“Surgery of Congenital Breast Asymmetry – Which Objective Parameter Influences the Subjective Satisfaction With Long-term Results?”

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Research Article

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Abstract

Purpose: Congenital breast asymmetry is a serious gynaecological malformation for affected patients. The phenotyping hits young women in puberty and is associated with a socio-aesthetic handicap, depression and psychosexual problems. Therefore, the time of therapy is usually early in view of the patient's entire life so that a sustainable solution is important. Although, postoperative outcome has been evaluated in several studies before, this study firstly analyses which objective parameters have the most influence on subjective satisfaction with long-term results.

Methods: 34 patients with a diagnosed congenital breast asymmetry that underwent either lipofilling or implant therapy in the years of 2008 - 2019 were examined. On average, our collective was seven years postoperatively. Data was mainly gathered by manual measurements, patient-reported outcome measures (Breast Q™) and breast volumetry based on 3D scans (Vectra® H2, Canfield Scientific).

Results: Among all analysed parameters, only the areola diameter correlated significantly negative with the subjective outcome satisfaction of the patient. Regarding the subjective assessment of the postoperative satisfaction with similarity of the breasts, again the mean of areola diameter, the difference of areola diameter between right and left breast and the difference of volume assessed with 3D scans correlated significantly negative.

Conclusion: The areola diameter was shown to be a significant influencing factor for patient-subjective long-term satisfaction in breast asymmetry patients. Besides, 3D volumetry was shown to be a good tool for objectifying patient subjective assessments. Our findings could lead to further improvement of surgical planning and will be built upon in further studies.

Introduction

The female breast plays an essential role for the human silhouette. Not the size of the breast is crucial for aesthetics, but the overall appearance [1], which is largely determined by symmetry [2]. Congenital breast asymmetry therefore is a serious malformation for affected patients. The phenotyping hits young women in puberty. In this phase of life humans are usually vulnerable and self-critical about their body and anxious to compare themselves with their peer group [3]. The breast is considered as a symbol of femininity, attractiveness, sexuality and fertility. Consequently, a deformation of this organ is associated with the loss of these values and often leads to a socio-aesthetic handicap. Especially psychological symptoms such as depression and psychosexual problems burden the patients [4–7]. It is important to note that breast asymmetry to some degree is natural and small volume differences between right and left breasts are found in almost every woman [8–10]. In contrast, obviously recognisable breast asymmetry should be classified as a deformity [8]. The specificity of the patient group lies in the phenotyping during puberty [11, 12]. Due to the described impairments, women with breast asymmetry have a strong self-motivation to undergo plastic surgery [3]. Most experts recommend an early correction in order to prevent both emotional and social problems such as stigmatisation [11, 13]. In several studies,

affected women showed a significant improvement in subjective psychological stability after surgical procedure. In addition, even in undressed situations, increased self-esteem is reported [3, 14]. In general, the time of therapy is relatively early in view of the patient's entire life, so that a long-term and sustainable solution is of particular importance for the patient [12].

Asymmetrical breasts still present a major challenge in plastic surgery [4]. Since the patient and the surgeon may evaluate a good result differently [15, 16], this study analyses which objective factors influence the subjective long-term satisfaction in patients with congenital breast asymmetry.

Materials And Methods

Recruitment and participants

Prior to participant recruitment, the ethics committee of Regensburg University approved the study (Approval number: 20-1654-101). Patients with diagnosed breast asymmetry and a correction surgery at our institution (University Center for Plastic, Aesthetic, Hand and Reconstructive Surgery, Regensburg) in the years of 2008–2019 with either lipofilling or silicone implant were included in the study. Women who were minor, had epilepsy, were in a post-mastectomy state or patients with acquired breast asymmetry were excluded from the study. The data collection period was from March 2020 to July 2020. A compact overview of our patient collective is given in Table 1:

