

Clinical Applications of Barbed Suture in Aesthetic Breast Surgery



Ryan T.M. Mitchell, MD, FRCSC^a,
Bradley P. Bengtson, MD^{a,b,*}

KEYWORDS

- Barbed suture • Sutures • Incision closure techniques • Wound closure techniques
- Surgical Specialties Quill suture • Covidien V-Loc suture • Ethicon Stratafix suture
- Breast incision closure

KEY POINTS

- In primary and revisional breast surgery, incisions are limited, and it often feels like trying to operate through a “mail slot”!
- In these limited access applications barbed technology is extremely useful by facilitating suturing internally in limited spaces without the need for tying knots.
- This limited access application and increased speed and efficiency of incisional closures are the main applications and benefits of using these barbed devices.
- The future development of barbed sutures technology along with the number of applications continues to grow.



Videos of 2-layer closure techniques accompany this article at <http://www.plasticsurgery.theclinics.com/>

BACKGROUND

The breadth of literature regarding barbed suture applications in plastic surgical procedures signifies the importance of this article. Barbed suture applications in breast surgery is growing dramatically as surgical practitioners are becoming more familiar with the advantages of this new suture technology. Barbed suture devices were first implemented by plastic surgeons for the use in various minimally invasive techniques for facial rejuvenation.¹ Although the initial devices had their share of pitfalls, the most noticeable advantage in their implementation was a reduction in procedural time.² With the increase of bariatric procedures, there has been a similar increase in the number of body-contouring procedures in order to

address the significant skin redundancies related to massive weight loss of the breast and body. In an effort to improve operative efficiency, the implementation of barbed suture technologies has increased to streamline the closure of large skin resection margins of the body and also the breast, particularly breast reductions and mastopexy procedures. A common theme to the advantages of this modality of tissue closure is the speed and ease of placement. Often either deep suture material is not required or fewer deep approximation points are necessary, which subsequently reduces the operative closure time.³ In addition, complications associated with more conventional suture material related to knot slippage or breakage,

^a Bengtson Center for Aesthetics and Plastic Surgery, 555 MidTowne Street, NE, Suite 110, Grand Rapids, MI 49503, USA; ^b Department of Surgery, School of Medicine, Michigan State University, East Lansing, MI, USA
* Corresponding author. Bengtson Center for Aesthetics and Plastic Surgery, Grand Rapids, MI.
E-mail address: drm@bengtsoncenter.com

suture extrusion or spitting, and infection may be reduced. Furthermore, tension may also be more uniformly distributed along the wound, and the barbed nature of the suture prevents tissue sliding with more than 20 points of fixation per square inch. Some have even suggested that the final scar result is subjectively improved from a clinical perspective as a result of a reduction of tissue-related ischemia, less suture extrusion, and locking of the tissues more tightly through the barbing, although this is difficult to prove clinically when Monocryl-type sutures are used.⁴⁻⁹

Three main barbed suture device companies are currently being used for soft tissue closure in breast, body contouring, and other soft tissue closure procedures in the United States. A bidirectional self-retaining suture (Quill SRS, now Surgical Specialties, Vancouver, British Columbia, Canada) uses a helically distributed back-cut spaced distance of 5.08 mm apart on a variety of monofilament sutures of both the absorbable (polyglycolic acid/polycaprolactone [Monoderm]) and polydioxanone (PDO) along with nonabsorbable (nylon and polypropylene) (Figs. 1 and 2). The barb cut in the strand reduces the diameter of the suture such that a 3-0 suture has the corresponding strength

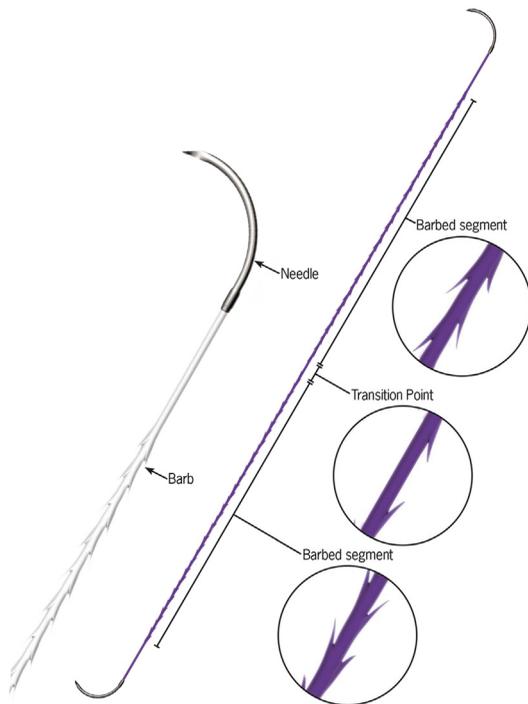


Fig. 1. The standard barbed suture is depicted with barbed segments oriented to lock the soft tissues into position and prevent back-tracking or sliding of the suture. The swaged on needles and transition zone centrally are also shown.

