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ORIGINAL ARTICLE

Three-dimensional imaging, an important factor of decision in breast augmentation

L'imagerie en trois dimensions, un important facteur de décision pour l'augmentation mammaire

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KEYWORDS Summary Three-Dimensional; Introduction. - Since the beginning of the 21st century, three-dimensional imaging systems have been used more often in plastic surgery, especially during preoperative planning for breast Mammoplasty; surgery and to simulate the postoperative appearance of the implant in the patient's body. The Imaging; main objective of this study is to assess the patients' attitudes regarding 3D simulation for breast Breast implants; Photography; augmentation. **Decision Making** Method. - A study was conducted, which included women who were operated on for primary breast augmentation. During the consultation, a three-dimensional simulation with Crisalix was done and different sized implants were fitted in the bra. Results. - Thirty-eight women were included. The median age was 29.4, and the median prosthesis volume was 310 mL. The median rank given regarding the final result was 9 (IQR: 8-9). Ninety percent of patients agreed (66% absolutely agreed, and 24% partially agreed) that the final product after breast augmentations was similar to the Crisalix simulation. Ninety-three percent of the patients believed that the three-dimensional simulation helped them choose their prosthesis (61% a lot and 32% a little). After envisaging a breast enlargement, patients estimated

that the Crisalix system was absolutely necessary (21%), very useful (32%), useful (45%), or

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unnecessary (3%). Regarding prosthesis choice, an equal number of women preferred the 3D simulation (19 patients) as preferred using different sizes of implants in the bra (19 patients). *Conclusion.* — The present study demonstrated that 3D simulation is actually useful for patients in order to envisage a breast augmentation. But it should be used as a complement to the classic method of trying different sized breast implants in the bra.

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MOTS CLÉS

Imagerie tridimensionnelle ; Mammoplastie ; Implants mammaires ; Photographie ; Prise de décision

Résumé

Introduction. — Depuis le début du 21^e siècle, l'imagerie en trois dimensions est de plus en plus utilisée en chirurgie et notamment en préopératoire dans la chirurgie mammaire pour simuler l'apparence de l'implant mammaire. L'objectif principal de l'étude est d'évaluer l'impression des patientes sur l'usage de l'imagerie 3D dans la mastoplastie d'augmentation.

Méthode. – L'étude inclut les patientes opérées d'une augmentation mammaire primaire ayant bénéficié en préopératoire d'une simulation 3D avec Crisalix et l'essai de prothèses dans le soutien gorge.

Résultats. — Trente-huit patientes étaient incluses. L'âge médian était de 29,4 ans et le volume médian implanté de 310 mL. La note donnée au résultat final est de 9/10 (IQR : 8–9). Quatre-vingt-dix pourcent des patientes sont d'accord que le résultat final est similaire à la simulation par Crisalix (66 % absolument d'accord et 24 % partiellement). Quatre-vingt-treize pourcent des patientes pensent que la simulation les a aidées à choisir leurs prothèses (61 % beaucoup et 32 % un peu). Pour envisager une augmentation mammaire, 21 % des patientes estiment que Crisalix est absolument nécessaire, 32 % qu'il est très utile et 45 % utile. Et 3 % inutile. Pour le choix des prothèses, autant de patientes préfèrent l'essai de prothèse dans le soutien gorge (19 patientes) que l'usage de Crisalix (19 patientes).

Conclusion. — L'étude démontre qu'actuellement la simulation en trois dimensions est utile pour envisager une augmentation mammaire. Mais elle doit-être utiliser comme un complément de la méthode classique d'essai de prothèse dans le soutien-gorge.

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Introduction

Since the beginning of the 21st century, three-dimensional imaging systems have been used more often in plastic surgery, especially during preoperative planning for breast surgery and to simulate the postoperative appearance of the implant in the patient's body [1-7].

3D surface imaging of a breast allows doctors to determine the influence of implant parameters on breast shape after augmentation mammoplasty. It may assist in preoperative planning by providing an example of how implants impact the breast shape. It may help patients to visualize the results of their breast augmentation, and to meet the patients' expectations for both volume and shape. It may also offer a better form of communication with patients about the expected breast shape and size and the choice of the prosthesis. The accuracy of three-dimensional imaging has been demonstrated for different systems [8–11].

