Breast Surgery

The Central Pillar Technique: A New Septum-Based Pedicle Design for Reduction Mammaplasty

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Abstract

Background: Successful breast reduction involves remodeling the breast parenchyma and creating a pedicle to maintain blood supply to the nipple-areola complex (NAC). Although vascular compromise is generally venous in breast reduction surgery, clear anatomical descriptions of the breast veins are lacking in textbooks.
Objectives: The author designed an NAC flap based on arterial and venous territories defined in a cadaver study and subsequently assessed the technique in a series of live patients.
Methods: Dynamic venous angiography was performed on hemithorax specimens from 6 fresh female cadavers. A new septum-based pedicle (the "central pillar") was designed, which protected the periareolar vein polygon along with the breast septum. Sixty-seven patients underwent breast reduction with this technique between 2005 and 2010.
Results: The patients were followed for an average of 26.4 months. Sixty-two of the 67 patients underwent bilateral reduction. The average reduction in tissue per breast was 910.7 g (range, 440-1935 g), and the average nipple transposition was 9.6 cm (range, 6-17 cm). The most common complications were delayed healing of the vertical "puckered" suture line (16 patients), seroma (7 patients), hematoma (2 patients), and unilateral deepithelialization of the NAC following transient venous congestion (2 patients). The patient satisfaction rate was high.
Conclusions: The central pillar technique is a promising alternative for young patients with glandular breasts that require gross reduction and high-transposition NAC, who are not good candidates for the "free nipple graft" technique.

Keywords

gigantomastia, reduction mammaplasty, pedicle choice, breast surgery

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Successful breast reduction involves resection and remodeling of the breast parenchyma, including the creation of a pedicle to maintain blood supply to the nipple-areola complex (NAC). The design of the pedicle should be based on thorough knowledge of the blood supply, which deserves the same diligence as flap surgery.[1-19] Reliable NAC flaps are based on anatomically-defined arterial and venous territories. The arterial network of the breast has been described in several detailed anatomic studies.[20-28] The description of the breast septum, which includes the arteries and nerves of the NAC, is the most important contribution to the breast anatomy.[28] This anatomical element has allowed for the design of reliable arterial pedicles.[29-32] However, the vascular compromise that can result from breast reduction surgery is generally venous in nature.[33] Despite the obvious clinical importance of the veins of the breast, clear anatomical descriptions of these veins are lacking in textbooks.

Although the venous network of the breast was described by Astley Cooper in detail in 1840,[34] the studies

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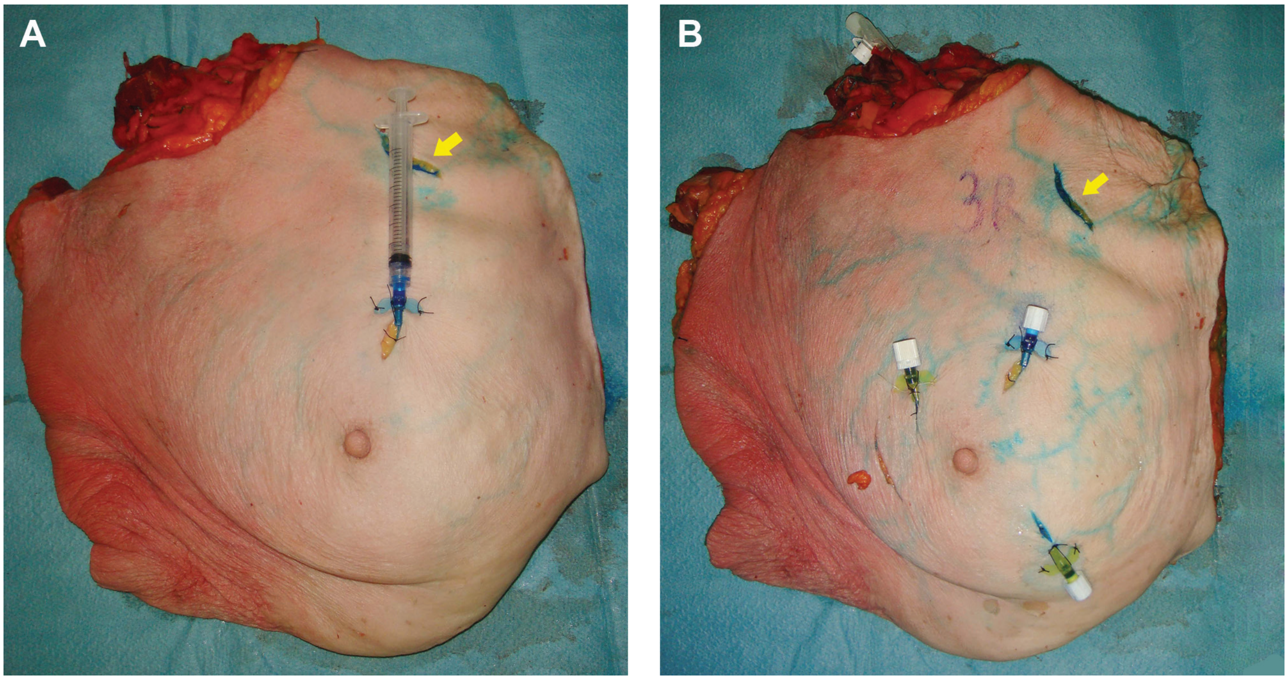

Figure 1. (A) A large superficial subcutaneous vein is located at the infraclavicular area through a small incision (arrow) and injected with methylene blue in retrograde direction. The vein is visible down to the next venous valve. (B) After injection, the veins around the nipple-areola complex become visible and are cannulated through small incisions.

that followed[33,35-37] added very little to his basic descriptions. This is attributable not only to underestimation of the importance of veins (compared with arteries) but also to the difficulty of performing radiographic injections to enable visualization of the venous network.[33,38] Thus, NAC flap pedicles are generally designed by considering their arterial supply along with the relatively empirical venous drainage. In this article, the venous network of the breast is revisited using dynamic venous angiography, which allowed for the design of a new septum-based pedicle (the "central pillar") that preserves the venous network. This technique may be a viable option for patients who are not good candidates for a free nipple graft procedure.