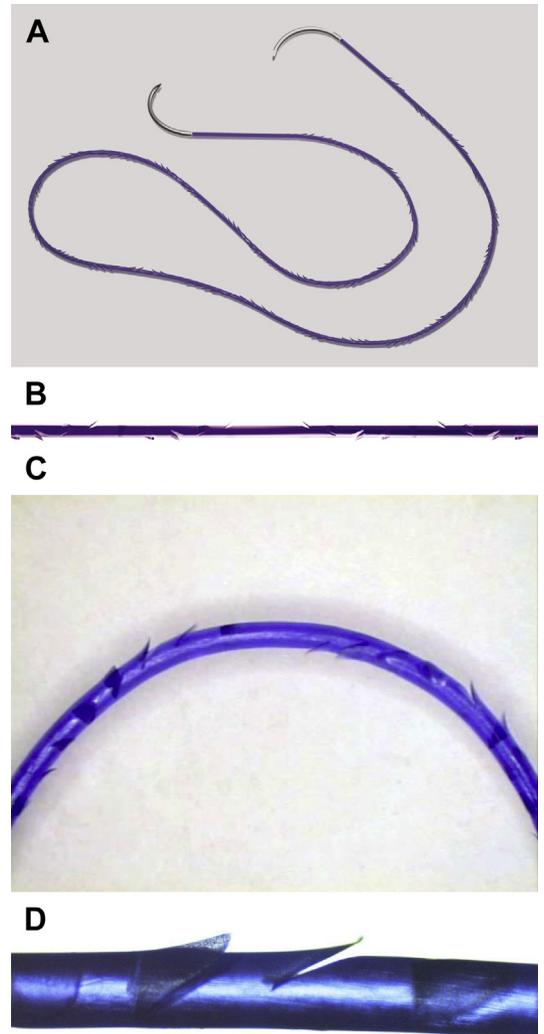


Fig. 2. (A–D) Progressively increasing magnification of the barbed suture technology. (Courtesy of Angiotech Pharmaceuticals, Inc, Vancouver, British Columbia, © 2015; with permission.)

of a 4-0 standard monofilament suture. Quill suture is available in both bidirectional and unidirectional formats.

Surgical Specialties licensed their Quill technology to Johnson & Johnson/Ethicon in 2012, who is also marketing and distributing their barbed suture under the trade name Stratifix (Somerville, NJ, USA). Quill and Stratifix 3-0 suture have a tensile strength of a 4-0 suture, while V-Loc keeps the 1:1 ratio of standard suture, so that a 3-0 Monocryl is the same diameter as a 3-0 V-Loc.

The third suture device is the Covidien V-Loc (Fig. 3) wound closure system (Covidien, Mansfield, MA, USA), which consists of a dual-angled back-cut spaced helically with 20 barbs per centimeter in a unidirectional orientation. Similar to the

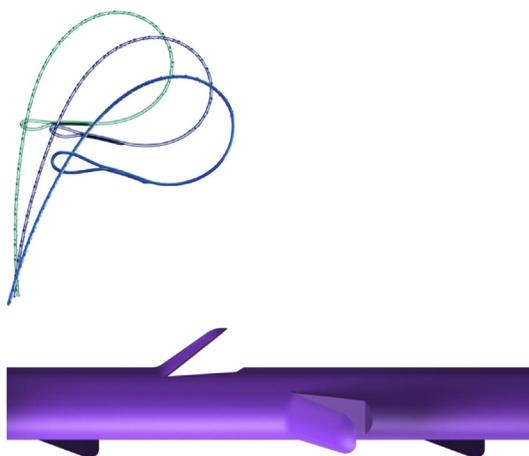


Fig. 3. The Covidien V-Loc suture. It is a unidirectional design with a slightly different barb cut and orientation (Product brochure: <http://www.covidien.com/surgical/products/wound-closure/barbed-sutures#resources>). (Courtesy of Medtronic, Minneapolis, MN; with permission.)

Quill device, the back cut into the suture reduces the diameter such that a 3-0 V-Loc device has a corresponding strength profile of a 4-0 standard monofilament suture.

CLINICAL APPLICATIONS

Internal cost studies performed by the authors have shown that for most breast procedures the net cost of using barbed versus standard sutures is essentially equivalent. For instance, the cost of using one 2-0 Vicryl and two 3-0 Monoderm for a bilateral breast augmentation is cost equivalent to using two 3-0 and 4-0 Monocryl sutures. In addition, surgery time is expensive, approaching \$100 per minute in large hospital settings; thus, any saving in Operating Room time may result in a significant overall cost savings. Additional advantages, such as time savings and closure techniques, have also been well outlined.¹⁰

TWO-LAYER BREAST AUGMENTATION CLOSURE

The authors' longest and most used closure application with barbed suture is the 2-layer breast closure in primary augmentation and revisional breast surgery. The authors have used this specific closure method for the past 5 years in more than 1200 breast procedures. It is fast and efficient and works well with first assistants, residents, and fellows, or dual surgeons. The authors have not experienced any wound breakdown, skin dehiscence, or suture track infections since its implementation. Their average standard primary

breast augmentation time is averages 35 minutes, skin to skin, with the incision closure time less than 5 minutes.

Following the breast augmentation and checking for pocket and implant symmetry, the deep closure is performed setting the inframammary fold, if the inframammary fold incision is being used, with either a 2-0 polydioxanone suture (PDS) or 2-0 Vicryl, placing the suture into the deep fascia directly in the fold and then through the breast fascia of the lower skin flap followed by the upper breast skin flap. Charles Randquist has termed this the "Baby-Sitter Stitch." The authors place 1 or 2 of these sutures followed by running the deep fascia. A more superficial bite is taken directly over these 1 to 2 deep sutures to potentially avoid damaging the underlying device. The fascia is run under direct vision, allowing for a more uniform tightly approximated closure and avoiding the potential knuckling of the device that patients may palpate between interrupted sutures. Two to 3 sutures of this deep closure material (2-0 Vicryl) is then placed to approximate the incision edges just beneath the dermis. Following this, a 2-layer closure of 3-0 Monoderm or similar barbed suture completes the closure (**Fig. 4** and **Videos 1** and **2**).

