

Nipple-Areola Complex Reconstruction

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Learning Objectives: After studying this article, the participant should be able to: 1. Understand how to determine nipple-areola complex positioning on the reconstructed breast. 2. Understand the multitude of local flap and distant graft options for nipple-areola complex reconstruction. 3. Draw at least three fundamental nipple-areola complex reconstruction patterns. 4. Understand the forces that are responsible for flattening of the reconstructed papule. 5. Understand the current techniques used in secondary nipple-areola complex reconstructions.

Summary: Nipple-areola complex reconstruction and tattooing represent the final two stages of breast reconstruction. Nipple-areola complex reconstruction is typically accomplished with the use of local flaps, local flaps with augmentation grafts, or a combination thereof. Regardless of the technique used, however, all nipple-areola complex reconstructions lose a degree of projection over time. Options for secondary reconstruction include the use of local tissue flaps alone or in combination with acellular biological matrices. (*Plast. Reconstr. Surg.* 141: 404e, 2018.)

The past 15 years have seen a 35 percent increase in breast reconstruction, with over 106,000 procedures performed in 2015 alone.¹ Whether alloplastic or autologous, comprehensive breast reconstruction frequently requires multiple surgical procedures beyond formation of the breast mound itself, the last of which most often includes nipple-areola complex reconstruction. Although generally fast and technically straightforward, nipple-areola complex reconstruction bears a tremendous psychological significance for patients, who commonly regard its completion as the final leg of the reconstructive journey. Furthermore, nipple-areola complex reconstruction has been associated with higher levels of general and aesthetic satisfaction compared with breast reconstruction alone.^{2,3}

Interest in nipple-areola complex reconstruction is longstanding, dating back to the mid 1940s, when two reports appeared in short succession describing free nipple-areola and labial skin grafting.^{4,5} The seven decades that have elapsed since these original descriptions have seen the development of numerous nipple-areola complex reconstructive techniques. These include local flaps,^{6–13}

distant grafts,^{14–17} injectable fillers,^{18,19} engineered tissue substitutes,^{20–24} or combinations thereof.^{25–30} Despite these efforts, a single technique with durable long-term results, ideally suited to all reconstructive scenarios, has yet to be developed. Given the persistence and perfectionism that so often characterize the plastic surgeon, pursuit of this ideal will undoubtedly be ongoing.

GENERAL CONSIDERATIONS

The ideal nipple-areola complex reconstruction is technically simple; quick to perform; mimics a native papule in size, position, projection, color, and texture; and maintains these features without the need for frequent, future revisions. In cases of unilateral reconstruction, the native nipple-areola complex may serve as a template that defines the aforementioned features. In cases of bilateral reconstructions, the surgeon must rely on judgment, often drawing from “standardized” morphologic values. In their study of 600 breasts,

Disclosure: The authors have no financial interest to declare in relation to the content of this article.

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Received for publication April 30, 2017; accepted October 23, 2017.

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DOI: 10.1097/PRS.0000000000004166

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Sanuki and colleagues measured average nipple and areola diameters to be 1.3 and 4 cm, respectively, whereas average projection measured 0.9 cm.³¹

Timing of nipple-areola complex reconstruction must be carefully considered. Nipple-areola complex reconstruction may be safely performed concurrently with small revisions (limited fat grafting, liposuction, axillary contouring, or scar revisions) that do not alter the stable configuration of the underlying breast reconstruction. Every effort, however, should be made to stage nipple-areola complex reconstruction by at least 2 to 3 months after larger revisions that require alteration of the size or position of the breast mound.³² It is the senior author's (A.J.G.) preference to perform nipple-areola complex reconstruction as a dedicated clinic procedure, 3 to 4 months after completion of all operative revisions, thus maximizing breast mound stability.

Finally, local soft-tissue resources and existing scar orientations are of paramount importance. Distant composite grafts rely only on the presence of a subdermal plexus for survival and provide their own soft-tissue bulk, and thus may be used regardless of local tissue resources or scar orientation. Local flaps, however, depending on their design, draw their blood supply centrally from deeper subcutaneous tissues, or peripherally from a subdermal pedicle.³³ Generally speaking, flaps deriving their blood supply from deeper subcutaneous tissues should be used with caution when subcutaneous tissue is lacking, as may be seen in the expanded and attenuated tissues overlying an alloplastic reconstruction. Flaps deriving their blood supply from dermal pedicles, however,

do not rely on central, subcutaneous tissues for survival, and may be oriented in any direction to maximize subdermal perfusion. In comparison with alloplastic reconstructions, autologous reconstructions, particularly those with large skin paddles, provide abundant, central soft-tissue bulk with distant, peripheral scarring. Thus, a wider array of nipple-areola complex reconstructive methods is generally permitted. Loss of reconstructed nipple-areola complex projection is the norm, and patterns should be designed at least 25 to 50 percent larger than the desired final papule dimensions without distorting the breast skin envelope.^{34,35}

PREOPERATIVE MARKINGS

Given the anatomical variation in breast shape from patient to patient, and the inherent asymmetries seen within each patient, no single objective measurement or anatomical relationship is sufficient to define nipple-areola complex positioning across all breast morphologies. This is particularly true of reconstructed breasts, whether alloplastic or autologous, where there is frequently effacement of the upper/lower pole breast junction, and accompanying loss of projection (Fig. 1).