Table 1
Description of our patient collective

n = 34	Mean (± SD)	Range
Age (at time of data collection) [in years]	30 (± 5.8)	21–45
Age (at time of first breast surgery) [in years]	21 (± 5.6)	16–42
BMI (at time of last breast surgery) [in kg/m^2]	23.6 (± 4.1)	18–38
Length of postoperative period [in years]	7 (± 3.3)	0.9–12
Cup Size	C	A-E
Scar quality (given a scale from 1 (best) to 3 (worst))	1.4 (± 0.6)	1–3
Number of surgery sessions	2 (± 1.2)	1–5

At the time of the first operation correcting breast asymmetry 10 of the 34 patients were minors. Half of the patients were treated with lipofilling and the other half with silicone implant augmentation. The cohort of patients with congenital breast asymmetry included five women with diagnosed Poland’s syndrome, fifteen patients with tuberous breast deformity and breast asymmetry, thirteen persons with Amazon’s syndrome and one woman with chest deformity.

Study design

Before participating, the patients received medical education about the study and signed an informed consent.

Following parameters were collected through the clinical examination: In addition, cup size (A/B/C/D/E) was determined by medical assessment. The scar quality was evaluated on a scale from 1–3 (hardly/moderate/highly visible scars). As body measurements can be an important predictor for female attractiveness [17], the patient was measured manually with a classic tape measure along the skin surface. The following distances were recorded: Sternal Notch to Nipple (SN–N), Inframammary Fold to Nipple (IMF–N), Upper Breast Pole to Nipple (UBP–N), Xiphoid to Nipple (Xi–N), Lateral Breast Pole to Nipple (LB–N), Inframammary Fold Length (IMF-Length) and Areola diameter (AD). The recorded distances are shown in Fig. 1. All measurements were performed as shortest distance along the skin surface.

Three-Dimensional Volumetry

The 3D breast volumetry was performed with the portable Vectra® H2 (Canfield Scientific, USA), which is frequently used in the literature [18–26]. The 3D model can be analysed in terms of breast volumes and various breast dimensions by using the BREASTsculptor® software, which is integrated into the programme. O'Connell et al. [20] conducted a validation study in 2018 using the Vectra® XT with a modified protocol and the anterior axillary line selected for the lateral breast boundary. The difference between users 1 and 2 was minimised by these precisely defined points [20]. We integrated these findings, so that the reference points were precisely defined in order to achieve the greatest possible reproducibility in our study:

(1) Sternal Notch (SN), (2) centre of the right clavicle (Cr), (3) centre of the left clavicle (Cl), (4) most cranial point of the right areola (Ar), (5) most cranial point of the left areola (Al), (6) right nipple (Nr), (7) left nipple (Nl), (8) end of right medial inframammary fold (MBr), (9) end of left medial inframammary fold (MBl), (10) end of right lateral inframammary fold (LBr), (11) end of left lateral inframammary fold (LBl), (12) most caudal point of the right inframammary fold (IMFr), (13) most caudal point of the left inframammary fold (IMFl)

Points (8) and (9) are seen as the medial border of the breast. They are more precisely defined as the respective point of the inframammary fold with the shortest distance to the linea mediana anterior. The lateral border of the breast is marked by points (10) and (11). As the appearance of the mamma varies greatly from woman to woman [27], depending on the shape of the breast, the inframammary folds can be very variable and might have a diffuse end [28], which makes reproduction of the present reference point inaccurate. The high inaccuracy of reference points was also criticised by O'Connell et al. [20]. They defined the lateral breast boundary as the anterior axillary line [20]. To use a reproducible reference point and to achieve uniformity with manual volumetry, we follow O'Connell et al. [20] and defined the point of the lateral breast boundary as the intersection of the anterior axillary line with a line through the nipple.

