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Long-term quality of life and aesthetic outcomes after breast conserving surgery in patients with breast cancer

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ABSTRACT

Introduction: Breast surgery has become less invasive without compromising survival and aimed at improving quality of life (QoL) in terms of satisfaction with cosmesis. Despite that, short-term patient-perceived aesthetic results after breast-conserving surgery (BCS) can still be displeasing. Long-term analysis regarding contentment with cosmesis are lacking and could be different, considering that over time, patients’ priorities might change and a different thought-out judgment could be given. The goal of this study is to describe long-term results in QoL after BCS and to identify possible predictors for disappointing aesthetic results.

Methods: In this retrospective cohort study, the long-term outcomes of QoL, patient-reported outcome measurements and aesthetic outcomes were investigated 4.5–10.8 years after BCS. In total, 104 patients received standardized questionnaires from the European Organisation of Research and Treatment of Cancer. The aesthetic results after BCS were evaluated subjectively through a diverse panel of healthcare observers. Objective assessment of the aesthetic results was done using the BCCT.core system of evaluating standardised breast photographs. Factors influencing aesthetic outcome were statistically analysed.

Results: QoL was high in around 75% of the patients. Correlation between QoL and aesthetic outcomes was found according to Spearman’s correlation ($r = 0.262$, $p = 0.007$). Significant factors negatively influencing patient reported aesthetic outcomes were sentinel node procedure ($p = 0.016$), axillary lymph node dissection ($p = 0.004$), chemotherapy ($p = 0.001$), and hormonal therapy ($p = 0.001$).

Conclusion: The majority of the patients have acceptable QoL after BCS during long-term follow-up. Unacceptable aesthetic outcomes after BCS are associated with lower QoL and are influenced by sentinel node procedure, axillary lymph node dissection, chemotherapy, and hormonal therapy.

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1. Introduction

According to the Dutch Cancer Society, in 2019, 17,500 patients were diagnosed with breast cancer in the Netherlands. After Halsted’s radical mastectomy with mutilating surgery in the 19th century, more refinement was seen through less invasive procedures (Patey, Madden) and movement ultimately toward breast-conserving surgery (BCS) in the ’90s of the last century [1–3]. Between 50 and 70% of women with breast cancer receive BCS as therapy [4]. BCS consists of lumpectomy followed by radiotherapy, with or without axillary therapy, depending on lymph-node stage [5].

BCS often results in adequate local control of disease with free margins. It was subjected to crucial tests by Veronesi and Fisher and proved to be a safe oncological procedure in early-stage breast cancer [6,7].

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Although BCS is safe and less mutilating than mastectomy, approximately 30% of the patients who undergo BCS are not satisfied with the aesthetic outcome [8]. There is a high correlation between poor aesthetic outcomes and poor scores of quality of life (QoL). Multiple studies have been done to determine the QoL and aesthetic outcomes; however, follow-up is a maximum of 3–4 years [4,5,8,9]. We hypothesize that concerns about cosmetic outcomes increase over the years, while concerns about oncological outcomes simultaneously decrease over time.

Previous research on long-term outcomes has focussed on subjective parameters rather than investigating QoL. We believe that the patient's perspective should be leading instead of subjective parameters. The primary aim of this study was to assess long-term QoL and cosmetic results in women after BCS. Secondary aims were to assess the correlation between aesthetic outcomes based on the values of the patient and various patient and therapy characteristics.

2. Methods

2.1. Study design

2.1.1. Patient characteristics

This study was designed as a retrospective follow-up study where the long-term outcomes of BCS on QoL and aesthetic outcomes were examined. The study was performed in the Isala Hospital, one of the largest teaching hospitals in the Netherlands. All patients who received BCS by a breast surgeon, without adding specific oncoplastic techniques, between 2000 and 2005, were eligible for inclusion. Both lumpectomy as well as guide-wire localisation biopsy (GLB) were considered breast conserving surgeries. With a response rate of 61.8%, 104 women completed the standardised questionnaires QLQ-C30 and QLQ-BR23 of the European Organisation of Research andTreatment of Cancer (EORTC) and were invited to visit the outpatient clinic. At the clinic, biometric measurements were taken and standard photographs were obtained.

