The closure of cutaneous wounds is a defining procedure in plastic surgery. Traditional techniques include the placement of buried dermal sutures to provide accurate tissue edge approximation, as well as long-term support of the wound closure. Exact cutaneous alignment is then provided by the placement of a subcuticular suture that winds back and forth across the wound, providing additional support for the wound and accurate approximation of the tissue edges. This is the basic 2-layered closure strategy used by many surgeons. Over time, modifications in this 2-layered closure strategy have relied on monofilament sutures to help prevent the formation of suture granulomas with subsequent “spitting” (extrusion) of the suture. Antibiotic-coated suture materials are designed to fight infection, with superficial wound support from tapes or tissue adhesives and topical agents designed to deliver pharmacologic agents to the wound and help produce a less conspicuous scar. Despite all of these wound closure modifications, none has appreciably affected the appearance of the resulting scar in a meaningful way, and complications related to wound separation, infection, and, most important, widened, hypertrophic, or unsightly scars continue to be a possible result of the traditional methods of wound closure.

Relatively recently, a technical modification in suture construction has been introduced that radically affects the wound closure procedure. Adding small barbs into the substance of the strand creates an effective strategy for stabilizing the suture and securing the wound into position. This seemingly minor modification provides significant advantage in the closure of cutaneous wounds. The self-stabilizing nature of the suture eliminates the need for a “third hand,” and tension on the suture need not be continuous during placement. This allows the surgeon better tactile control of the wound closure process. The speed and efficiency with which long incisions can be closed is increased, providing a particular advantage when closing long abdominoplasty or bodylift-type defects. Finally, my experience using this type of suture in more than 300 cases suggests that the appearance of the final scar seems to be subjectively improved, likely as a result of the near-complete stabilization of the wound edges. By eliminating micromotion, the final appearance of the scar is a thin and...
fine line, as is only occasionally seen with traditional methods of wound closure. In my experience, the use of barbed sutures offers one of the most significant advantages in wound closure strategy. This report will outline the design features of barbed sutures, describe the types of procedures in which they are optimally used, and provide examples of the results in a variety of clinical situations.

SUTURE DESIGN

The inspiration behind the strategy for the use of barbed sutures was the porcupine quill (Figure 1). When these quills are lodged in the skin, they are very difficult to remove because of the angled back-cuts in the quill’s shaft. The same design is used to manufacture fishing hooks. The barb that is behind the sharpened end of the hook prevents easy dislodgment. Incorporating these types of barbs into the length of a suture strand stabilizes the strand into the soft tissue. Wherever the barbs are engaged within the soft tissue—whether in skin, fat, or fascia—as tension is released, slippage of the suture is prevented by the barbed back-cuts. This is the basic advantage afforded by the use of barbed sutures. Currently, there are 2 types of barbed sutures available for use in plastic surgery: bidirectional and unidirectional.

Quill Self-Retaining System

The Quill Knotless Tissue-Closure Device (Angiotech Pharmaceuticals, Inc, Vancouver, British Columbia, Canada) uses a back-cut in the strand of several types of monofilament sutures, both absorbable (polyglycolic acid/polycaprolactone [Monoderm] and polydioxanone [PDO]) and nonabsorbable (nylon and polypropylene). The back-cut is performed at a set, cut angle that creates a barb that is broad at the base and then tapers to a point (Figure 2). This cut in the suture strand reduces the effective diameter of the suture so that a 3-0 suture has the effective strength...
of a standard 4-0 suture. The back-cuts are placed so that there are 8 barbs per centimeter arranged helically, with 1 helix of barbs spanning a distance of 5.08 mm.\(^5\)

The basic strategy relies on a bidirectional approach, with a needle swedged on either end of the suture. The directionality of the barbs then changes at the midpoint of the suture strand. As a result, wound closure using a Quill device begins at the midpoint of the wound. Several passes of the suture are made in 1 direction until there is purchase of the barbs into the soft tissue. This then acts as the anchor by resisting the pulling of the opposite end of the suture through the tissues, as tension is applied by passing the remaining half of the strand in the opposite direction. Both ends are then passed through the tissue running in opposite directions until the wound is closed. At the end of the suture, a small back pass is added to the closure to enhance the engagement of the barbs, and thus there is no need to incorporate a loop or other type of fixation method as the suture is locked into position. As a result, the suture is simply cut flush with the skin and the cut end retracts slightly below the skin level. This creates a completely buried suture with no exposed ends to clip postoperatively.