METHODS

Angiography of the Breast Vein

Hemithorax specimens from 6 fresh female cadavers were prepared for venous angiography. Because it can be difficult to locate and cannulate the small-caliber periareolar veins, a large, superficial, subcutaneous vein located at the infraclavicular area was cannulated initially and methylene blue was injected in a retrograde direction. With the dye in the lumen, the large subcutaneous vein became visible down to the next venous valve (Figure 1A). After 2 or more injections in retrograde fashion, the veins around the NAC became visible. Through 2 or 3 small incisions, these veins were exposed and cannulated (Figure 1B).

Dynamic venous angiography was performed with injection of radio-opaque material (Urografin 370; Schering AG Ltd, Berlin, Germany), and results were recorded. Following this, the radio-opaque material was injected into the subclavian artery to visualize the relationship between the arterial and venous networks. A superficial vein polygon, with the nipple at its center, was visualized in all angiographic examinations (Figure 2). Taylor et al[38] reported that the nipple was situated in a plexus of oscillating veins, which spread away from the nipple. The hexagon-shaped periareolar polygon has valves at its angles and at its junctions with the valveless oscillating veins. These valves prevent the flow of radio-opaque material back to the oscillating nipple veins. Thus, the oscillating veins of the nipple could not be visualized from our intrapolygonal injections. Different segments of the hexagonal polygon filled independently during the injections, and 5 or 6 large superficial veins that radiated from the angles of the polygon were filled directly with radio-opaque material from these segments. The entire polygon could be visualized only by injections through multiple cannulas in different directions.

The periareolar vein polygon appears to be a critical structure for interconnecting the superficial and deep venous systems. Although the superficial veins have larger channels, the number of deep connections of the polygon is more than its connections to the superficial system. The deep veins accompany the deep arterial system. Both systems merge by numerous channels and drain to the lateral thoracic, intercostal, or internal mammary veins.[38,39] Lateral veins drain to the axillary-subclavian route through the lateral thoracic system. The veins of the medial quadrant of the breast drain to the internal mammary vein and intercostal perforators. The second,

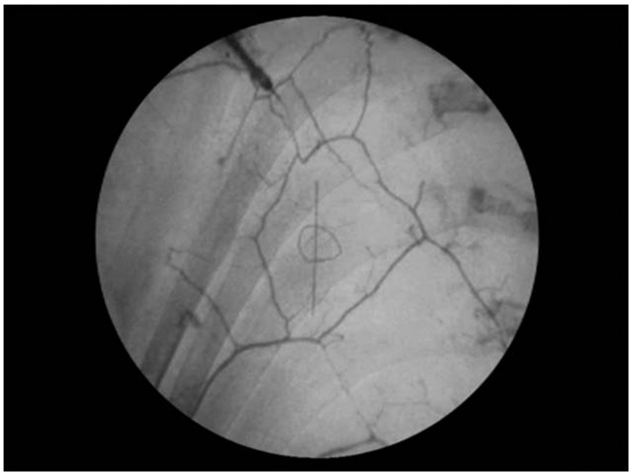

Figure 2. A periareolar vein polygon, with the nipple at its center (marked with a metal circle and a pin).

third, and fourth perforators of the internal mammary vein are larger than the other deep channels. The highest medial channels have a longer course to the level of the clavicle (initially cannulated vein in the study), possibly draining to the first intercostal space. The veins of the inferior quadrant drain to the intercostal veins near the inframammary fold.[39] Either system seems sufficient for venous drainage of the NAC, provided the periareolar polygon—with all of its segmental drainage connections—is kept intact (Figure 3).

A video of the angiography technique is available at www.aestheticsurgeryjournal.com. You may also use any smartphone to scan the code on the first page of this article to be taken directly to the video on www.YouTube.com.

The Central Pillar Technique

A new septum-based pedicle was designed in accordance with the anatomical findings from the cadaver study. The new pedicle design is similar to Elisabeth Würinger's original technique and subsequent septum-based techniques,[29-32] but the major difference in planning was to ensure the protection of the periareolar vein polygon along with its deep connections to the arterial and vein plexi of the breast septum. The superficial polygon usually can be seen in thin-skinned individuals and can be included in the pedicle marking. If the polygon cannot be visualized over the skin, the pedicle may be planned in a circular fashion of 10 to 12 cm in diameter. This empirical pedicle planning is essentially an extended Schwarzmann maneuver that protects the underlying venous plexus during the deepithelialization process and may be modified according to the location of the periareolar vein polygon. The preoperative markings are similar to those of medial or lateral septum-based pedicles, with the main difference being the planning of deepithelialization of the central pedicle (Figure 4).

Clinical Experience

The only major inclusion/exclusion criteria for this procedure was the size of the breast. Sixty-seven patients underwent breast reduction with the central pillar technique between June 2005 and December 2010. Initially, patients with gigantic glandular breasts who needed reduction more than 1000 g per breast and who were not good candidates for the free nipple graft technique because of their young age were selected for this alternative technique. After the initial clinical experience with 9 patients, the

