Practical Do-It-Yourself Device for Accurate Volume Measurement of Breast

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Breast volume is one of the crucial measurements in preoperative planning and postoperative evaluation of the results in mammaplasty. The two areas in which the measurement of breast volume is especially important are asymmetry and augmentation mammaplasty.

Because symmetry is a prerequisite of beauty and normality,[1] no matter how beautiful each of the breasts is as a result of the operation, neither the surgeon nor the patient will be satisfied with asymmetric breasts. Therefore, in cases of asymmetric breasts, the aim of the mammaplasty is to achieve correction with symmetry. In such cases, a proper measurement of the differences in volume between breasts is extremely important. Also, in augmentation mammaplasty, a satisfactory way is needed for the patient to convey to the surgeon the desired breast size.

There are several methods suggested by different authors,[2–8] but there is still no commonly accepted standard method for measuring breast volume. Many surgeons still rely on visual estimations to measure differences in volume between breasts and differences in volume between the mammary prosthesis to be used and the existing breast.

To enable the surgeon to base his or her estimation on an objective evaluation, we have developed a simple device based on Archimedes' principle. Archimedes' principle is a physical law of buoyancy, which states that any body completely or partially submerged in a fluid is acted upon by an upward force equal to the weight of the fluid displaced by the body.[8]

Materials and Methods

Three items are needed for the construction of our device: a container, a pliable plastic bag, and a rubber stopper (Fig. 1). For the first item, we use the plastic, transparent container in which the mammary prosthesis was shipped. Of course, another container can be obtained. The container should be large enough to embrace the breast, without putting any pressure on the breast. A 2-cm hole is made in the center of the bottom of the container. The open edge of the bag is pulled through this hole (Fig. 2). The hole is closed by the rubber stopper of a liter bottle of normal saline. The device is ready to be used.

The logic behind the process is to measure the volume in the container, i.e., the volume remaining after breast occupies part of it. This measurement can be achieved by adding water to the bag, filling the space between the breast and the container. The bag prevents the leakage of water, keeping the patient from getting wet.

The device is placed on the breast of the patient lying in supine position (Figs. 3 and 4). The stopper is removed, and the bag is filled with warm water by using an injector. The volume of the water used is measured. The same process is applied to the other breast. The difference between the two measurements is the difference in volume between the two breasts (Fig. 5).

In augmentation mammaplasty, the patient wears a brassiere with a well-formed cup. This brassiere is of the size that she will prefer to wear after the operation. If needed, a sponge may be placed inside the brassiere to support

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FIG. 1. Three materials used in construction of device: a container, a pliable plastic bag, and rubber stopper.

FIG. 2. The open edge of the pliable plastic bag is pulled through the hole of the container.

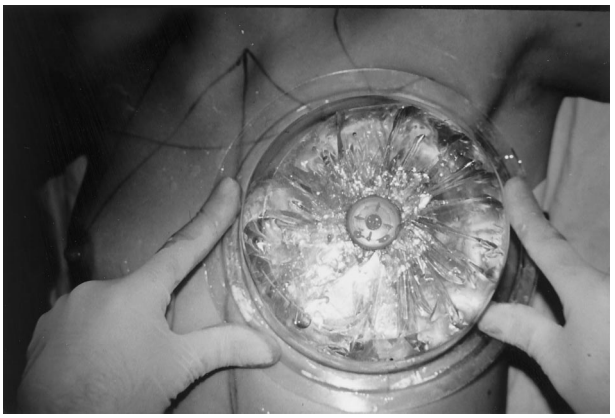


FIG. 3. View from above while positioning the device on the patient.

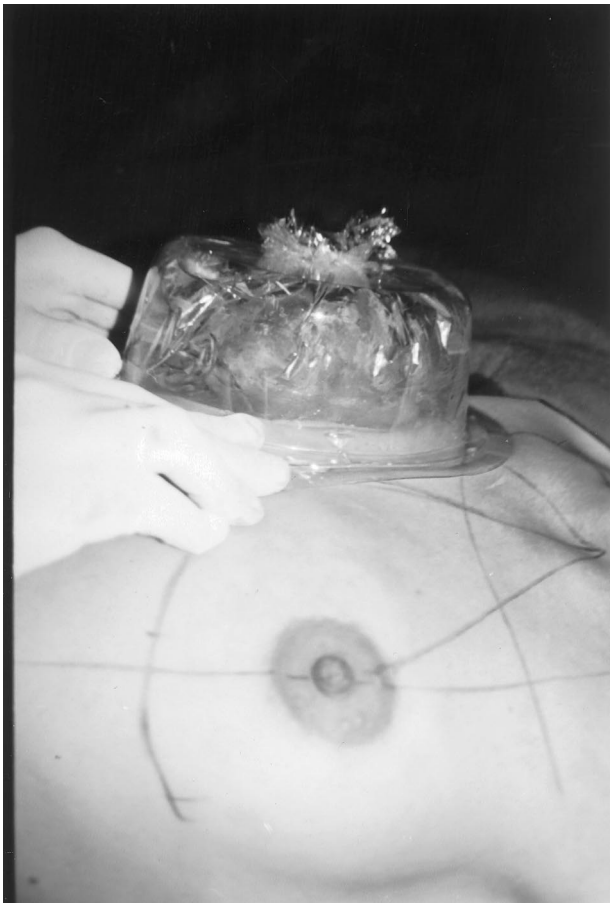
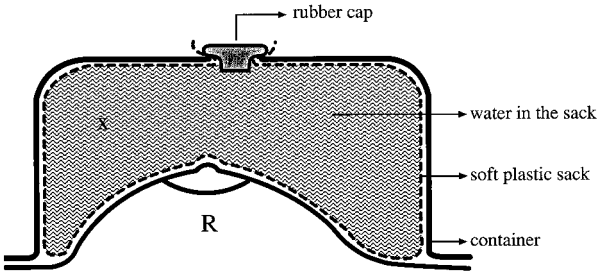