**V-Loc 90, V-Loc 180**

The V-Loc wound closure device system (Covidien, Mansfield, Massachusetts) operates on a similar strategy. The barbs are rendered at a dual-cut angle that creates an initial oblique cut in the suture strand and is followed by a cut that runs parallel to the length of the suture (Figure 3).\(^5\) As a result, the barbs have less projection but a broader base, providing a substantial anchor for engagement into the soft tissues. Placing the barbs in the suture strand reduces the diameter of the suture slightly so that a 3-0 strand is used to make a 4-0 V-Loc suture. The nomenclature used with this suture takes this mild weakening of the suture strand into account; therefore, a 4-0 V-Loc suture is actually the size of a standard US Pharmacopeia (USP) 3-0 suture. The barbs are placed so that there are 20 barbs per centimeter arranged helically, with 1 helix spanning a distance of 1.52 mm.\(^5\) Currently, the V-Loc suture is available only in an absorbable form (combination of polyglycolic acid, 60%; polytrimethylene carbonate, 26%; and polydioxanone, 14%). The basic strategy with the V-Loc device is similar to that used with Quill, with the major difference being that the V-Loc is a unidirectional barbed suture. The V-Loc has a welded loop at 1 end of the suture strand that is used to secure the beginning of the wound closure. Therefore, as opposed to starting in the middle of the wound as with Quill, closure with the V-Loc begins at either end of the wound. The suture is passed through the loop, and closure then proceeds along the length of the wound in a unidirectional fashion until the wound is closed.

**INDICATIONS**

**Abdominoplasty**

The advantages of using barbed sutures can be demonstrated most dramatically during the closure of an abdominoplasty.\(^6,7\) Traditional closure after removal of the redundant skin and fat involves the use of a heavier absorbable suture placed in an interrupted fashion to approximate Scarpa’s fascia across the entire wound. This is then followed by the use of absorbable, interrupted, inverted, monofilament sutures placed in the dermis, with final closure using a running absorbable monofilament subcuticular suture. The placement of multiple interrupted sutures is time-consuming and labor-intensive. Using barbed technology eliminates the need for these sutures. By using a 0 to 2-0 barbed suture, a running technique closing Scarpa’s fascia can be performed without the aid of an assistant, creating a secure and well-approximated closure in a matter of minutes. The locking nature of the suture eliminates the need for a “third hand,” allows accurate reaproximation of the fascial edges, evenly distributes the inherent tension on the wound, and is quickly completed. The subcuticular closure is performed in a similar fashion, using a 3-0 to 4-0 barbed suture to complete the cutaneous portion of the closure. In most cases, the secure nature of this closure can even obviate the need for interrupted, inverted sutures to reinforce the wound; thus, a complete and secure wound closure can be accomplished with 2 running sutures. This approach saves time and is now my standard technique for the closure of large abdominal wounds. Final wound dressing can be done...
with paper tapes or, more preferably, tissue adhesives. Because the suture ends are cut flush with the skin, there is no need to clip them postoperatively.

While the time saved is significant, perhaps the greatest advantage is the appearance of the resulting scar. In most instances, even at an early stage, the scar is a fine line and lacks the usual evidence of inflammation that can be observed with traditional techniques using braided or nonbarbed monofilament sutures. One likely explanation for this observation relates to the inhibition of micromotion at the suture line as a result of the locking nature of the suture. By preventing the subtle sliding of the tissue edges that can occur with a monofilament suture, a more secure and stable wound environment may be created, leading to less “reactive” scarring. Regardless of the mechanism, I can subjectively say that the scars associated with the use of barbed sutures for closure have been the most fine-line and inconspicuous scars I have seen in 20 years of practice (Figure 4).

**Bodylifting**

Using barbed suture technology can be beneficial for the long incisions occurring in the circumferential wounds associated with bodylifting. The advantages of the secure closure, as well as the savings in operative time and effort, are magnified as wound closure in these patients can be particularly labor intensive. Also, the improved appearance of the scar makes this an attractive option for these patients, for whom the scar burden can be extensive.

**Brachioplasty**

While the contour correction associated with brachioplasty can be significant, the resulting scar remains a decided disadvantage. In these cases, the use of barbed sutures not only allows for a secure and well-approximated 2-layer closure in an area that can be difficult to close, but the resulting scar is as inconspicuous as possible (Figure 5). As noted previously, this effect is likely related to the improved stability of the wound edges associated with barbed sutures. With the brachioplasty scar being placed in an area prone to variable tension depending on the movement of the arms, the ability of the barbed suture to resist wound-edge motion may be particularly pronounced, leading to a less conspicuous and fine-line scar.

**Breast Reduction/Mastopexy**

One of the hallmark techniques for breast reduction and mastopexy is lifting the position of the nipple-areola complex (NAC) using periareolar techniques. After placing the periareolar purse-string suture that is used to control the areolar diameter, placing a subcuticular barbed suture to complete the skin closure further supports the wound and evenly distributes the tension on the closure. It also creates a final appearance of the scar that is fine and inconspicuous (Figure 6). Using barbed sutures inside the breast as shaping sutures can help stabilize the breast in position and improve the overall aesthetic result.

**Facelifting**

Modern facelift techniques now include excision and lifting of excess skin and repositioning of the superficial musculoaponeurotic system (SMAS) and associated fascial planes to achieve aesthetic and long-lasting results. The use of barbed sutures for internal plication of ptotic facial fat and suspensory structures allows precise and stable repositioning of these various tissues to rejuvenate the skin and deeper structures. The locking nature of the suture allows the effect of each suture pass to be assessed without the need to apply tension, a technical advantage that makes reshaping the various tissue planes more precise and effective.

