Original Article

Role of 3D Simulation in breast augmentation

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ABSTRACT

Objectives: Patient satisfaction is of paramount importance in breast augmentation surgery. One of the most important determinants of the post-operative outcome is the implant volume. Conventionally, patients are fitted with different-sized implants under their bra to give them an idea of the post-operative result. However, it is cumbersome, and the patient is not able to visualize the final appearance of her breast. With the advent of three-dimensional (3D) simulations, this technique is increasingly being employed in pre-operative counseling sessions to aid the patient in choosing the right implant size for herself. We wished to study the usefulness of 3D simulation as a clinical aid in pre-operative counseling of breast augmentation patients.

Materials and Methods: In this study, we asked a set of three questions to the patients who chose their breast implant size based on 3D simulation to understand their views on the utility of this technique.

Results: The majority (85–90%) of the respondents found 3D simulation to be very helpful in choosing the implant and would strongly recommend it to their peers. They also found the post-operative results to be very concordant with the pre-operative simulated image.

Conclusion: 3D simulation is a useful aid in choosing the implants for breast augmentation and helps in involving the patient in the decision-making process, resulting in higher satisfaction.

Keywords: Three-dimensional simulation, Breast augmentation, Breast implant, Implant volume

INTRODUCTION

Breast augmentation is an elective surgery and patient satisfaction with the results is of utmost importance. The patient's discontentment with the final appearance defeats the purpose of the surgery. Realistic expectations have to be set, right in the beginning, to prevent this unfortunate situation. More so during these evolving times of medico-legal suits and social media reputation management, any unhappy patient is unaffordable.

During the pre-operative consultation, in addition to clinical evaluation by the surgeon, the patient's expectations are taken into consideration when deciding on the size of the implant. Conventionally, different size implants are fitted inside the bra of the patient and she is asked to opine regarding her preference.[1,2] Patients are also shown photographs of results of other women who have undergone implant breast augmentation, to give them an approximate idea of the outcome. However, it is difficult for the patient to accurately visualize the eventual post-operative appearance of her breasts, with these methods alone. Apart from implant size, there are numerous other factors that impact the surgical outcome such as plane of placement and projection

of implant, which cannot be accounted for with these techniques of pre-operative sizing.

With recent advances in technology, many software has been developed that create three-dimensional (3D) images from scans of the patient.[3] These have found a wide range of applications in esthetic as well as reconstructive breast surgery such as for estimation of breast volume, creation of 3D bio-models for flap shaping, and pre-operative visualization of result of implant insertion.[4-9] The software can simulate the post-operative result of augmentation with different size implants. It gives the patient a visual idea of how her breast would appear after the surgery, which is not possible with sizer placement in the bra.

Studies have validated the use of 3D imaging in breast augmentation and found it to be accurate in predicting breast volume and contour.[9-11] We conducted this study to analyze the patient's response to the use of 3D simulation as an aid in choosing the implant size during the pre-operative consultation.

MATERIALS AND METHODS

In a descriptive study, we analyzed the data of all females who presented to our center for primary, bilateral breast

augmentation from January 2020 to July 2021. Women with any congenital breast deformity or history of previous breast surgery were excluded from the study. Written, informed consent for surgery was obtained from all patients.

All the surgical candidates were clinically evaluated with Tebbett's High Five system.[12] They were counseled in detail about three key aspects of choosing the implant: Base diameter of the breast, volume, and profile of the implant. They were asked to choose the different implant volumes based on the base diameter of their breast. They were also shown computer-generated 3D images of their breasts with different profile implants. Patients could also use virtual reality (VR) goggles to visualize the results and see for themselves the outcome in different postures and with clothes on or off. Thus, the final selection of the implant was made in discussion with the patient. Patients were well informed that this result is not a hundred percent accurate and is only for depiction purposes.

All patients were operated upon by the same surgeon and underwent either dual plane or subfascial implant placement (depending upon indication) with smooth, round silicone gel implants with an inframammary incision. Subcuticular closure was done with Monocryl 3-0 suture.

Patients were placed in a compression garment sports bra on the evening of the surgery and were discharged on the same day. They were allowed to resume their daily activities from the next day and gentle exercises were permitted from day 7 onward. Photographs were taken at 3-month follow-up and the patients were asked to respond to a set of three questions:
1. Whether the 3D simulation was very helpful, somewhat helpful, or not helpful; in choosing the implant size
2. Whether the result of the augmentation procedure was very concordant, somewhat concordant, or discordant with the pre-operative 3D simulation results
3. Whether the patient would strongly recommend, may recommend, or not recommend the use of 3D simulation as an aid in choosing the breast implant size for her peers who wish to undergo breast implant augmentation.

Technique of 3D simulation and use of VR

A web-based 3D simulation software (Crisalix, S.A., Lausanne, Switzerland) was used. The app was downloaded on the surgeon's I-pad (Apple Inc., Cupertino, CA, USA). After opening the camera in the app, four photos of the patient's breasts; one each in frontal profile, right and left lateral and end-on view, were taken by the surgeon with the I-pad placed at a distance of 100 cm. A set of anatomical landmarks were marked on the pictures and the base diameter was entered into the app, which then converted the pictures into three-dimensional images. These images are interactive and take color and texture into account as well. Different simulations

were created with the software with varied implant sizes and were shown to the patient on a computer screen. The patient could also visualize the probable post-operative appearance of her breasts through VR goggles synced to the surgeon's I-pad.