Deep closure is typically performed simultaneously on both sides, and if operating with a first assistant, transition to the contralateral side following deep closure next to the device, and superficial barbed suture closure on the right side, as the assistant is closing the patient's left side. The barbed suture skin closure is initiated beginning medially. The bidirection suture is preferred for this application with both sutures being able to be run toward the surgeon and obtaining a strong 2-layer repair. The closure begins internally at the medial crotch of the deep dermis. The free end of the suture is placed beneath an instrument or sponge and held out of the way. The first pass approximates the deep dermis and is then brought out directly through the skin approximately 1 to 2 cm lateral to the lateral incision edge. The next pass begins again suturing toward the surgeon in the superficial dermis, a 3-0 Monoderm or 4-0 Stratifix, or 4-0 V-Loc, for this closure in either a 7 × 7-cm or a 14 × 14-cm length depending on the incision length for either a primary or a revision patient. This second pass is made approximating the dermis directly underneath the epidermal layer in the more superficial plane and also brought out laterally through the skin and both sutures cut flush with the skin and massaged gently, allowing the cut end to migrate subdermally. Again, this closure is very fast and strong, is an efficient use of suture material, and allows the

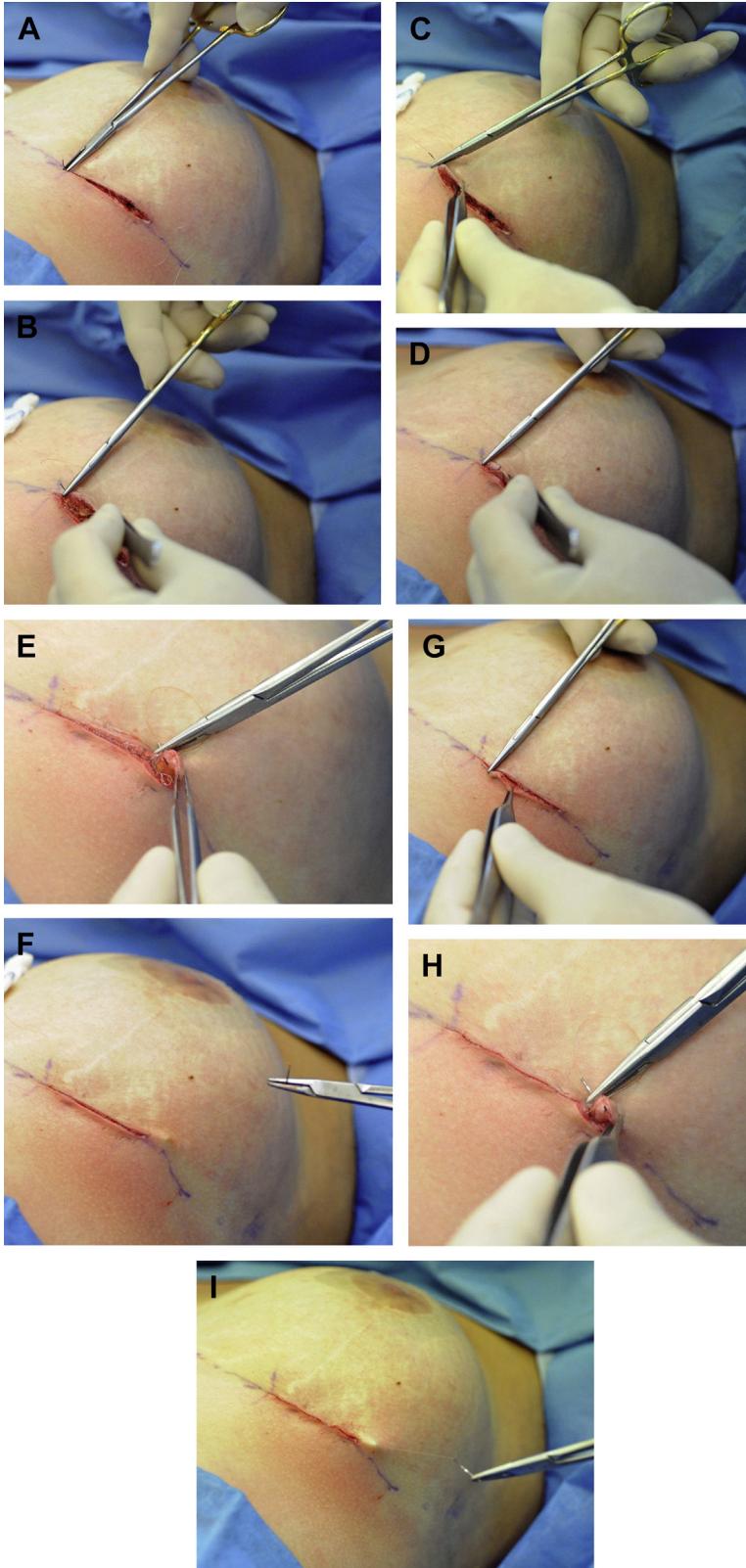


Fig. 4. (A–I) The repair sequence is initiated medially backhanding the suture out deeply into the corner of the dermis. A short bite is then taken, and the deep dermal layer is initiated. The deep dermis is then approximated, and the suture is brought out laterally through the skin. The second pass is then initiated at the superficial dermal-epidermal junction, completing the closure with the suture brought out percutaneously through the skin and cut at the skin level. The area is massaged to allow the cut edge of the suture to retract just deep to the dermis.

entire closure to be performed suturing toward the surgeon. More than 600 augmentation closures have been performed with this technique with no suture spitting, dehiscence, or wound healing complications (Bengtson, unpublished data).

