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Determining Silicone Breast Implants Sizes In Augmentation Of Asymmetrical Breasts Using Pre-Operative Breast Volumetry

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ABSTRACT

Background: Plastic surgeons face challenges in augmentation of non-symmetrical breasts. The aim of this work was to improve symmetry of breasts using silicone implants of different sizes with the help of a simple device to measure the breast conus volume.

Methods: This current study was carried out on 10 female patients aged from 18 to 50 years old, with congenital non-syndromic breast hypoplasia, post lactational breast atrophy at least 6 months after breastfeeding cessation, patients with sufficient breast volume to cover the silicone implants. Preoperative assessment involved breast measurements and implant size determination using a specially designed breast volumetry device.

Results: There was a significant improvement was observed at 6 months postoperatively regarding psychosocial wellbeing, sexual wellbeing, and satisfaction with breasts. The mean preoperative volume difference between the Right and left breasts was 116 ± 103.30. Regarding the size of the implants, they varied from 180 to 430 cc. Round textured silicone gel implants were used in the 10 patients. In all the 10 patients the implants were placed in sub glandular plane.

Conclusion: This study explores the potential benefits and challenges of the breast volumetry device in assisting with implant selection to improve breast symmetry. While it provides a cost-effective and accessible method for preoperative breast volume estimation, particularly in resource-limited settings, several challenges must be considered. Despite these, the device helps reduce subjectivity in breast augmentation planning and contributes to improved patient satisfaction by offering an objective approach to breast volume measurement, ultimately enhancing the quality of interventions and outcomes..

Keywords: *Symmetry, Breast Q, Augmentation, Breast Volumetry, Silicone*

1. INTRODUCTION

Breast augmentation with silicone gel implants is one of the most popular cosmetic surgery operations globally [1].

This surgery has gained global appeal over the last 40 years by improving the appearance and self-esteem of millions of women. The ultimate objective of breast augmentation is to produce a set of breasts that are symmetrical, aesthetically acceptable, and proportionate to the patient's body [2].

Female breasts, on the other hand, frequently exhibit asymmetry, either minor or substantial[3]. Breast asymmetry is commonly produced by variances in breast form or volume, but it can also be caused by chest wall asymmetry or variability in nipple size, shape, and/or location [4].

Breast asymmetry is almost always present among individuals seeking cosmetic breast surgery [5].

Breast asymmetry can be represented in terms of form or volume, thus each of these criteria must be handled independently. Severe breast asymmetries may necessitate a parenchymal rearrangement by mastopexy, with volume correction achieved either breast reduction or the placement of an implant—either a unilateral implant or bilateral different-sized implants—to achieve volumetric symmetry [6].

Smaller asymmetries have traditionally been accounted for by asymmetrical breast augmentation, which uses implants of varying size, projection, and form [7].

Preoperative examination of breast asymmetry is critical for determining surgical decisions and achieving excellent postoperative outcomes. Nevertheless, existing methodologies for comparing three-dimensional structures have made it difficult to conduct a totally objective and thorough investigation of breast asymmetry[2].

The aim of this work was to improve symmetry of breasts using silicone implants of different sizes with the help of a simple device to measure the breast conus volume

2. PATIENTS AND METHODS

This current study was carried out on 10 female patients aged from 18 to 50 years old, with congenital non-syndromic breast hypoplasia, post lactational breast atrophy at least 6 months after breastfeeding cessation, sufficient breast volume to cover the silicone implants. The study was done from October 2022 to May 2024 after approval from the Ethical Committee Cairo University Hospitals, Cairo, Egypt. An informed written consent was obtained from the patients.

Exclusion criteria were patients aged less than18 years or more than 50 years, chest wall deformities: pectus excavatum and pectus carinatum, associated hypoplastic syndromes: Jeune and Poland syndromes, post lactational breast atrophy less than 6 months after breastfeeding cessation, breast cancer, acquired mammary hypoplasia due to breast radiation for the treatment of cutaneous haemangiomas, burns to the anterior chest wall, traumas and infections which result in breast scars and patients with insufficient breast volume to cover the implants.

Breast volume measurement:

Preoperative evaluation of the breast augmentation patient is essential to identify breast asymmetry. The Plastic breast cup was applied to each breast while the patient was sitting. To help with sealing, plaster was used to avoid fluid leakage.