FIG. 4. Lateral view while positioning the device on the patient.

it. A measurement is made as described above (Fig. 6). The second measurement is made on the same breast without the brassiere. The difference between the two measurements is the volume of the prosthesis to be used (Fig. 7).

To check the reliability of this method, preoperative and postoperative volume differences were measured in 10 augmentation mammaplasty patients and 5 mastectomy patients. For the augmentation mammaplasty cases, when the preoperative volume of the water in the bag was subtracted from the postoperative volume, the result was equal to the volume of the mammary prosthesis used in the operation (Fig. 8). The same is true for mastectomy cases, i.e., preoperative volume of the



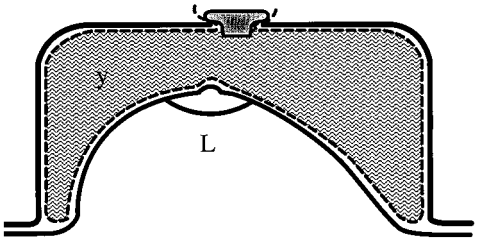


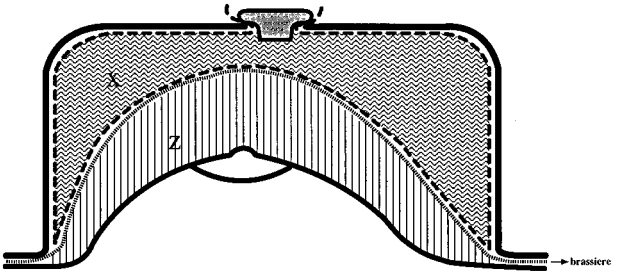
FIG. 5. Measurement of differences in volume in asymmetric breasts. x is the volume of the container after the container is placed over the right breast; y is the volume of the container after the container is placed over the left breast; L is the volume of the left breast; and R is the volume of the right breast.

FIG. 6. How to measure volume when the patient wears the brassiere.

water in the bag subtracted from the postoperative volume equals the volume of the tissue excised.

After having confirmed the reliability of our method, we began clinical applications. To date, we have used our method for 12 cases of asymmetry. After mammaplasty to correct asymmetrical breasts, for which we used our technique described above, breast volumes were equal in postoperative measurements.

We have also used our method of measurement to determine the size of the prosthesis to be used in augmentation mammaplasty in 20



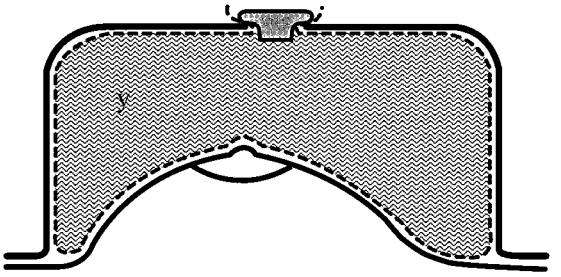


FIG. 7. The measurements with and without brassiere. $y - x = z$. ,where x is the volume of the container after it is placed over the brassiere; y is the volume of the container after it is placed over the naked breast, and z is the volume of the space between the breast and the brassiere, which indicates the volume of the prosthesis to be used.

cases. The patient chooses the size of the brassiere, which simulates the desired postoperative breast size. None of the patients complained about the size of the breasts after the operation.

DISCUSSION

The method developed by Schultz et al.[8] is the most reliable for breast volume measurement. Our method also is based on the principle of water displacement. In their method, the breast is submerged into a calibrated cylinder, which is filled with water. But they have a problem that stems from the patient's participation, i.e., the level of submergence depends on the patient, and this variation affects the accuracy of the measurement, as stated in their article. In our method, patient participation is minimized. Because the patient is lying in a supine position, which is the reverse position of their method, measurement is under the control of the physician, not the patient. Another advantage of our method is that the patient is more comfortable, because she does not get wet during the measurement process.