In determining nipple-areola complex position on the reconstructed breast, every attempt should be made to place the nipple-areola complex along the breast meridian at its most projecting point, recognizing that in cases of unilateral reconstruction, matching contralateral nipple position may compromise either of these parameters. Whether unilateral or bilateral, however, "proper" nipple-areola complex positioning

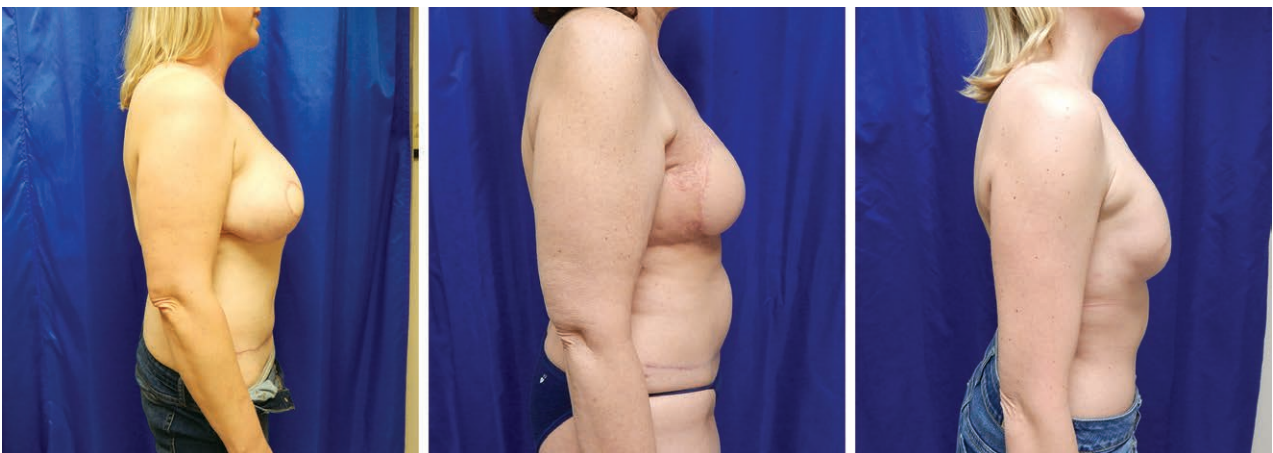


Fig. 1. Profile of immediate autologous breast reconstruction (*left*), delayed autologous breast reconstruction (*center*), and alloplastic breast reconstruction (*right*). Note the effacement of the upper/lower pole junction, and the ill-defined point of maximal projection.



Video 1. Supplemental Digital Content 1, which displays preoperative markings for a bilateral nipple-areola complex reconstruction, is available in the “Related Videos” section of the full-text article on PRSJJournal.com or at <http://links.lww.com/PRS/C653>.

is highly subjective and therefore necessitates patient input. Surgeon and patient perceptions of ideal nipple-areola complex position frequently differ, and even slight adjustments to position may result in increased patient satisfaction. To permit visualization of the ultimate papule position, the authors use self-stick electrocardiograph tabs with central, circular lead attachments. Once the patient confirms the nipple-areola complex position, the papule is then marked on the breast mound and the desired flap is designed around that point. (See **Video, Supplemental Digital Content 1**, which displays preoperative markings for a bilateral nipple-areola complex reconstruction. This video is available in the “Related Videos” section of the full-text article on PRSJJournal.com or at <http://links.lww.com/PRS/C653>.)

FLAP SELECTION

As mentioned previously, no one nipple-areola complex reconstructive method is ideally suited to all scenarios. Conversely, no given breast mound, regardless of the reconstructive technique used, can support only one particular nipple-areola complex flap design. As such, the surgeon must have a handful of reconstructive techniques from which to draw. An understanding of the various nipple-areola complex reconstructive techniques, along with their indications and associated risks, will serve to avoid complications and maximize aesthetic results.

All nipple-areola complex reconstructions are accomplished with use of either local flaps, local flaps with augmentation grafts, or composite

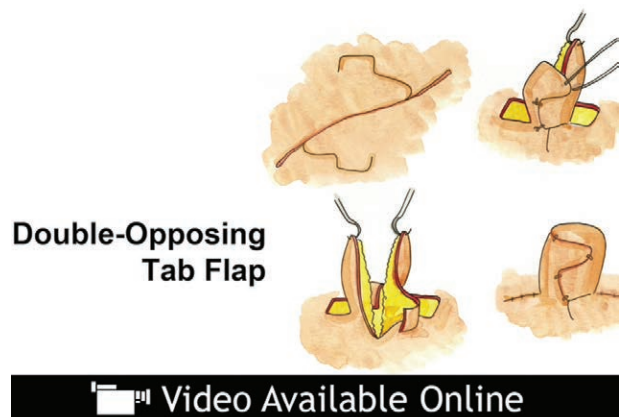
tissue grafts. Although a complete description of all reconstructive techniques is beyond the scope of this CME article, readers are directed to the impressively comprehensive reviews of Sisti et al. and Winocour et al. for further descriptions of local flaps and augmentation grafts, respectively.^{36,37}

LOCAL FLAPS

A recent review identified 30 unique local flaps for nipple/nipple-areola complex reconstruction.³⁶ Despite the abundance of designs, all local flaps share common characteristics (i.e., they are random-pattern composites of epidermis, dermis, and subcutaneous tissue, which derive their blood supply from a subdermal pedicle or pedicles or, in rarer instances, from central subcutaneous tissue).³³ Despite the plethora of designs, a few select local flaps have emerged as the most popular. Numerous modifications to these core design patterns have been proposed over the years, most of which augment soft-tissue volume in an attempt to limit loss of projection.^{28,38–43} (See **Video, Supplemental Digital Content 2**, which displays common local flaps for nipple-areola complex reconstruction. This video is available in the “Related Videos” section of the full-text article on PRSJJournal.com or at <http://links.lww.com/PRS/C654>.)

