Shaping the Breast in Aesthetic and Reconstructive Breast Surgery: An Easy Three-Step Principle

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Creating or recreating an aesthetically pleasing breast shape in reconstructive and aesthetic breast surgery is an act that most experienced "breast" surgeons will find self-evident. We propose a simple three-step philosophical and hands-on approach that will make it easier for young and unexperienced plastic surgeons to not only analyze the problematic breast but also come up with an easy surgical strategy to create reproducible results.

This is Part I of four parts describing the three-step principle being applied in reconstructive and aesthetic breast surgery. Part I explains how to analyze a problematic breast by understanding the three main anatomical features of a breast and how they interact: the footprint, the conus of the breast, and the skin envelope. Part II deals with reconstructions after complete mastectomy and Part III covers reconstruction after breast conservation surgery. Finally, Part IV applies the same principles in the field of aesthetic breast surgery. Throughout these four parts, the three-step principle will be the red line to fall back on to define the problem and to propose a solution. (*Plast. Reconstr. Surg.* 123: 455, 2009.)

Although abundant literature exists regarding the anatomical and technical points in aesthetic breast surgery and breast reconstruction with either autologous tissue or implants, there is virtually no written information about the artistic aspects of shaping the breast in the process of aesthetic or reconstructive breast surgery. Every surgeon has his of her own tricks for achieving a great result. Mostly, however, a specific surgical method was never taught by their teacher and the long process of trial and error finally got transformed into "experience and mastership." Often we, as teachers, feel that it is sometimes difficult to teach this "artistic finesse" to our surgical offspring. Our own artistic insight interacting with the artistic skills of the apprentice will be determining factors in the transfer of knowledge and the final surgical result obtained. Although artistic awareness is difficult to define and teach, we believe that an analytical and methodic approach will facilitate the process of defining and solving the problem of the deformed breast in a reliable and reproducible manner.

We present our approach for systematically shaping a natural-appearing breast in both reconstructive and aesthetic breast surgery. The analytical approach described in the different parts of this article allows the surgeon to break down, understand, and describe the different deformities present in the troubled breast, whatever the cause might be. With a better comprehension of what is wrong with the size and shape of the breast, the same surgical philosophy (the "three-step" principle) can be applied to perform a systematic and step-by-step improvement or reconstruction leading to an aesthetically pleasing and reproducible result. The three-step principle is also a great tool—in addition to assisting with understanding the problem—with which to teach young residents and inexperienced surgeons the basic steps in reconstructive and aesthetic breast surgery.

Before defining the problem it is important to define what is normal. The sizes and shapes of

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different breasts vary so much that it is impossible to define what the perfect breast appears like. Still, we all are able to identify what the majority of people would call a "beautiful breast." An aesthetically pleasing breast may vary in shape and volume, depending on the anatomy and proportions of the person to whom the breast belongs. There are four important parameters that define the beauty of a breast: location on the chest wall, proportions of the breast in relation to the torso, an aesthetically pleasing shape, and symmetry of both breasts in volume and shape. It is clear that a breast that resides too high or too low will appear imperfect. A very small breast in an overweight woman might be less desirable. In contrast, breast hypertrophy, certainly if accompanied by an awkward shape, may be far from attractive as well. It is important to state here that the attractiveness of a certain breast volume is subject to personal interpretation and varies in different cultures. Generally, an attractive breast is proportional to the length and width of the torso. The lateral border of the breast should surpass the lateral outline of the anteroposterior silhouette of the torso. There is progressive transition of the breast at the upper and medial borders of the breast, whereas the transition at the inframammary fold is well defined. The angle of this transition should not be too sharp, as this will result in a drooping breast. An aesthetically pleasing breast holds most of its volume in the lower outer quadrant and the least volume in the medial upper quadrant. The line connecting the clavicle and the nipple in a side view should be straight or slightly concave. Obviously, breasts symmetrical in both size and shape will be more attractive, even if the shape is not perfect. In Part I, we further explain the normal position and proportions of a breast. However, the definition of a beautiful breast is often a matter of personal opinion and very much influenced by time (cf. the paintings and drawings of Peter Paul Rubens), social inspiration (i.e., fashion trends), and cultural habits (as in the difference between Asian and Western cultures). We should not forget to listen to the patient, to interpret her wishes and desires, and finally try to create or recreate a breast she thinks is desirable.