BREAST REDUCTION AND MASTOPEXY CLOSURE

Barbed suture material may be used in all types of breast reduction patterns, nipple areolar incisions, and pedicle orientations. Both unidirectional and

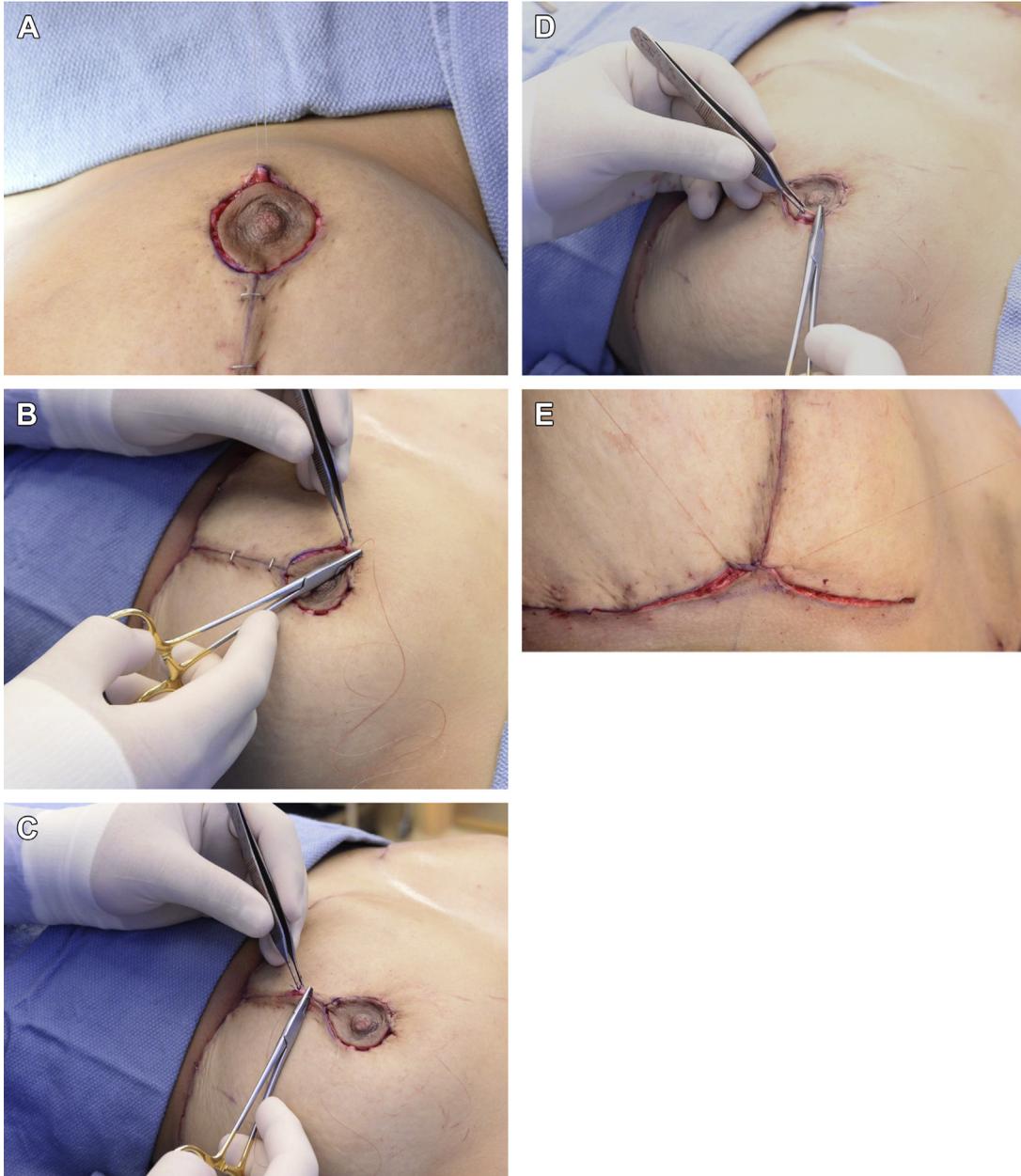


Fig. 5. (A–E) For full mastopexy closures, the authors begin at the 12 o'clock position with the bidirectional barbed suture and run each arm, one medially and one around the areola laterally. At the vertical limb, one suture is run in the deep dermis and the second pass at the dermal-epidermal junction to the T region. At this point, one suture is run medially and the other is run laterally and brought out percutaneously through the skin after the closure is complete. It may be helpful to run the contralateral closure from the opposite side of the bed toward yourself.

bidirectional suture orientations may be used to facilitate final closure. A similar theme is consistent with regards to skin closure in these procedures. Once the markings have been incised and the required tissue resected, closure begins with the placement of a unifying suture that will orient the breast into its respective shape. The areola is initially tacked into position at respective positions around the face of a clock (ie, 12, 3, 6, and 9 o'clock). The authors' preference is to use bidirectional sutures beginning at the apex, or the 12 o'clock position. Beginning at this position, a subcuticular barbed suture, typically with a 3-0 Monoderm Quill, 4-0 Monocryl Stratafix, or 3-0 V-Loc barbed suture, is then run around the circumference in a subcuticular fashion, allowing for fine manipulation of tissue tension and locking the tissues in place. With bidirectional suture, the sutures are run in opposite directions and then at different dermal depths, deep and superficial, similar to the 2-layer augmentation closure, and then at the T point, one of the sutures is run medially and one is run laterally (**Fig. 5**).