All images were taken at our institute, composited and analysed using Vectra® using Breast Sculpture®. The camera equipment includes a special positioning mat which precisely specifies the position of the patient and photographer for each of the three images. The 45° angle of the arms was checked with a goniometer. Additionally, a telescopic stick was used in order to support the patient holding the angle of the arms. The first and third images show the patient at a 45° angle from the right and left respectively. The second image is taken frontally. The Vectra® software then assembles a 3D model from the three captured images. In order to perform calculations on this image, 13 reference points are required. As the automatic detection of the reference points by the Vectra® software did not work as well as expected, the reference points were marked on the patient before the images were taken and then set manually accordingly in the software. This seems to be a common problem which is as well described by other researchers [19]. Following Eder et al. [29], we used the positive effects of pre-marking the reference points [29].

Patient-Related-Outcome Measures: Breast Q™ questionnaire

All participants answered the Breast Q™ questionnaire (Breast-Q Version 2.0©, Augmentation Modules Pre- and Postoperative Scales, German (DE) Version, The University of British Columbia, licensed for non-profit users by Memorial Sloan Kettering Cancer Center and translated by Mapi Research Trust, 2008). This is a standardised patient-reported outcome measures (PROM) on subjective quality of life developed by Pusic et. al. [30]. Over five years the Breast Q™ was validated with the help of about 3000 women [31]. It is therefore considered a clinically relevant standardised outcome evaluation instrument that meets psychometric criteria and assesses the patient's self-assessment according to a state-of-the-art system [31] and has recently been used by other researchers in similar studies [32, 33].

This study used the module requesting the patient’s satisfaction after breast surgery. It evaluates the satisfaction with the breast surgery outcome by means of eight questions with three possible answers for each: 1 = disagree; 2 = somewhat agree; 3 = completely agree. Using the enclosed transformation score, the sum for each module can be interpreted directly as a value between 0 (worst value) and 100 (best value) and thus also as satisfaction in percent.

Statistical analysis

The statistical evaluation was carried out with SPSS® Statistics Version 25.0.0. from IBM®. Using Spearman's correlation, all meaningful parameters were examined for a correlation with patient subjective outcome satisfaction. Spearman correlation was chosen, because either at least one parameter was ordinally scaled or there was at least one outliner. For a comparison between two groups the Mann-Whitney test was applied, because they did not show a normal distribution (Kolmogorov-Smirnov test and the Shiparo-Wilk test) for both groups. A significance level of 0.05 was considered. Simple calculations were carried out with the help of Microsoft® Excel Version 16.41.

Results

Correlations of objective parameters with long-term subjective satisfaction

The long-term overall result in the Breast-Q™ is composed of several individual questions and is given in percentage, with 0% being the worst and 100% the best result.

Table 2
Spearman correlation of outcome satisfaction with surveyed parameters. r_s = correlation coefficient; *significant ($p < 0.05$) **highly significant ($p < 0.01$).

n = 34	BreastQ™ satisfaction with outcome	
	r_s	p-value
Age (at time of data collection) [in years]	0.260	0.137
Age (at time of first breast surgery) [in years]	0.000	0.999
BMI (at time of last breast surgery) [in kg/m^2]	-0.179	0.310
Length of postoperative period [in years]	-0.80	0.653
Cup Size	-0.136	0.443
Scar quality (given a scale from 1 (best) to 3 (worst))	-0.113	0.523
Number of surgery sessions	0.234	0.183

None of the objective parameters in the table above had a significant correlation to the long-term outcome satisfaction for breast asymmetry patients in our study.

Specifically, for the manually measured parameters, it was tested whether a distance (mean value (MV) or Δ between right and left side) had an influence on subjective outcome satisfaction or the perception of breast similarity in the long-term observation. The latter is a single question about the patient's subjective satisfaction with the similarity of her breasts (scale from 1 (worst) to 4 (best)).