The different parts of this article will attempt to provide an answer to the main question related to this issue: How can we surgically achieve the goal of creating an attractive breast in a reproducible way? To do so, we developed a three-step principle based on three important anatomical entities of the breast: the footprint of the breast, or the interface of the posterior surface of the breast with the thoracic wall; (2) the conus of the breast, or the principal shape and volume made up by the mammary gland in normal breasts; and (3) the envelope of the breast consisting of the skin and subcutaneous fat. By breaking down the breast into these three structures, we can easily analyze the problems present at each of these levels and devise a surgical strategy for correcting the different issues at the three levels and creating an aesthetically pleasing breast.

In this part, we describe how to analyze the often complex problems present in a deformed breast and how to prepare for surgery. In Part II, shaping of the breast after mastectomy will be discussed. Part III will talk about reconstructing partial defects after breast conservative surgery and developmental anomalies, and Part IV will explain how to optimize one's results in aesthetic breast surgery.

> *The difference between art and science is that science is what we understand well enough to explain to a computer. Art is everything else.*
>
> —Donald Knuth, "Discover"

Anatomy of the Breast Pertinent to Breast Shaping

Breast Footprint

The breast "footprint" is the outline or footprint that the breast makes on the chest wall, analogous to the footprint a tent makes on the ground. The footprint forms the basis or foundation of the overlying three-dimensional structure of the breast (Fig. 1). The footprint of the breast can best be observed during surgery just at the end of a mastectomy while retracting the overlying mastectomy skin. Serratus anterior and pectoral muscles are nicely exposed.

This footprint may vary individually in height and width. Also, the position of the footprint on the chest wall may vary slightly from one woman to another, but mostly the borders of the footprint are related to well-known anatomical structures on the chest wall. Working counterclockwise around a right-sided breast, the footprint takes a gentle curve starting from the pectoralis tendon 3 to 6 cm below the superiormost point of the anterior axillary fold, extending down the lateral chest wall at approximately 1 to 2 cm behind the anterior axillary line. The footprint never extends to the midaxillary line, but in obese patients, accessory fat can be found extending to the back. From its lateralmost point, there is a progressive curved transition of the lateral border of the footprint into the inframammary crease (Fig. 1, *above*, *left*).

