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The CoBRA Score - "Comprehensive Breast Reconstruction Assessment Score" - An Easy, Accessible and Reproducible scoring system for Aesthetic Assessment for Reconstructed Breast

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Abstract: ***Breast reconstruction following mastectomy is viewed not only as a procedure to restore a woman's physical well - being but also has a major bearing on her mental and emotional health. There are numerous methods of reconstruction of the breast however; there is a paucity of uniform aesthetic evaluation methods. Methods: In this paper we present a multi - tier aesthetic evaluation of the breast through involvement of both the Physician and Patient herself. Assessment methods included anthropometry, subjective parameter analysis by a Medical Personnel and patient both and Linear Analogue Scale. Physician evaluation and anthropometric measurements were done by a doctor who was not a part of the treating team. Certain uniform guidelines were followed for ease and uniformity of gauging subjective parameters. We further converted these results and ratings given by patients and physician into scores and reached a cumulative number by adding individual scores. In our opinion it is the only evaluation of such kind where each result is represented by a score rather than ambiguous terms of good or fair. We call this the Comprehensive breast reconstruction assessment (CoBRA) score. Hence two sets of numeric scores were determined for all patients which represented their satisfaction with the reconstructive surgery and the physician's assessment of the result separately and overall grading of the result when added.***

Keywords: CoBRA, Breast Reconstruction, Reproducible Scoring System, Aesthetic Assessment

1. Introduction

Breast cancer management does not end at tumor resection, but at a good aesthetic outcome following breast reconstruction [1]. Satisfying outcome with recreation of natural appearance and restoration of body image is the goal of plastic surgery. Breast reconstruction with positive outcome also has a significant impact on psychological recovery of patient [2]and is a means of restoring other dimensions of women's physical and psychological health that are compromised by the ablative surgery [3], such as loss of feminity, sexual attractiveness, and a sense of wholesome body image. Although the psychosocial benefits, body image, sexuality, and health - related quality - of - life changes may differ based on the timing of breast reconstruction and evaluation. Assessment of patient outcomes and psychological responses using validated instruments is essential to determine success from the patient's perspective. The literature is replete with several methods of reconstruction, and equally varied methods of assessment of the aesthetic results, patients satisfaction and quality of life following reconstructive surgeries. However these methods failed to achieve widespread acceptance and application.

Traditionally, such subjective evaluations have been performed mostly by surgeons and not patients based on the assumption that only expert evaluations provide a valid assessment of outcomes. Considering the psychosocial impact of breast reconstruction on a woman's life, the final judge of the appearance of her reconstructed breast should be woman herself. Aesthetic appearance of the reconstructed breast constitutes a large proportion of the patient's degree of satisfaction with her operations. Nevertheless professional judgment is indispensable when evaluating factors that cannot be measured objectively, like symmetry, contour and infra - mammary fold.

The following study presents a method to evaluate the aesthetic outcome of breast reconstruction, objectively as well as subjectively and both by the patient as well as the physician following any of the various methods. The goal of this study is to give an economical, accessible, easy yet comprehensive evaluation system for judging the overall aesthetic satisfaction after breast reconstruction which includes self - assessment by patients as well as professional evaluation by the physician. The results of this evaluation are expressed as a score rather than ambiguous terms of excellent, good or bad.

2. Methodology

The Methods of Aesthetic assessment of outcomes in breast cancer surgery can be broadly divided into subjective and objective methods [4]. In our Scoring method - Evaluation of Breast per se was carried under two broad heads: Physician assessment (**Anthropometry & Subjective**) and Patient's self - assessment (**Subjective and Linear Analogue Scale**).

