ORIGINAL ARTICLE

Factors Determining Esthetic Outcome after Breast Cancer Conservative Treatment

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■ **Abstract:** The aim of this study was to evaluate the factors that determine esthetic outcome after breast cancer conservative treatment, based on a consensual classification obtained with an international consensus panel. Photographs were taken from 120 women submitted to conservative unilateral breast cancer surgery (with or without axillary surgery) and radiotherapy. The images were sent to a panel of observers from 13 different countries and consensus on the classification of esthetic result (recorded as excellent, good, fair or poor) was obtained in 113 cases by means of a Delphi method. For each patient, data were collected retrospectively regarding patient characteristics, tumor, and treatment factors. Univariate and multivariate analysis were used to evaluate the correlation between these factors and overall cosmetic results. On univariate analysis, younger and thinner patients as well as patients with lower body mass index (BMI) and premenopausal status obtained better cosmetic results. In the group of tumor- and treatment-related factors, larger removed specimens, clearly visible scars, the use of chemotherapy and longer follow-up period were associated with less satisfactory results. On multivariate analysis, only BMI and scar visibility maintained a significant association with cosmesis. BMI and scar visibility are the only factors significantly associated with cosmetic results of breast cancer conservative treatment, as evaluated by an international consensus panel. ■

Key Words: breast cancer conservation, Delphi method, esthetic result, subjective evaluation, treatment outcome

Over the last 3 decades several publications have been dedicated to factors determining cosmetic outcome of breast cancer conservative treatment, during a period where not only surgery but also radiotherapy techniques suffered important modifications (1–11). Generally, factors affecting cosmetic outcome of breast cancer conservative treatment were usually divided as patient, tumor, and treatment factors. The factors most frequently reported as important to the final esthetic result are patient weight (12), breast size (12–15), tumor localization(11,16,17), tumor size (5,8,10,12,13), specimen weight or volume (10–13, 15,18–20), placement of incisions (10,12,15,20), chemotherapy(8,21,22), and irradiation (7,11,18).

However, methods of evaluating esthetic results have not been subjected to comparable changes. Subjective evaluation remained the most widely used assessment method, leading to poor reproducible results and therefore leaving doubts about the real influence of the studied factors on cosmetic results (23). Hence, the need for a consensus over subjective

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esthetic evaluation in breast cancer conservative treatment, to determine more accurately those factors impacting on the final cosmetic outcome (24,25).

Based on a consensual classification made by two expert panels using a Delphi procedure we analyzed various clinical- and treatment-related factors for their possible effect on esthetic result of breast cancer conservative treatment.

MATERIALS AND METHODS

Population

Photographs were taken from 120 breast cancer patients submitted to unilateral conservative breast surgery and radiotherapy with treatment completed at least 1 year before the onset of the study. All patients signed an informed consent to participate. A digital camera with a resolution of four megapixels was used, having as background a blue panel and photographs were taken in four positions with the patient standing on floor marks: face arms down; face arms up; left-side arms up; right-side arms up.

All patients were treated with conservative breast surgery, with or without axillary surgery, and whole breast radiotherapy, in three different institutions in Portugal. Treatment was undertaken by surgeons with different experiences in breast surgery. Patient, tumor, and treatment factors were recorded for each case (Table 1).

Table 1. Patient, Tumor- and Treatment-Dependent Factors Recorded for Each Patient

Patient-dependent factors	Tumor- and treatment-dependent factors
Age	Incision size (cm), tumor size (mm)
Height (cm)	Incision type (radial, sulcus, periareolar, curved)
Weight (kg)	Specimen weight (g)
Thorax perimeter (cm)	Side (left, right)
Body mass index (BMI)	Tumor location (UOQ, UIQ, LOQ, LIQ, OQT, SQT, IQT, LQT)
Breast size (radius cm)	Type of intervention (tumorectomy or tum.
Bra cup size (A, B, C, D)	with sentinel node biopsy or with
Age of menarche	axillary dissection)
No. pregancies	Scar visibility (not, slightly, very visible)
Age of first pregnancie	Surgeon (general, breast—>150 cases/year)
Oral contraceptives (yes, no)	Chemotherapy (yes, no)
Menopause (yes, no)	Hormone therapy (yes, no)
	Follow-up (months)

UOQ, upper outer quadrant; UIQ, upper inner quadrant; LOQ, lower outer quadrant; LIQ, lower inner quadrant; OQT, outer quadrant transition; SQT, superior quadrant transition; IQT, inner quadrant transition; LQT lower quadrant transition.