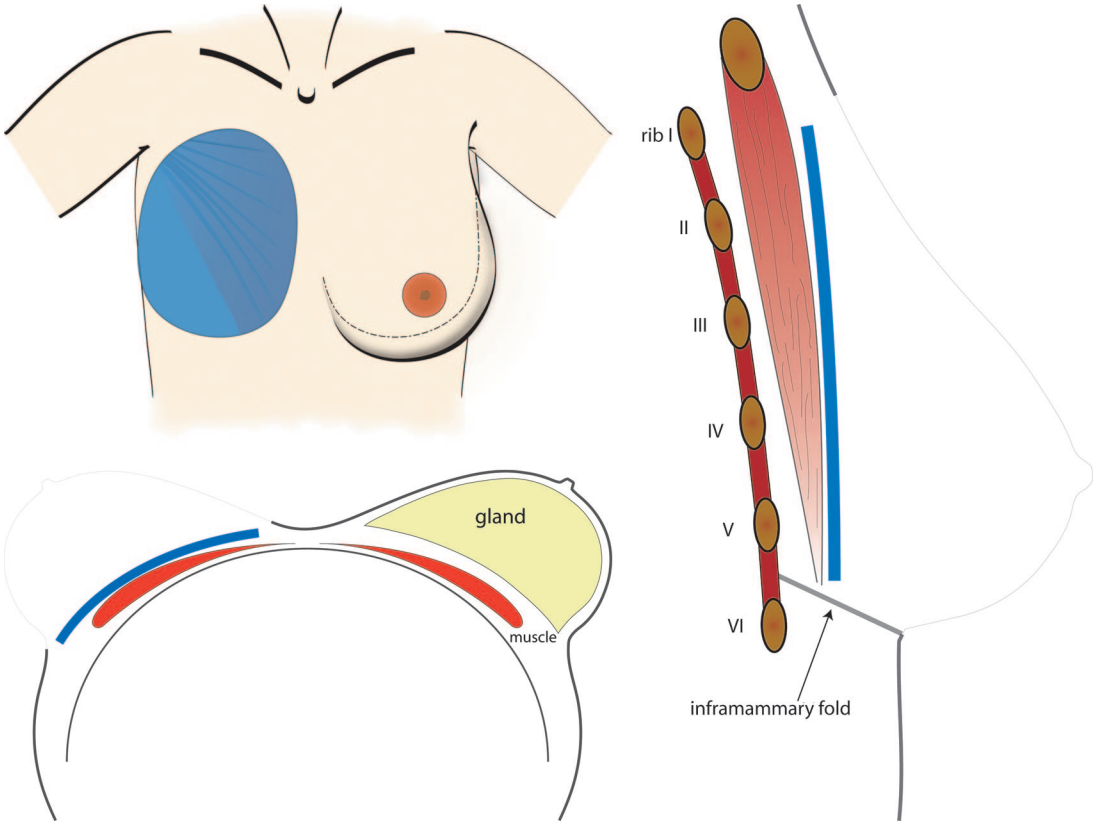

Fig. 1. Average position and dimensions of the footprint of the breast on the chest wall in frontal (*above*, *left*) and sagittal (*right*) standing views and an axial supine view (*below*, *left*).

Along the inframammary fold, the breast footprint is most caudal at the midclavicular line at approximately the sixth or seventh rib (Fig. 1, *right*). Medially, the inframammary fold of the breast footprint extends to within 1 to 2 cm of the sternal midline in most women (Fig. 1, *below*, *left*), making a gentle upward curve as the inferior portion of the medial breast border is reached. The medial border of the breast footprint continues cranially, curving laterally at a point approximately 7 cm below the sternal notch. Superiorly, the breast footprint has a curvilinear contour that is most cranial at the midclavicular line (Fig. 1, *above*, *left*). This curve tapers into the lateral part of the chest wall at approximately two fingerbreadths below the clavicle just before ending at its lateral border back at the axillary fold.

The dimensions and position of the footprint are different for each woman, but it is important to understand that the footprint will never change in the same woman either in position or in dimensions after puberty. When the breast becomes larger because of hormonal influences or weight gain, the breast will never grow over the midaxillary line, the inframammary crease, the midline, or up to the clavicle. Establishing an appropriate footprint is the first step in reconstructing the breast.

Breast Conus

The breast conus refers to the three-dimensional shape, projection, and volume of the tissue (or implant) on top and anterior to the footprint of the breast. This conus has a very specific volume distribution yet is different in each individual woman. An aesthetic breast is inherently asymmetric, with a greater proportion of its volume residing in the lower pole of the breast. Although the breast footprint is relatively similar from one patient to the next, the breast conus differs significantly from patient to patient and with age. This is demonstrated most obviously when looking at breasts with different degrees of hypertrophy or ptosis.

With the key features of the breast footprint in mind, it is easy to understand the basis and key features of the conus (Fig. 2). The basis of the conus corresponds or is slightly smaller than the breast footprint. Normally, in a standing position