Under Physician Assessment two methods were employed. First the **anthropometry** of breast was carried by taking key measurements. Anthropometry of breasts in real time is a reliable, economical and accessible method of analyzing the measurable parameters of the breast although the whole exercise is highly dependent on observer skills and precision of measuring instruments
We measured Sternal Notch (SN) to Maximum projecting point (MPP), midline (ML) to maximum projecting point (MPP) and Volume of breast. Isaac in 2015 showed SN - MPP and ML - MPP and breast width as the most reliable

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anthropometric parameters [5]. Volume assessment was done by a formula given by Siguardson et al which utilizes Breast circumference among other measurements for volume determination [6]. Hence a set of three pair of values was derived and symmetry was compared with normal side. The scoring was done according to the deviation from the normal side for e. g. variation <10%, 10 - 15%, 15 - 20% and >20%. Scores were awarded as 4, 3, 2 and 1 respectively for symmetry achieved. Least the asymmetry, higher the score. Hence it was a total of 12 out of which the breast was scored in this head.

Next the **Subjective Assessment** of five parameters of breast was carried out by a physician and graded in 4 subscales. Parameters like volume, shape, size, symmetry should be considered pertinent for evaluation of breast aesthetics [7]. Many authors have employed a variant of the scale for such assessment originally described by Harris et al., which divides outcomes into one of four categories: excellent, good, fair or poor [2]. In our methodology, the physician assessed consistency, ptosis, shape, scar and IMF under this head and awarded score to each using certain predetermined guidelines. Using these guidelines for categorizing results as good, excellent, fair or bad has ensured removal of all ambiguity that arises when evaluating subjective criterion as skin texture. Also we like to call this scoring system a highlight of our study which is sure to find many proponents. A score was then generated for this subhead by awarding points (4, 3, 2, 1) as shown in the chart.

The Perception of impact of disease and management on person's life is an important part of any assessment [3]. Hence, Patient's self - assessment was an integral part of our scoring system. It was also carried out by employing 2 methods. First the patients were asked to judge their breasts on six **aesthetic criterions** and label under 3 subscales as excellent, fair or poor. Here again a certain set of guidelines were given to the patients to make the decision easier and a similar numeric score (3, 2 or 1) was generated. Next, a **linear analogue scale** was used where the patients were asked to assign a numerical score to their result with 10 representing the maximum score and 1 being the minimum. Hence, in this study all evaluations yielded a numeric score. A comprehensive scoring was also done by adding up all individual scores of physician assessment and self - assessment. Patients could score maximum of 60 in our analysis. (32+28).

1) Physician Assessment

a) Anthropometry

Percentage difference between normal and operated breast

Table 1: Anthropometry with scoring criteria based on percentage difference between normal and operated breast

S. No.	Scores	4	3	2	1
1.	Volume	<10%	10 - 15%	15 - 20%	>20%
2.	Sternal notch– Maximum projecting point (MPP)	<10%	10 - 15%	15 - 20%	>20%
3.	Midline – MPP	<10%	10 - 15%	15 - 20%	>20%

Max score = 4*3 =12
Min score = 1*3 = 3

b) Subjective assessment:

Table 2: Physician's Subjective assessment parameters with their pre - determined criteria for scoring

	Scores	4	3	2	1
1	Consistency	Normal /Soft	Firm+soft	Firm + Hard	Hard
2.	Scar/Flap paddle	Small, easily concealed/ paddle blends with normal skin.	Scar medium, within bra/ distinct paddle	Scar outside bra/ visually unpleasant paddle	Alters choice of bra/ patch like flap paddle.
3.	Ptosis	Normal	Irregular	Mostly immobile	Tethered
4.	Shape	similar	Comparable	Dissimilar	No resemblance to normal.
5.	IMF	Symmetrical	Asymmetrical	Ill - defined	Absent

Max Score = 4*5= 20
Min score = 1* 5= 5

Total Maximum score in physician assessment= **12+20 =32**
Minimum Score in Physician Assessment**= 3 + 5 = 8**

2) Patient's Self Assessment

a) Patient's subjective assessment score:

Table 3: Patient's Subjective assessment parameters with their pre - determined criteria for scoring

S. No.	Scores	3	2	1
1.	Shape with Bra	Excellent	Average	Poor
2.	Shape without Bra	Excellent	Average	Poor
3.	Symmetry	Grossly symmetrical	Comparable	Grossly asymmetrical
4.	Sensations	Normal	Reduced	Absent
5.	Consistency	Normal	Firm	Hard
6.	Scar/Paddle	Supple and hidden/ Blends with breast	Hypertrophic or minimally exposed/ Distinctly visible	Keloid or grossly exposed/ Patch like