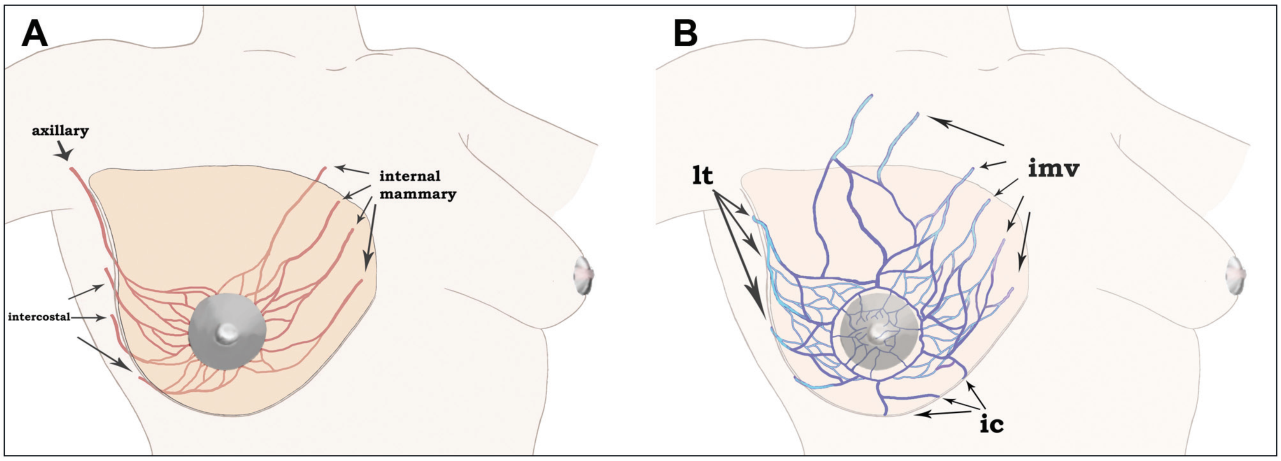

Figure 3. Schematic representation of the (A) breast arteries and (B) breast veins. The superficial (dark blue) and deep (light blue) venous systems of the breast are noted. Lateral veins drain to the axillary-subclavian route through the lateral thoracic system. The veins of the medial quadrant of the breast drain to the internal mammary vein and intercostal perforators. The second, third, and fourth perforators of the internal mammary vein are larger than the other deep channels. The highest medial channels have a longer course to the level of the clavicle, possibly draining to the first intercostal space. The veins of the inferior quadrant drain to the intercostal veins near the inframammary fold. lt, lateral thoracic system; imv, internal mammary vein perforators; ic, intercostal vein.

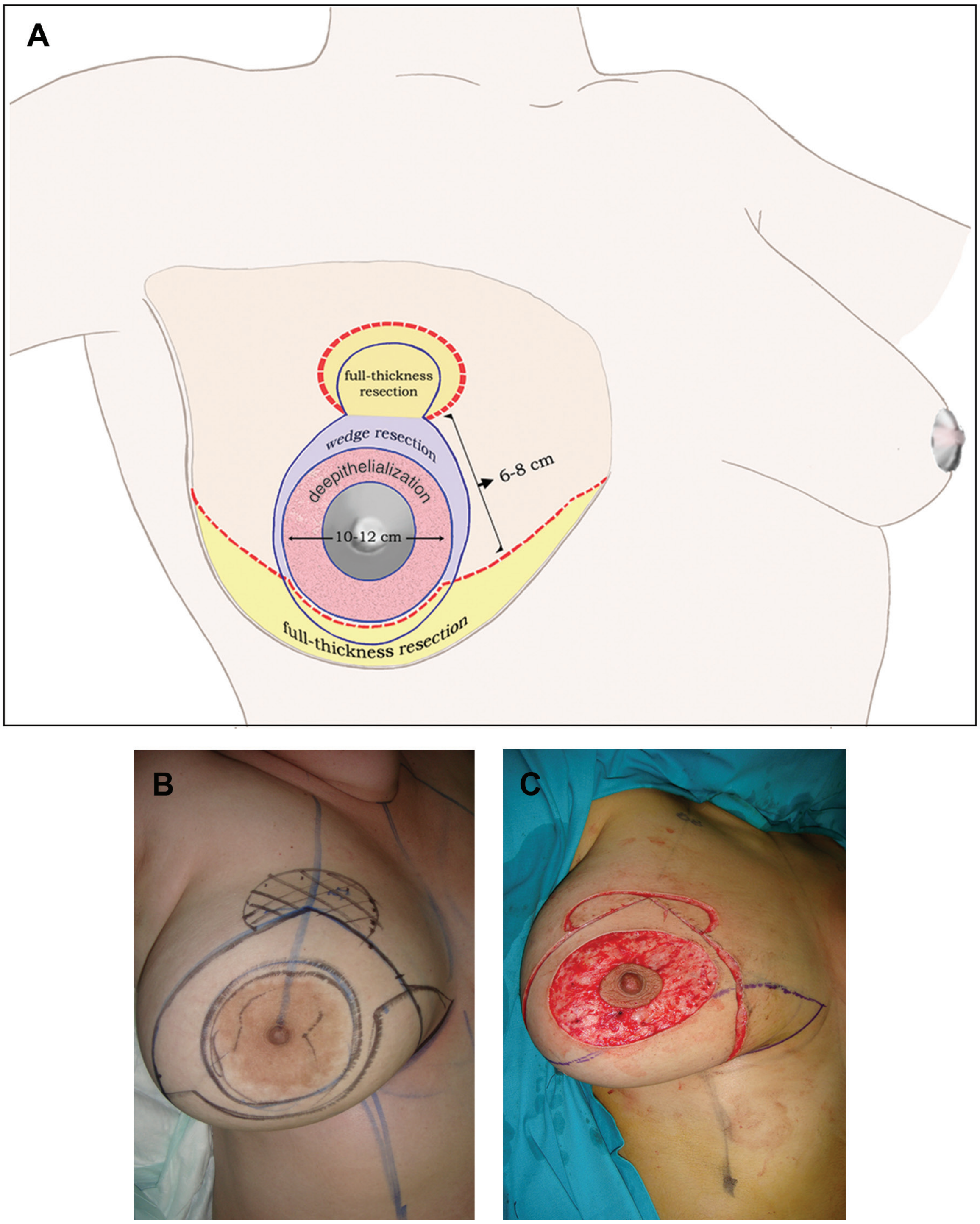

Figure 4. (A) The preoperative markings are similar to those of the medial or lateral septum-based pedicles[31] (blue line). The main difference is the planning of deepithelialized periareolar skin. The diameter of the pedicle is generally 10 to 12 cm. The lengths of the medial and lateral pillars are planned to be 6 to 8 cm each. The excess tissue to be resected at the inferior pole and at the new areola site is also marked on the skin (red dashed line). The light blue area depicts the superficial wedge resection to create a mobile central tissue block. (B) Preoperative markings of a patient. (C) The same patient after deepithelialization of the pedicle.

indication spectrum was expanded to include patients who desired reductions of more than 500 g per breast and/or NAC transposition of more than 8 cm.