Table 3
Results of Spearman correlation for body measurement parameters (mean and Δ between right and left breast), objective volumetry, and symmetry index with outcome satisfaction or satisfaction with similarity of breasts. r_s = correlation coefficient; *significant ($p < 0.05$) **highly significant ($p < 0.01$).

n = 34	**BreastQ™ satisfaction with similarity of breasts**		**BreastQ™ satisfaction with outcome**	
	r_s	p-value	r_s	p-value
MV SN–N	-0.159	0.370	-0.300	0.084
MV IMF–N	0.071	0.689	-0.119	0.504
MV UBP–N	-0.194	0.272	-0.039	0.826
MV Xi-N	-0.115	0.519	-0.186	0.293
MV LB–N	-0.305	0.079	-0.153	0.387
MV AD	**-0.355***	0.039	**-0.405***	0.017
MV IMF-Length	-0.168	0.343	-0.314	0.071
Δ SN–N	-0.269	0.123	0.098	0.580
Δ IMF–N	-0.137	0.441	-0.043	0.811
Δ UBP–N	-0.187	0.290	-0.054	0.761
Δ Xi-N	-0.287	0.100	-0.283	0.105
Δ LB–N	0.002	0.989	-0.176	0.320
Δ AD	**-0.381***	0.026	-0.242	0.168
Δ IMF-Length	0.076	0.669	-0.138	0.435
Δ 3D volume	**-0.389***	0.023	-0.231	0.189
satisfaction with similarity of breasts	1	0	**0.597****	< 0.01

Regarding the mean values of the areola diameters (MV AD), there was a significant correlation both, the general satisfaction with the result (r_s = -0.405; p-value = 0.017) as well as the subjective assessment of similarity between the right and left breast (r_s = -0.355; p-value = 0.039). All other mean values of the body measurements (SN–N, IMF–N, UBP–N, Xi–N, LB–N, IMF-Length) had no significant influence on the subjective satisfaction result or the self-perception of similarity between both breasts. The larger the mean value of the areola diameter, the more dissatisfied the patients were with the long-term result and the more dissimilar they felt their two breasts to be.

Regarding the Δ comparing right and left breast differences, a significant correlation could again only be found for the Δ in the areola diameter of right and left side (Δ AD). This correlated negatively with the patient's subjective satisfaction regarding similarity of her breasts (p-value = 0.026; r_s= -0.381). Clearly, the smaller the difference between the areola diameters of the right and left breast, the more satisfied the patient was with the similarity of her breasts. In addition, the question regarding satisfaction with similarity of the breasts correlated strongly with the overall outcome satisfaction. The p-value was less than 0.01 and the correlation coefficient 0.597. One can conclude that the satisfaction with the similarity of the breasts has a huge impact on the satisfaction with the overall, long-term result. All other calculated Δ of the body measurements (SN–N, IMF–N, UBP–N, Xi–N, LB–N, IMF-Length) had no significant influence on the resulting satisfaction or the satisfaction with the similarity of the breasts.

Regarding the 3D scans, they also showed a significant correlation to patient-subjective satisfaction with the similarity of the breasts. The smaller the difference between right and left breast volume, the more satisfied the patient was with the similarity of her breasts (p = 0.023; r_s =-0.389).

Discussion

Discussion of methods

Compared to other authors in the research field who tend to assess patient satisfaction between a few months and a maximum of one year postoperatively [14, 34, 24], the patients in our study were examined on average seven years postoperatively. This made it possible to attach comparatively greater importance to the long-term outcome. However, the disadvantage of the long-term observation was the collective generation. Although our study collective of 34 patients is not unusual compared to similar studies concerning congenital breast asymmetry (Kuzbari et al. [35] n = 30; Neto et al. [14] n = 35; Eder et al. [29] n = 28), the small collective should be critically discussed as it allows only limited generalisations. Therefore, a multicentre approach could be chosen in follow-up work in order to generate a larger collective.