RESULTS

A total of 94 women were included in the study. The mean age of the patients was 29.5 years (22–45 years) and mean body mass index was 26.7 and the mean implant volume was 310 cc (275–380 cc).

Eighty-eight (93.6%) found the 3D simulation to be very helpful in choosing the implant size, 3 (3.2%) women found it to be somewhat helpful and 3 (3.2%) did not find it helpful at all.

Eighty-four (89.4%) found the post-operative result to be very concordant to the pre-operative simulation images, 8 (8.5%) found it to be somewhat concordant, and 2 (2.1%) found it to be discordant.

Eighty-two (87.2%) women said that they would strongly recommend the use of 3D simulation to her peers, as an aid in choosing a breast implant size, whereas 10 (10.6%) women said that they might recommend it. Two (2.2%) women felt that they would not recommend 3D simulation to their peers.

DISCUSSION

Breast augmentation is one of the most commonly performed cosmetic surgeries throughout the world. Choice of implant size is of utmost importance to achieve patient satisfaction, thus, magnifying the role of detailed and accurate pre-operative consultation. Three-dimensional simulation is used as a consultation tool to ease the process and allow the patient to visualize the results and hence involve her in the decision-making on the size of the implant. Although 3D simulation has been found to be more than 90% accurate in estimating breast volumes and analyzing contours, a few studies have proved it to be less reliable in certain specific conditions.[8-10] Objective evaluation of pre-operative 3D simulated images with actual post-operative outcome was done by Vorstenbosch and Islur, and they found that the simulated images were more representative of the results for symmetric breasts rather than for ptotic or tuberous breasts.[13] Another study reported that the simulations were less accurate when patients chose a larger fill volume than the maximum optimal fill volume based on clinical evaluation.[10] In our practice, we found that patients usually chose implants between 275 cc and 380 cc.

Despite these limitations, this 3D simulation is increasingly being used during pre-operative planning for a breast augmentation procedure. Through our study, we wish to bring forth the patient's perception of the role of 3D

simulation in pre-operative consultation for breast implant augmentation, as there is limited literature representing the patients' viewpoint.

In a study by de Runz *et al.*, 90% of 38 patients found the post-operative results to be similar to the 3D simulation images and 93% thought that it helped them in choosing the prosthesis and only 3% found it to be unnecessary in visualizing the results of breast augmentation.[14] In a larger series of 150 patients, 81% of patients felt that 3D simulation helped them very much in selecting the implant. About 86% felt that the predictions were very accurate, 11% felt that they were rather accurate, and only 4% thought the simulation was unnecessary.[15] We had similar results in our study, with more than 90% of women finding the 3D simulation of help in choosing their implants and 89% found the results to be very concordant with simulated images. Likewise, only 2% felt that they would not recommend 3D simulation to their peers. With the use of 3D simulation and VR, the patient has a better understanding of the complex process of implant breast augmentation. Breast asymmetries if any can be pointed out to the patient preoperatively. Patients can visualize the intermammary distance, the outward movement of the nipples which might happen in some cases after implant insertion, and the eventual enhancement. For the patient, this ability to choose the implant and make such observations invokes a feeling of involvement in the decision-making process and accounts for the positive perception of this technology in our study. This process also helps to keep the onus of deciding the right size of implant both on the patient herself as well as the surgeon. In case, the patient is dissatisfied with the results, she knows that she has chosen the implant. Our results were unlike those of Cruz, who observed a high dissatisfaction rate of 25% with the accuracy of the simulation. They stated that simulation does not take tissue elasticity into account and shows well-rounded breasts whereas, in reality, the post-operative results have more ptosis, which gives rise to patient dissatisfaction.[16] The disparity with their results can be attributed to a small sample size and lack of heterogeneity, in our study population. Further studies are, however, needed to compare the role of 3D simulation in improving satisfaction with breast augmentation when compared to conventional techniques.

Increased conversion rates have also been observed with the use of 3D simulation and surgeons find that its use helps them communicate better and explain the possible outcomes to their patients in a simpler manner.[15] In our experience as well, 3D simulation proved to be a practical teaching tool. It acted as a medium to apprise the patients of the limitations of their existing breast footprint, explain the plausible changes in the breast contour with implant placement, and demonstrate the results that can be achieved realistically. The use of this technology helped us effectively engage the patients in our

pre-operative session for breast augmentation, giving us the opportunity to comprehend the patient's expectations in a better manner.

This study, however, has some potential limitations. A small sample size was studied and the inclusion of patients undergoing only bilateral breast augmentation resulted in a homogenous population. Furthermore, as we wanted to bring forth the patient's perspective, the study takes into consideration only the subjective opinions of the patient and we did not perform any objective evaluation or comparison of the simulated images and the post-operative results. Further studies can incorporate both subjective and objective evaluations of the role of 3D simulation in breast implant augmentation. Furthermore, there is a need to carry out a cost-benefit analysis for the use of this technique as compared with traditional methods of estimating breast implant volume.

CONCLUSIONS

Three-dimensional imaging is currently being used as a tool in pre-operative counseling for breast augmentation. It proved to be an excellent educational tool and played a cardinal role in helping our patients choose the implant. The majority of our patients found the final results of the breast augmentation to be concordant with the 3D images shown to them preoperatively and recommended the use of 3D simulation as an aid to choose the implant. However, this tool should be used with discretion and careful consideration has to be given to the fact that the images are not of the actual result and are only a reference to increase the understanding of the final outcome.

Declaration of patient consent

Patient's consent not required as patient's identity is not disclosed or compromised.

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Conflicts of interest

There are no conflicts of interest.

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