Following ensuring proper positioning and sealing, 1000cc water at body temperature was added to the cylindrical jar. Water was transferred from the jar to the plastic breast cup by gravity. Once the water level stabilized and excess water overflowed, breast volume measurements were recorded, it is equal to the volume of remaining water in graduated jar(the volume of water inside plastic cup =the volume of the breast + the volume of water in the empty space between the inner aspect of the plastic cup and the breast=1000cc) **figure (1,2)** [8].

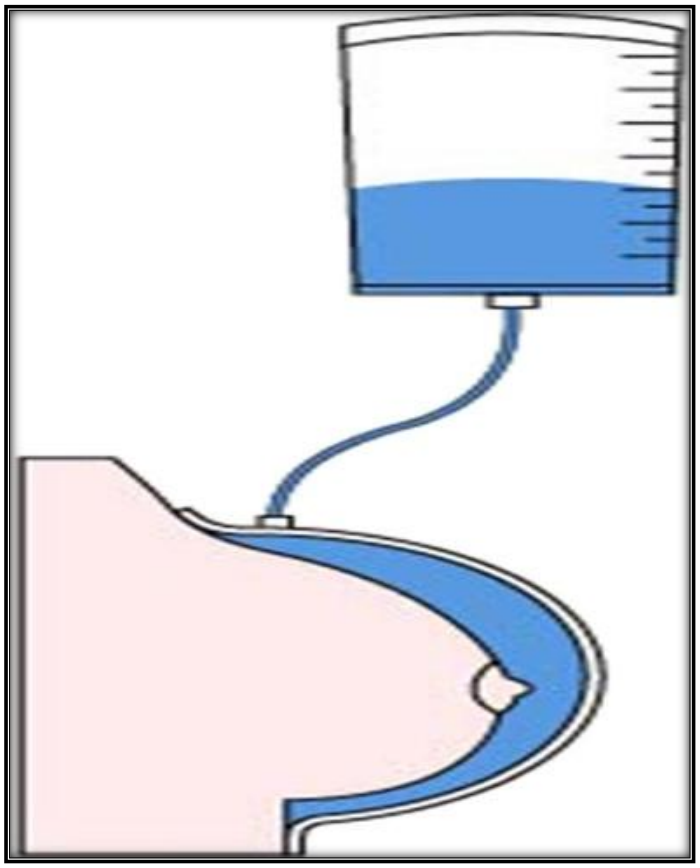


Figure (1): Plastic cup was applied to the breast, 1000cc water at body temperature was added. By simple gravity, the water moved from the jar filling the breast cup and the breast volume is obtained, it is equal to the volume of remaining water in graduated jar [8].

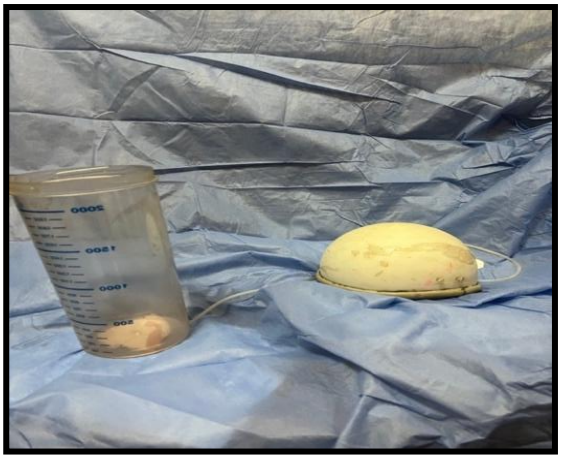


Figure (2): Breast volumetry device.

Implant size selection:

Breast volume asymmetry was measured using the breast volumetry device, and implant size was determined based on the 5P system: Pre-existing Breast Volume, Parenchymal Thickness, Ptosis Degree, and Proportionality to the Body Frame, while also considering patient preferences. The volumetry device provided objective measurements to guide implant selection, ensuring asymmetry correction. Parenchymal thickness was clinically assessed using the pinch test over the planned implant site (upper and lower poles) to estimate soft tissue thickness. A thickness of **≥2 cm** is generally considered sufficient for adequate implant coverage. Ptosis degree was assessed clinically by evaluating the position of the nipple relative to the inframammary fold, with mastopexy considered when needed. Implant sizes were chosen to complement the patient's body proportions, the volume discrepancy between the breasts was compensated for by choosing implants that closely matched the measured difference, and final positioning was refined intraoperatively through real-time symmetry assessment in a semi-sitting position.