For periareolar or circumvertical mastopexies, the bidirectional or unidirectional suture may be

used. Typically, the authors will run circumferentially 1.5 to 2 times, overlapping the suture for better skin approximation. It may be also of interest, in the case of a noncircular nipple areolar complex postoperatively, the authors have had some success stretching and fracturing the barbs at 1 to 2 weeks postoperatively with some improvement in re-creating the circular diameter versus more oval or a flattened side. Long-term outcomes are pending, but it would be a nice additional benefit to have somewhat of an adjustable suture for this application in helping to create a round nipple-areolar complex if needed. For the use of a unidirectional barbed suture, it is advisable to begin at the extent of the incision margin, although building in smaller areas of overlap may create a better approximated incision (**Figs. 6-8**).¹¹

ADDITIONAL BREAST APPLICATIONS

Review of the Literature

Although the history of the use of barbed suture material in Plastic Surgery has been well documented,¹² previous reviews of the literature highlight barbed technology uses in suspension

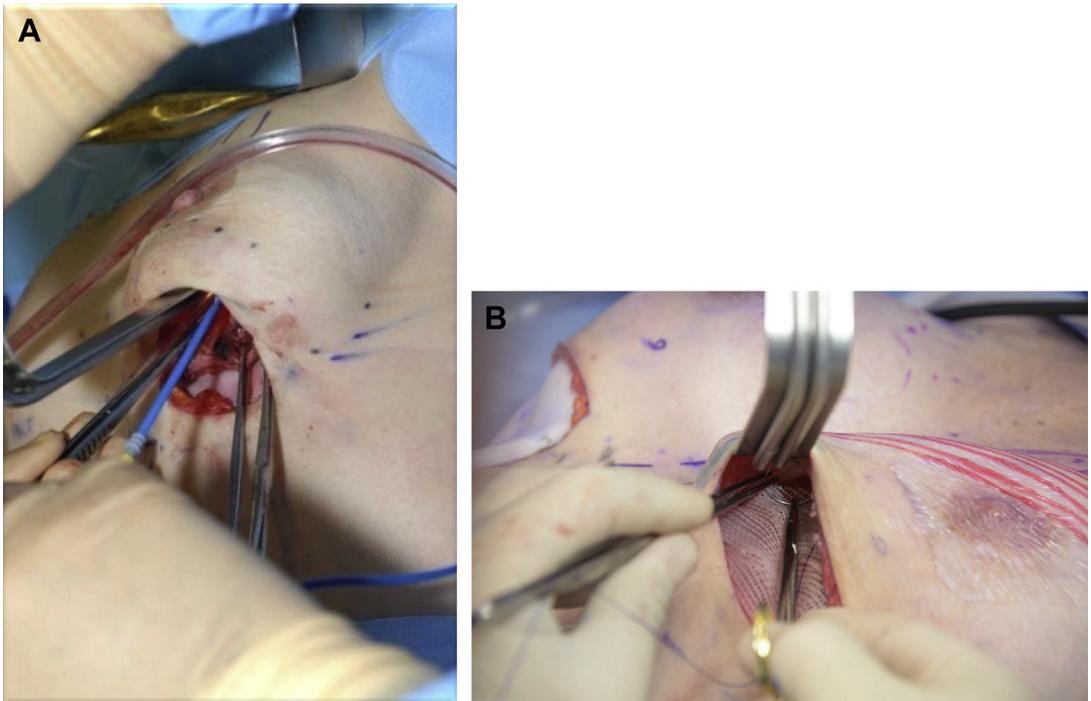


Fig. 6. (A, B) In these 2 images, it is evident how barbed suture is having increased applications in both primary augmentation mastopexy and breast reduction surgery in massive weight-loss patients that require significant soft tissue support. In addition, barbed suture is a critical element in breast revision surgery, which has created a new zone of surgery that may be referred to as limited access surgery. It is the surgical area between open surgical procedures and laparoscopic/endoscopic surgery. It requires operating through smaller, limited incisions, and it is here where the barbed suture is extremely beneficial. Trying to operate through these small incisions is like operating through a mail slot.