**Thighlifting**

The desire to create an aesthetic and fine-line scar after a thighlift is just as important as with brachioplasty. The tension placed on the wound closure after a thighlift can be significant, and it is in this aspect that barbed suture closure provides a particular advantage. As the deep layers are approximated with the barbed suture, the tension on the wound is evenly and securely distributed in an easy and straightforward fashion, enhancing the accuracy of wound closure and maximizing the potential for the wound to heal. The absence of knots also minimizes the potential for suture granuloma formation and possible subsequent wound dehiscence. Finishing the wound closure with a running barbed subcuticular suture enhances the security of the wound and improves the subsequent appearance of the scar.

**Fascial Plication**

A permanent barbed suture can also be used in the fascia of the abdominal wall after transverse rectus abdominus myocutaneous (TRAM) flap harvest or as an adjunct to abdominoplasty. The ability to control fascial tightening without the need to apply constant pressure to the suture enhances the accuracy of placement and allows the tightening of the fascial and muscular elements to proceed with proper tension as opposed to the sliding in and out of the suture strand that occurs when a smooth monofilament suture is used. Such suture sliding can actually tear the fascia as it is repeatedly tightened and loosened, leading to a tenuous fascial closure and the possibility of suture-line failure with the subsequent development of an...
abdominal bulge or even a frank hernia. Again, there is no need to employ knots as the suture strand is simply backed over itself with several additional throws to enhance the security of the closure. Therefore, the potential for palpability of knots through the skin in thin women is completely negated.

**Quilting Suture**

Whenever large spaces are developed during dissection—as can happen with TRAM flap elevation, abdominoplasty, or latissimus flap elevation—the buried barbed suture can be of great assistance in closing the dissection space and

Figure 4. (A) This 36-year-old woman presented for abdominoplasty. (B) Preoperative markings. (C) Early postoperative result at 7 weeks after abdominoplasty in which closure was performed using a 2-0 PDO Quill suture (Angiotech Pharmaceuticals, Inc, Vancouver, British Columbia, Canada) in Scarpa’s fascia along with 3-0 monoderm Quill in the skin. (D) Close-up view at 7 weeks showing mild edema along the wound edge but only minimal redness and inflammation. A fine-line scar is already in evidence. (E) One-year postoperative result showing a fine-line and inconspicuous scar.
minimizing the chances for postoperative seroma formation. Again, due to the self-locking nature of the suture, progressive areas of the dissection pocket can be cinched down from the periphery, working centrally without the need to tie knots. This speeds the procedure, enhances the accuracy of the suture placement, may obviate the need for drains, and allows accurate positioning of the overlying skin flap in relation to the deep aspect of the cavity, whether in the abdominal wall or the posterior back. In this regard, barbed sutures offer a significant technical advantage in the placement of what can be very difficult sutures to place accurately and effectively.

Figure 5. (A) This 48-year-old woman presented for brachioplasty after undergoing massive weight loss. (B) Preoperative markings. (C) Early postoperative result at 6 weeks after brachioplasty in which closure was performed with a deep 2-0 PDO Quill barbed suture along with a 3-0 Monoderm Quill (Angiotech Pharmaceuticals, Inc, Vancouver, British Columbia, Canada) subcuticular suture. The wound shows mild edema along the suture line with little associated redness or inflammation. (D, E, F) Three-year postoperative result showing a fine-line and inconspicuous scar.
Due to the chemical composition of the various types of absorbable barbed sutures, some materials that have a slower absorption rate can work through to the surface before full absorption has occurred, creating temporary draining sinuses, wound dehiscence, and excessive scar formation. In particular, the use of polydioxanone (PDO) suture closures on the skin surface appears to be prone to erosion and subsequent "suture spitting." This material is only minimally absorbed at 120 days and may work its way to the surface before complete absorption is realized. For this reason, it is recommended that PDO suture materials be used only for deeper closures, reserving the polyglycolic...
elimination of the “third hand” during wound closure, wound, increased ease and accuracy of suture placement, and the ability to provide fine-line and inconspicuous scars. Based on my personal experience, the use of this technology is recommended as a means of enhancing the surgical outcomes for a variety of plastic surgery patients.

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**REFERENCES**


**SUMMARY**

Although simple in design, barbed sutures offer numerous benefits, including even distribution of tension along the wound, increased ease and accuracy of suture placement, elimination of the “third hand” during wound closure, avoidance of knots, shorter operative times, and the ability to provide fine-line and inconspicuous scars. Based on my personal experience, the use of this technology is recommended as a means of enhancing the surgical outcomes for a variety of plastic surgery patients.

**Figure 7.** Close view of a barbed suture that has been rubbed against a 4 × 4 gauze surgical sponge. Fibers from the sponge can be seen lodged into the interstices of the barbs along the length of the suture strand.