Preoperative photography was done while patients were undressed down to the waist and multiple views were taken for every case which are the frontal view, right lateral view, left lateral view, right oblique view, left oblique view, inferior view, superior view.

Before surgery, marks are drawn on the skin corresponding to the current inframammary fold (CIMF), lateral limit of the pocket represented by the anterior axillary line (AAL), and the mid sternal line (MSL). The para-sternal lines (PSL) are generally marked, maintaining 2–3 cm between the breasts. The superior and inferior limits of the pocket, represented by the future IMF (FIMF) and superior breast line (SBL), are planned according to the implant volume, which permits accurate centring of the implant and maintains precise pocket dimensions based on the implant size.

Operative technique:

All patients underwent general anesthesia followed by local infiltration using xylocaine 2% with adrenaline1/100,000 in the incision line and infiltration in the site of implant using xylocaine 2% with adrenaline 1\200,000 and prophylactic IV antibiotics were given before induction of general anaesthesia. Inframammary incision was about 5 cm long, depending on the implant size. A vertical line parallel to the lateral border of the areola is drawn down to the fold. From this line, the incision extends 1 cm medially along the fold, with the remainder of the excision extending laterally. The incisions were adjusted to be symmetrical. By using a scalpel, the skin and the subcutaneous tissue were opened. Dissection proceeds through the dermis and subcutaneous fat until the glandular layer is identified. Using blunt and electrocautery dissection, the glandular tissue is separated from the underlying pectoralis major muscle to develop the subglandular pocket according to the predetermined dimensions of the implant. Proper haemostasis was achieved throughout the operation to prevent any hematoma formation and possible infection. The surgical pocket was irrigated with saline, and gentamycin. The same procedure was done on the other breast. Afterwards, checking for symmetry and shape was done in a semi-sitting position. No drains were inserted. The subcutaneous layer was closed using absorbable (3\0 vicryl) and skin was finally closed by continuous subcuticular suture using3/0 prolene. After proper cleaning of the patient chest and sterilization of wound by antiseptic solution, small pad of gauze applied followed by application of Elastoplast bandage. All patients were admitted to the inpatient for 24 hours for close monitoring. The patient is kept in a semi sitting position. The patients were instructed to start oral intake when they are fully conscious. Early post-operative, analgesics were given in the form of NSAIDs (diclofenac sodium 75 mg. deeply I.M) when needed. Outpatient oral antibiotics (ciprofloxacin 500mg was taken every twelve hours) and diclofenac sodium tablets 100mg. when needed. First dressing was done three days postoperatively, removal of elastic band was done after 1 week and the patient was instructed to wear a sports bra.

The primary outcome was evaluation of patient satisfaction by means of the mammary augmentation BREAST-Q™.

The questionnaires were provided by the surgeons directly to their patients, they were not anonymous. The preoperative section of the BREAST-Q™ consists of four questionnaires. Satisfaction with breasts was assessed by a seven-item questionnaire. Three quality of-life questionnaires measure physical, psychosocial, and sexual well-being. The postoperative BREAST-Q™ scale is made up of nine separate questionnaires. Satisfaction with breasts is assessed by a 17-item questionnaire that covers breast appearance, softness, cleavage, breast size, and scar appearance. The three quality-of-life questionnaires repeat the same questions as in the preoperative scale. All the response items were displayed in the form of a Likert scale. Consistent with the BREAST-Q™ Manual, patient scores were transformed using Q-Score on a scale of 0 to 100, with values close to 100 representing a better result.

Post-operative follow-up:

All patients were followed up once per week in the first month, and each other week in the next two months then once per month for six months. It always includes clinical examination, Photos were taken at 3month, 6month postoperatively (anterior, lateral, and oblique, superior, and inferior views) and filling the BREAST-Q™ questionnaire.

3. Statistical analysis:

The statistical analysis was performed using SPSS version 26.0. The Shapiro-Wilks test and histograms were employed to determine the normality of the data distribution. Quantitative parametric variables were expressed as mean ± SD and compared between the two groups using the unpaired Student's t-test. Quantitative non-parametric data were provided as median and interquartile range (IQR) and analyzed using the Mann Whitney test. Qualitative variables were provided as frequency and percentage (%) and analyzed using the Chi-square test or Fisher's exact test, as applicable. A two-tailed P value of <0.05 was judged statistically significant.