Patients were recruited through their yearly follow-up visits to our oncologic surgery department. Patients were approached directly during follow-up visits or by telephone if scheduled later in the year. The STROBE guidelines were used to ensure the reporting of this observational study [10]. The medical ethical committee of our hospital approved the study (NL29060.075.09).

2.1.2. Inclusion and exclusion criteria

Inclusion criteria:

- Breast-conserving surgery: lumpectomy of palpable breast cancer or guide-wire localisation biopsy;
- Ability to understand information in Dutch, both written and spoken;
- 18 years or older;
- Written informed consent.

Exclusion criteria:

- Bilateral breast-conserving surgery;
- Reconstructive correction of one or both of the breasts;
- Local, regional or distant recurrence of breast cancer;
- Postoperative wound complications, with a severe adverse event score of Clavien Dindo 3 [11].

2.2. Preoperative and perioperative measurements

2.2.1. Demographic and clinical parameters

General parameters like age, time since treatment, re-excision, and treatment with hormonal therapy, chemotherapy or axillary lymph node dissection were documented. Complications were recorded in all patients.

2.2.2. Lump volume measurements

The excision (lump) volume in pathology reports is not a standard parameter. Therefore, we recorded lump dimensions to calculate an approximation of lump volume. To determine the excision volume (lump volume) as precisely as possible, we used the ellipsoid volume formula: \( V = \frac{4}{3} \pi \cdot l \cdot w \cdot h \).

2.3. Follow-up measurements

2.3.1. Patient questionnaires

Assessment of overall QoL was done using the patient-reported outcome measurements (PROM) of the EORTC Quality of Life Questionnaire-C30 (EORTC QLC-C30) [12]. The PROM EORTC Quality of Life Questionnaire BR23 Breast Cancer Module (EORTC QLC-QR23) was used to investigate body image, sexual functioning, sexual enjoyment and breast symptoms [13]. This questionnaire was designed especially for breast cancer patients. To describe aesthetic outcome, the body image score from the EORTC QLC-QBR23 was extracted for evaluation. The EORTC manual was used to calculate the PROM scores, according to protocol.

2.3.2. Biometric parameters

Biometric measurements were obtained for the distance from the jugulum to nipple and sternum-nipple, on either side, using a measuring tape. Differences in these parameters could indicate possible relevant asymmetry.

2.4. Breast photographs

Standardized digital breast photographs were obtained during the clinic visit: frontal, left and right oblique and left and right lateral. These photographs were assessed subjectively by a panel and objectively by a computer programme (BCCT.core).

2.4.1. Panel

Subjective assessment of the breast photographs, with visual analogue scale scores between 1 and 10, was achieved by a panel consisting of 12 surgical experts (three oncologic surgeons, three plastic surgeons, three surgery residents and three plastic surgery residents) and two non-surgical experts (breast oncology-specialized nurses) [14]. The averages of these scores were used for analysis. A score below 3 was considered poor; between 3.5 and 5, fair; between 5.5 and 7.5, good; and above 7.5, excellent.

2.4.2. BCCT.core software

Objective assessment of the frontal photograph was conducted by quantitative scoring using BCCT.core software. This is an objective standardised programme that is widely used for aesthetic evaluation after BCS. By digitally marking the nipples, axillae, sternum and jugular notch, overall scores were obtained that varied between excellent, good, fair and poor.

2.5. Statistical analysis

Patient characteristics were presented using the median and interquartile range or with the number and percentages in case of proportions. To enable comparisons between the median score of the patient’s satisfaction rating, panel evaluation and BCCT.core, Spearman’s correlation was used.

To assess the aesthetic outcome, ‘body image’ from the QLQ-BR23 was used to represent the patients’ satisfaction. The QoL was assessed by the ‘global health status’ from the QLQ-C30.
Univariate linear regression was used to examine the relationship between ‘body image’ scores and patient characteristics. A two-tailed alpha of p < 0.05 was used as the significance level. All analyses were performed using IBM SPSS Statistics 26.