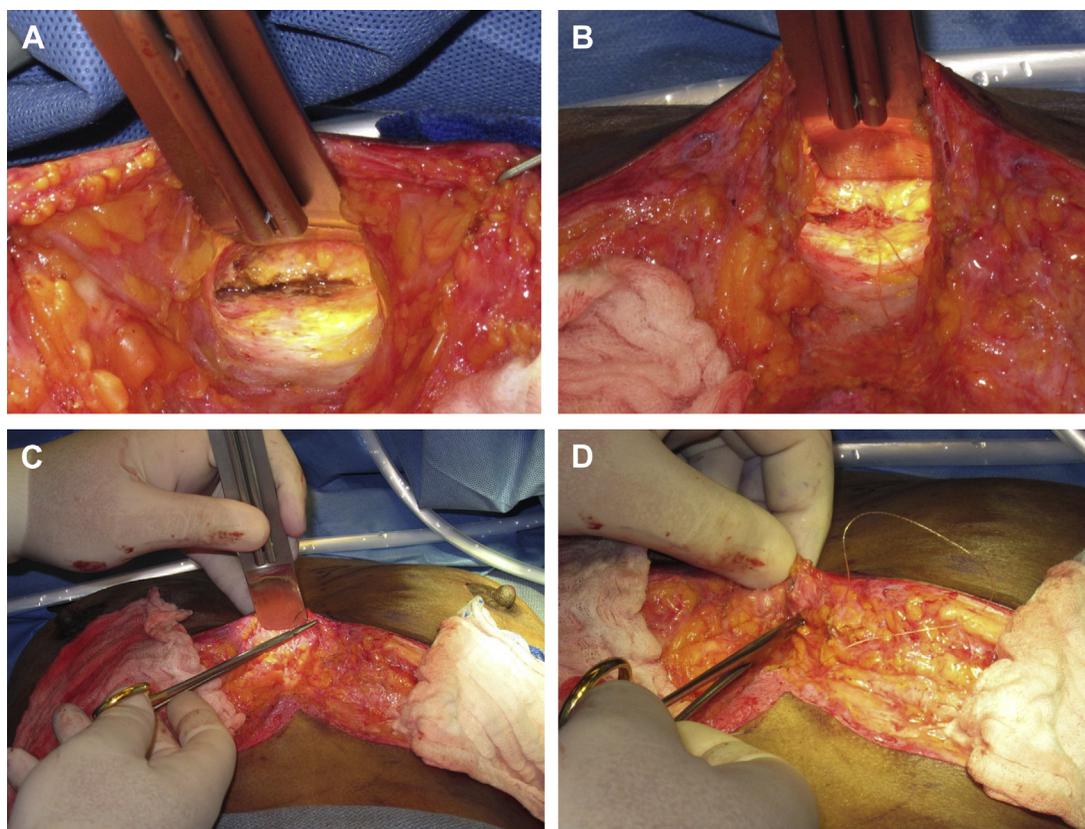


Fig. 7. (A–D) This sequence of images shows a case of natural symmastia. Both symmastia that occurs naturally and following breast augmentation or reconstruction have been difficult to treat in the past with one operation. In breast revision, capsular flaps and scaffolds or tissues are helpful in reinforcing pockets and correcting the deformity. In primary cases where symmastia occurs, barbed sutures are critical in that they may be placed percutaneously with multiple rows run down simultaneously, closing down the presternal space. In this patient, liposuction was also performed in the presternal area. It is also important to come at least 1.5 cm off the midline to help re-establish the proper intermammary distance.

procedures for facial rejuvenation,⁵ bariatric surgery,¹³ and a significant bulk pertaining to its use in body-contouring procedures.^{2,4,11,14–17} With specific regards to its use in the breast, there currently is a paucity of literature depicting barbed suture applications.^{18–20} Early literature with respect to breast surgery has focused on the effectiveness of barbed suture material in the closure of donor sites in breast reconstruction.^{21–23} Thekkinkattil and colleagues²¹ in 2013 evaluated the use of unidirectional barbed suture for quilting of the donor site in a latissimus dorsi myocutaneous flap breast reconstruction compared with nonbarbed material in 50 patients. The implementation of barbed sutures was found to have a similar complication profile with regards to seroma formation and wound concerns as conventional suture materials. Furthermore, there was no significant difference in their secondary outcomes in relation to total duration of surgery, total

inpatient stay, and total amount of drain at the donor site.

In comparison with conventional closure devices, barbed sutures have a comparable wound strength and tissue reaction scores in animal models.²⁴ There have been mixed results with respect to the use of barbed sutures in breast procedures. Jandali and colleagues²³ reported conflicting results. They found that there were time savings associated with the use of barbed sutures as well as an associated cost benefit. However, this came with an increased risk, which trended toward significance with respect to wound dehiscence, infection, and suture extrusion. These initial increased rates of wound dehiscence and suture exposure were related to the PDS/PDO version of suture used superficially. When using the Monocryl/Monoderm version of suture in the dermal and direct subdermal planes, these wound-healing issues have largely been mitigated.