4. RESULTS

The mean of age was 32.7±10.53 years while their mean BMI was 28.8±2.09. Regarding to marital status, 3(30.0%) of patients was married, 3(30.0%) of patients were single, 1(10.0%) of patients were widow and 3(30.0%) of patients were divorced. Two patients suffered from wound dehiscence following mastopexy and breast augmentation. They were treated by repeated dressing and I.V or I.M antibiotics, mainly Ceftriaxone 1mg IM once daily for 5 days. **Table 1**

Table 1: Demographic characteristics, and complications of the studied participants

		N=10
Age (Years)		32.70±10.53
BMI		28.28±2.09
Marital status	**Married**	3(30.0%)
	Single	3(30.0%)
	Widow	1(10.0%)
	Divorced	3(30.0%)
Complications	**Wound dehiscence**	2(20.0%)
	Nothing	8(80.0%)

Data are presented as mean ± SD or frequency (%). BMI: Body mass index.

Regarding the volume of the breasts, the right breast mean volume was 491 ± 216.20 cc. The left breast mean volume was 489 ± 173.04 cc. The mean preoperative volume difference between the Right and left breasts was 116 ± 103.30. Regarding the size of the implants, they varied from 180 to 430 cc. Round textured silicone gel implants were used in the 10 patients. In all the 10 patients the implants were placed in sub glandular plane. **Table 2**

Table 2: Breast volumes and silicone implant sizes of the studied participants

	N=10
RT breast size (CC)	460.0(250.0-850.0)
LT breast size (CC)	435.0(290.0-790.0)

Difference (CC)	85.0(40.0-390.0)
Rt silicone size (CC)	350.0(180.0-430.0)
LT silicone size (CC)	280.0(180.0-390.0)

Data are presented as median (IQR). RT: right, LT: left.

There was a significant improvement was observed at 6 months postoperatively regarding psychosocial wellbeing, sexual wellbeing, and satisfaction with breasts. **Table 3**

Table 3: Comparison between preoperative/postoperative scales the BREAST-Q ™

	Preoperative	**Postoperative**	**P**
Psychosocial well-being	19.0(0.0-32.0)	51.0(28.0-94.0)	**0.005***
Sexual well-being	16.50(0.0-29.0)	43.50(29.0-67.0)	**0.005***
Satisfaction with breasts	25.50(17.0-47.0)	65.50(44.0-77.0)	**<0.001***

Data are presented as median (IQR). *Significant p value<0.05.

Case 1: 36 years old patient with asymmetrical post lactational breast atrophy underwent augmentation mammaplasty in the right breast by silicone implant of a size 350 cc and left breast by silicone implant of a size 390 cc. **Figure 3**