Delphi Consensus

Twenty-four clinicians working in different countries were selected for evaluation of the esthetic result based on their experience in breast cancer conservative treatment (number of cases seen per year and/or participation in published work on evaluation of esthetic results). They were asked to evaluate individually a series of 240 photographs taken from 60 patients (the limit was due to time restrictions of the participants).

Overall esthetic results were evaluated classifying each case into one of four categories of the Harris scale: excellent—treated breast nearly identical to untreated breast; good—treated breast slightly different from untreated; fair—treated breast clearly different from untreated but not seriously distorted; poor—treated breast seriously distorted (7).

To obtain a consensus between observers, a Delphi process was used (26,27). The method is an attempt to obtain expert opinion in a systematic manner. Experts are recruited individually and anonymously. The survey is conducted over several rounds, and the results are analyzed and then reported to the group. The process is considered complete when there is a convergence of opinion or when a point of diminishing returns is reached (28). Consensus was reached in 59/60 cases (98%) after two rounds. The evaluation of each case was considered consensual when >50% of observers provided the same classification on esthetic result (25).

To obtain a larger sample size, a second consensus panel with another 60 cases was initiated. Participants were limited to those who had obtained at least 35 (60%) coincident answers with the final consensus in the previous panel (taking into account the weight of wrong answers for noncontiguous classes; Table 2). Nine of the 11 invited experts participated on this second Delphi consensus. Evaluation of each case was considered consensual when >67% of observers provided the same classification on esthetic result and consensus was obtained in 54/60 cases (90%). Six were considered nonconsensual caseses (10%) (Fig. 1).

Statistical Methods

To evaluate the influence of patient, tumor, and treatment factors on cosmetic result of breast cancer conservative treatment an analysis of variance was undertaken, using the Kruskal–Wallis test for continuous variables and the chi-squared and Fisher exact tests for categorical variables; p-values of 0.05 or less

Table 2. Invitations for Participating on the Second Delphi According to Answers of the First Participation (Number of Coincident Answers with or without Weight)

Gender	Age	Working area	Country	Correct answers	Correct answers (weight)	Invitations and answers
Male	≥50	Breast surgeon/medical oncology	Italy	—	—	Withdraw 1st consensus
Female	<50	Radiation oncology	Netherlands	38	38	Invited/accepted
Male	<50	Radiation oncology	Australia	36	35	Invited/accepted
Male	<50	Breast surgeon	Netherlands	41	41	Invited/declined
Male	<50	Breast surgeon	Portugal	21	19	Not invited
Male	≥50	Radiologist	Portugal	33	33	Not invited
Female	<50	Breast Surgeon/reconstructive surgery	UK	—	—	Withdraw 1st consensus
Male	>50	Breast surgeon	Sweden	35	35	Invited/accepted
Female	<50	Radiation oncology	Portugal	36	35	Invited/accepted
Female	>50	Radiation oncology	Portugal	39	33	Not invited
Male	<50	Surgeon, consultant	Slovenia	39	37	Invited/declined
Male	<50	Radiation/medical oncology	Denmark	40	40	Invited/accepted
Male	≥50	Reconstructive surgery	Portugal	45	45	Invited/accepted
Female	≥50	Radiation oncology	USA	35	34	Not invited
Female	≥50	Reconstructive breast surgeon	France	40	38	Invited/accepted*
Female	≥50	Breast surgeon/gynecology	Italy	43	43	Invited
Male	<50	Breast surgeon	UK	38	38	Invited/accepted*
Male	≥50	Breast surgeon	Spain	38	37	Invited
Male	≥50	Breast surgeon/gynecology	Portugal	37	37	Invited/accepted
Male	≥50	Breast surgeon	Austria	22	6	Not invited
Female	≥50	Breast surgeon	Finland	36	35	Invited/accepted
Male	<50	Radiologist	UK	33	32	Not invited
Female	≥50	Medical oncology	Portugal	33	32	Not invited
Male	<50	Breast surgeon	USA	47	47	Invited/accepted

*Both invited and accepted but answers not in due time.