LOCAL FLAPS WITH AUGMENTATION GRAFTS

Simply stated, all nipple-areola complex reconstructions lose projection. The extensive number of nipple-areola complex flap designs



Video 2. Supplemental Digital Content 2, which displays common local flaps for nipple-areola complex reconstruction, is available in the “Related Videos” section of the full-text article on PRSJJournal.com or at <http://links.lww.com/PRS/C654>.

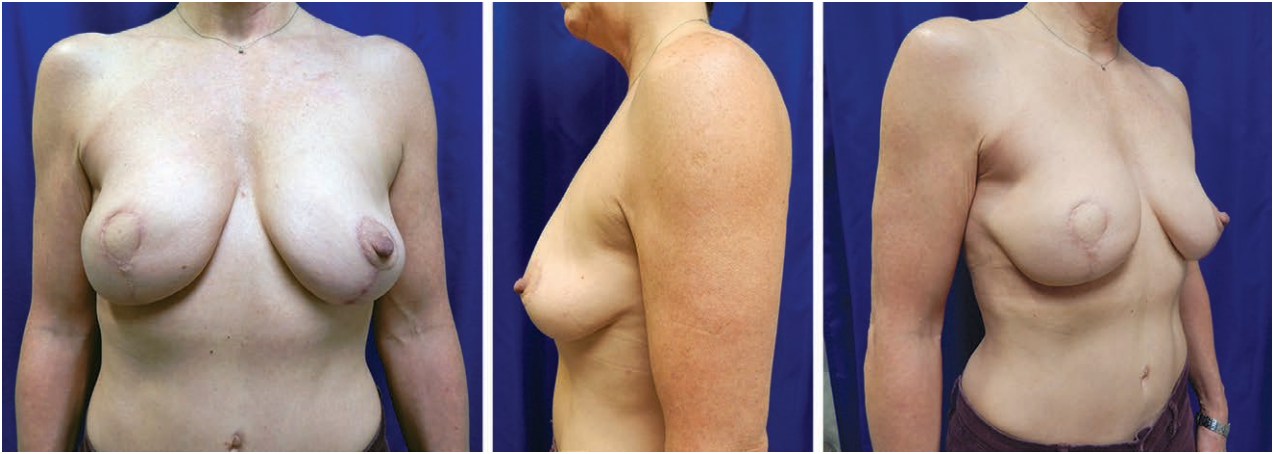


Fig. 2. An example of an excellent nipple-sharing candidate. Note the wide and projecting native papule that could easily accommodate a 50 percent loss in volume.

and modifications, in combination with the heterogeneity of breast mound reconstructive techniques, has made studies comparing long-term nipple-areola complex projection challenging. In their comprehensive review of nipple-areola complex reconstructive techniques, Sisti et al. noted a loss of projection ranging from 45 to 75 percent.³⁶ Other studies have echoed this finding.^{44,45} In an attempt to preserve nipple-areola complex projection, local flaps have been combined with a variety of autografts/allografts with varying success.³⁷ Although allografts may avoid the donor-site morbidity commonly associated with autologous harvest sites, extrusion of allograft material is a frequently cited criticism of these techniques, particularly in irradiated settings.^{36,37} Several reported autograft/allograft sources are described (see **Video, Supplemental Digital Content 2**, <http://links.lww.com/PRS/C654>).

NIPPLE SHARING

Nipple sharing is a unique approach to nipple-areola complex reconstruction, allowing for simultaneous reconstruction of the absent papule and contralateral balancing reduction of the native papule. As pointed out by Zenn and Garofalo, an ideal nipple-areola complex reconstruction mimics the native nipple-areola complex not only in size and position, but also in shape, color, and texture.⁴⁶ In cases of bilateral nipple-areola complex reconstructions, the reconstructive surgeon is afforded the liberty of defining these parameters identically from side to side, thus maximizing symmetry. In cases of unilateral reconstruction, however, all of these characteristics are largely predefined by the native, contralateral nipple-areola complex. It follows logically,

therefore, that no single reconstructive technique can match the characteristics of the native papule better than the native papule itself.

If a nipple-sharing technique is to be successfully used, appropriate patient selection is critical. The ideal candidate for a nipple-sharing reconstruction has a native papule of sufficient height and volume to withstand a 50 percent reduction in these features while still maintaining adequate projection (Fig. 2). The patient must also be willing to accept a scar on the native nipple-areola complex and the possible complications of nipple flattening (both native and reconstructed), paresthesias, poor scarring of the native nipple, compromised breast-feeding potential, partial or complete graft loss, and residual nipple asymmetry requiring additional intervention. (See **Video, Supplemental Digital Content 3**, which displays



Video 3. Supplemental Digital Content 3, which displays the nipple-sharing procedure, is available in the “Related Videos” section of the full-text article on PRSJournals.com or at <http://links.lww.com/PRS/C655>.

the nipple-sharing procedure. This video is available in the “Related Videos” section of the full-text article on PRSJJournal.com or at <http://links.lww.com/PRS/C655>.)