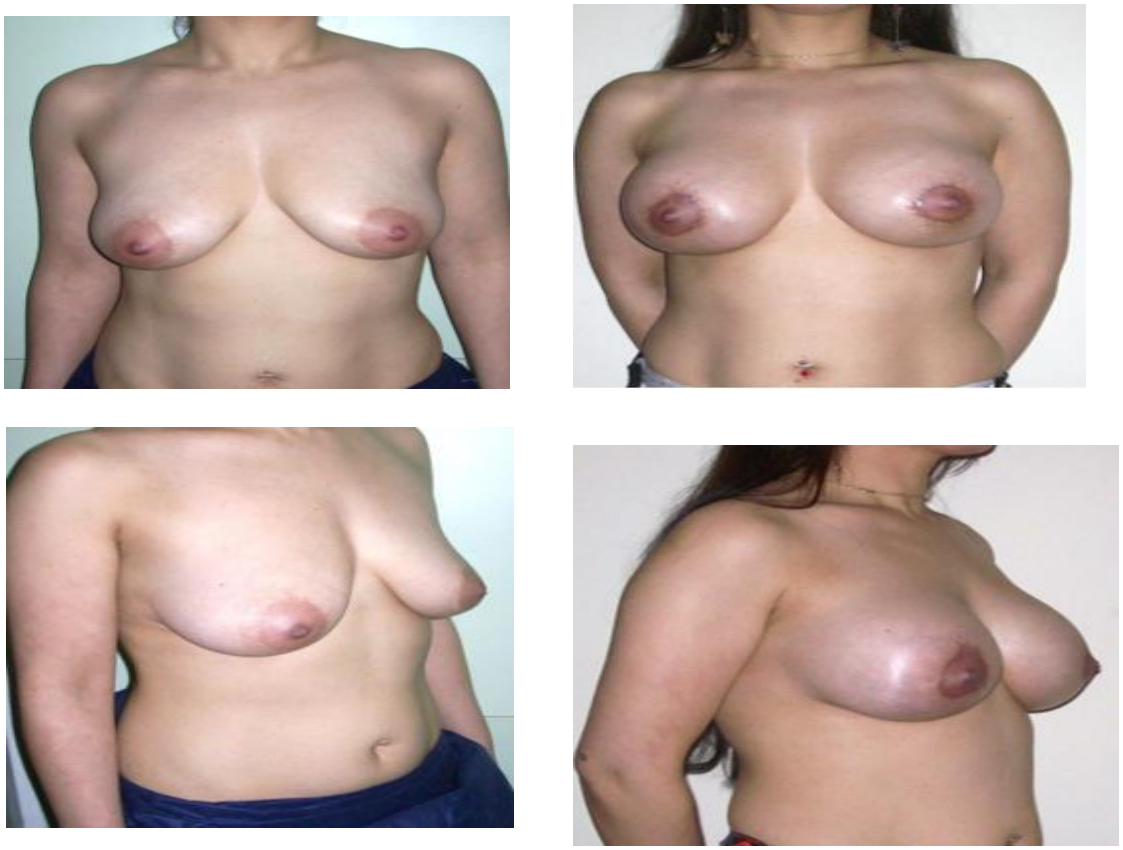


Figure 3: Showing right silicone implant of a size 350 cc and left breast implant of 390 cc.

Case 2: 21 years old patient, with asymmetrical congenital hypoplasia underwent augmentation mammaplasty in the right breast by silicone implant of a size 350 cc and left breast by silicone implant of a size 390 cc. **Figure 4**