Skin markings. Preoperative markings were made while the patient was in a standing position. Initially, skin markings were made for the inframammary fold (IMF), the breast meridian, and the anterior axillary line. The position of the new nipple-areola was determined by placing the index finger, slightly lower than the inframammary fold and was marked on the breast. The vertical lines on both sides of the breast meridian were marked down from the new nipple site by rotating the breast medially and laterally upwards; these were joined several centimeters above the preexisting inframammary fold, as described previously.[40,41] Finally, the periareolar circular pedicle and the excess tissue to be resected at the inferior pole were marked (Figure 4).

Surgical procedure. The nipple was circumscribed with a 42-mm areola marker without tension, and the skin over the pedicle was deepithelialized (Figure 5). The remaining incisions were made down to the level of the deep dermis and then were deepened with electrocautery. The inferior part of the breast was undermined at the mastectomy plane by separating the small subcutaneous fat lobules from the large lobules of breast fat. Approximately 1 to 2 cm of fatty tissue and fascia was kept attached to the IMF for sutures to suspend the IMF in a higher position at the end of the procedure. When the undermining was completed, the lower pole of the breast was fully exposed and resected by peeling the excess gland from the horizontal septum, as described previously.[31]

Next, the upper border of the deepithelialized circle was incised with electrocautery. The superior side of the pedicle was bluntly dissected down to the muscle fascia while respecting the curtain of breast septum in which the vessels were visible. The glandular resection of the upper pole was made safely at the loose plane over the pectoralis fascia, in a cranial direction. The hole created at the new areola site was large enough for the pedicle to fit through without any tightness during closure. The parenchymal wedge resections at the lateral and medial sides of the central pillar were made in continuity with the same specimen of the superior pole. However, the aim of these wedge resections was to create a mobile central pillar that could advance easily to the new areola hole. Thus, the resected wedge tissues were superficial, and at least a 2 to 3 cm of breast tissue was left at their bases to protect the vascular continuity between the central pedicle and the breast septum (Figure 6).

When the tailoring was finished, a very mobile NAC flap was created, which was attached to the pectoral wall with a septum-based pedicle. This flap was easily transferred to the new areola hole, in a cranial fashion, without any risk of torsion. It was not necessary to fix the pedicle directly to the pectoralis fascia because the medial and lateral pillars joining each other at the midline “hugged” the central pedicle and avoided bottoming out. After 3 or 4 absorbable sutures were placed in the deep fatty plane, several deep dermal sutures were placed to adjust the flap in the new areola site. The medial and lateral pillars, which had been joined to each other, also were fixed to the pectoralis fascia with 2-0 absorbable sutures at their inferior border. Then, with several deep dermal sutures, the skin edges were approximated. The skin was closed without any tension. Excessive pressure on the central pedicle during the closure of pillars could impair the circulation and therefore should be avoided.

After hemostasis, the inframammary fold was suspended and fixed to the pectoralis fascia and to the inferior border of the pillars with absorbable sutures. Several deep dermal sutures were placed to join the skin edges. The skin was closed in a vertical pattern, with a short inverted T scar at the deepest point, using monofilament absorbable subcuticular running sutures. Suction drains were placed, which were removed after 24 to 48 hours.

A video of the author’s technique is available at www.aestheticsurgeryjournal.com. You may also use any smartphone to scan the code on the first page of this article to be taken directly to the video on www.YouTube.com.

RESULTS

Clinical Experience

The patient average age was 47.8 years (range, 24-71 years). The follow-up period ranged from 4 to 61 months (average, 26.4 months). Sixty-two of the 67 patients underwent bilateral reduction; the other 5 patients underwent unilateral reduction after having had reconstruction of the opposite breast. The average reduction in tissue per breast was 910.7 g (range, 440-1935 g), and the average nipple transposition was 9.6 cm (range, 6-17 cm).

The patient satisfaction rate was high. All patients whose chief preoperative complaints had been neck pain, back pain, and/or bra-strap indentations reported relief of these symptoms. Satisfactory conical breast shape was restored, and good nipple projection was achieved. The patients who underwent bilateral breast reduction have had significant improvement in their quality of life, and most of them (58 of 62) reported good satisfaction with the cosmetic outcome in their follow-up visit notes.

Sensation was retained in 124 of the 129 breasts, as assessed by light touch and patient response during follow-up visits. In the majority of moderate breast reductions (500-600 g per breast), near-complete nipple sensitivity was present in the immediate postoperative period. Other patients reported moderate to very good sensitivity of the NAC within 6 to 8 months postoperatively. Loss of nipple sensation occurred in only 5 breasts in 4 patients.

Several complications were observed in the early postoperative period of the first 3 weeks. The most common complication was delayed healing of the vertical “puckered” suture line, which occurred in 16 patients. Resuturing was performed after margin refreshing in 9 of these patients. Seroma occurred in 7 patients, 5 of whom underwent percutaneous drainage to address the problem. Hematoma developed in 2 breasts despite the use of vacuum drains, and approximately 75% of the NAC was lost in 1 of these patients. Two patients suffered from unilateral deepithelialization of the NAC following transient venous congestion. These complications resolved spontaneously without any major long term sequelae.

Clinical results are shown in Figures 7 to 10.

Figure 5. (A) The glandular resections from the superior and inferior poles are made in full-thickness fashion over the pectoralis fascia. The wedge resections on both sides of the pedicle tissues should be in partial thickness so that sufficient tissue remains at the base, thus protecting the central pedicle's vascular continuity with the breast septum. (B) The hole created at the new areola site should be large enough to accommodate the pedicle. The tissue at the base of the wedge resections on both sides of the pedicle maintains the central pedicle's vascular continuity with the breast septum. The very mobile central pillar advances directly and easily to the new areola hole (arrow), without any risk of torsion. (C) The medial pillar and lateral pillar join each other at the midline to "hug" the central pedicle and avoid bottoming out. The inframammary fold (IMF) is advanced cranially and fixed to the pectoralis fascia and to the inferior border of the pillars with absorbable sutures. LP, lateral pillar; MP, medial pillar; sp, breast septum on both sides of the central pedicle; CP, central pillar.