A recent, novel nipple-sharing technique preserves the central ductal architecture of the papule by removing a C-shaped rim of skin and superficial muscle from the base of the papule.⁴⁷ This composite tissue is then inset in a spiral configuration, followed by a full-thickness skin graft from the labia majora. Because the central ductal architecture is not violated with this technique, breast-feeding potential is preserved. One hundred percent maintenance of projection at 5-year follow-up was noted, although objective measurements were not provided.

THE THOMAS FLAP REVISITED

In 1996, Thomas published his variation on the C-V flap, making the two segments flanking the central C-shaped cap rectangles rather than triangles.⁴⁸ This design results in the formation of more robust flaps that add soft-tissue bulk to the interior of the cylindrical papule. Classically, this flap is designed as illustrated in Figure 3, *above*, where the desired papule position is centered in the flap between the two rectangular segments. When using this design, it has been our observation, however, that the reconstructed papule will

consistently end up displaced from its desired position. This stems from the fact that when the donor site is closed, the resulting linear incision rests halfway between the two incised skin edges. The base of the papule, however, hinged about its pedicle, will come to rest distal to the resulting donor-site scar, rather than centered on it (Fig. 3, *above*). Assuming a papule of 12-mm width is designed, this will displace the papule by approximately 6 mm, or half its diameter, from the anticipated, desired position. Particularly in those cases of unilateral reconstruction, a papule displacement of even 6 mm from the desired location can result in a noticeable and distressing asymmetry. We therefore find it preferable to work backward in a series of logical steps that ensure that the papule’s final position is where it was determined to be preoperatively. The following steps, illustrated in Figure 4 and Video 4, assume a papule base width and height of 12 mm. (See Video, Supplemental Digital Content 4, which displays preoperative design of a C-H flap. This video is available in the “Related Videos” section of the full-text article on PRSJJournal.com or at <http://links.lww.com/PRS/C656>.)

1. A 12-mm circle is drawn, centered on the desired papule position (Fig. 4, *above*, *left*).

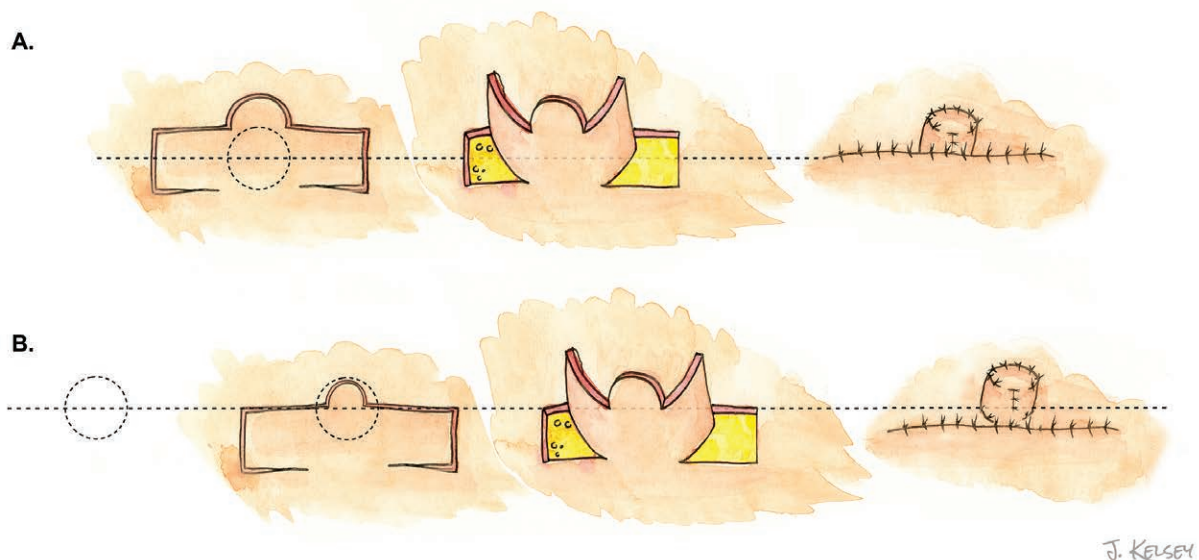


Fig. 3. The traditional Thomas modified C-V flap design (*above*). The *dotted circle* represents the desired papule position. When elevated, however, the papule lies distal to the donor-site incision that is centered on the *dotted line*. Simple displacement of the flap design as shown will result in proper papule positioning (*below*).

