rate of 88.5% for patients who underwent OBCS, while in patients who underwent classic BCS, the OS and the DFS rates were found to be 97.3% and 78.2%, respectively. The groups did not differ in terms of the observed survival rates.

Frequency of complications

According to our data, OBCS does not seem to increase morbidity compared to CBCS; moreover, the rate of complications was slightly higher in the CBCS group (6.6%) with the most common complication of seroma formation, found in 2.6% of the cases.

In the OBCS group, complications occurred in 5.7% of the cases, and the most common complication was infection, which occurred

Table 4
Comparison of the complication rate in the OBCS and CBCS group.

Complications	OBCS group (n = 350)		CBCS group (n = 350)	
	minor (n,%)	major (n,%)	minor (n,%)	major (n,%)
seroma	3 (0.9)	2 (0.6)	6 (1.7)	3 (0.9)
haematoma	0 (0.0)	2 (0.6)	0 (0.0)	4 (1.1)
infection	5 (1.4)	3 (0.9)	4 (1.1)	3 (0.9)
skin/NAC necrosis	2 (0.6)	1 (0.3)	1 (0.3)	1 (0.3)
fat necrosis	1 (0.3)	1 (0.3)	0 (0.0)	1 (0.3)
Total minor/major	11 (3.1)	9 (2.6)	11 (3.1)	12 (3.4)
Overall	20 (5.7)		23 (6.6)	

in a total of 2.3% of the cases. The rates of revisional surgery were similar in the investigated groups.

A recent large systematic review by De La Cruz et al. involving 6011 breast cancer patients demonstrated no statistically significant difference in the incidence of postoperative complications among women undergoing oncoplastic and non-oncoplastic lumpectomies. However, Tenofsky et al. [34] found a higher incidence of non-healing wounds in the oncoplastic group than in the non-oncoplastic group (8.6% vs. 1.2%), although this higher incidence did not prolong the time to radiation for the oncoplastic group. Therefore, oncoplastic reconstruction at the time of BCS does not appear to significantly increase the risk of postoperative complications that would delay initiation of adjuvant therapy [12].

Initiation time of adjuvant therapy

The median time to the initiation of adjuvant treatment was almost the same in the OBCS and CBCS groups (4.2 weeks vs. 4.1 weeks). In the OBCS group, our results were in line with those of the majority of the current publications, showing no delay in the time to the initiation of adjuvant treatments due to complications [6,35–43].

Aesthetic outcome and quality of life

A meta-analysis of 61 publications comparing 3165 patients after OBCS with 5494 patients after CBCS showed that satisfaction with the aesthetic outcome was higher in the OBCS group than in the CBCS group (89.5% vs. 82.9%, $p < 0.001$) [5,18,36,37].

In a prospective study, Veiga et al. demonstrated significantly higher quality of life outcomes in the OBCS group than in the CBCS group [44].

At the 1st postoperative year, the results of the EORTC questionnaire rated by the patients showed that all median values for the quality of life outcomes (emotional functioning, social functioning, body image) were greater than 83.4 points, representing a high quality of life in the OBCS group that was significantly better than that of the CBCS group. In the CBCS group, the vast majority of the patients rated their quality of life parameters near 71.2.

According to our data, patients who underwent OBCS had higher median aesthetic outcome scores than the patients treated with CBCS (4.4 vs. 3.2 points).

Operation time

According to a recent publication, patients who underwent wide local excision required significantly shorter operation times than those patients who underwent OBCS (62 min vs. 91.4 min) [45].

In a prospective cohort study by Clough et al., out of 101 OBCS cases, 89 patients underwent immediate contralateral symmetrisation, with a mean operation time of 2 h [15].

In the present study, even without immediate contralateral symmetrisation, the OBCS cases required significantly (10 min) longer operative times than the CBCS cases.

Conclusion

Our results revealed that the investigated volume displacement OBCS techniques (therapeutic mammaplasty, dermoglandular rotation and periareolar) could be used as standard techniques in the removal of breast cancer located in any quadrant of the breast.

The aforementioned techniques could allow the removal of large volumes of breast tissue with improved cosmetic outcomes and without causing delay in the initiation of adjuvant therapies, maintaining the oncological safety. However, the OBCS techniques required longer operation times. The extended radicality of OBCS could reduce the rate of re-excision and completion mastectomies, although it may result in overtreatment of some breast cancer patients.

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Declarations of interest

The authors have no conflicts of interest to declare.

Conflicts of interest

The authors have no conflicts of interest to declare.

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Appendix A. Supplementary data

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