Figure 6. The skin is closed through a vertical pattern, with a short inverted T scar at the deepest point.

DISCUSSION

Many breast reduction techniques have been described in the literature. Although none of them is applicable to every clinical situation, there are some common concepts for achieving satisfactory results. Satisfactory volume reduction, which relieves the weight and associated physical burden of the patient, is the primary goal of the operation, along with creating an aesthetically pleasing breast shape and a well-placed and viable NAC. Viability of the NAC is necessary to achieve a functionally-acceptable breast with the potential for breastfeeding and a sensitive NAC. Although the latter aim is abandoned in the free nipple graft technique, which may be appropriate in exceptional circumstances, it is difficult to accept the suboptimal functional and aesthetic outcomes of this technique in young and healthy patients. Thus, the most important technical challenge of breast reduction appears to be maintaining the viability of the NAC as a flap.[1-19,29-32]

Meticulous studies have been performed of the arterial anatomy of the breast, and the modern concepts of breast reduction techniques were developed based on these studies.[20-32] Although the venous network of a flap has the same importance as its arterial counterpart, and venous insufficiency is even more important with regard to vascular compromise of the NAC flap, the veins of the breast have been somewhat neglected in the literature. Other than Cooper's classic text,[34] a detailed literature search revealed only 2 detailed anatomical studies that described the veins of the breast.[38,39] The other reports described only the most superficial vessels with infrared photography[35] or direct vision without any special aid. Thus, venous angiographic study was instrumental in revisiting and examining the anatomical pattern of the venous network.

The angiographic studies yielded some important observations that should be applied to reduction mammaplasty techniques. The venous network of the breast has both deep and superficial systems, and the periareolar vein polygon is the most critical anatomical structure; it has a connection to both systems. The venous polygon receives blood from the nipple and appears to be the principal link between the superficial and deep venous systems, with numerous short connecting veins.[34,36] Cunningham[36] noted that the deep veins provide the chief routes of drainage in the breasts of nonpregnant women, but in pregnancy, there is conspicuous enlargement of the superficial veins. The periareolar vein polygon is separated into segments by valves, and different segments of the polygon fill independently because of these valves. Large superficial veins radiate from the angles of the polygon, and all segments of the polygon are drained by a superficial vein as well as its deep connections. Although the deep venous system is associated with the arteries of the breast septum and deep veins are slightly larger than their companion arteries, the superficial venous system has larger channels.[36] However, either system is sufficient for venous drainage of the NAC when the periareolar polygon is preserved. It is noteworthy that these findings coincide with those described by Cooper.[34]

Most of the current reduction mammaplasty techniques are designed to preserve either venous system partially. In cases of moderate reduction, these designs appear sufficient for venous drainage of the NAC flap. However, when the deep connections of the vein polygon are severed, it is important to protect more than one of the large superficial veins. The problem with the superior pedicle is the difficulty of inset, particularly with larger reductions. The pedicle requires excessive thinning to transpose the NAC to a higher position, which means severing all deep connections and folding the superior pedicle. Thus, the superficial veins that radiate from the cranial border of the periareolar polygon are at risk of kinking.

Septum-based pedicles, which may be medial or lateral, appear to be more effective because they partially protect both the superficial and deep venous systems. Moreover, they are easily applicable techniques that achieve good aesthetic outcomes. This author still uses the septum-based centrolateral glandular pedicle design of Hamdi[30-32] in mild to moderate reductions and the superior pedicle for mastopexies. The choice of technique depends on the size of the breast, age and expectations of the patient, and the quality of the skin and breast parenchyma. However, septum-based designs can result in pedicle torsion in gigantic glandular breasts that require high transposition of the NAC. In addition, the risk of kinking in the superficial veins is greater with septum-based pedicles, as is the risk of strangulation of the deep system from pressure applied to the pedicle during vertical closure. With the