Long-term outcome satisfaction was assessed in the present study using the validated BreastQ™, which was developed specifically for breast augmentation [30] and corresponds to the current state of research [36]. Especially in earlier studies, some authors worked with a simple satisfaction scale [10, 35, 37, 38] or used measurement tools that did not specifically refer to the breast [14]. In recent years, however, these have been increasingly replaced by the breast specific BreastQ™ and frequently used in the research community [24, 32–34]. Critically, however, it should be noted that long-term outcome satisfaction as assessed by the BreastQ™ is a very complex construct [39] and could be influenced by many other individual factors besides those assessed in the present study. Many people consider plastic surgery as a cure for their personal and relationship problems [40]. For instance, this could have created a bias in long-term outcome satisfaction. Another drawback of the BreastQ™ is that the sensitivity of the breast after surgery is not included in the questionnaire. However, this appeared to be particularly relevant in our

study. Some patients reported numbness or hypersensitivity as one of their biggest postoperative problem. Therefore, in follow-up work, we recommend including breast sensitivity.

By using a state-of-the-art 3D scanning technique for objective outcome assessment, the methodology of our study is based on the latest research. In current literature, state-of-the-art 3D volumetry has been evaluated as objective and effective [41, 42]. Regarding volumetry with the Vectra® H2 from Canfield, however, it should also be considered that there are some limitations. The camera is well suited to create a 3D model of small to medium breasts and analyse their volumes. However, for larger and ptotic breasts, the most caudal point of the inframammary fold, an essential reference point for Canfield's Vectra® H2 (see methods), is not visible and obscured by the breast itself. This limited proper volumetry in this study, as it was the case in Koban et. al. 2018 [41]. In summary, the methodology of our study is characterised not only by its proximity to the current state of research, but also by the comprehensive survey of subjective and objective factors and the long-term observation of the rare diagnosis of congenital breast asymmetry.

Discussion of results

In our study, volumetry with the Vectra® H2 by Canfield proved to be a significantly good tool to quantify patient's subjective satisfaction in a side-by-side comparison of right and left breasts. The results of Ji et al. [42] proving the 3D scan technique to be an objective and effective tool for analysing and documenting breast morphology could thus be confirmed with the present study. In addition, the results of Eder et al. [29] regarding the increasing relevance of 3D technology for comparison of breast augmentation therapies could also be supported with this study.

In the present study, the mean value of the areola diameter was remarkable as it correlated significantly with the patient's subjective assessment of similarity between their breasts as well as with the long-term outcome. Furthermore, our study confirmed the findings of Osinga et al. [38] that neither scar appearance nor breast size had a significant influence on the overall outcome. In everyday clinical practice, the SN–N is considered the most important parameter. However, the present study did not show that a smaller ΔSN–N had a positive effect on the subjective symmetry score for the patient. On this point, our results differ from Osinga et al. [38]. The mean areola diameter (MW AD) was the only body measurement in our work that had a significant influence on the long-term outcome. With this finding our study supports the results of Pietruski et al. [43], who recently showed in their eye tracking study that the nipple-areola complex is one of two key focus areas of the female breast.

Conclusion

The areola diameter was shown to be a significant influencing factor for patient-subjective long-term satisfaction in breast asymmetry patients which will be part of our future research and could lead to further improvement of surgical planning. Thus, our study contributed to the long-term quality assurance of breast surgery for congenital breast asymmetry at the University Center for Plastic, Aesthetic, Hand and Reconstructive Surgery.

Declarations

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The study was not funded.

Conflict of interest

The authors declare that they have no conflict of interest.

Author's contribution

VN: conceptualization, data collection, data analysis and interpretation, original draft and writing of the article

AE: photo editing, critical revision of the manuscript, final approval

MW: critical revision of the manuscript, data preparation, final approval

SS: critical revision of the manuscript, final approval

LP: critical revision of the manuscript, final approval

VB: conceptualization, data collection, supervision, critical revision of the manuscript, final approval

Ethical approval

This study was approved by the institutional Ethics Committee of the Medical Faculty of the University of Regensburg, Germany (Approval number: 20-1654-101). All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent

Written informed consent was obtained from all individual participants included in the study.