3. Results

3.1. Study population

Patients treated with BCS between 2000 and 2005 in our hospital and still receiving yearly follow-up (N = 178) were assessed for participation in the study. Six patients had to be excluded. Four of these patients had bilateral BCS, and two had a history of reconstructive surgery (one contralateral breast reduction, one ipsilateral breast reconstruction). In total, 68 refused to participate. The most common reason was that the extra travelling was too demanding (n = 24/35%). Only five of these patients (7.4%) did not want to participate to avoid confrontation with the past disease. Three patients (4.4%) refused to have photos taken. Thirty-six patients gave a variety of other reasons (54.4%). Ultimately, with a response rate of 61.8%, a total of 104 patients could be included in the study.

3.2. Quality-of-life scores

Fig. 1 shows the distributions of results on several items of the EORTC QLQ-C30 questionnaires. The majority of patients were satisfied with their ‘emotional functioning’ (56.7%) and gave a perfect score for ‘social functioning’ (80.8%), whereas the minority gave a perfect score for the item ‘quality of life/global health status’ (34.6%). Of the patients, 74.6% gave a score of 80 or higher on the item ‘quality of life/global health status’.

Fig. 2 shows the distribution of results on several items of the EORTC QLQ-BR23. The majority of patients gave a perfect score on the items ‘body image’ (66.3%) and ‘breast symptoms’ (62.6%). Results about sexual functioning and enjoyment were obtained in n = 102 and n = 70 patients, respectively. Sexual enjoyment was only measured in patients with a partner and sexual functioning in patients who were sexually active. The minority of patients gave a perfect score on the items ‘sexual functioning’ (2%) and ‘sexual enjoyment’ (14.3%).

3.3. Follow-up

Patient characteristics of the study population are shown in Table 1. The median follow-up time in this population was 6.5 years.
between BCCT.core and panel evaluations was 0.558 (p = 0.001), with a correlation: BCCT.core and ‘body image’ – 0.110 [p = 0.267], BCCT.core and ‘global health status’ – 0.870 [p = 0.379], panel and ‘body image’ – 0.155 [p = 0.117], panel and ‘global health status’ – 0.105 [p = 0.288]. Agreement was found between the two questionnaires with a correlation of 0.262 (p = 0.007).

4. Conclusion and discussion

In this observational cohort study, consisting of 104 breast cancer patients who underwent BCS at least five years ago, we demonstrated three out of four patients have acceptable long-term

Table 1 shows the univariate linear regression analyses. These analyses showed statistical significance in the variable sentinel node procedure (p = 0.016), axillary lymph node dissection (p = 0.004), chemotherapy (p = 0.0001) and hormonal therapy (p = 0.001).

3.4. Aesthetic outcomes

Correlation according to Spearman’s rank correlation coefficient between BCCT.core and panel evaluations was 0.558 (p < 0.001), see Table 2. Despite good correlation between the software programme and the expert panel, no correlation was found between BCCT.core or the expert panel and the EORCT QLQ-BR23 ‘body image’ and the EORCT QLQ-C30 ‘global health status’ (Spearman’s

Table 1
Baseline characteristics and univariate analysis of all 104 patients’ ‘body image’ after BCS according to the EORTC QLQ-BR23.