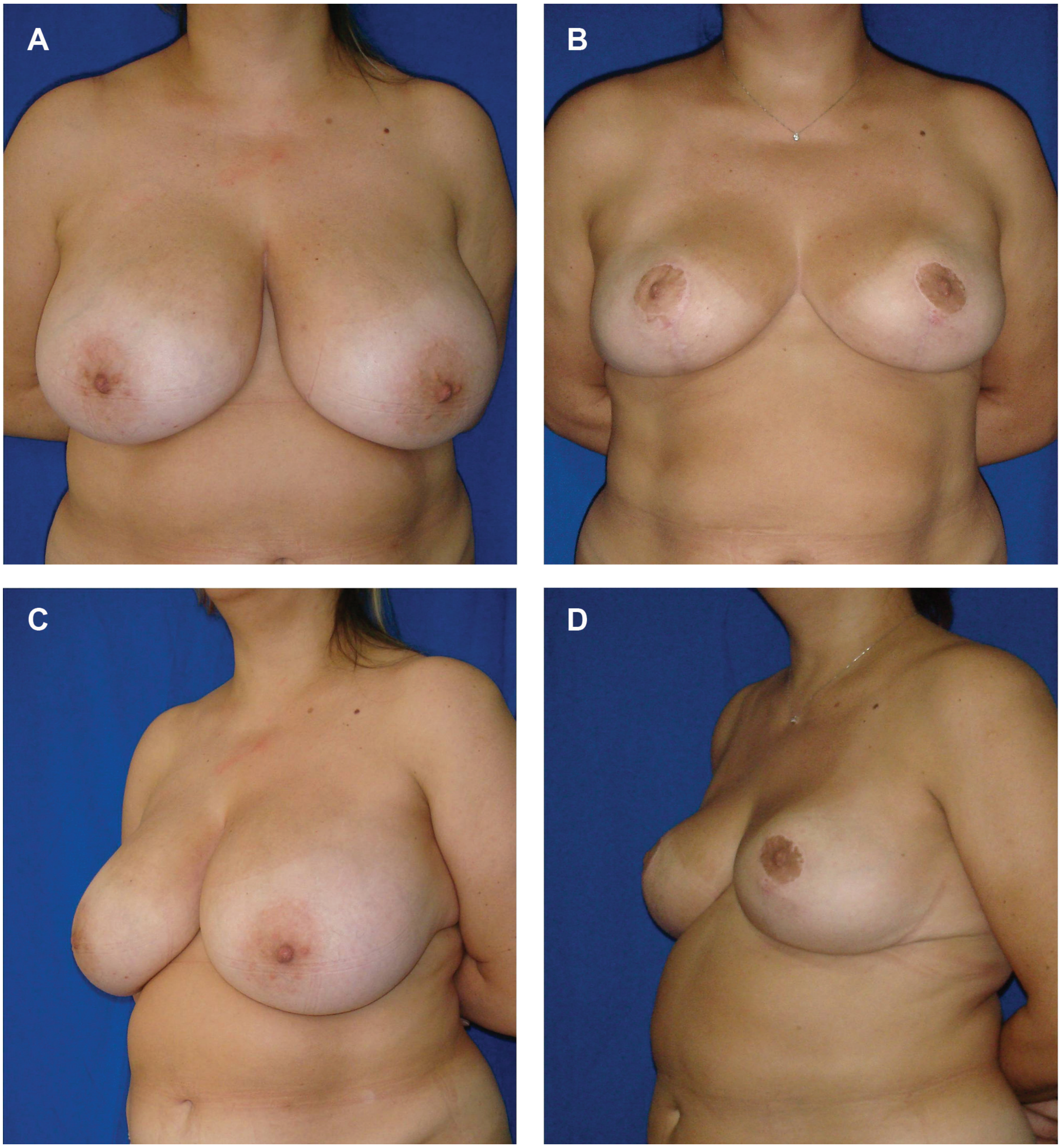

Figure 7. (A, C) This 44-year-old, mildly overweight woman presented for reduction mammaplasty. The distance from the jugular notch to the nipple was 32 cm for both breasts. (B, C) One year after reduction mammaplasty with the author's central pillar technique. The right breast was reduced by 905 g and the left breast by 1070 g. Both nipples were transposed to 22 cm from the jugular notch.

current technique, the central pillar pedicle advances directly to its new site, owing to the superficial wedge resections on both sides, instead of being rotated; this avoids the risk of torsion.

The NAC flap is based on the horizontal septum, with protection of the periareolar vein polygon and its deep connections to the breast septum veins. The dimensions of the deepithelialized area are determined to enable protection