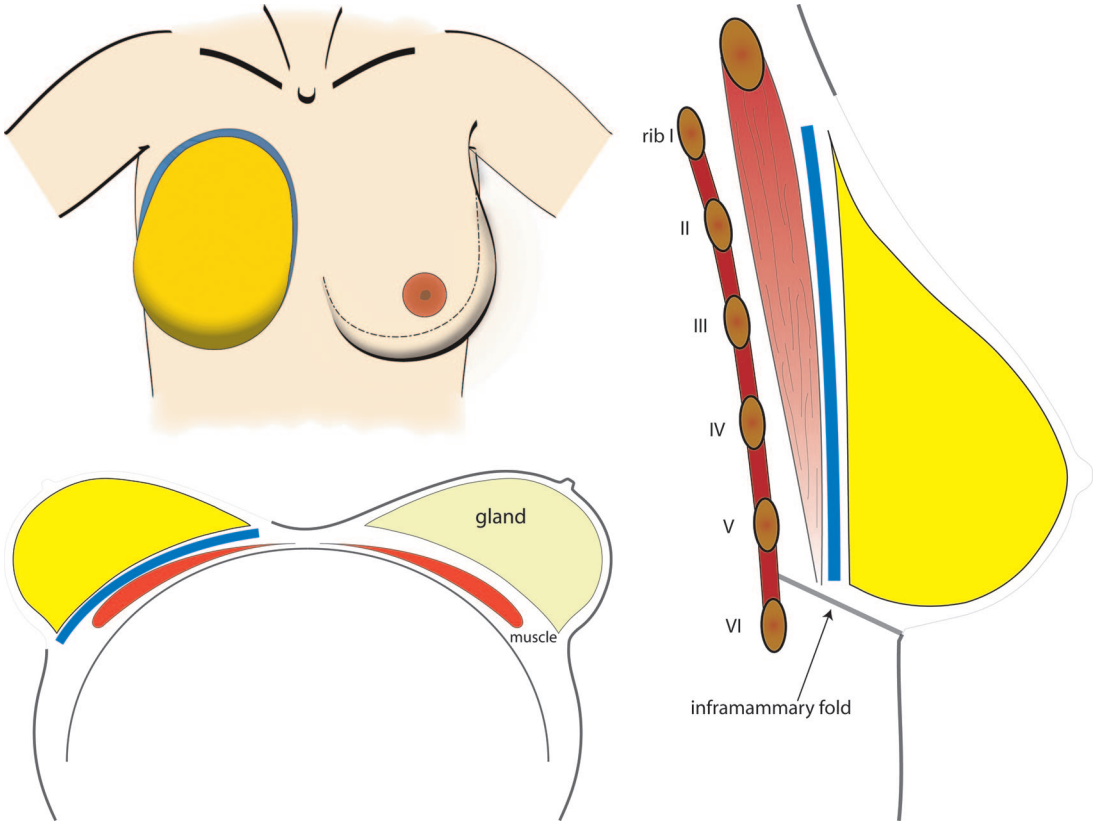

Fig. 2. Average position and dimensions of the footprint (*blue*) and the conus (*yellow*) of the breast on the chest wall in frontal (*above*, *left*) and sagittal (*right*) standing views, and an axial supine view (*below*, *left*).

there is a progressive transition, through an obtuse angle, of the chest wall into the medial and cranial sides of the female breast. The transition angle at the lateral and certainly the caudal part of a normal breast is sharper and may even reach 180 degrees for the caudal border in hypertrophic or severely ptotic breasts. This means, for example, that the new conus that will replace the ablated breast gland will need a very obtuse angle at its superior border, approximately 45- to 60-degree angles at the medial and lateral borders and an almost straight angle at the inferior border (this may vary from 70 degrees or less for a small breast to 120 degrees or more for larger breasts). An anatomical implant is an excellent example of a typical breast conus.

The new conus will also need (1) an inferolateral fullness, which defines the lower outer quadrant of the breast; (2) a maximum projection in an anteroposterior direction in its lower part at the level of the nipple-areola complex; and (3) some degree of ptosis. The degree of medial fullness and the angle of the conus at its medial border will determine the amount of medial cleavage possible but only in conjunction with the medial position of the breast footprint. The infraclavicular fill extends from the inferior border of the clavicle into the superior quadrants of the breast. The infraclavicular fill is flat or even slightly concave in a normal breast. Overfilling of this area resulting in convexity of this area will produce unnatural results.