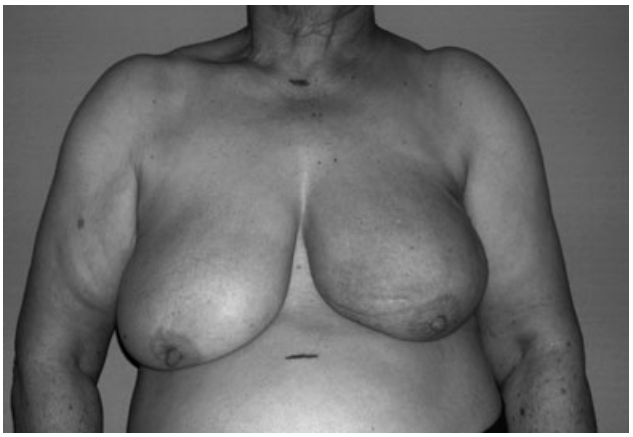

Figure 1. Photograph of one of the nonconsensual patients (classified as good by 33%, fair by 44% and poor by 23% of the experts).

were considered significant. Factors considered significant on univariate analysis were selected for multivariate analysis.

Multivariate analysis was performed with logistic regression for calculating the odds ratio at 95% confidence intervals. An initial analysis was done inside each factor group and subsequently in a final model including the significant variants from each group. To obtain a more adequate sample size for multivariate analysis, the four classes of cosmetic results were associated in two groups: excellent/good and fair/poor.

RESULTS

Consensus on esthetic results of breast cancer conservative treatment was obtained by the two panels in 113 of the 120 evaluated patients (94%). Fourteen patients were classified as excellent (12%), 64 as good (57%), 24 as fair (21%), and 11 as poor (10%). On univariate analysis, patient-related factors influencing esthetic results were age, weight, BMI, breast size, and menopausal status. Younger and thinner patients obtained better esthetic results (age: $p < 0.013$ and weight: $p < 0.008$) while BMI ($p < 0.006$), breast size ($p < 0.005$) and menopausal status ($p < 0.002$) were associated with a negative impact on esthetic evaluation (Table 3).

In the group of tumor- and treatment-related factors, surgical specimen weight ($p < 0.001$), scar visibility ($p < 0.001$), the use of chemotherapy ($p < 0.052$) and longer follow-up ($p < 0.039$) were the only significant factors determining a negative impact on final esthetic results (Table 4). On multivariate analysis, only BMI and scar visibility remained as significant factors for poor esthetic evaluations (Table 5).

Table 3. Univariate Analysis for Patient-Dependent Factors

	Consensus results				
	Poor (n = 11)	Fair (n = 24)	Good (n = 64)	Excellent (n = 14)	p
Average (±standard deviation)					
Age	54.3 (9.3)	56.8 (9.6)	56.4 (10.2)	46.8 (10.8)	**0.013**
Height (cm)	158.9 (1.6)	160.4 (1.3)	158.7 (0.8)	161.6 (1.7)	0.334
Weight (kg)	75.8 (2.8)	72.8 (3.2)	65.6 (1.2)	64.2 (1.8)	**0.008**
Thorax perimeter (cm)	99.8 (2.4)	97.1 (1.9)	92.5 (1.6)	90.1 (1.4)	0.058
BMI	30.1 (1.4)	28.1 (1.0)	26.1 (0.4)	24.6 (0.7)	**0.006**
Breast size (radius-cm)	11.3 (0.8)	10.3 (0.6)	9.3 (0.3)	8.2 (0.5)	**0.005**
Age of menarche	12.3 (0.5)	13.1 (0.3)	13.2 (0.2)	12.6 (0.4)	0.175
Number of pregnancies	1.4 (0.2)	1.5 (0.2)	1.7 (0.2)	1.6 (0.3)	0.796
Age of first pregnancy	23.4 (1.0)	23.6 (0.7)	24.0 (0.8)	26.2 (2.2)	0.518
n (%)					
Bra cup size					
A	0 (0.0)	4 (16.7)	16 (25.0)	6 (42.9)	0.116
B	3 (27.3)	10 (41.7)	28 (43.8)	6 (42.9)	
C	4 (36.4)	6 (25.0)	10 (15.6)	2 (14.3)	
D	4 (36.4)	4 (16.7)	10 (15.6)	0 (0.0)	
Oral contraceptives	8 (72.7)	12 (50.0)	32 (50.0)	9 (64.3)	0.438
Menopause	7 (63.6)	23 (95.8)	57 (89.1)	8 (57.1)	**0.002**

DISCUSSION

In the present study, the cosmetic results after breast cancer conservative treatment were evaluated by an international consensus panel using a Delphi method. This consensual approach had the advantage of reuniting a consistent subjective classification over a subject were reproducible results were always difficult to obtain (20,23,24).