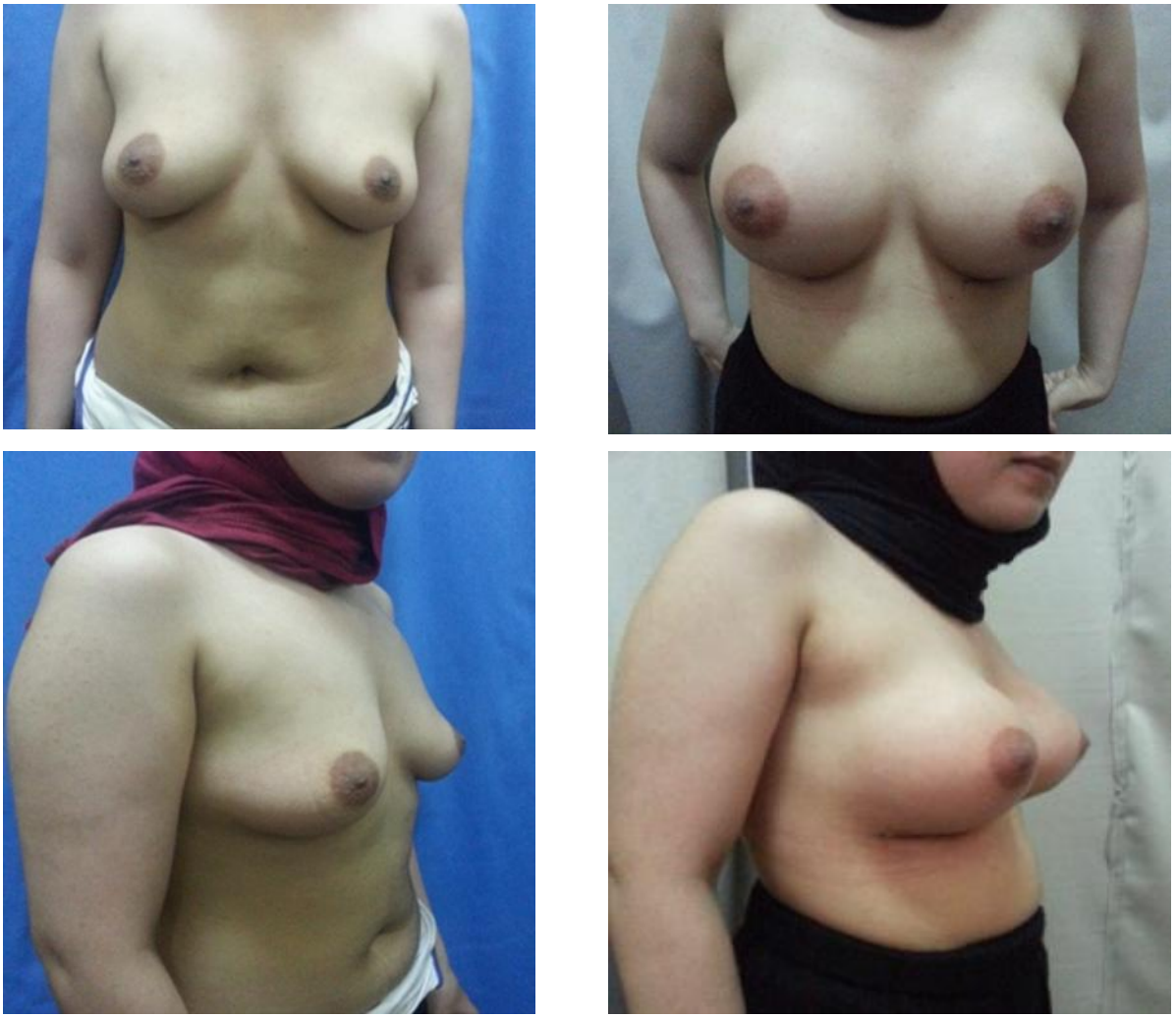
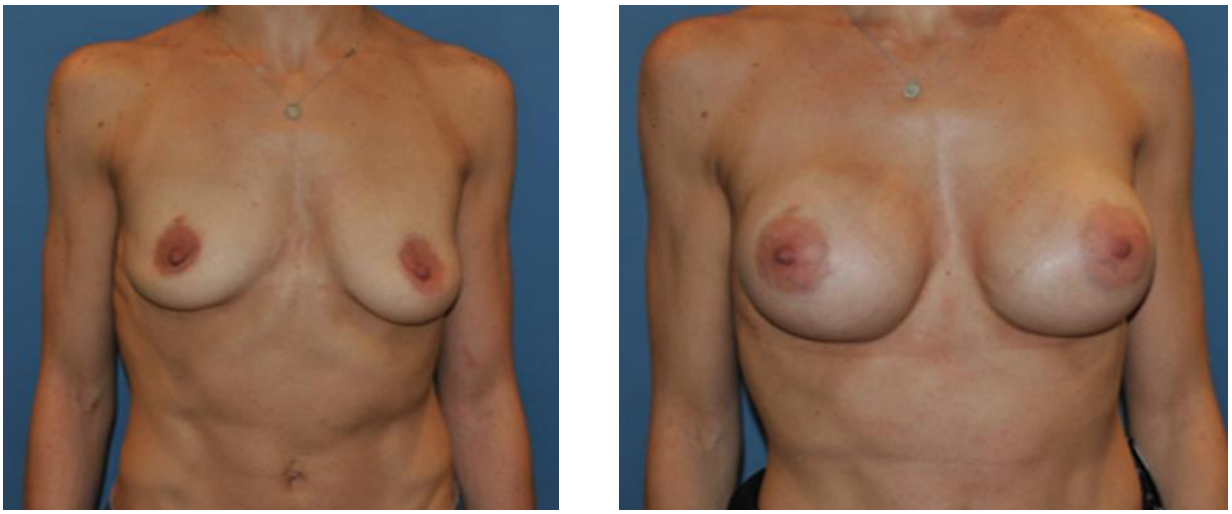


Figure 4: Showing right silicone implant of a size 350 cc and left breast implant of 390 cc.

Case 3: 28 years old patient, with asymmetrical congenital hypoplasia underwent augmentation mammaplasty in the right breast by silicone implant of a size 265 cc and left breast by silicone implant of a size 215 cc. **Figure 5**