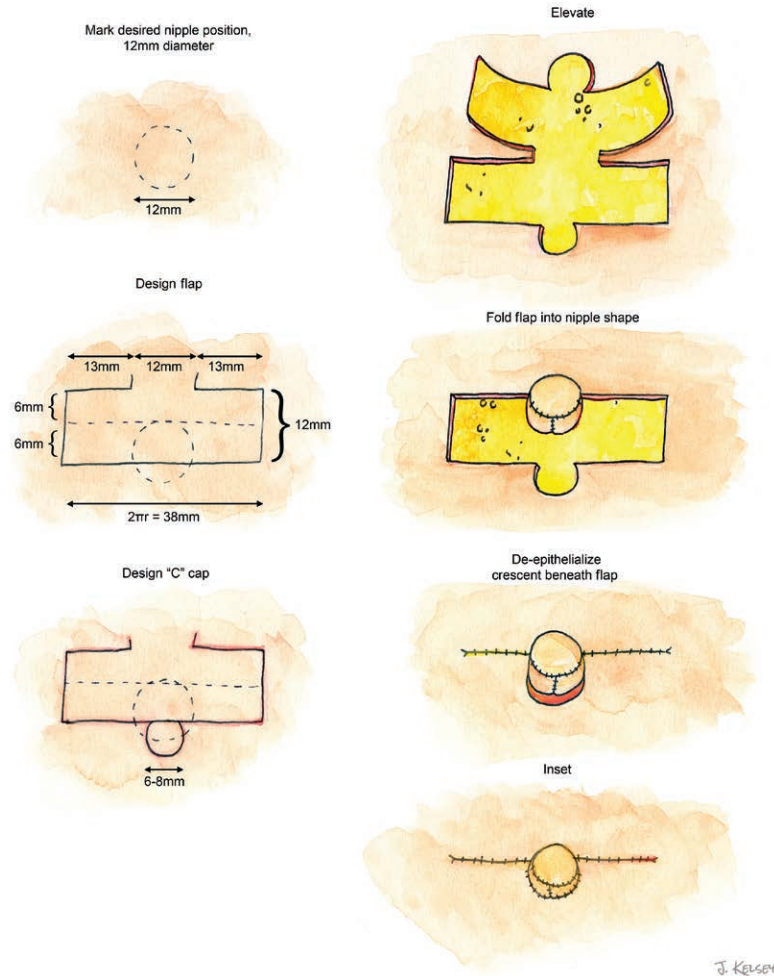


Fig. 4. Detailed steps to ensure the ultimate desired papule location.

2. Once the desired orientation of the flap is determined, a dotted line just tangential to the circle is drawn (Fig. 4, *second row, left*).
3. The flap is then designed with the rectangular segments centered about this dotted line with a pedicle width equal to the papule base width. Assuming a 38-mm areolar diameter is desired, simple math determines that each rectangular wing should measure 13 mm (Fig. 4, *second row, left*).
4. Finally, the “cap” of the flap is designed to be several millimeters narrower than the pedicle width of the flap. This not only results in a more natural, conical papule reconstruction, but also allows for deepithelialization of a skin crescent beyond the cap marking, which provides a supporting dermal platform⁴⁹ (Fig. 4, *center, right, and below*).



Video 4. Supplemental Digital Content 4, which displays preoperative design of a C-H flap, is available in the “Related Videos” section of the full-text article on PRSJournal.com or at <http://links.lww.com/PRS/C656>.

DOUBLE-OPPOSING PERIAREOLAR FLAP

In 2007, Shestak and Nguyen published a novel technique for nipple-areola complex reconstruction that they dubbed the “double-opposing periareolar flap.”⁵⁰ This technique uses a Thomas C-H flap encircled by a full-thickness incision through the breast mound skin island that defines the areolar diameter. Once the Thomas flap is elevated and closed, the two hemiareolar island flaps are advanced and sutured together, closing the C-H donor site (Fig. 5). As pointed out by the authors, this technique recreates the nipple-areola complex as a single aesthetic subunit, with all scars confined within the boundaries of the areolar diameter. The double-opposing periareolar flap was later modified by Hammond et al.^{51,52} to incorporate a permanent Gore-Tex (W. L. Gore and Associates, Flagstaff, Ariz.) periareolar suture. This modification permits greater control over areolar shaping and prevents widening of the areolar diameter over time.

The double-opposing periareolar flap is ideally suited to autologous reconstructions with

circular or ovoid skin islands, as are most frequently seen in the immediate reconstructive setting. In this setting, an incision already exists at the boundary of the ovoid or circular skin island that can then naturally be incorporated into the double-opposing periareolar design. Use of this flap design on large, delayed autologous skin islands, although possible, mandates an unnecessary circular scar at the areolar border that would otherwise be defined by a tattoo alone. A double-opposing periareolar nipple-areola complex reconstruction design, with and without a Gore-Tex purse-string suture, is demonstrated in Videos 5 and 6. (See Video, Supplemental Digital Content 5, which displays double-opposing periareolar nipple-areola complex reconstruction without use of a Gore-Tex purse-string suture. This video is available in the “Related Videos” section of the full-text article on PRSJJournal.com or at <http://links.lww.com/PRS/C657>. See Video, Supplemental Digital Content 6, which displays double-opposing periareolar nipple-areola complex reconstruction with use of a Gore-Tex purse-string suture. This video is available in the