Consent for publication

The written consent on using the patient's photographic documentation and data for publication was obtained from all patients included in this study.

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Figures

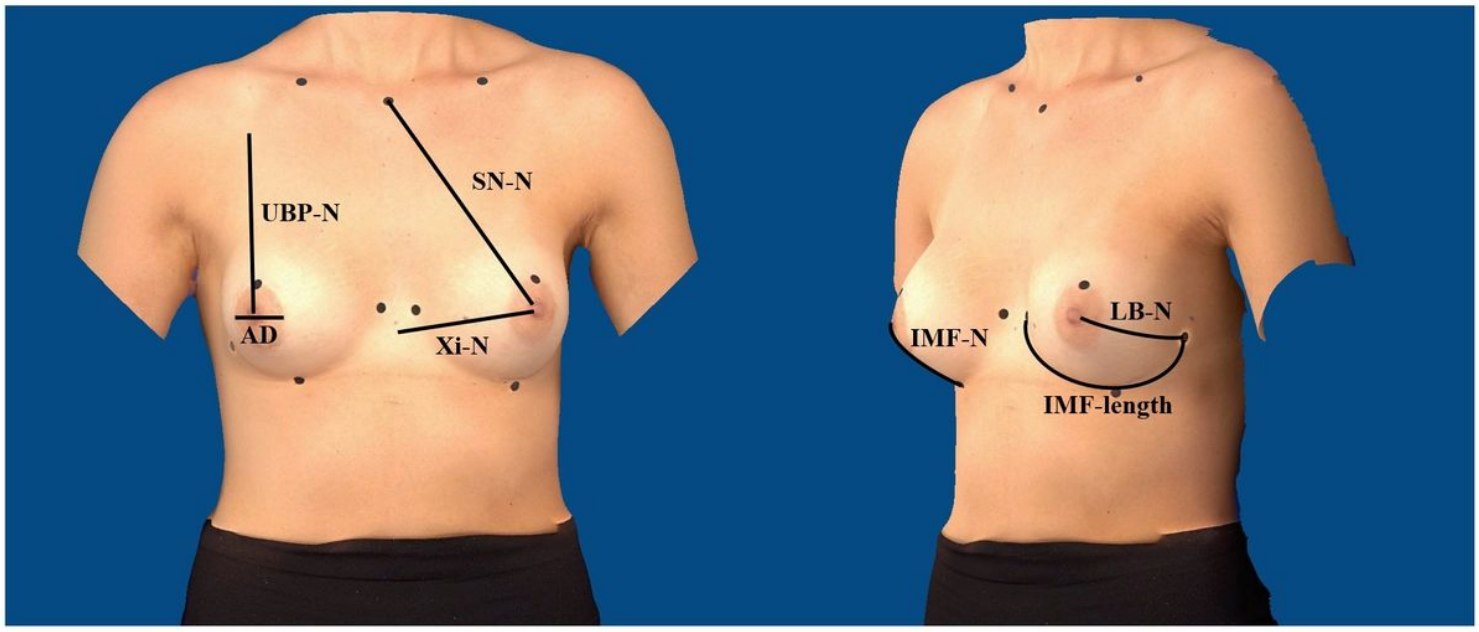

Figure 1

Detailed illustration of measurements (picture created with Canfield Vectra® H2 and edited), patient with implant therapy.