The process of systematically considering each feature establishes a very intuitive and important link between the breast footprint and breast conus. An aesthetic breast is virtually impossible to reconstruct without an appropriately established footprint that serves as the foundation for the overlying breast conus. The conus shape and volume may vary from one woman to another and needs to be adjusted and remodeled to achieve final symmetry with the contralateral side.

Skin Envelope

The *quantity* and *quality* of the skin envelope have a major influence on breast aesthetics (Fig. 3). A skin envelope of appropriate *quantity* functions like a well-fitting brassiere, holding the parenchymal volume, or conus, in an appropriate

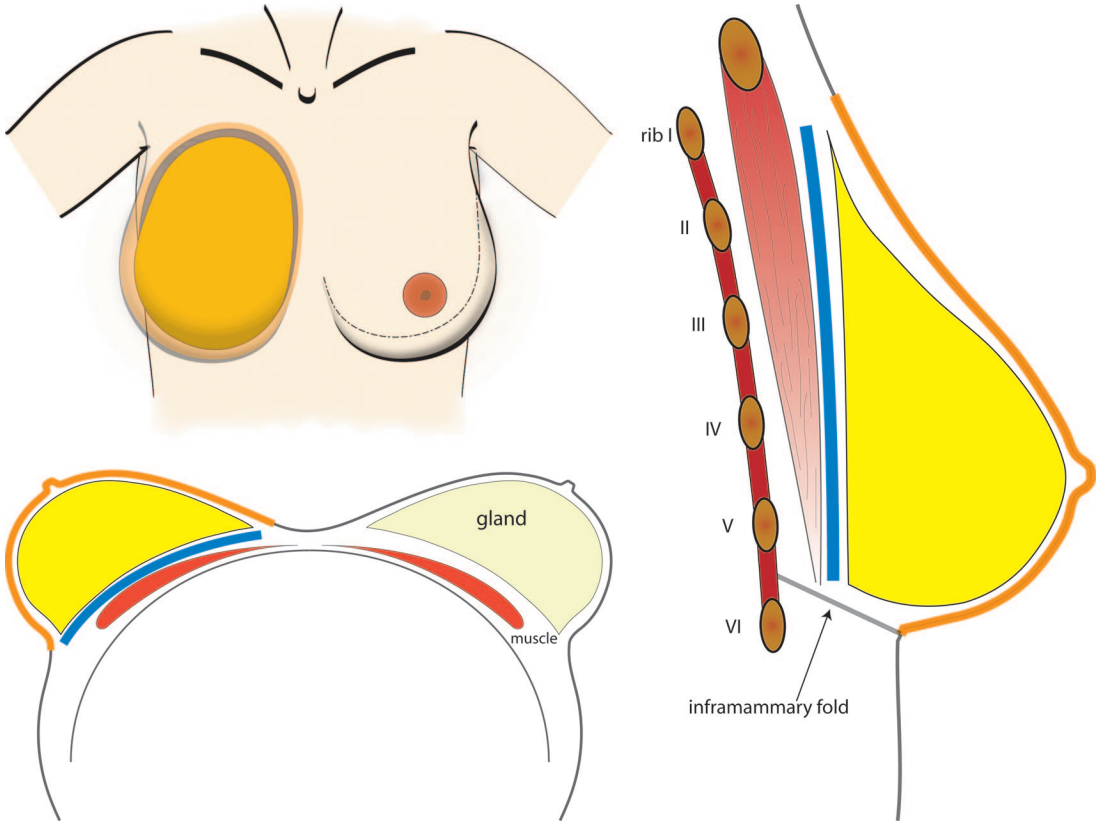

Fig. 3. Average position and dimensions of the footprint (*blue*), the conus (*yellow*), and the skin envelope (*orange*) of the breast on the chest wall in frontal (*above*, *left*) and sagittal (*right*) standing views, and an axial supine view (*below*, *left*).

position. Both in a vertical and horizontal direction, the exact amount of skin is necessary to create a nice shape. Any redundancy of skin in any direction will lead to awkward breast shapes and to (early) ptosis. Skin shortage or overtightening will lead to flattening of the breast, wound-healing problems, or even necrosis of the underlying autologous tissue.