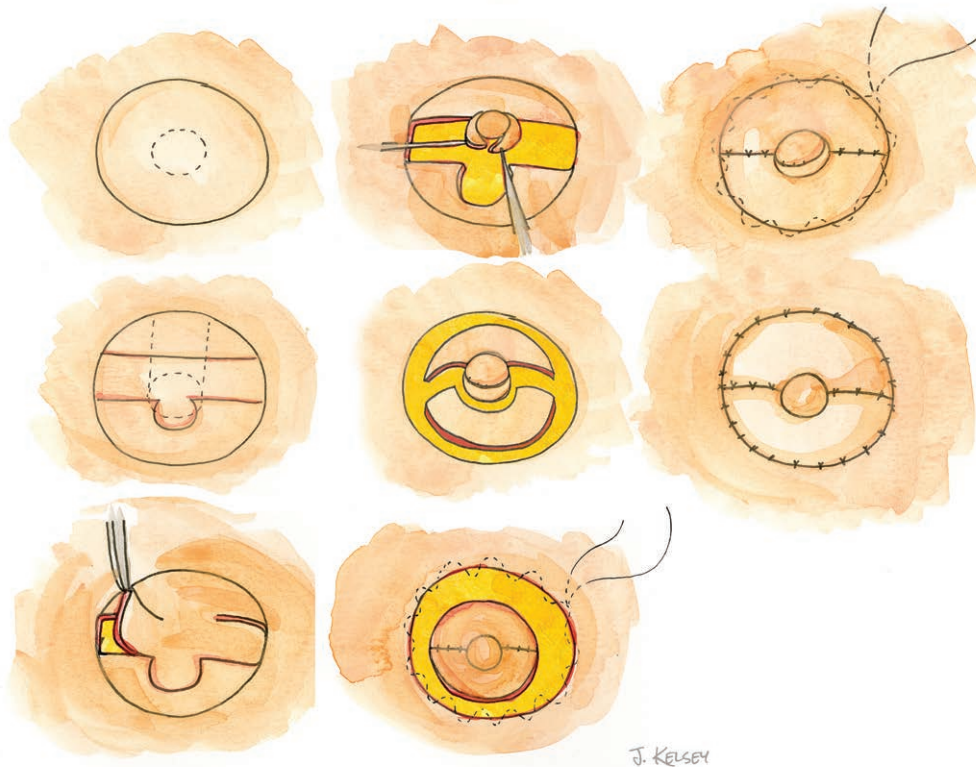


Fig. 5. The double-opposing periareolar nipple-areola complex reconstruction. (Adapted with permission from Shestak KC, Nguyen TD. The double opposing periareola flap: A novel concept for nipple-areola reconstruction. *Plast Reconstr Surg.* 2007;119:473–480.)



Video 5. Supplemental Digital Content 5, which displays double-opposing periareolar nipple-areola complex reconstruction without use of a Gore-Tex purse-string suture, is available in the “Related Videos” section of the full-text article on PRSJJournal.com or at <http://links.lww.com/PRS/C657>.



Video 6. Supplemental Digital Content 6, which displays double-opposing periareolar nipple-areola complex reconstruction with use of a Gore-Tex purse-string suture, is available in the “Related Videos” section of the full-text article on PRSJJournal.com or at <http://links.lww.com/PRS/C658>.

“Related Videos” section of the full-text article on PRSJJournal.com or at <http://links.lww.com/PRS/C658>.) Although use of the double-opposing periareolar flap design overlying alloplastic reconstructions has been described,⁵³ it is the authors’ opinion that the additional periareolar incision carries an increased risk of implant infection/exposure, and thus should be avoided in this setting.

SECONDARY NIPPLE-AREOLA COMPLEX RECONSTRUCTION

As previously noted, whether using local flaps, distant grafts, or a combination of the two,

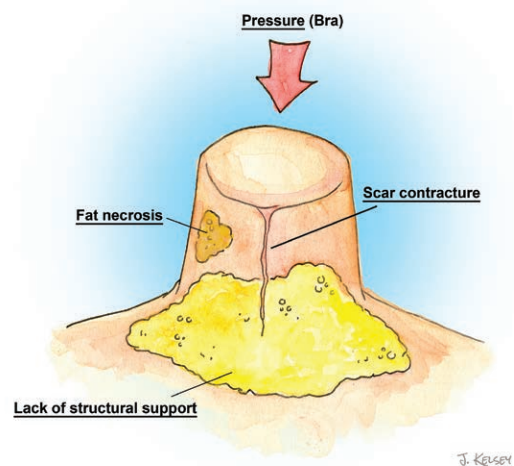


Fig. 6. Forces responsible for loss of nipple projection over time.

all nipple-areola complex reconstructions suffer gradual loss of projection over time. The reasons for this are likely multifactorial and include a lack of structural soft-tissue support within or at the base of the flap, fat necrosis, scar contraction, delayed wound healing or infection, inelastic irradiated skin, and external pressures^{29,54,55} (Fig. 6).

The influence of the breast reconstructive technique (alloplastic versus autologous) on long-term nipple-areola complex projection is unclear, as studies are conflicting and limited in number, with inconsistent nipple-areola complex flap designs and breast reconstructive techniques.^{39,44,56} In one series demonstrating greater long-term nipple-areola complex projection when performed overlying an implant, the authors hypothesized that the nipple-areola complex flap is bolstered by the underlying implant shell, a firmer and less distensible foundation when compared to the subcutaneous fat constituting an autologous tissue foundation.⁵⁷ Greater subcutaneous tissue volume/quality combined with the absence of strong contractile forces seen within an expanded breast envelope are cited as possible explanations in series demonstrating opposite results.^{39,58}