Before the emergence of 3D simulation, the most commonly used method for determining the best implant size and form for a breast augmentation was a simulation that places numerous different-sized trial implants in the patient's bra [12,13]. However, do patients prefer the modern 3D simulation method? Will the use of implants in the bra become obsolete with the use of 3D breast simulation becoming more necessary for envisaging breast augmentation?

The main objective of this study is to assess the patients' attitudes regarding 3D simulation for breast augmentation and to evaluate the subsequent benefits.

Methods

A study was conducted in the plastic surgery department of the University Hospital of Nancy (Nancy, France), which included women who were operated on for primary breast augmentation from December 2014 to July 2016.

All women were operated on using the same breast augmentation protocol that consisted of inserting round microtextured silicone gel implants subpectorally through an inframammary incision.

The exclusion criteria were the presence of tuberous or congenital breast deformity, past reconstructive surgery, secondary or revision surgery, unilateral augmentation, the need for a concurrent mastopexy, or being male.

All breast augmentations were performed by the same operator (ES).

All patients received a minimum of two consultations before undergoing breast enlargement surgery.

During the consultation, a three-dimensional simulation with Crisalix was done and different sized implants were fitted in the bra in order to determine the correct implant size.

Crisalix (Crisalix, Switzerland) is a web-based 3D simulator for plastic surgery and aesthetic procedures. The program creates 3D surface images from three 2D images taken with a consumer camera and uses physical distance measurements of the patient's anatomy and a set of landmarks (Fig. 1).

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Three-dimensional imaging, an important factor in breast augmentation



Figure 1 Patient before breast augmentation, after Crisalix 3D simulation with 330 mL round silicone prosthesis, and one year after breast augmentation.

Images were only shown to the patients during the consultation, and no copy was given.

All the presented pictures comported the mention: "Crisalix 3D serves visualization and illustrative purposes only. It does not endorse or guarantee any outcome".

Six months following surgery, patients were contacted, and five questions were asked:

- is the final result similar to the three-dimensional simulation? (absolutely agree, partially agree, no opinion, partially disagree, absolutely disagree);
- did the 3D simulation help you choose a prosthesis? (not at all, a little, a lot);

- now after being operated, how do you consider the 3D simulation to envisage a breast augmentation? (absolutely necessary, very useful, useful or unnecessary);
- do you prefer 3D simulation or trying different sizes of breast implants inside the bra as a means of choosing the prosthesis?
- how would you note your final result? (0 to 10).

The Institutional Review Board approved the study, and informed consent was obtained from all of the enrolled patients.

Statistical analysis was performed using IBM^\circledast SPSS Statistics 22.0 software. We used Fisher's exact test for qualitative

variables and the Mann-Whitney U test for quantitative variables. First-order risk was set at 5%.

Results

Thirty-eight women were included in the present study. The median age was 29.4 (Inter-Quartile Range (IQR): 26.4-35.9), and the median prosthesis volume was 310 (IQR: 310-330) mL. The median note given regarding the final result of the breast enlargement was 9 (IQR: 8-9) (Table 1).

Ninety percent of patients agreed (66% absolutely agreed, and 24% partially agreed) that the final product after breast augmentations was similar to the Crisalix simulation (Fig. 2).

Ninety-three percent of the patients believed that the three-dimensional simulation helped them choose their prosthesis (61% a lot and 32% a little). After envisaging a breast enlargement, patients estimated that the Crisalix system was absolutely necessary (21%), very useful (32%), useful (45%), or unnecessary (3%) (Fig. 2).

Regarding prosthesis choice, an equal number of women preferred the 3D-simulation (19 patients) as preferred using different sizes of implants in the bra (19 patients).

The median age of patients who preferred the 3D simulation for prosthesis choice was 30.1 years, and the median age was 28.6 for those preferring the prosthesis inside a bra. The age difference was not significant (P = 0.583).

There is a correlation between patients who prefer the use of 3D simulation when choosing prosthesis and the additional evaluation provided by Crisalix when choosing a prosthesis (P = 0.010). There is also a correlation between patients who prefer the use of 3D simulation and those who believed 3D simulation was necessary afterwards in order to envisage a breast augmentation (P = 0.031).