A skin envelope of appropriate *quality* has good elasticity and a certain firmness allowing and assisting in appropriate projection of the (parenchymal) tissue. Once the skin envelope has lost a significant degree of elasticity, the skin will stretch and the breast will appear ptotic even if the parenchymal volume and shape are maintained. Irradiation and previous scars both influence the skin envelope, causing it to be tighter and less elastic. In daily practice, one can observe that a breast irradiated after breast conservation surgery sometimes has a nicer shape than the contralateral, nonoperated breast because of tightening of the skin envelope and sclerosis of the remaining parenchyma.

One also has to consider that, at the interface between the envelope and the conus, a variable interaction will take place. In case of autologous tissue, variable amounts of scar will form, depending on the type of surgery and on possible complications such as hematomas and infections. In case of implants, a capsule will form. This capsule will not interact directly with the skin but might displace or deform the conus. The skin envelope will not have sufficient strength to counteract this process and will follow the changes in the capsule.

Interaction of the Three Anatomical Features

The final shape of the breast is never determined by the footprint, the conus, or the envelope independently. It is the combined action of these three elements that will result in a pleasing and natural-appearing breast that maintains a stable shape over years. One cannot obtain a good result by neglecting one or two elements. For example, in breast reduction, some consider the skin as a determining factor in obtaining a nice shape, whereas others are convinced that internal shaping of the gland is more important. In reality, both are equally important; however, also the interaction between skin and gland, through the process

of scar formation, will contribute to the final appearance. In breast reconstruction, the utmost attention needs to be given to each of the three elements. Only by meticulously preparing and executing each individual step can reproducible and natural-appearing results be achieved. If no complications occur, the (limited) scar formation at the interface of the three elements will contribute to instead of deteriorate the final result.

Nipple-Areola Complex

Finally, the nipple-areola complex contributes to the aesthetic appearance of the breast by highlighting the point of maximal anteroposterior projection, thus enhancing the conical shape of the breast. Although the shape, projection, and contours of the nipple-areola complex differ significantly from patient to patient, aesthetic breasts consistently have nipple-areola complexes that reside at the point of the breast's maximal anteroposterior projection and either along the vertical meridian of the breast or slightly lateral to it (Fig. 4). An attractive areola is more pigmented, has a conic shape, and is a fluid continuation of the natural rounded contour of the skin envelope of the breast. The nipple protrudes above the areola. The nipple may have a variable width and length. Although a nice breast shape can be accomplished by performing the first three steps described above, the nipple-areola complex will give the key signature to the naturalness and attractiveness of the breast. Correct location and adequate size of the nipple-areola complex are therefore mandatory for a beautiful breast. Nipple-areola complex color and nipple dimensions are open to personal interpretation and subject to individual taste.

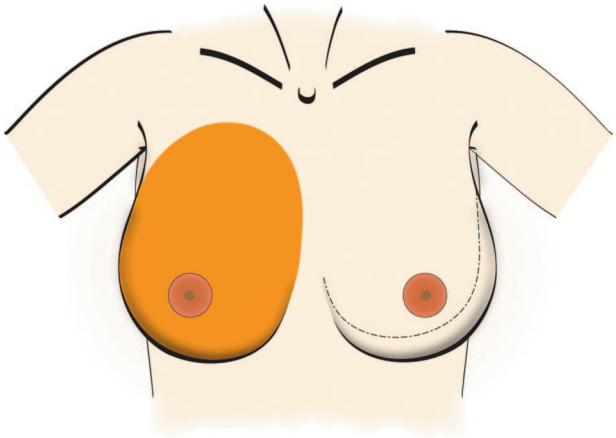

Fig. 4. The nipple-areola complex resides at the point of the breast's maximal anteroposterior projection and either along the vertical meridian of the breast or slightly lateral to it.