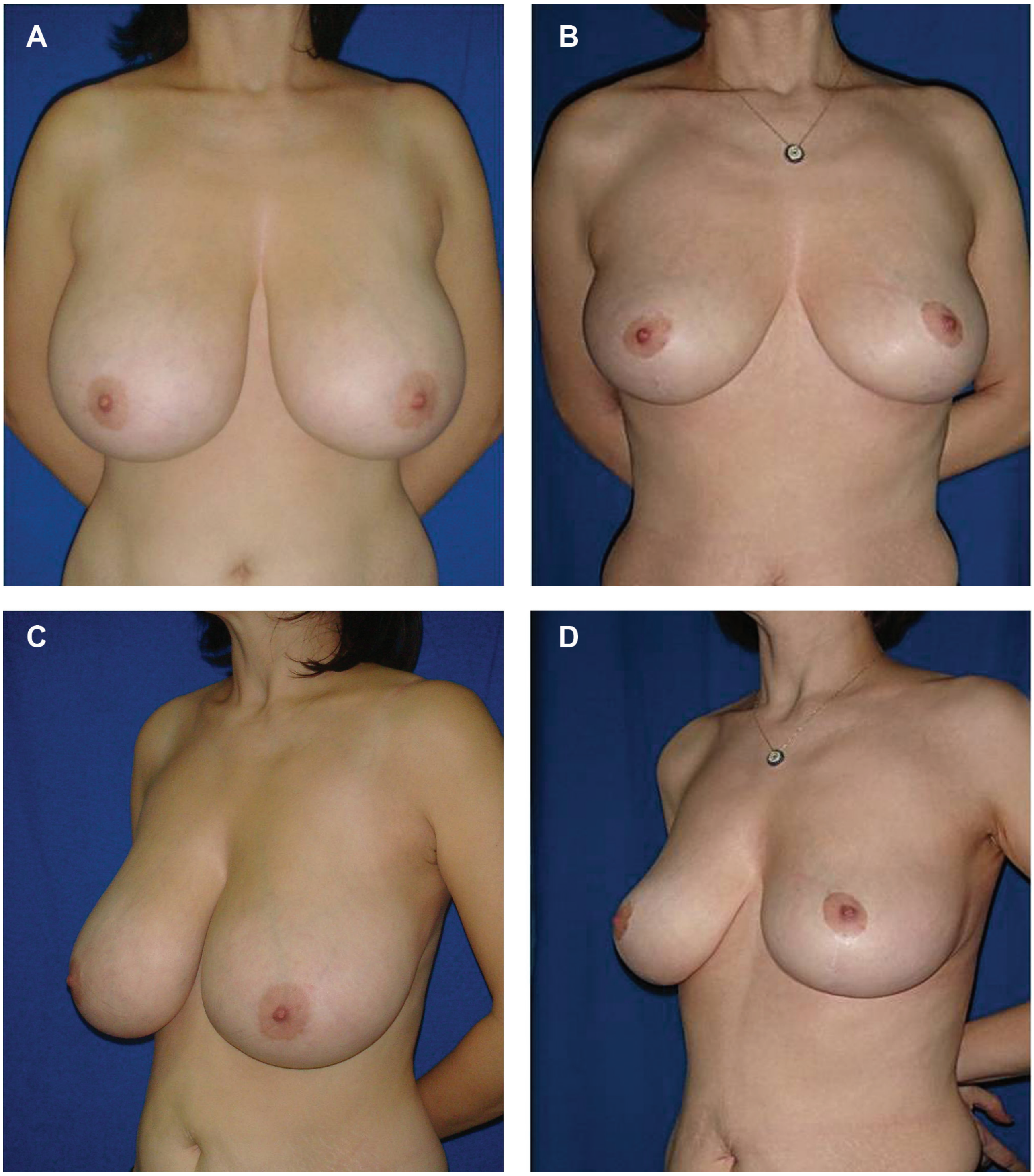

Figure 8. (A, C) This 36-year-old woman with large breast hypertrophy presented for reduction mammaplasty. The distance from the jugular notch to the nipple was 30 cm for both breasts. (B, D) Forty months after reduction mammaplasty with the author's central pillar technique. The right breast was reduced by 875 g and the left breast by 840 g. The nipples were transposed from 30 to 22 cm from the jugular notch.

of the periareolar vein polygon. The NAC is prepared on a circular dermal island (Figure 4). This provides great mobility to the pedicle, which advances easily into the new areola hole without the risk of torsion. Beveled lateral and medial pillars join each other caudal to the pedicle, as if hugging it, which allows for a better breast shape long term. The caudal resection procedure is similar to that of Hamdi's centrolateral glandular technique.[30-32] The major

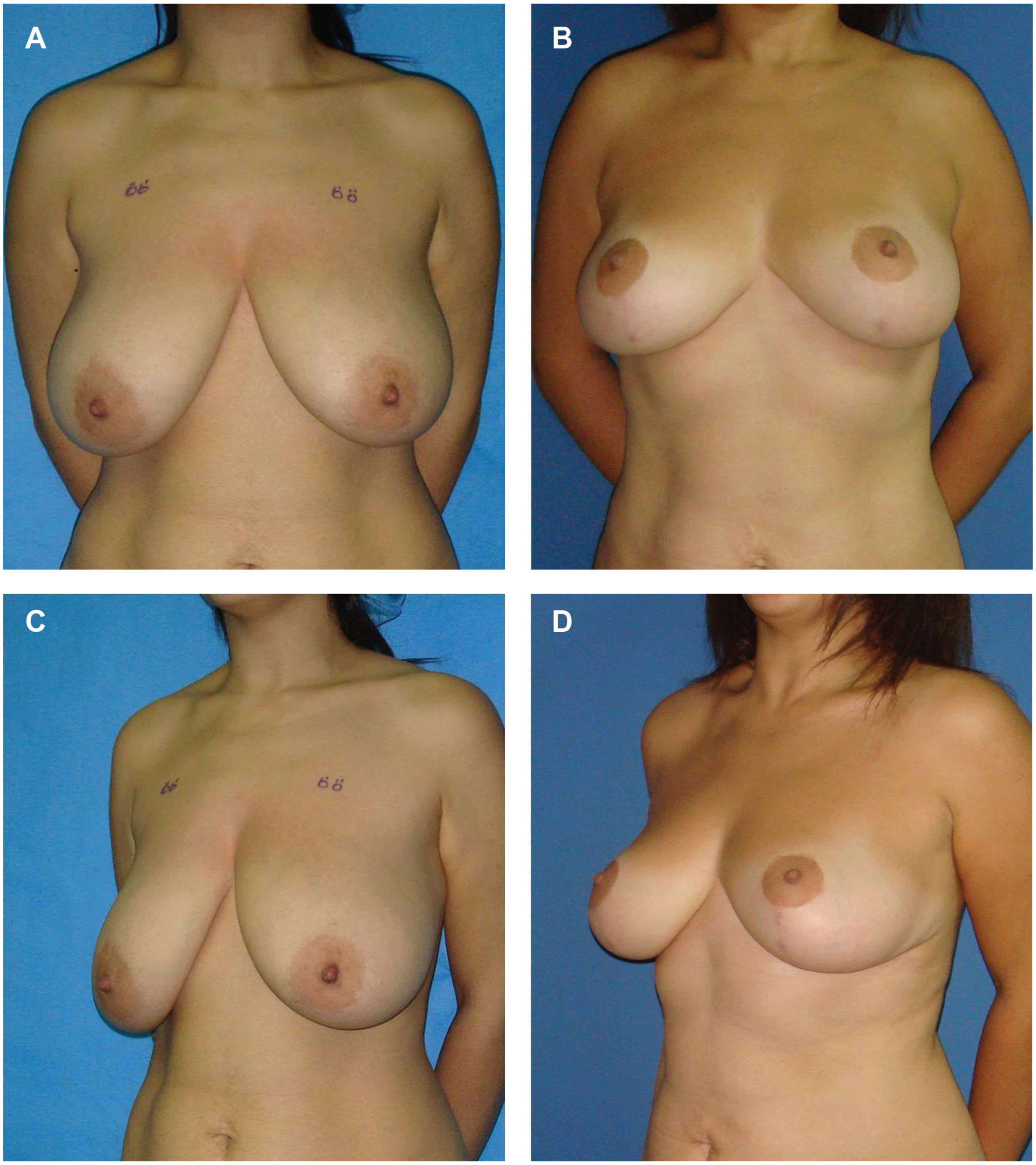

Figure 9. (A, C) This 34-year-old woman presented for reduction mammaplasty. The distance from the jugular notch to the nipple was 31 cm for the right breast and 30 cm for the left breast. (B, D) Thirty-two months after reduction mammaplasty with the author's central pillar technique. The right breast was reduced by 735 g and the left breast by 685 g. Both nipples were transposed to 21 cm from the jugular notch.

difference with the central pillar technique is the wedge resections, including partial thickness of the horizontal septum on both sides of the central pillar. These wedge resections give the central pillar a pyramidal shape while maintaining the continuity of the horizontal septum at the base. The deep arterial and venous networks of the