Dry measurement is also achieved through

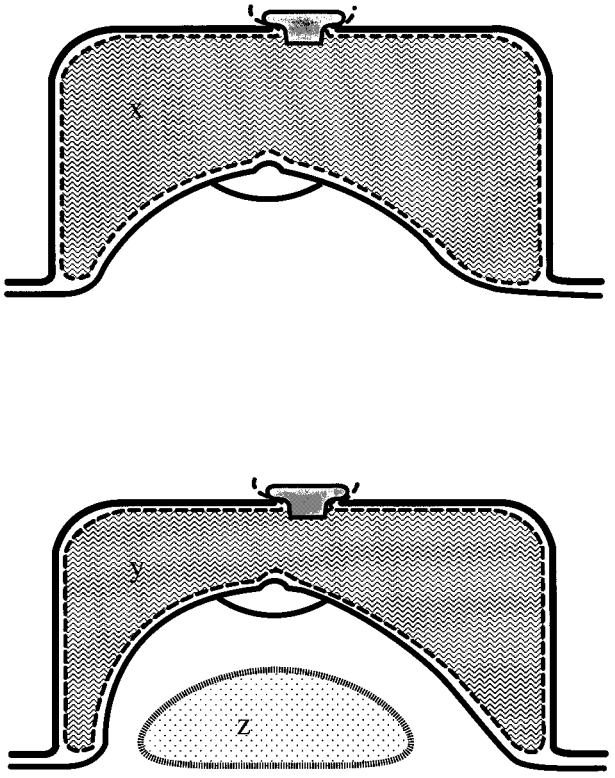


FIG. 8. The volume differences denoted by *z*, which is also equal to volume of the mammary prosthesis, is given by the equation $x - y = z$, where x is the volume of the container after it is placed over the preoperative breast, y is the volume of the container after it is placed over the postoperative breast (including the mammary prosthesis), and z is the volume of the mammary prosthesis.

the commercial mammometer developed by Tegtmeier.[4] Unlike his method, our method does not require the purchase of a special commercial device. Our do-it-yourself method involves building a device by using materials that are readily available to the plastic surgeon. Three different materials are needed for building our device: a plastic bag, a container, and a rubber stopper. The last two are actually disposable parts of other medical products. Thus, the cost of our device is negligible. It is easy and fast to build. Our device can be gas sterilized for intraoperative use, as is that of Tegtmeier.

The base of our device has two components: the pliable plastic bag and a semirigid plastic container, which are flexible materials. Because of this characteristic, the device can be used for patients who have minor but not major rib cage asymmetry. Correction of cases of major rib cage asymmetry in conjunction with mammary asymmetry is beyond the scope of this article.

Our method is precise in sizing the breast for augmentation mammaplasty. The surgeon has to select a size that will both fit the body of the patient anatomically and meet the expectation of the patient. During their preoperative discussions, the surgeon considers the size of the prosthesis, while the patient becomes accustomed to her new desired breast size by wearing the brassiere she wants to wear after the operation.

Brassiere sizes and styles change from one country to another and from one brand to another. Because of this variation, it is difficult to understand the patient's actual expectation of breast volume from the stated brassiere size alone. The surgeon must see the brassiere that the patient has chosen. Even when the brassiere is seen on the patient, there is another difficulty remaining, i.e., the surgeon must estimate the size of the prosthesis that will fill the brassiere.[3,7] Although experience and skill at estimating are extremely important, an objective assessment is essential.

Two preceding methods of determining volume using the brassiere were based on measuring of the void between the brassiere and the breast. In these methods, the filled bag is between the brassiere and breast, which makes it not visible and can put pressure on the breast, affecting the accuracy of the measurement. In our method, the measurement is realized over a brassiere with a well-formed cup, without putting any pressure on the breast. Because our device is transparent and because it is visible, we can ensure that the bag fills the empty space completely.

This method is sensitive enough to measure the volume of a mammary prosthesis, as proven by preaugmentation and postaugmentation measurements in 20 breasts of 10 patients. Its sensitivity also was proven by measuring the volume of the tissue excised in five mastectomy cases.

In cases of asymmetrical breast size, our device enabled us to measure the difference between the volumes of the two breasts. After obtaining these measurements, it was easy to decide on the size of the prosthesis if only one breast was to be augmented or to decide on the sizes of the two different prostheses in cases of bilateral augmentation. By the same token, if reduction was needed for correction of asymmetry, the volume of tissue to be excised can be determined. When we checked the volumes

postoperatively, it was confirmed that the volumes of the two breasts were equal.

Our method provides precise measurement of breast volume without consuming much time or spending much money and by caring for the comfort of the patient. And it enables the patients to indicate their choice of brassiere size properly, which increases the satisfaction of the patient.

SUMMARY

A simple and accurate method of measuring differences in breast volume based on Archimedes' principle is described. In this method, a plastic container is placed on the breast of the patient who is lying in supine position. While the breast occupies part of the container, the remaining part is filled with water and the volume is measured. This method allows the measurement of the volume differences of asymmetric breasts and also helps the surgeon to estimate the size of the prosthesis to be used in augmentation mammaplasty.

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