Conclusions about the impact of patient, tumor-, and treatment-related factors on cosmetic outcome, in spite of the consensual evaluation, must however be carefully considered because of the sample size. On multivariate analysis only BMI and scar visibility modified the final cosmetic outcome according to consensus classification in the 113 evaluated patients. Age, menopausal status, specimen size, chemotherapy, and longer follow-up, all affected cosmetic result only on univariate analysis.

Similar results have previously been reported by others. Touboul et al. (29) studied a group of 329 patients and concluded that age affected significantly cosmetic results, obtaining more excellent and good results in younger patients. Steeves et al. (16) had also found a significant association between young age and better cosmesis in a study of 124 patients. Perhaps younger and usually fitter patients have better cosmetic results because of general appearance and not to other more objective aspects as asymmetry measurements. This particular point gets even more relevant when we confirm that in studies done with objective measurements the age factor, usually, looses its statistical significance (15,19). Menopause had exactly the same implications as age in our analysis probably due to the same reasons.

Heavier women presented in our series also with poorer esthetic results. Clarke et al. (12) concluded identically and justified this fact by saying that heavier women have usually larger breasts with more fat, rending homogeneity distribution of radiation much more difficult, leading to worse cosmetic results.

Curiously in the group of the tumor- and treatment-related factors higher specimen weight, but not tumor size, was responsible for worse cosmetic results, meaning probably that tumor size, and specimen size were not proportional in our series. Liljegren et al. (30) referring to this particular problem stated that this fact is noticed frequently in retrospective series where there is no standardization of surgical procedures, and consequently specimen size or weight is more consistent than tumor size as resected margins are extremely variable.

Another factor associated with poorer results was scar visibility. This parameter was a subjective appreciation made by an independent observer when patient's photographs were captured. This factor should be cautiously considered because classifying subjectively scar visibility can be biased by overall esthetic result. Yet some other authors as Taylor et al. (10) with larger series with 458 patients, considered

Table 4. Univariate Analysis for Tumor and Treatment-Dependent Factors

	Consensus results				
	Poor (n = 11)	Fair (n = 24)	Good (n = 64)	Excellent (n = 14)	p-value
Average (±standard deviation)					
Incision size (cm)	77.7 (14.2)	63.5 (7.7)	57.6 (3.7)	62.1 (8.8)	0.335
Specimen weight (g)	102.4 (40.7)	63.2 (33.2)	54.9 (36.2)	40.4 (22.8)	**<0.001**
Tumor size (mm)	20.5 (2.9)	23.5 (1.8)	20.7 (1.6)	19.3 (5.0)	0.746
n (%)					
Side					
Left	5 (45.5)	11 (45.8)	33 (51.6)	7 (50.0)	0.958
Right	6 (54.5)	13 (54.2)	31 (48.4)	7 (50.0)	
Tumor location					
UOQ	5 (45.5)	16 (66.7)	25 (39.1)	7 (50.0)	0.465
UIQ	0 (0.0)	1 (4.2)	11 (17.2)	1 (1.7)	
LOQ	1 (9.1)	1 (4.2)	4 (6.3)	1 (1.7)	
LIQ	0 (0.0)	1 (4.2)	0 (0.0)	0 (0.0)	
OQT	1 (9.1)	2 (8.3)	11 (17.2)	1 (1.7)	
SQT	3 (27.3)	2 (8.3)	9 (14.1)	4 (28.6)	
IQT	0 (0.0)	1 (4.2)	1 (1.6)	0 (0.0)	
LQT	1 (9.1)	0 (0.0)	3 (4.7)	0 (0.0)	
Type of intervention					
Tumorectomy	0 (0.0)	2 (8.3)	9 (14.1)	1 (7.1)	0.629
Tumorectomy, sentinel node	0 (0.0)	0 (0.0)	5 (7.8)	1 (7.1)	
Tumorectomy, axillary dissect.	11 (100.0)	22 (91.7)	50 (78.1)	12 (85.7)	
Incision type					
Radial	4 (36.4)	8 (33.3)	15 (23.4)	2 (14.3)	0.393
Sulcus	2 (18.2)	3 (12.5)	14 (21.9)	5 (35.7)	
Curved	4 (36.4)	4 (16.7)	14 (21.9)	1 (7.1)	
Periareolar	1 (9.1)	9 (37.5)	21 (32.8)	6 (42.9)	
Scar visibility					
Not visible	2 (18.2)	5 (20.8)	26 (40.6)	12 (85.7)	<0.001
Slightly visible	3 (27.3)	10 (41.7)	35 (54.7)	2 (14.3)	
Very visible	6 (54.5)	9 (37.5)	3 (4.7)	0 (0.0)	
Surgeon					
General	5 (45.5)	8 (33.3)	17 (26.6)	4 (28.6)	0.612
Breast	6 (54.5)	16 (66.7)	47 (73.4)	10 (71.4)	
Average (±standard deviation)					
Follow-up	45.5 (19.4)	39.6 (25.4)	28.8 (15.2)	38.8 (8.7)	**0.039**
n (%)					
Chemotherapy	9 (81.8)	12 (50.0)	24 (37.5)	6 (42.9)	0.052
Hormone therapy	8 (72.7)	18 (75.0)	49 (76.6)	10 (71.4)	0.957