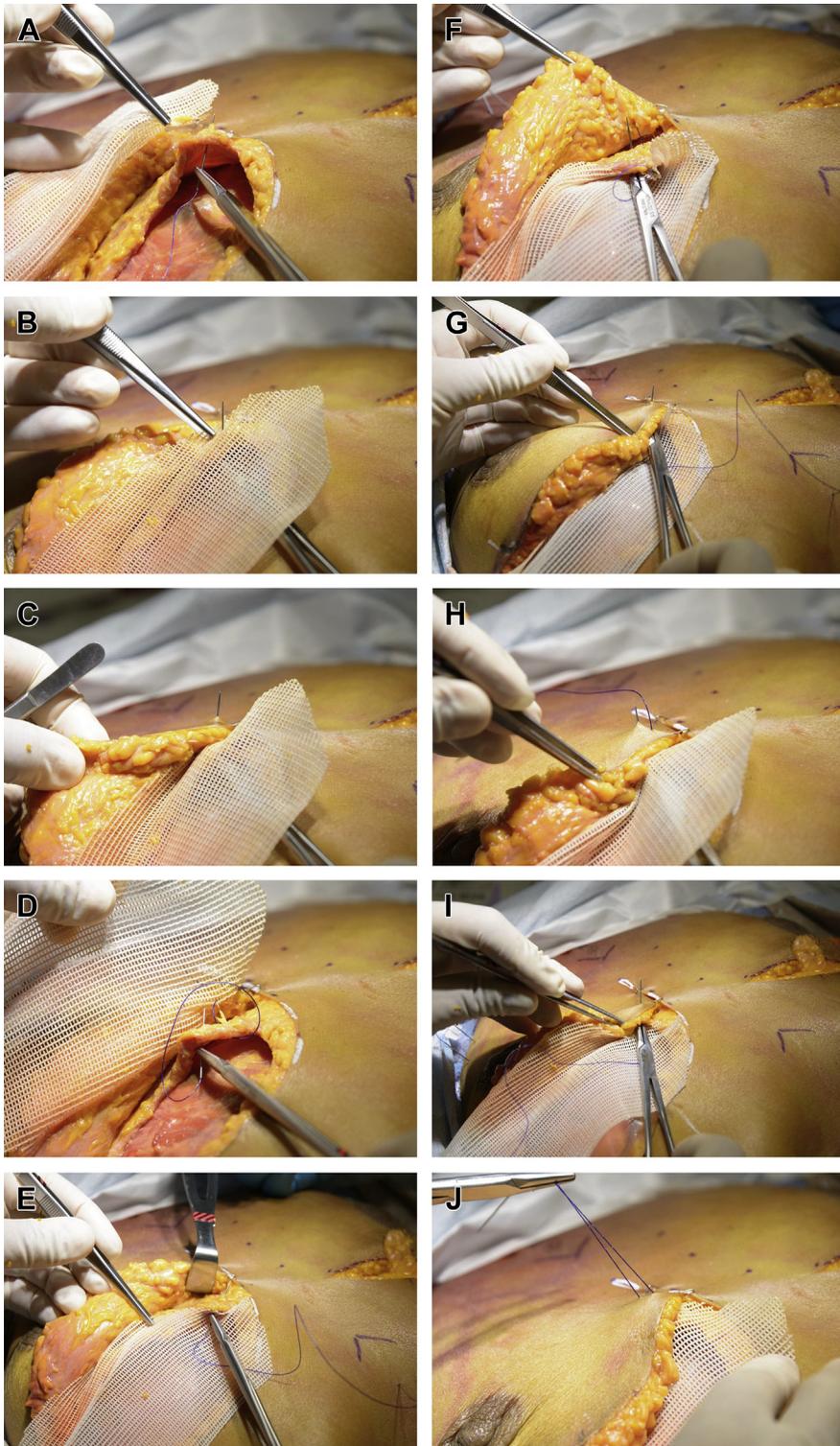


Fig. 8. (A–J) This sequence of images depicts one of the main benefits of barbed sutures in the placement of scaffolds or tissues. Parachute or marionette-type sutures are useful but may create suture track infections if left in position or lose their function if removed at the end of the procedure. Barbed suture particularly on a double-armed Keith needle can be placed through the muscle, then through the scaffold or tissue, and then through the breast, and when placed medially, centrally, and laterally, will set up the material for the surgeon, who can then more easily inset the scaffold and visualize the templating and finalize the inset.

de Blacam and colleagues²² compared closure of deep inferior epigastric perforator flap donor sites in breast reconstruction patients. In 142 patients, the initial 71 were closed with conventional suture, and the latter 71 were closed with unidirectional barbed material. They showed no significant difference with respect to wound dehiscence, wound infection, or seroma formation.

Mantarasso and Paul¹¹ in the very thorough *ASJ Supplement* on barbed suture in September 2013 gave a great overview of barbed technology, and although primarily focused on facial applications, it included 2 brief but significant descriptions on mastopexy and breast reduction closure.¹⁰

Rubin and colleagues¹⁰ in a multicenter randomized controlled trial compared conventional absorbable sutures to a unidirectional barbed suture for closure of open wounds. They found that the mean dermal closure time was significantly faster in all procedures conducted with barbed sutures, primarily because of the need for fewer deep dermal sutures.

Although the literature in body contouring is expanding within this realm,^{2,4,11,14-17} far fewer articles discuss the benefits and surgical techniques using barbed suture with specific reference to the breast. Most of the literature is anecdotal with reference to barbed suture technology. Salzberg¹ discussed his experience with barbed suture in breast reconstruction with and without acellular dermal matrix. Since he started using barbed sutures, he noticed that his operative time decreased, and he was better able to control skin tension on closure by more uniform distribution of vectors along the skin edge. In addition, in immediate and delayed implant-based reconstructions, he places barbed sutures in the inseting of acellular dermal matrix to the pectoral muscle and for definition of the pocket by recreation of the inframammary fold and lateral breast curvature. He has also found barbed suture material useful for autologous reconstruction for closure of the donor and recipient site. The incorporation of barbed material in the periareolar closure of breast cases has also been described.⁴ Here, a barbed subcuticular suture evenly distributes tissue tension and prevents tissue slippage, which would result in subsequent widening of the nipple areolar complex. In this article, the authors review of more than 300 cases, leading to the impression that there is a subjective improvement on the appearance of the final scar. The theory is that the barbed sutures eliminate the micromotion associated with traditional suture material in final wound closure. This lack of motion allows for the final appearance of the scar to heal in well and allows for a thin fine line. Furthermore, there is less

of a risk of suture spitting and erosion associated with other suture material, particularly in regards to periareolar closure techniques. Paul¹¹ described the uses of barbed sutures in esthetic surgery. In the breast, he uses a bidirectional device for deep dermal closure of the areola. Starting at the 12 o'clock position, one strand is run clockwise and the other is run counterclockwise. If a vertical and horizontal component is present, the suture can then be run down the vertical incision and along their respective horizontal component within the inframammary fold. For thicker dermal tissue, a second suture in the mid to superficial dermis can be applied.

In conclusion, there is an emerging new area of plastic surgery that has been termed limited access surgery. Often in primary and revisional breast surgery, the incisions are limited, and it often feels like trying to operate through a mail slot! It is in these limited access applications where barbed technology is extremely useful by facilitating suturing internally in limited spaces without the need for tying knots. This limited access application and increased speed and efficiency of closures are the main applications and benefits of using these barbed devices.