ANALYZING THE PROBLEM AND PREPARING FOR THE SOLUTION

The importance of a detailed and systematic preoperative physical examination cannot be overemphasized. The anatomical features described above are evaluated and documented for both breasts. In addition, the following elements need to be examined: (1) status of the chest wall and (2) possible asymmetries. All these elements interact and are discussed separately for each specific surgical strategy.

In relation to the size and location of the footprint, a number of measurements are necessary in the process of problem analysis and preoperative planning. A marker can be used to, on the one hand, draw the borders of the footprint the way they are presented in a specific patient; and, on the other hand, to draw, sometimes with a different color, the borders of the footprint the way they should be (corrected). The level of the inframammary crease is determined. Cleavage is different in each patient. Therefore, the distance is measured between the midline and the medial border of the breast. The upper border of the breast can vary but should be symmetrical for both sides. The upper border can be determined easily by pushing the normal breast upward. A natural crease will form at approximately two to three fingerbreadths below the clavicle. At the anterior axillary line over the pectoralis major muscle, a natural fold is always visible that indicates the lateral slanted transition of the upper border of the footprint into the lateral border. The anterior axillary line is drawn, as is the lateral breast border 1 to 2 cm behind it (sometimes using the contralateral breast as a guide).

All these marks, connected with each other, should form a gentle oval/round shape (Fig. 1, *above, left*). If this is not the case (e.g., in a tubular breast malformation or quadrantectomies), it will be easy to understand why the size and shape of the footprint are aberrant. By subtracting the drawing of the normal footprint from the deviated footprint, one can easily grasp where and how much correction is needed. In aesthetic breast surgery, the footprint is rarely affected. As described above, the footprint size and shape hardly change with varying volumes. The footprint can easily be drawn on the chest in all breast augmentation, reduction, and mastopexy cases. Congenital malformations (i.e., breast atrophy), developmental changes (i.e., tubular breast), and postablative (i.e., partial or total mastectomy) deformations may cause a variable distortion of the

footprint. If the contralateral breast is not affected, a mirror image of the nonaffected breast can be drawn on the contralateral chest wall. In bilateral malformations, however, a new footprint needs to be drawn based on the knowledge we have on the size, position, and shape of the footprint with respect to the shape and dimensions of the thoracic cage.

The size and volume of the conus of the new breast are mainly the choice of the patient and need to be discussed with her. In contrast, the attractiveness of the shape of the conus needs to be created by the surgeon. The shaping of the conus is the main subject of the different parts in this article and will be discussed elaborately later, depending on the malformation. The size of the conus is the main subject of communication before aesthetic breast augmentation and reduction. It is easier to give preoperative insight of the volume change in breast augmentation with the help of sizers. Sometimes, it might be difficult to explain to a patient how much reduction she can expect. In a mastopexy, per definition, the volume of the conus is not altered.

After breast conservative surgery or certain congenital and developmental malformations such as tubular breast, a variable amount of glandular tissue is missing. Sometimes, it is possible to know exactly how much volume is lacking when the weight of the resected specimen is known. The volume decrease caused by radiotherapy is often hard to estimate. Visual inspection and comparing both breasts will tell the observing surgeon where and how much tissue is missing from the conus. Obviously, after mastectomy, the entire conus needs to be replaced. Intraoperative sterile sizers can be used to either compare the volume with the contralateral nonoperated breast in unilateral reconstructions or achieve an appreciation of the size and proportions in bilateral reconstructions.

After defining the deformities of the borders of the footprint and the amount of tissue of the conus that needs to be added or resected, the envelope needs to be evaluated. An excess of floppy skin is the main problem in the ptotic breast. A shortage or tightness of skin can cause deformation of the conus. Atrophy of both lower quadrants in tubular breast deformities results in a shortage that can be corrected by the use of a tissue expander. Radiotherapy causes variable fibrosis and contraction of the skin that might be difficult to correct by expansion. Often, skin needs to be added with the help of a locoregional or distant flap. Lipofilling improves irradiated skin quality and might be used to relax and stretch the envelope. Skin quality in general may be affected in smokers, after multiple pregnancies, and after ultraviolet light damage. Good shaping of the conus will be even more important in these patients.