Max Score = 3*6= 18
Min Score = 1*6 = 6

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b) Linear Analogue Scale
Max score =10
Min Score =1

Total Maximum Score in Patients' Self Assessment = **18 + 10 = 28**
Minimum Score in Self Assessment = **6 + 1 = 7**

Cumulative Maximum Score - 1 (a +b) + 2 (a +b) = 32+ 28 = 60

Minimum Score - 1 (a +b) + 2 (a+b) = 8 + 7 = 15

We call it CoBRAscore - Comprehensive Breast reconstruction assessment score. It equals [Physician assessment {Anthropometry +Subjective} + Patient's self - assessment score + Linear analogue scale]. Maximum score is 60. Scores of 75% or more separately in both heads are considered satisfactory. Score higher than 24 under Physician Assessment and 21 under Patient assessment can be labelled as satisfactory result from both the physician and patient's perspective.

3. Results and Examples

A total of 40 patients who had already undergone autogenous breast reconstruction (partial volume or total volume) following any type of mastectomy and were attending follow up clinic during the study period were evaluated. All such patients were initially evaluated at least 6 months after the completion of their adjuvant therapy. A proper written consent was obtained from all such patients and their disease free status was ascertained before embarking on the evaluation procedures. Patients who underwent autologous breast reconstruction were part of our study. Alloplastic reconstruction is not very frequently done in our institute and hence such patients were not a part of our study. Similarly, as patients frequently do not agree for another surgery, NAC reconstruction is also infrequent in our institute. For all practical purpose, Maximum projecting point (MPP) in our study corresponds to NAC. Women, who had residual or metastatic disease or any other comorbidity that could confound the result of our evaluation were also excluded.

Figure 1: Patient A

Figure 2: Patient B

Table 4: Scoring and comparison between Patient A and B

A) Physician Assessment:				
a) **Anthropometry**:				
	S. No.		Patient A	Patient B
	1.	Volume	4 (<10% asymmetry)	2 (15 - 20% asymm)
	2.	Sternal Notch - MPP	3 (10 - 15%asymmetry)	2 (15 - 20% asymmetry)
	3.	Midline - MPP	4 (<10% asymmetry)	3 (10 - 15% asymmetry)
	Anthropometry score		11/12	7/12
b) Subjective Assessment:				
	S. No.		Patient A	Patient B
	1.	Consistency	4 (Normal)	2 (Firm)
	2.	Scar/Flap	4 (Lower Quadrant/ Blends with normal.)	2 (Scar outside bra/ unpleasant)
	3.	Ptosis	4 (Normal)	1 (Tethered)
	4.	Shape	4 (Symmetrical)	2 (Dissimilar)
	5.	IMF	4 (Symmetrical)	3 (Asymmetrical)
	Subjective assessment score		**20/20**	**10/20**
Total Physician Assessment Score**31/32 (>75%) 17/32 (<75%)**				
B) Patient's Self - Assessment				
a) Patient subjective assessment score				
	S. No.		Patient A	Patient B
	1.	Shape with Bra	3 (Excellent)	2 (Average)
	2.	Shape without Bra	3 (Excellent)	1 (Poor)

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	3.	Symmetry	3 (Grossly symmetrical)	1 (Grossly asymmetrical)
	4.	Sensations	2 (Reduced)	3 (Normal)
	5.	Consistency	3 (Normal)	2 (firm)
	6.	Scar/Paddle	3 (Supple/ Blends with breast)	1 (Keloid/Patch like)
	Patient subjective Assessment score		**17/18**	**10/18**
b)	**Linear analogue Scale**			
	Linear Analogue Scale		**10**	**5**
Total Self - Assessment score **27/28 (> 75%) 15/28 (<75%)**				
Total Score= **58/60 32/60**				
Overall Result ☺☺☹☺				