Nipple-areola complex flattening is a frustrating phenomenon for both surgeon and patient alike, noted in one study to be the primary source of nipple-areola complex dissatisfaction in over 50 percent of women queried.⁵⁹ Given the propensity of all nipple-areola complex reconstructions to flatten over time, patients questioning their options for added projection should be



Video 7. Supplemental Digital Content 7, which displays secondary nipple-areola complex reconstruction with acellular dermal matrix, is available in the "Related Videos" section of the full-text article on PRSJournals.com or at <http://links.lww.com/PRS/C659>.

anticipated. The reconstructive surgeon must therefore have an understanding of the options

available for augmenting the flattened nipple-areola complex. To date, little has been written about secondary nipple reconstruction; however, the limited descriptions that do exist offer elegantly simple solutions with encouraging results.^{22,60,61}

An early case report by Vecchione⁶¹ succeeded in restoring "satisfactory" projection to a modified skate flap designed over an underlying implant. This was accomplished by undermining the flattened nipple core and placing a full-thickness, retroauricular skin graft around the stalk of the reconstructed nipple-areola complex. A later report by Kim and Ahn attempted to restore projection to flattened C-H flaps constructed over transverse rectus abdominis musculocutaneous flaps, by undermining the subcutaneous tissue beneath the reconstructed papule and augmenting this space with four buried dermal flaps.⁶⁰

In 2004, Nahabedian published his series of secondary nipple reconstructions performed

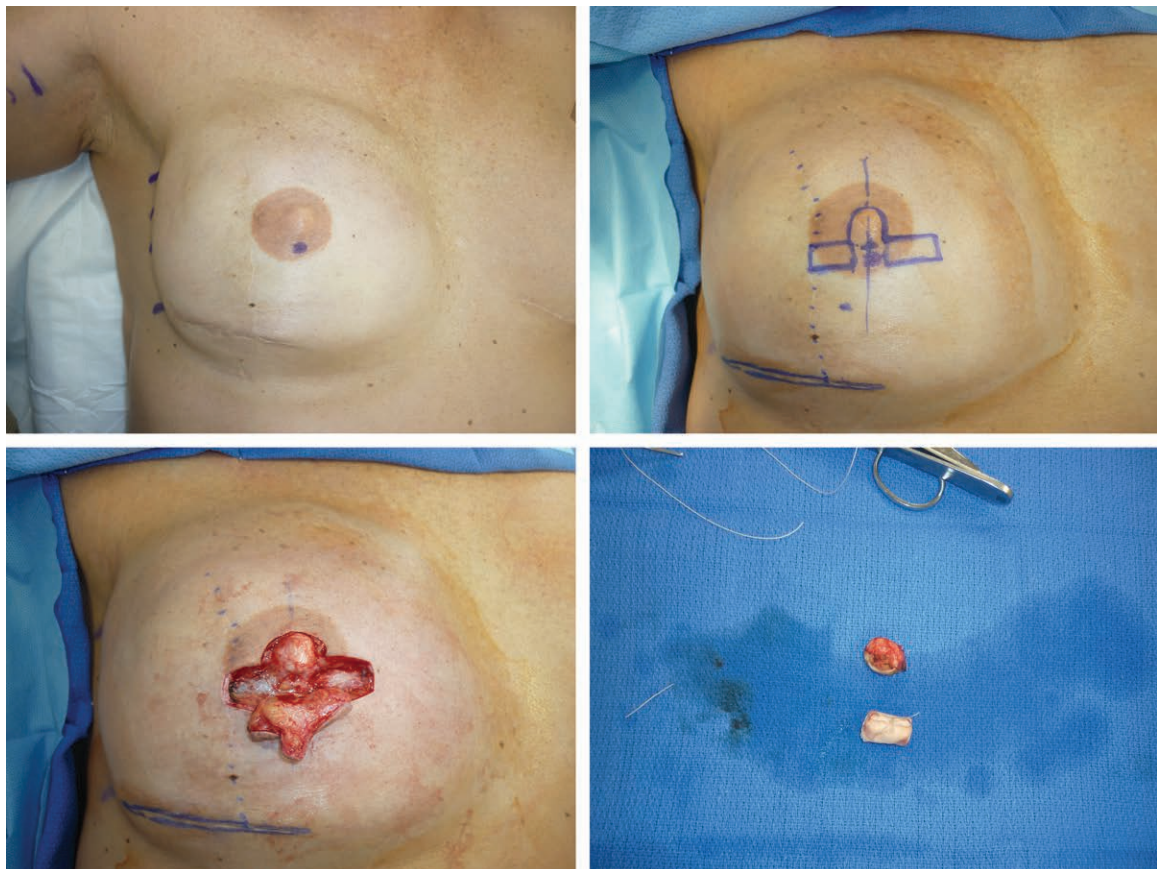


Fig. 7. A poorly projecting nipple-areola complex reconstructed with an extracellular matrix cylinder buried in a subcutaneous pocket (*above, left*). New modified C-V flap is designed around the original nipple-areola complex (*above, right*). The flap is raised and the extracellular matrix cylinder is exposed (*below, left*). Extracted extracellular matrix cylinder (*top*) juxtaposed with rolled acellular dermal matrix (*bottom*) (*below, right*).

with a combination of local flaps and a biological tissue substitute.²² In this description, secondary nipple reconstruction was accomplished using a rolled acellular dermal plug buried within the core of C-V flaps. This resulted in an additional 2 to 4 mm of projection at 6 to 12 months postoperatively. A modification to this technique is demonstrated. (See Video, Supplemental Digital Content 7, which displays secondary nipple-areola complex reconstruction with acellular dermal matrix. This video is available in the “Related Videos” section of the full-text article on PRSJournal.com or at <http://links.lww.com/PRS/C659>.)