Once the different problems have been isolated at the level of each of the three anatomical features of the breast and the way they interact with each other, the global deformation of the breast can be understood with better clarity. From this understanding follows automatically the next step: the therapeutic strategy. In other words, after analyzing which structure at each of the three levels is damaged, we can very easily determine which problem needs repair. By correcting the different problems step-by-step at each level starting with the footprint, moving on to the conus, and finally dealing with the skin, a successful outcome is guaranteed in all cases. In the process of getting to the final result, it might be possible that two or more operations are needed. It is important to explain this to the patient before starting the first surgical step.

For example, after a unilateral modified radical mastectomy, the footprint and conus are totally absent and the envelope is partially missing. The reconstructive steps are easy: (1) recreate the footprint by copying the footprint of the contralateral side; (2) undermine the skin (and/or pectoral major muscle) up to the borders of the new footprint; (3) recreate the conus by putting an implant and/or adding autologous tissue, shaped in the correct fashion (see later); and (4) redrape the remaining skin over the conus or progressively expand the skin in case of an expander.

Another typical example is the problem of a normovolemic tubular breast. First, the problem should be analyzed: deformity of the lower part of the footprint, deficiency of the lower part of the conus, and retraction of the skin envelope in the lower poles because of hypotrophy of both lower quadrants of the breast. Then, a step-by-step solution should be implemented: (1) undermining of the breast and skin down to the normal level of the inframammary crease, (2) redraping of the gland by longitudinal or radial scoring of the posterior surface of the gland, and (3) temporary expansion of the skin by an expander, if necessary.

In some cases, it might be interesting to compare the physical examination to preoperative radiographic imaging. All patients undergo at least an ultrasound examination (younger patients) but mostly the combination of mammography and ultrasound. If necessary, chest radiography and magnetic resonance imaging can be added. Suspicious lesions or cysts that may alter postoperative

volume need to be identified and resected if necessary. The severity of chest wall deformities—congenital, iatrogenic (radiotherapy or surgical), or traumatic—can also be evaluated in detail.

Standard color photographs with the hands behind the back and the arms at the sides (frontal and three-quarters) are an important part of the preoperative analysis and planning, aid in intraoperative shaping, and allow an honest appraisal of results postoperatively. Photographs are taken in lateral, oblique, and anterior views. Photographs can be a great help when discussing surgery with patients. In the following parts, we describe how to shape a breast in breast reconstruction after mastectomy with either implant or autologous tissue (Part II), to shape a breast with partial defects (Part III), and to shape a breast in aesthetic breast surgery (Part IV).

Despite all the meticulous analysis, measurements, preparations, and flawless surgery, we still will not be able to create an "amazing" result in every case. Even if the surgeon is finally convinced that for once he or she has got it just right and is convinced the patient will be pleased, we regularly see that our achievements do not match the patient's expectations. In particular, in primary reconstructions, women compare the reconstructed breast with the normal preoperative breast and often forget they are dealing with a reconstruction. Women presenting for secondary reconstruction have often lived a period with more or less chest wall mutilation and often expect less-than-perfect results.

Physical, anatomical, and medical limitations often restrict the reconstructive capacities of a surgeon to be able to provide the perfect match to what nature has given. The three-step principle is not a mathematical formula that will be able to provide the perfect shape and volume for every patient. It is not even intended to be that. The three-step principle is just a simple guide that will assist mainly the less-experienced breast surgeons in developing their own personal technique to achieve aesthetically pleasing results. More experienced surgeons who developed their own technique long before us writing this article might find the three-step principle a handy tool or model with which to explain and teach their own technique to younger colleagues. Finally, the three-step principle is a model that we found to work for us certainly to be able to obtain reproducible results. This does not mean that other techniques are less valuable. There are many "roads to Rome."

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