<table>
<thead>
<tr>
<th>Variable</th>
<th>n = 104</th>
<th>R²</th>
<th>F</th>
<th>Regression coefficient</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow-up from last surgery (y)</td>
<td>6.5 (IQR 6–8)</td>
<td>0.001</td>
<td>0.083</td>
<td>-0.250</td>
<td>0.774</td>
</tr>
<tr>
<td>Age at (first) surgical procedure</td>
<td>59.0 (IQR 53–65.5)</td>
<td>0.021</td>
<td>2.174</td>
<td>0.229</td>
<td>0.143</td>
</tr>
<tr>
<td>Location of the tumour</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper lateral</td>
<td>47 (45%)</td>
<td>0.005</td>
<td>0.544</td>
<td>2.218</td>
<td>0.463</td>
</tr>
<tr>
<td>Upper medial</td>
<td>32 (31%)</td>
<td>0.016</td>
<td>1.690</td>
<td>-4.022</td>
<td>0.197</td>
</tr>
<tr>
<td>Lower lateral</td>
<td>12 (11%)</td>
<td>0.009</td>
<td>0.966</td>
<td>4.408</td>
<td>0.328</td>
</tr>
<tr>
<td>Lower medial</td>
<td>9 (9%)</td>
<td>0.010</td>
<td>1.005</td>
<td>-5107</td>
<td>0.319</td>
</tr>
<tr>
<td>Centre</td>
<td>4 (4%)</td>
<td>0.010</td>
<td>1.060</td>
<td>7.667</td>
<td>0.306</td>
</tr>
<tr>
<td>Tumour type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DCIS</td>
<td>5 (5%)</td>
<td>0.000</td>
<td>0.012</td>
<td>0.741</td>
<td>0.913</td>
</tr>
<tr>
<td>IC</td>
<td>11 (12%)</td>
<td>0.004</td>
<td>0.458</td>
<td>3.160</td>
<td>0.500</td>
</tr>
<tr>
<td>IDC</td>
<td>81 (76%)</td>
<td>0.005</td>
<td>0.517</td>
<td>-2.487</td>
<td>0.474</td>
</tr>
<tr>
<td>ILC</td>
<td>7 (7%)</td>
<td>0.001</td>
<td>0.070</td>
<td>1.522</td>
<td>0.792</td>
</tr>
<tr>
<td>Lumpectomy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>24 (23%)</td>
<td>0.003</td>
<td>0.313</td>
<td>-1.910</td>
<td>0.577</td>
</tr>
<tr>
<td>Yes</td>
<td>80 (77%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GLB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>80 (77%)</td>
<td>0.003</td>
<td>0.313</td>
<td>1.910</td>
<td>0.577</td>
</tr>
<tr>
<td>Yes</td>
<td>24 (23%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>46 (44%)</td>
<td>0.056</td>
<td>6.001</td>
<td>6.918</td>
<td>0.016</td>
</tr>
<tr>
<td>Yes</td>
<td>58 (56%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALND</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>63 (61%)</td>
<td>0.078</td>
<td>8.603</td>
<td>-8.298</td>
<td>0.004</td>
</tr>
<tr>
<td>Yes</td>
<td>41 (39%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemotherapy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>63 (61%)</td>
<td>0.105</td>
<td>11.963</td>
<td>-9.640</td>
<td>0.001</td>
</tr>
<tr>
<td>Yes</td>
<td>41 (39%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hormonal therapy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>77 (74%)</td>
<td>0.108</td>
<td>12.319</td>
<td>-10.886</td>
<td>0.001</td>
</tr>
<tr>
<td>Yes</td>
<td>27 (26%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Re-excision needed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>71 (68%)</td>
<td>0.023</td>
<td>2.401</td>
<td>-4.737</td>
<td>0.124</td>
</tr>
<tr>
<td>Yes</td>
<td>33 (32%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tumour diameter palpation (cm)</td>
<td>n = 92, 1.6 cm (IQR 1.2–2.1)</td>
<td>0.016</td>
<td>1.506</td>
<td>-2.762</td>
<td>0.223</td>
</tr>
<tr>
<td>Tumour diameter ultrasound (cm)</td>
<td>n = 40, 1.45 cm (IQR 1.00–1.98)</td>
<td>0.006</td>
<td>0.243</td>
<td>0.432</td>
<td>0.625</td>
</tr>
<tr>
<td>Total excision volume (mL)</td>
<td>n = 43, 49.87 mL (IQR 25.26–82.21)</td>
<td>0.023</td>
<td>2.147</td>
<td>-0.032</td>
<td>0.146</td>
</tr>
<tr>
<td>Jugulum- nipple R-L (cm)</td>
<td>n = 104, 25.0 cm (IQR 22.0–26.38)</td>
<td>0.006</td>
<td>0.397</td>
<td>0.322</td>
<td>0.442</td>
</tr>
<tr>
<td>Sternum- nipple R-L (cm)</td>
<td>n = 104, 11.0 cm (IQR 10.0–12.0)</td>
<td>0.003</td>
<td>0.309</td>
<td>-0.486</td>
<td>0.579</td>
</tr>
</tbody>
</table>

ALND, axillary lymph node dissection; GLB, guide-wire localisation biopsy; SNP, sentinel node procedure; DCIS, ductal carcinoma in situ; IC, invasive carcinoma; IDC, invasive ductal carcinoma; ILC, invasive lobular carcinoma.

Table 2
Aesthetic outcomes according to the panel and BCCT.core software of pictures of all 104 patients after BCS.