Discussion

We evaluated the patients six months after the study in order to better judge the memory and impact of the 3D simulation and to evaluate the final appearance of the breast augmentation (in the study of Eder [14], the inframammary fold had dropped by 1.4 cm after 6 months, and the final breast volume \pm 0.5% was reached).

The study population included only women who were receiving primary breast augmentation using exactly the same breast augmentation protocol, in order to obtain a homogenous cohort and to avoid bias.

In a study conducted by Cruz [15], patients reported a high percentage of dissatisfaction (25%) with the information provided by the 3D simulation, since the 3D simulations

Table 1Patient's age, prosthesis volume, rank of the final volume.					
	Median	Q1–Q3	Mean	Max	Min
Age (years)	29.4	26.4-35.9	31.8	62.2	31.8
Prosthesis volume (mL)	310	310-330	321	475	220
Rank of the final result? $(0-10)$	9	8–10	8.82	10	3

Is the final result similar to the three-dimensional simulation?



Did the 3D simulation help you choose a prosthesis?



Do you prefer 3D simulation or trying different sizes of breast implants

No

Yes

inside the bra as a means of choosing the prosthesis?

Now after being operated, how do you consider the 3D simulation to envisage a breast augmentation?





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tended to show perfectly round breasts, while the final results may actually have more ptosis and less fullness because of the elasticity of the tissue. We found a similar result in the present study, with 66% of women who absolutely agreed and 24% who agreed that the final result was similar to the three-dimensional simulation.

From a legal point, we have to be very careful with the use of this 3D simulation. Final result may diverge of the simulated image and patients may be disappointed or may lodge a complaint. In order to avoid this, we prevent patients orally and it's directly by the program written on every showed image that ''Crisalix 3D serves visualization and illustrative purposes only. It does not endorse or guarantee any outcome''. Furthermore we do not give any copy of the presented picture to the patient in our practice.

Crisalix license price depends on the volume of patients and the period of the license: 1, 2, 3 years. The monthly subscription to Crisalix gold is 405 euros [16].

There was no significant age difference between women who preferred the 3D simulation for prosthesis choice, than those who preferred test prostheses fitted inside the bra. Prior to the present study, we hypothesized that a younger population would be more apt to prefer newer technology, such as the 3D simulation, but we found that this was not the case. The correlations between women who preferred the use of 3D simulation as a means of choosing their prosthesis and women who believed the 3D simulation was necessary in order to envisage a breast augmentation were expected.

A large majority of patients found that the three-dimensional simulation was beneficial (93%) in choosing the implant size. Furthermore, the simulation was similar to the final result for 90% of the patients. When patients were asked directly, 21% of them believed that the 3D simulation was absolutely necessary when envisaging a breast augmentation, and 3% deemed it unnecessary. With these results, we can conclude that offering the choice to the patients and explaining the benefits of 3D simulation would be a good approach. The results indicate that the plastic surgeon may propose with relative confidence 3D simulation to the patient when choosing the implant size.

However, these results also demonstrate that the more traditional, widespread method of inserting different breast implants into the bra is still useful. Fifty percent of patients preferred this classic method to the 3D simulation. Many patients affirm that they prefer this method because it is more hands-on and allows the patient to directly see and touch the shape and size of the proposed breast in the bra. Thus, plastic surgeons should continue to use this more traditional method since it is also preferred by many women.

To our knowledge, this is the first study to both evaluate the utility of the 3D simulation Crisalix and compare the breast sizing process between the use of a range of implant sizers with preoperative bra-fitting, and a three-dimensional simulation system.

There have been no previous studies assessing the attitudes towards a three-dimensional simulation after breast augmentation. This is the first study demonstrating the utility of the 3D system simulation as a means of envisaging breast augmentation.

Conclusion

The present study demonstrated that 3D simulation is actually appreciated by patients in order to envisage a breast augmentation. The 3D simulation may be useful for choosing implants and seeing the final expected product, which is reported to be similar to the final postoperative result for the majority of patients. Although the 3D simulation of breast augmentation seems to be beneficial, it should be used as a complement to the classic method of trying different sized breast implants in the bra. The use of 3D simulation should be used carefully by the surgeon to avoid disappointment or legal problems. Actually a new tool is also appearing with the augmented reality using 3D glasses technology, and should be evaluate.

Disclosure of interest

The authors declare that they have no competing interest.

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