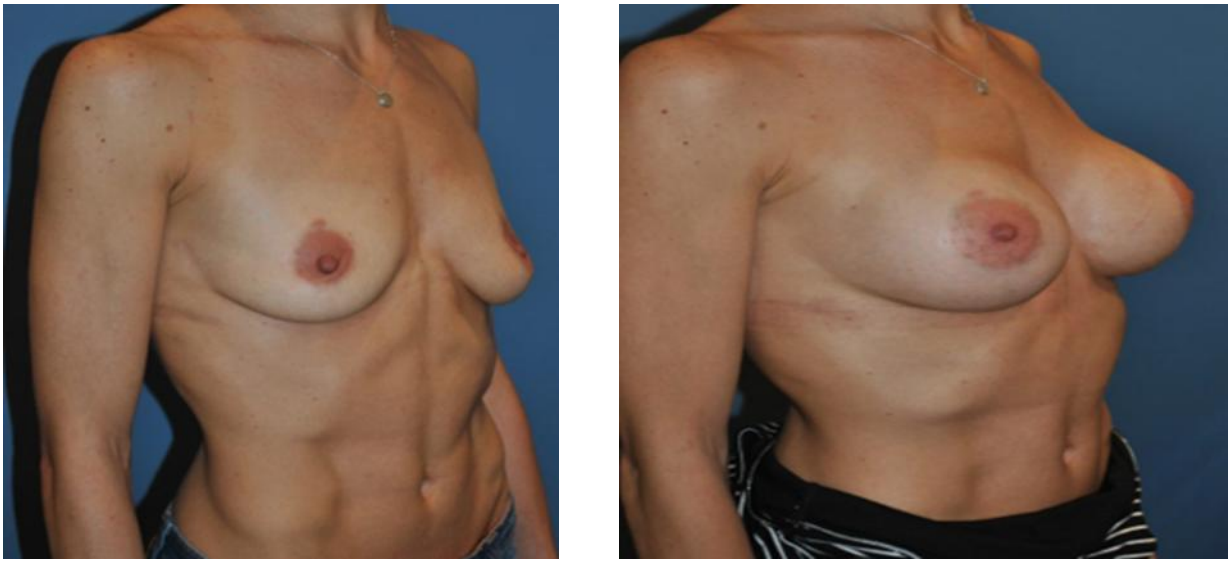


Figure 5: Showing right silicone implant of a size 265 cc and left breast implant of 215 cc

5. DISCUSSION

Breast augmentation remains one of the most performed aesthetic procedures worldwide. Achieving symmetry in cases of breast asymmetry is a key challenge that requires meticulous preoperative planning and intraoperative precision. Various techniques have been explored to address volume and shape differences between breasts, ranging from implant selection to fat grafting and mastopexy. In recent years, advances in imaging technology, particularly three-dimensional (3D) imaging, have enhanced preoperative assessments, allowing for more precise surgical planning. In this study, we utilized a simple breast volumetry technique to measure volume differences before selecting implant sizes. The following discussion evaluates different methods for achieving breast symmetry, highlighting the advantages and limitations of each approach.

Mallucci et al. [9] reported that asymmetry in breast augmentation can be managed by selecting implants with different sizes, projections, or shapes to compensate for volume discrepancies. In their study, they used preoperative patient photographs, detailed anthropometric measurements, and simulation-based implant selection to determine appropriate sizes. The technique proved effective for cases where volume difference was the primary concern. However, their findings suggested that this approach does not account for variations in breast footprint or skin laxity, which may necessitate additional surgical manoeuvres.

Peterson et al. [10] suggested that liposuction of the larger breast can serve as an alternative to direct volume correction, reducing excess tissue and allowing for more symmetrical augmentation. They measured preoperative breast volume differences using 3D scanning before performing ultrasound-assisted liposuction, ensuring targeted fat removal while preserving overall contour. However, their study highlighted that liposuction alone is not always sufficient for long-term symmetry due to the unpredictable nature of fat resorption. In cases requiring substantial volume adjustment, Chasan [11] emphasized that direct tissue excision remains a more controlled approach, particularly when combined with mastopexy to address skin laxity.

Farag et al. [12] examined the role of mastopexy and reduction mammaplasty in restoring symmetry. They performed preoperative assessments using traditional measuring techniques, including sternal notch-to-nipple distance and breast projection measurements, to determine the necessary adjustments. Their findings indicated that mastopexy combined with augmentation significantly improved breast symmetry, particularly in cases of ptosis. However, the study also noted that such techniques introduce additional scarring, requiring careful preoperative planning to optimize skin resection and implant volume selection.

Somogyi et al. [13] explored the use of deep parenchymal resection to equalize breast volumes before augmentation. Their method involved intraoperative tissue resection guided by preoperative MRI-based volumetric assessments. The goal was to achieve symmetrical implant placement without relying on different implant sizes. However, their study identified discrepancies between preoperative imaging estimates and the actual intraoperative findings, emphasizing the need for real-time intraoperative adjustments to ensure optimal symmetry.