The future development of barbed sutures technology along with the number of applications continues to grow. It is hoped that this brief review of clinical applications has been helpful in current practice as well as in spawning new ideas and innovations in the use of barbed suture technology to improve efficiency and patient outcomes.

Editorial Comments by Bradley P. Bengtson, MD

The use of barbed suture has gained significant popularity in the past few years. There continues to be ongoing misinformation about barbed suture use. The Monocryl/Monoderm products, regardless of manufacturer, should be the only type used in the subcuticular or direct subdermal plane. We have had no suture spitting or incision dehiscence in 2-layer augmentation closures in over 1000 consecutive patients. When using PDO or PDS suture, we initially experienced significant wound healing issues. Surgeons need to discriminate between suture types, PDO should not be used in the direct subdermal plane. These barbed sutures may be used in innovative ways in all types of breast surgery with uni-directional or bi-directional suture types and facilitates closures by reducing surgical time, placing fewer knots, and can be used by two surgeons simultaneously. The reduction of surgical time can create significant cost savings intraoperatively.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found online at <http://dx.doi.org/10.1016/j.cps.2015.06.003>.

REFERENCES

- Salzberg CA. Barbed sutures in breast reconstruction. *Aesthet Surg J* 2013;33(3):40S–3S.
- Moya AP. Barbed sutures in body surgery. *Aesthet Surg J* 2013;33(3):57S–71S.
- Paul MD, Budd M. Evaluating the Quill self-retaining system: closure time, cost analysis and current clinical applications. *Plast Surg Pract* 2009;30–3.
- Hammond DC. Barbed sutures in plastic surgery: a personal experience. *Aesthet Surg J* 2013;33(3):32S–9S.
- Villa MT, White LE, Alam M, et al. Barbed sutures: a review of the literature. *Plast Reconstr Surg* 2008;121(3):102e–8e.
- Paul MD. Bidirectional barbed sutures for wound closure: evolution and applications. *J Am Col Certif Wound Spec* 2009;1(2):51–7.
- Ruff G. Technique and uses for absorbable barbed sutures. *Aesthet Surg J* 2006;26(5):620–8.
- Rosen AD. Use of absorbable running barbed suture and progressive tension technique in abdominoplasty: a novel approach. *Plast Reconstr Surg* 2010;125(3):1024–7.
- Matarasso A, Pfeifer TM. The use of modified sutures in plastic surgery. *Plast Reconstr Surg* 2008;122(2):652–8.
- Rubin JP, Hunstad JP, Polynice A, et al. A multicenter randomized controlled trial comparing absorbable barbed sutures versus conventional absorbable sutures for dermal closure in open surgical procedures. *Aesthet Surg J* 2014;34(2):272–83.
- Matarasso A, Paul MD. Barbed Sutures in Aesthetic Plastic Surgery: evolution of thought and process. *Aesthetic Surg J* 2013;33(3 Suppl 1):17S–31S.
- Ruff GL. The history of barbed sutures. *Aesthet Surg J* 2013;33(3):12S–6S.
- Kassir R, Breton C, Lointier P, et al. Laparoscopic Roux-en-Y gastric bypass with hand-sewn gastrojejunostomy using an absorbable bidirectional monofilament barbed suture: review of the literature and illustrative case video. *Surg Obes Relat Dis* 2014;10(3):560–1.
- Shermak MA. The application of barbed sutures in body contouring surgery. *Aesthet Surg J* 2013;33(3):72S–5S.
- Hurwitz DJ, Reuben B. Quill barbed sutures in body contouring surgery: a 6-year comparison with running absorbable braided sutures. *Aesthet Surg J* 2013;33(3):44S–56S.
- Gutowski KA, Warner JP. Incorporating barbed sutures in abdominoplasty. *Aesthet Surg J* 2013;33(3):76S–81S.
- Shermak MA, Mallalieu J, Chang D. Barbed suture impact on wound closure in body contouring surgery. *Plast Reconstr Surg* 2010;126(5):1735–41.
- Hirsch EM, Seth AK, Fine NA. Reconstruction of the inframammary fold using barbed suture. *Ann Plast Surg* 2014;72(4):388–90.
- Prucz R, Wheeler C, Edwards J, et al. The use of a barbed self-retaining suture system in the positioning and manipulation of the breast mound during reconstructive and aesthetic breast surgery. *Plast Reconstr Surg* 2011;128(2):90e–1e.
- Aveta A, Tenna S, Cagli B, et al. V-Loc suture: a simple wound closure device for areola diameter and shape control in breast reduction and mastopexy. *Plast Reconstr Surg* 2012;129(6):1004e–5e.
- Thekkinkattil DK, Hussain T, Mahapatra TK, et al. Feasibility of use of a barbed suture (v-loc 180) for quilting the donor site in latissimus dorsi myocutaneous flap breast reconstruction. *Arch Plast Surg* 2013;40(2):117–22.
- de Blacam C, Colakoglu S, Momoh AO, et al. Early experience with barbed sutures for abdominal closure in deep inferior epigastric perforator flap breast reconstruction. *Eplasty* 2012;12:e24.
- Jandali S, Nelson JA, Bergrey MR, et al. Evaluating the use of a barbed suture for skin closure during autologous breast reconstruction. *J Reconstr Microsurg* 2011;27(5):277–86.
- Zaruby J, Gingras K, Taylor J, et al. An in vivo comparison of barbed suture devices and conventional monofilament sutures for cosmetic skin closure: biomechanical wound strength and histology. *Aesthet Surg J* 2011;31(2):232–40.