Figure 3
Physicians – 11/12 +14/20 = 25/32☺
Patients - 10/18+8/10= 18/28☹
43/60
Overall - ☺☹

Figure 4
Physicians – 6/12+11/20 = 17/32☹
Patients - 13/18 + 4/10 = 17/28☹
34/60
Overall - ☹☹

Figure 5
Physician - 6/12+14/20 = 20/32 ☹
Patient - 12/18+9/10 = 21/28 ☺
41/60
Overall - ☹☺

Figure 6
Physician - 10/12 + 14/20 = 24/32☺
Patient - 15/18 + 10/10 = 25/28 ☺
49/60
Overall = ☺☺

4. Discussion

The assessment of aesthetic outcomes in breast cancer surgery is especially pertinent, because patient satisfaction, together with surgical outcomes, is the predominant factor for quality of life [1, 8]. However, because it is in many aspects a subjective matter that involves several factors, aesthetic outcomes evaluation methods are heterogeneous. They can be divided into subjective and objective methods. Subjective methods include patient self - evaluation, evaluation by one specialist, or evaluation by a panel of specialists. Objective assessment entails evaluation by specialists by means of Software, 3D Scans, usually performed through the photographic registrations, comparing the treated breast with the non - treated one. Different authors report different levels of agreement with this methodology

Certain specific software programs such as BCCT. core developed for objective aesthetic analysis have been used in many series [1, 9, 10, 11, 12]. These software use measurements taken directly from the patient or from photographs, and evaluate essentially the asymmetries between treated and non - treated breasts. They are associated with increased reproducibility of assessment, but they do not take into account size, breast shape, position of tumor and also do not integrate patients' opinion [13]. Also this methodology does not fit in aesthetic assessment of patients who have undergone mastectomy and are lacking a NAC.

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Cardoso et al reviewed [14] deep learning based medical image analysis. This technique used artificial intelligence (AI) for assessment of results by computer based software. These software based assessments are limited by lack of transparency as the assessment it provides is hidden from the user and prevents verification from expert or non - expert human.

Another recent advance is the 3D scanning technique, which measures breast volumes directly and assesses the asymmetry is claimed to be accurate, precise, and reproducible. However, because 3D surface scanning cannot look through the breast substances, is thought to be inaccurate in large and/or ptotic breasts [15].

Mickolajczyk et al conducted a study with aim to present and validate a web application Breast Idea (BI) designed for indirect breast anthropometry purposes. The measurements of sternal notch to nipple and nipple to midline showed a high level of intra class correlation coefficient [16].

To date no computerized program assesses aesthetic outcome considering the patients perception of her outcome considering that sensation and consistency are very important for patients satisfaction. None of the programs and soft wares incorporate patient input in this regard to generate an overall outcome verdict [10]. Another fact that prevents Software assessment and 3D scanning from wide application is its high cost and lack of access [17].

Objective assessment of the photographs or 3D scans by a panel of surgeons is the most widely accepted technique [4, 18 - 23] to measure aesthetic outcome in breast surgery but is inherently biased, costly, time - consuming, and un - standardised. Deficiencies shared to a variable extent by all panel scales include lack of responsiveness (ability to distinguish clinically relevant differences), repeatability, and interpretability. Also the logistics of arranging a panel assessment are complex and inefficient both in terms of time and cost [13].

Rather than simply obtaining subjective ratings based on photographs, several investigators describe measurements calculated on digital/digitized photographs. Odo et al proved that direct measurements is gold standard to depict differences in breast when comparing asymmetry [24].

Many other objective measures were explained by various authors ex. Limbergen et al [25] proposed Lower breast Contour and Upward Breast Retraction, Tsouskas & Fentiman [26] described Breast Compliance Evaluation. The major drawback in these assessment measures is that they are primarily based only on asymmetry impact on aesthetic result and many other relevant factors are not considered.

In the present study the direct physical anthropometry was an integral part of the objective physician assessment of the breast. Clinical examination of the patient was done as routinely done in follow up and certain set of measurements were taken by two surgeons who weren't part of operative team but were proficient in assessing breast aesthetics and taking measurements. The anthropometric measurements taken in our series were Midline –MPP, Sternal Notch - MPP, and volume. We assessed breast volume using the formula given by Siguardson et al [6] and then calculated the percentage of symmetry with the other side.