scar appearance also as having impact on final cosmetic result. Our own previous work considered scar appearance as being one of the factors contributing to global esthetic result and also contributing to distinction between classes (25).

Chemotherapy and longer follow-up were the only treatment dependent factors affecting cosmetic outcome on univariate analysis. Chemotherapy as for long time been associated with contradictory results, for some authors being associated with worse esthetic results (21,22,31,32) while for others showing no impact on cosmetic results (19,29,34,35). Longer follow-up is also associated with poorer esthetic results in the majority of published works, due most probably to the delayed effects of radiotherapy (32).

In the multivariate analysis, however, only two factors, BMI and scar visibility, remained has having impact on the final cosmetic result of this 113 patients according to the consensual classification. The outcome of the multivariate analysis is disappointing having in mind the possible modification of factors that will improve the final esthetic result. Obviously, BMI will not be susceptible to changes and only scar visibility could eventually be modified.

However, extending sample size will probably lead to more consistent results rending other variables significant to the final esthetic result and consequently permitting the improvement of other factors capable of modifying the cosmetic outcome of breast cancer conservative treatment.

Table 5. Multivariate Analysis

	Odds ratio	95% CI
Patient-related factors		
Age	1.00	0.96–1.05
Thorax perimeter	1.01	0.97–1.05
BMI	**1.15**	1.00–1.32
Breast size (radius, cm)	1.11	0.89–1.37
Tumor- and treatment-related factors		
Scar visibility		
Not visible	1	
Slightly visible	1.85	0.65–5.25
Very visible	**22.6**	5.03–101.22
Specimen weight (g)	1.01	1.00–1.03
Chemotherapy	**2.40**	1.06–5.43
Final model		
BMI	**1.24**	1.08–1.43
Scar visibility		
Not visible	1	
Slightly visible	1.91	0.62–5.86
Very visible	**29.8**	5.72–155.36
Specimen weight (g)	1.80	0.65–4.99
Chemotherapy	1.00	0.99–1.02

The following were participants in the consensus evaluation panels: Bruno Salvadori, (Policlinica S. Marco, Bergamo, Italy), Conny Vrieling (Netherlands Cancer Institute, Amsterdam, The Netherlands), David Christie (East Coast Cancer Center, Tugun, Australia), Emiel Rutgers (Netherlands Cancer Institute, Amsterdam, The Netherlands), Fernando Castro (Instituto Português de Oncologia, Porto, Portugal), Fernando Lage (Instituto Português de Oncologia, Lisbon, Portugal), Fiona MacNeill (Essex County Hospital, Colchester, UK), Goran Liljegren (University Hospital, Örebro, Sweden), Isabel Azevedo (Instituto Português de Oncologia, Porto, Portugal), Isabel Monteiro Grillo (Hospital Santa Maria, Lisbon, Portugal), Janez Zgajnar (Institute of Oncology, Ljubljana, Slovenia), Jørgen Johansen (University Hospital, Odense, Denmark), José Rosa (Instituto Português de Oncologia, Lisbon, Portugal), Leela Krishnan (University of Kansas Medical Center, Kansas City, KS), Lise Barreau (Institut Gustave Roussy, Villejuif, France), Maria Piera Mano (CPO Piemonte, Torino, Italy), Michael Dixon (Edinburgh Breast Unit, Western General Hospital, Edinburgh, Scotland, UK), Miguel Prats Esteve (University Hospital, Barcelona, Spain), Natália Amaral (Hospital da Universidade, Coimbra, Portugal), Raimund Jakesz (AKH University of Vienna, Austria), Rauni Saaristo (University Hospital, Tampere, Finland), Robin Wilson (Nottingham Breast Institute, City Hospital, Nottingham, UK), Vera Tomé (Instituto Português de Oncologia, Lisbon, Portugal), Virgilio Sacchini (Memorial Sloan Ketterin Cancer Center, New York, NY).

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