Maximiliano et al. [14] investigated fat grafting as an adjunct technique to refine volume discrepancies. They utilized preoperative MRI and water displacement volumetry to assess breast volume differences before performing microfat grafting in staged procedures. Their results demonstrated that fat grafting allows for precise contouring, particularly in cases with

minor asymmetry. However, Choppin et al. [15] reported that the survival rate of transferred fat remains variable, often requiring multiple sessions to achieve the desired outcome. Additionally, donor site morbidity and potential resorption present challenges in maintaining long-term symmetry.

De Runz et al. [16] assessed the impact of 3D imaging on preoperative planning, specifically comparing Crisalix and Vectra systems. Crisalix, a cloud-based software, generates 3D simulations from standard digital photographs, providing an accessible and relatively cost-effective tool for surgeons and patients. Hall-Findlay [17] noted that while Crisalix improves communication between surgeon and patient, its accuracy in volumetric prediction is limited, particularly in cases involving significant asymmetry or ptotic breasts. The estimated cost for Crisalix software ranges from $250 to $400 per patient, depending on usage and subscription model.

Liu et al. [18] reported that Vectra 3D offers higher-resolution stereophotogrammetry and volumetric analysis, providing more precise preoperative assessments. The system measures breast volume using multi-angle imaging, creating a highly detailed model that aids in implant selection. However, Somogyi et al. [12] stated that despite its superior imaging capabilities, Vectra's predictions often do not match intraoperative findings due to variations in tissue elasticity and chest wall shape. Vectra is also significantly more expensive, with system costs exceeding $25,000, plus ongoing maintenance fees, making it less accessible for smaller practices. The discrepancy between simulated and actual postoperative outcomes remains a major concern, as reliance on 3D imaging alone may not fully capture intraoperative variables that influence breast shape and volume.

In our study, we used the simple preoperative breast volumetry to measure the breast volume in patients with asymmetrical breasts seeking breast augmentation. This device provided a cost-effective means for volume evaluation, utilizing simple materials and basic principles that allow for application in resource-limited settings. However, several limitations must be acknowledged. Water leakage was a common issue, affecting measurement consistency. Additionally, accurate positioning of the patient was critical, as improper posture led to variations in displaced volume. Some patients also reported discomfort during the procedure, particularly those with large or ptotic breasts. Furthermore, Minor discrepancies in measurement were noted, potentially due to variations in breast positioning within the sealed chamber, as well as underlying chest wall deformities, which could influence the accuracy of volume assessment.

In addition, the sample size was relatively small. The study was in a single centre. So, we recommended a study on a bigger scale as well as including patients with a bigger variety of breast volumes. Despite these drawbacks, the simplicity and affordability of this method make it a valuable tool, particularly in resource-limited settings where advanced imaging is not available.

6. CONCLUSION

Achieving breast symmetry in augmentation remains a complex challenge requiring a combination of preoperative planning and precise intraoperative techniques. While various methods, including asymmetric implant selection, liposuction, mastopexy, and fat grafting, offer viable solutions, each approach presents distinct advantages and limitations. The introduction of 3D imaging technologies such as Crisalix and Vectra has improved preoperative assessments; however, cost constraints and discrepancies between predicted and actual outcomes must be considered.

Our study suggests that preoperative breast volumetry using a basic water displacement method provides a relatively accessible and cost-effective approach for volume estimation, particularly in resource-limited settings and developing countries where advanced imaging may not be readily available. However, several limitations must be acknowledged. Water leakage can affect measurement consistency, and patient positioning must be precise to ensure reliable results. Additionally, some patients, especially those with larger or ptotic breasts, may experience discomfort during the process. The device also lacks the precision and reproducibility of more sophisticated imaging techniques, which may lead to minor discrepancies in volume estimation.

Despite these challenges, this method remains a practical preliminary option for surgeons in developing countries, where affordability and accessibility are critical factors. Future research should prioritize refining volumetric measurement techniques by enhancing device design to minimize errors, improving standardization to reduce variability, and exploring cost-effective alternatives that increase accuracy while remaining feasible in low-resource settings. Additionally, efforts should be made to integrate advanced imaging technologies, such as AI-assisted volumetric analysis or low-cost 3D scanning solutions, to bridge the gap between affordability and precision. Such innovations could significantly optimize surgical planning and outcomes, ensuring more predictable and reproducible results in breast augmentation procedures.

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Conflict of Interest:

The utilized device is patented technology by co-author Rasha Mohamed AbdelKader, under patency number 11801110 issued by the United States Patent and Trademark Office (USPTO).

The corresponding author and the rest of co-authors have no conflict of interest to be declared

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