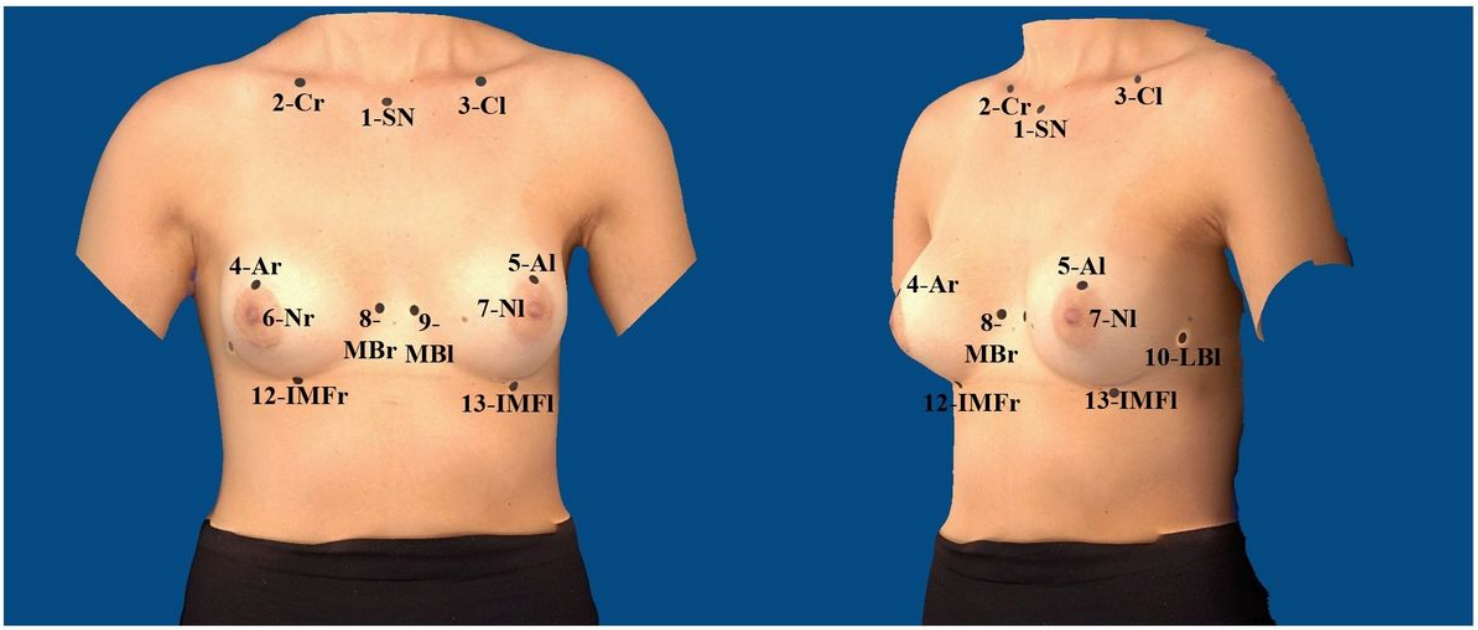

Figure 2

Reference points for Canfield Vectra® H2 (Picture created with Canfield Vectra® H2 and edited), patient with implant therapy.