An interesting case using a rolled acellular dermal plug is illustrated in Figures 7 and 8. A 42-year-old woman underwent alloplastic reconstruction and nipple-areola complex reconstruction with a prefabricated, extracellular matrix cylinder buried in a subcutaneous pocket.⁶² She subsequently experienced flattening of the reconstruction (Fig. 7, *above, left*) and sought revision for added projection. An inferiorly based, modified C-V flap was designed around the existing papule (Fig. 7, *above, right*) and raised, exposing the underlying extracellular matrix cylinder (Fig. 7, *below, left*). The extracellular matrix was removed and replaced with a rolled acellular dermal matrix plug (Fig. 7, *below, right*, and Fig. 8, *above and center*). One-month postoperative results demonstrate significantly improved projection (Fig. 8, *below*).

In the aforementioned series by Nahabedian, a limited number of flattened nipple-areola complexes were reconstructed secondarily with local flaps alone, without the use of a biological tissue substitute. This was accomplished by designing new C-V flaps, pedicled in the same direction as the original flaps, with the flattened papule centered on the new C-shaped cap of the C-V design (Fig. 9). Although poor results using this technique were noted, early results at our institution using the same technique have been promising (Fig. 10).

Evans et al. describe a novel technique for volume augmentation in poorly projecting nipple reconstructions.¹⁸ In their preliminary study of six patients, hydroxylapatite (Radiesse; BioForm, Inc., Franksville, Wis.) was injected into the subdermal component of flattened nipple reconstructions. Although no objective data were reported, 67 percent of patients reported a “major” improvement in appearance. Given the limited lifetime of this synthetic material, long-term data are required to evaluate the efficacy of this technique.



Fig. 8. Secondary nipple-areola complex reconstruction with rolled acellular dermal matrix plug. The rolled plug is inserted into the subcutaneous pocket (*above*). A modified C-V flap is closed around the rolled plug (*center*). One-month postoperative result demonstrating improved projection (*below*).

AREOLAR RECONSTRUCTION AND NIPPLE-AREOLA COMPLEX TATTOOING

As noted by Shestak and Nguyen,⁵⁰ the nipple-areola complex should be regarded as one aesthetic unit. Like the papule, the reconstructed areola should mirror the native areola not only in diameter and location, but also in color and texture. Classically, areolar reconstruction is

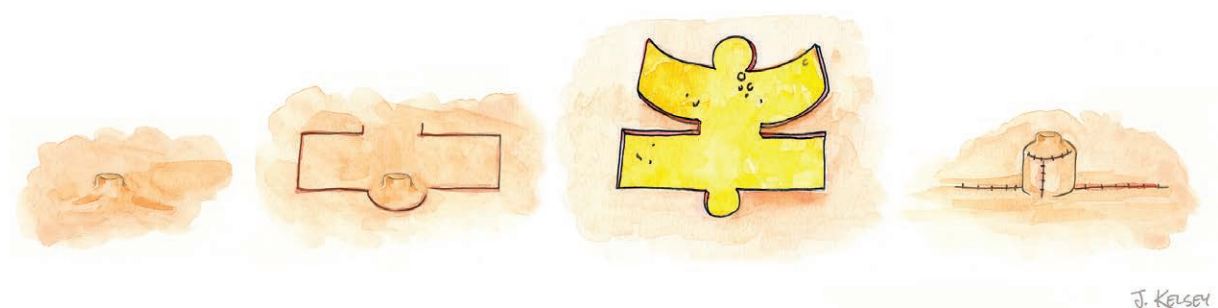


Fig. 9. Repeated modified C-V flap for nipple-areola complex flattening. Note that the original, flattened papule serves as the C-shaped cap of the new modified C-V design.



Fig. 10. A patient with secondary left nipple-areola complex reconstruction. Note the flattening of the original modified C-V nipple-areola complex flap (*above*). A repeated C-V flap was designed with the original papule serving as the new C-shaped cap. The same patient 3 months after this secondary reconstruction (*below*).

accomplished with multicolored tattooed pigment, with or without prior skin grafting for texture. A three-dimensional nipple-areola complex tattoo may be used in those patients who wish to avoid a projecting papule or who do not have sufficient tissue to adequately reconstruct a projecting

papule, and still maintain a visual depiction of the nipple-areola complex.⁶³ A further discussion of areolar reconstruction and tattooing is demonstrated. (See Video, Supplemental Digital Content 8, which displays areolar reconstruction and nipple-areola complex tattooing. This video



Video 8. Supplemental Digital Content 8, which displays areolar reconstruction and nipple-areola complex tattooing, is available in the “Related Videos” section of the full-text article on PRSJournal.com or at <http://links.lww.com/PRS/C660>.

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ACKNOWLEDGMENTS

The authors would like to acknowledge John Kelsey, Rhode Island School of Design, for all original artwork included in this CME article, and Otway Louie, M.D., Shannon Colohan, M.D., and Peter Neligan, M.D., for their input.

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