<table>
<thead>
<tr>
<th>Aesthetic outcomes</th>
<th>BCCT.core, n = 104</th>
<th>Panel, n = 102 (n = 12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>n = 41 (40%)</td>
<td>n = 20 (19.2%)</td>
</tr>
<tr>
<td>Good</td>
<td>n = 42 (40%)</td>
<td>n = 40 (38.5%)</td>
</tr>
<tr>
<td>Fair</td>
<td>n = 18 (17%)</td>
<td>n = 35 (33.3%)</td>
</tr>
<tr>
<td>Poor</td>
<td>n = 3 (3%)</td>
<td>n = 9 (8.7%)</td>
</tr>
</tbody>
</table>

The median age at follow-up from last surgical procedure was 65.5 years (IQR 53–88 years) after the last surgical procedure. The last surgical procedure is either the initial operation or a re-excision. At follow-up, patients had a median age of 59.0 (IQR 53–65.5) years, which was normally distributed according to skewness and kurtosis. Other continuous factors, like tumour diameter according to the pathologist, tumour diameter on ultrasound and tumour volume, were not normally distributed.
results regarding their QoL and aesthetic results. Aesthetic results were negatively influenced by sentinel node procedure, axillary lymph node dissection, chemotherapy, and hormonal therapy. We also found that expert panel and objective BCCT.core software judgement give similar outcomes and that patients are more positive than expert panels or BCCT.core software. This could benefit optimal shared decision-making.

Factors that influence aesthetic outcome are difficult to define objectively. The amount of studies that include patient-reported outcomes reflects the importance of women’s perception of aesthetic outcomes after BCS [15–20]. As a result of the increasing number of patients who survive breast cancer, we have to focus on aesthetic outcomes as another endpoint of BCS [21,22]. Although surgical cosmetic outcomes are related to QoL, previous studies have shown that other factors such as fear of the future also affect QoL [18–21]. We hypothesized that, for example, survival-specific concerns such as fear of recurrence would affect the QoL and aesthetic outcome in the first period after BCS and that these concerns would decrease over time and more attention would be given to aesthetic outcomes [23,24]. However, most studies are outdated and report on short-term outcomes, which highlights the importance of this study.

In this study, we used the body image value from the EORTC QLQ-BR23 to define the aesthetic outcome according to the patients’ opinions. When data were included, the BreastQ questionnaire was not yet available. Factors negatively influencing this score were sentinel node procedure, axillary lymph node dissection, chemotherapy, and hormonal therapy. Already in 1985, Patterson et al. asked breast cancer patients for their opinion on aesthetic outcomes and factors determining this [24]. At that time reverse outcomes of ALND mostly determined patients’ satisfaction. ALND or sentinel lymph node excision as risk factor for poor body imaging is consistent with the literature [25,26]. No axillary clearance means less extent of the operation, and thus decreased risk of breast oedema [27]. Another hypothesis that could explain the association between axillary clearance and aesthetic outcome, is that the axillary scar pulls the upper lateral quadrant of the breast up towards the axilla. Chemotherapy has proven to be associated with lower QoL, probably because of side effects and long-term physical effects [28,29]. Some previous studies have shown no influence of hormonal therapy on aesthetic outcome, however others have shown it may have negative impact [16,18,30,31]. Although asymmetry is not associated with aesthetic outcome in this study, other studies that include breast-specific factors in their analysis towards aesthetic outcomes have also been negatively influenced by asymmetry and scar appearances [15,18,22]. This underlines the importance of emphasizing aesthetic goals and the use of oncoplastic techniques where indicated.

This study has certain strengths and limitations. This study describes long-term patient-reported outcomes of QoL and aesthetic outcomes, with longer follow-up than has been reported before. Another strength of the current study is that it uses not only subjective but also objective methods to evaluate aesthetic outcomes. Both BCCT.core and panel observation as well as two validated questionnaires were used, which evaluates aesthetic outcomes from more point of views. Agreement between expert panel observation and BCCT.core was high in this study. Although panel formations in previous studies differ, a stable association between panel and BCCT.core was found and showed that both techniques can be used to objectively measure aesthetic outcomes [32,33].