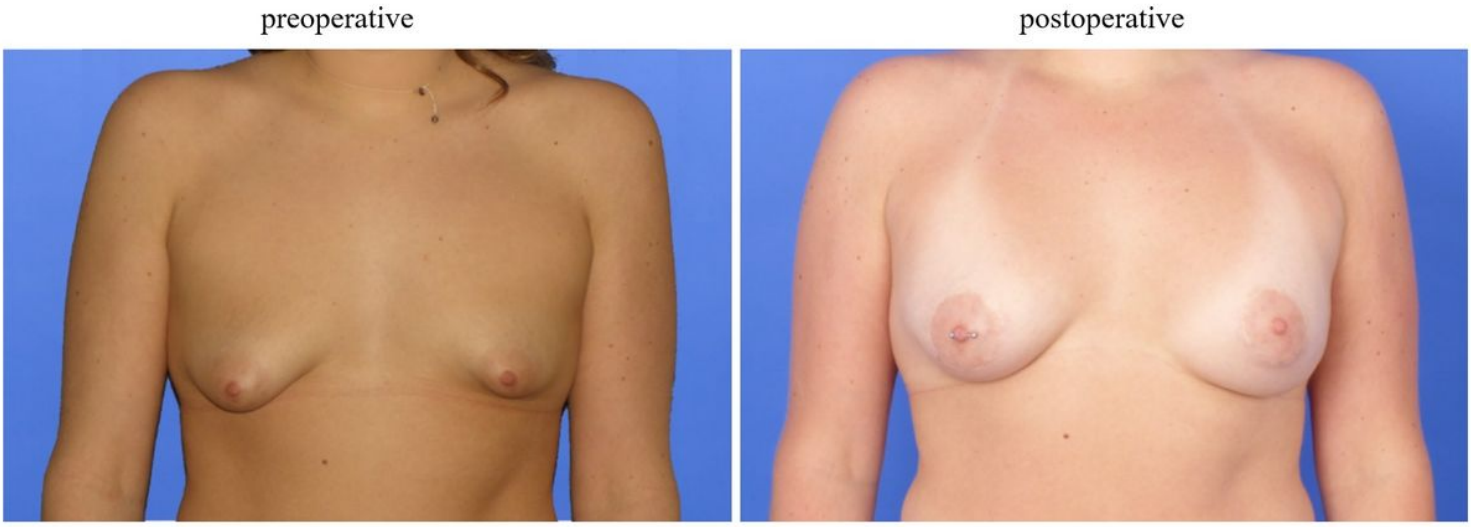

Figure 3

Patient with congenital breast asymmetry (tubular deformity): left preoperative (surgery: 2017), right postoperative 2020, therapy: implant.

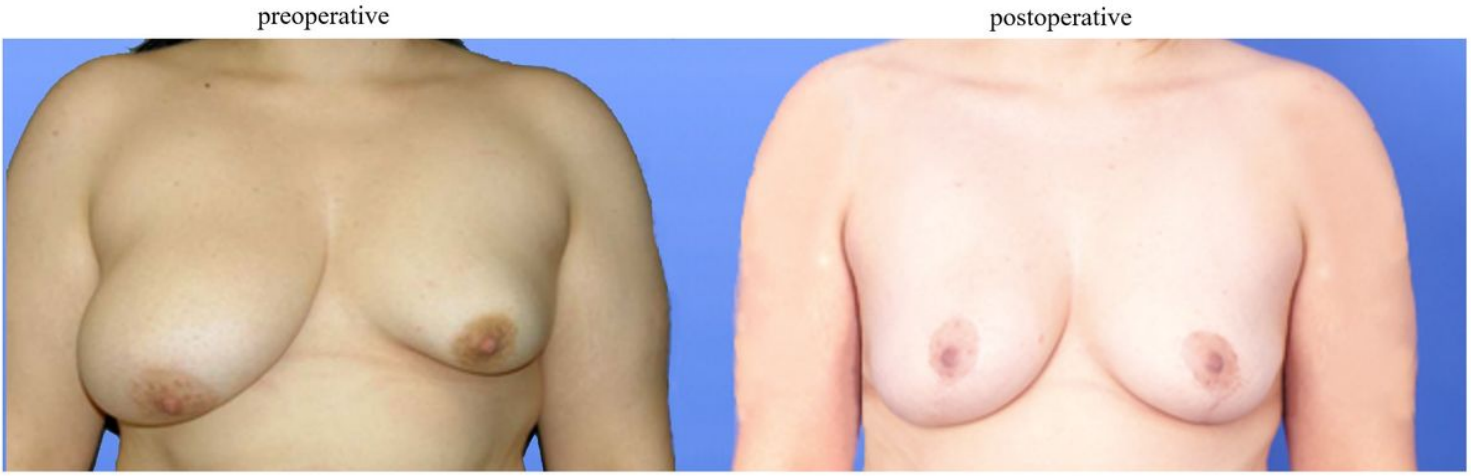

Figure 4

Patient with breast asymmetry (Poland's syndrome): left preoperative, before lipofilling therapy in 2 sessions (surgery: 2010 and 2013) right postoperative 2020.