Munshi et al noted that ideal method of aesthetic assessment professionally should be based on reproducible, easily understandable quantitative measures which in addition to meeting the minimal validity and reliability criteria applied to other measurement systems, should also include an additional PRO domain to capture the perspective of the patient [27, 28].

In a handful of previous works aesthetic evaluations were rightly done by a combination of patient's self - assessment by judging their response to a questionnaire as well as professional analysis of the result by surgeons who were not part of the operating team. The methodology employed in most of these series was similar. Dahlback et al conducted a study in Sweden with the aim of comparing the agreement between three different methods for evaluation of aesthetic outcome following breast - conserving surgery and adjuvant radiotherapy: a patient questionnaire, panel evaluation of photographs and the software BCCT. Core [29]. Although this study revealed a low agreement between all methods. It duly emphasized the use of patient - related outcome measures as the most definitive measure of a satisfactory outcome demonstrating a stronger predictive ability for longer - term health - related quality of life as compared to objective measures or panel assessment [4].

Although Patient's self - evaluation is certainly the most valued evaluation method but its reproducibility is limited, as it usually reflects the individual psychosocial adaptation and it is directly related to factors such as age, socio-economic level, and expectations [14].

In our series the aesthetic evaluation was carried out by the Patients themselves as well as by a surgeon who was not part of the operating team. For the self - assessment patients graded their breast characters and also scored their breast on the Linear Analogue scale. Six major parameters were graded by patients (shape, sensation, etc) into 3 categories i. e. excellent, good and bad. To make the result more reproducible, a certain set of guidelines was provided for each category which were unique to this grading system. Similarly the physician also assessed 5 parameters into 4 scales (excellent, good, fair or bad) based on similar guidelines. Few key measurements were also taken including volume on the breast for comparing with the normal side. Also in this system we gave a numeric score to all our grades and quantified the result. Every patient was hence represented by a score that was a sum of all evaluation scores. The only shortcoming of our evaluation system was its limitation in assessing bilateral operated patients.

Schuster et al used a 3 section patient questionnaire to carry out assessment of risk factors, aesthetic outcome and patient satisfaction following breast reconstruction. Certain shortcomings of his method included employing a Likerts scale, which in our opinion oversimplified the patient's task. Also there was no uniformity of definite criteria to evaluate the parameters [30].

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Studies that compared evaluations by patients and by specialists showed that the patients usually consider their results more favorable [1, 8]. Wachter et al. compared the differences between 47 patients and 18 physicians in the evaluation of aesthetic outcomes and found that evaluation by patients was better than that of the medical staff [31].

We have drawn a balance of the physician conducted assessment and the patients self - assessment in our methodology. Although the numeric weightage of the physician method is more (max score 32) nevertheless we have included maximum parameters under patients self - assessment for a comprehensive evaluation.

A study [32, 33]on breast subunits concluded that symmetry of breast volume and infra - mammary fold is the most crucial in obtaining an optimum result. The desirable infra - mammary fold should have a well - defined take off near the median line and flow in an uninterrupted convex manner into the lateral contour [32]. Hence in our study very specific criterion were employed by physicians for judging IMF which we feel is the uniqueness of our scoring system. We let the patients speak for the shape and symmetry of their breast as it has been shown that [34, 35] breast size, shape with brassiere and scar appearance are strongly associated with patient assessed cosmetic outcome.

Majority women agreed to recommend the similar procedure to other women although patients who expected improvement in sexual relations are disappointed. In the absence of an absolute “gold standard”, a comparative analysis of quantitative aesthetic outcome assessment by medical professionals, assessment by patients, and degree of patient satisfaction would be useful for identifying factors that influence a woman's quality of life after breast cancer treatment and rehabilitation and as a check of the appropriateness of new assessment measures [23].

Conflict of Interest - We have no conflict of interest to disclose.

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