In contrast to previous studies assessing body image in breast cancer, linear regression models were used instead of logistic regression models. This difference is explained because body image, a continuous variable, must be dichotomized for logistic regression models. Dichotomization can distort the true relationships among predictor variables [34,35]. Therefore, this study used only linear regression models. However, the R2-value indicates that the independent variables, does not explain much in the variation of the dependent variable, body image. Nevertheless, a univariate regression does not control for endogeneity of omitted variables or correlated variables and for that purpose, the univariate regression is good evidence even with a low R2.

Since conducting the study, more has become clear about the lack of correlation between objective assessments like BCCT.core software and panel opinions with the judgement of the patient. With the patient centered idea of PROM’s, this is the most valuable information gathered in this study. The availability of objective measures like BCCT.core software and the panel opinion does again give very intriguing side information to the team that treats the patient. However, in pursuing the highest quality of care, the focus should be on the patients’ judgement.

On the other hand, our study has some limitations due to its retrospective design and single-centre approach, although we received an acceptable response rate of 61.8% with a near-complete database. One potential source of bias in our study, is that we excluded postoperative wound complications with a severe adverse event score of Clavien-Dindo score >3. This could have influenced our data since this would negatively influence wound healing and scarring, and consequently also influence our primary outcomes quality of life and aesthetic outcome. A definite bias could be found in the radiotherapy treatment. As all patients in this study received radiotherapy, the factor was not taken into account at time of data collection. However, information of dose and fractions is missing and since this is a known factor of cosmetic outcome it might have influenced our data.

To evaluate the aesthetic outcome according to the patient we used the subscale body image from the EORTC QLQ-BR23. This subscale focuses on aesthetic outcome specifically and is thereby the most relevant score for this study. However, by itself it is not validated. Therefore, although it is justifiable to use only body image for studying the effect of the aesthetic outcome according to the patient after breast conserving surgery, we should interpreted the results with precaution.

This study did not obtain preoperative QoL scores in our study population. The lack of baseline values is partly explained by the retrospective study design. Another reason is that the recording of PROMs was unusual in the days of the surgical treatment of this study population. Prospective measurements pre- and postoperatively will presumably give a better view of changes in QoL and reflect the effects of breast-conserving surgery.

It is challenging to look for ways to improve the results of those patients with disappointing results and thus a lower QoL. The results of our study show that the factors chemotherapy and nipple position give a lower QoL and a lower score in body image. These patients could benefit from adequate counselling before surgery or innovative surgical techniques like oncoplastic resections/reconstructions to impact their satisfaction with aesthetic outcomes. To identify more detailed location-specific predicting parameters, the number of included patients should be much greater to achieve large enough subpopulations per location to be able to analyse those statistically. Moreover, data from the current era, with more advanced oncoplastic techniques, should be used.

Future long-term studies should contain a bigger sample size and analyse populations treated with better and currently more widely used oncoplastic techniques to evaluate the QoL and
aesthetic outcomes in patients receiving breast-conserving surgery. More meaningful data pre- and postoperatively on how women interpret their aesthetic outcomes could benefit optimal shared decision-making.

In the current time frame increasing real time data on QoL in PROMS are collected in our and many other hospitals in the Netherlands and worldwide. This could lead to more accurate data on this topic. Our analyses might provide insights into reinforcing the role of oncoplastic surgery and the importance of discussing contralateral oncplastic techniques to overcome lower quality of life and aesthetic outcome after lumpectomy in breast cancer patients. Naturally, our data need to be validated in larger cohorts.

In conclusion, in this study the majority of the patients have acceptable QoL after BCS during long-term follow-up. Unacceptable aesthetic outcomes after BCS are associated with lower QoL and are influenced by sentinel node procedure, axillary lymph node dissection, chemotherapy, and hormonal therapy.

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**CRediT authorship contribution statement**

- M. Zwakman: Formal analysis, Investigation, Methodology, Project administration, Writing — original draft.
- A. Tan: Data curation, Investigation, Methodology, Project administration, Writing — review & editing.
- C. Boersma: Writing — original draft, Supervision, Validation, Writing — review & editing.
- E.M. Noorda: Supervision, Validation, Writing — review & editing.
- T.R. de Jong: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Writing — review & editing.
- A.B. Francken: Methodology, Supervision, Validation, Writing — review & editing.

**Declaration of competing interest**

No declarations of interest.

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