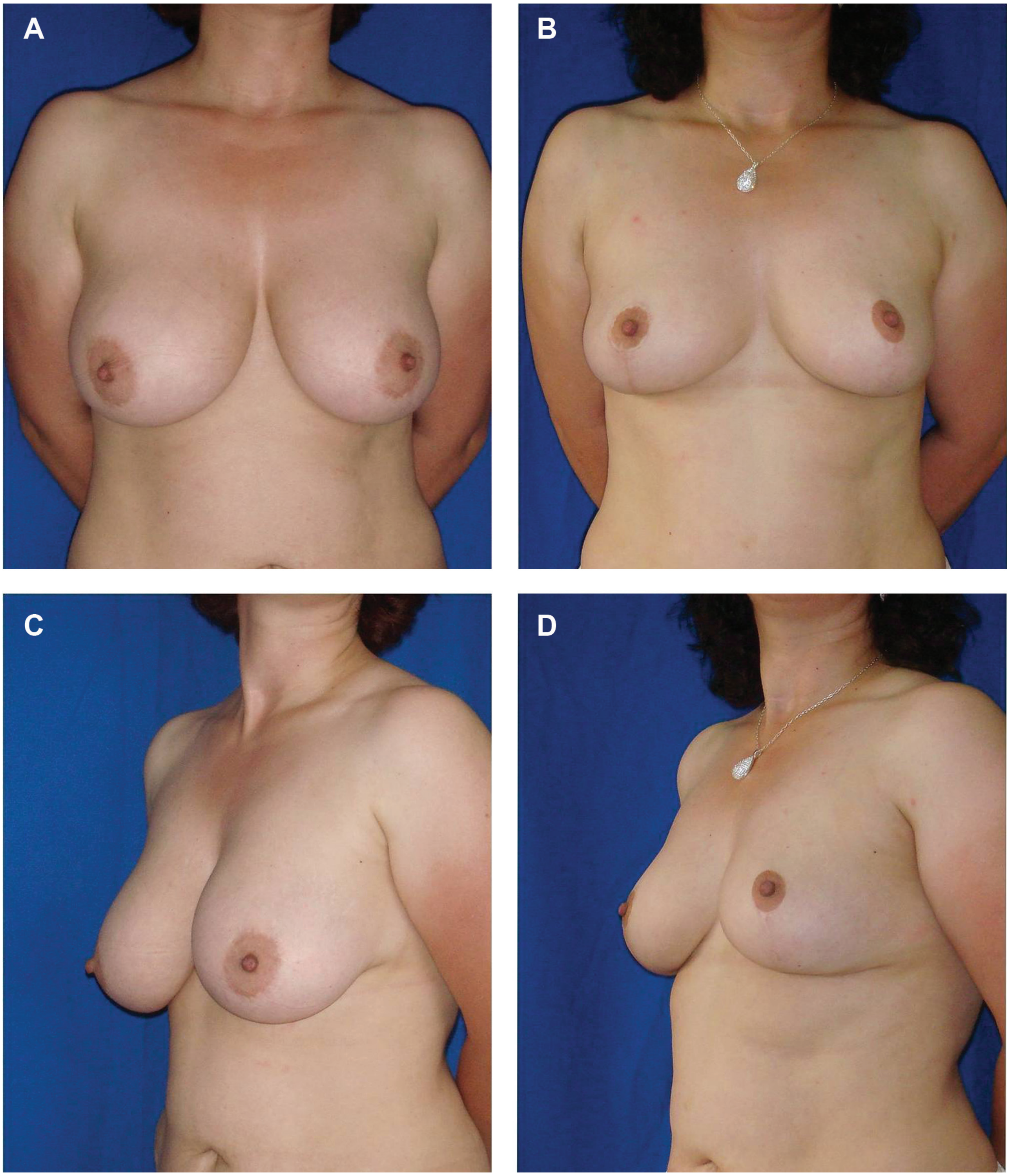

Figure 10. (A, C) This 33-year-old nulliparous woman presented for reduction mammaplasty. The distance from the jugular notch to the nipple was 29 cm for the right breast and 28 cm for the left breast. (B, D) Thirty-two months after reduction mammaplasty with the author's central pillar technique. The right breast was reduced by 560 g and the left breast by 490 g. Both nipples were transposed to 21 cm from the jugular notch.

horizontal septum and intercostal perforators are included in the central pillar pedicle. After partial wedge resections are made on both sides, this pyramidal tissue "block" gains great mobility without the risk of torsion.

The main disadvantage of the central pillar technique is the sacrifice of all large superficial veins radiating from the areola. None of these large superficial veins is protected with this technique, and venous drainage is provided solely by the deep vein system through the communicating veins of the periareolar polygon. The design is similar to that of Elisabeth Würinger's septum-based technique,[29] in which the venous return is also provided by the deep system of the horizontal septum. Although Würinger also used large periareolar deepithelialization, her objective was very different. She stated that the large periareolar dermal tissue had no nutritive function and was used only to shape the gland. However, by protecting this large dermal tissue, she inadvertently also protected the critical vein polygon, which is an important structure interconnecting the superficial and deep vein systems.

Although it is obvious from clinical practice that the deep system is sufficient for venous drainage of the NAC, this procedure is more demanding technically than the medial- or lateral-based pedicles. The central block of breast tissue should be prepared diligently in order to protect the deep connection of the venous network, and pressure over the pedicle by side pillars should be avoided.

In the beginning, this technique was reserved only for gigantic glandular breasts of young patients who were not good candidates for the free nipple graft technique. As the author gained experience with the technique, the indication spectrum was widened to include patients who desired reductions of more than 500 g per breast and/or NAC transposition of more than 8 cm. When the indication spectrum was expanded, there was no concern about patient age. The central pillar technique is a viable alternative to the free nipple graft technique, particularly in young patients, for whom breast functionality is an important issue.

CONCLUSIONS

The central pillar technique is an appropriate alternative for young patients with glandular breasts that require gross reduction and high-transposition NAC, who are not good candidates for the free nipple graft technique. Conical breast shape can be achieved successfully, along with good nipple projection. Patient satisfaction has been high, with significant improvement in quality of life, and postoperative complications have been manageable.

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