Suture Products and Techniques: What to Use, Where, and Why

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BACKGROUND There are an increasing number of wound closure materials and suturing techniques described in the dermatologic and surgery literature. A dermatologic surgeon's familiarity with these materials and techniques is important to supplement his or her already established practices and improve surgical outcomes.

OBJECTIVE To perform a thorough literature review of wound closure materials (sutures, tissue adhesives, surgical tape, and staples) and suturing techniques and to outline how and when to use them.

MATERIALS AND METHODS A literature review was conducted using PubMed and other online search engines. Keywords searched included suture, tissue adhesive, tissue glue, surgical tape, staples, dermatologic suturing, and suturing techniques.

RESULTS Numerous articles outline the utility of various sutures, surgical adhesives, surgical tape, and staples in dermatologic surgery. In addition, there are various articles describing classic and novel suturing techniques along with their specific uses in cutaneous surgery.

CONCLUSION Numerous factors must be considered when choosing a wound closure material and suturing technique. These include wound tension, desire for wound edge eversion/inversion, desired hemostasis, repair type, patient's ability to care for the wound and return for suture removal, skin integrity, and wound location. Careful consideration of these factors and proper execution of suturing techniques can lead to excellent cosmetic results.

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There are numerous wound closure materials and techniques available to dermatologic surgeons. A thorough knowledge of these options helps the surgeon choose the best combination to create the most cosmetically appealing scar. This article will review the basic concepts of suture and other wound closure materials, discuss when to use these products, and outline suturing techniques and their appropriate use.

Sutures

Sutures are the materials most commonly used in skin closure. There are a variety of suture types, each with their own unique characteristics that must be understood to choose the best suture for a particular wound closure procedure. Sutures are best characterized by their physical properties, which include composition, configuration, surface, coating, color, and ability to degrade over time.[1] Secondary characteristics are the secondary properties that sutures acquire in response to their composition. These are listed in Table 1.[2]

Suture Characteristics

Suture Composition

Sutures are composed of either natural or synthetic materials. Natural suture materials have a higher inflammatory reaction and more uneven distribution of strength along the length of the suture as compared to synthetic suture materials.

Suture Configuration

The configuration of a suture denotes whether it is multifilament or monofilament. Multifilament sutures are composed of several filaments, braided, or twisted

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TABLE 1. Suture Properties

Property	*Description*
Tensile strength	Weight necessary to beak suture Dependent on suture diameter
Knot security	Likelihood that a knot will hold without slipping
Capillarity	Absorption of fluid along the suture (can increase infection risk)
Elasticity	Ability to return to normal size and shape after stretching
Plasticity	Ability to stretch and maintain their deformed shape
Pliability	Ease with which suture bends
Memory	Ability of a suture to maintain its original shape
Tissue reactivity	Likely inflammatory tissue response caused by the suture
Coefficient of friction	Ability to slide through tissue

together, whereas monofilament sutures are made of a single strand. The benefits of multifilament sutures are their increased tensile strength, good pliability, greater knot strength, and low memory. In general, it is easy to handle and ties well. Because of its braided or twisted nature, however, multifilament sutures have a relatively high coefficient of friction that causes more drag as they pass through tissue. Multifilament sutures also have high capillarity and inflammatory potential, which may increase the risk of surgical site infection. The advantages of monofilament sutures are their low coefficient of friction leading to minimal tissue drag, low inflammatory reaction potential, and at least theoretically lower risk of infection. However, monofilaments have a high memory, making them more difficult to handle and tie than seen in multifilament sutures. It is the opinion of the authors that an extra throw and tug may be necessary to form a secure knot with monofilament sutures because of their decreased knot security.

Surface

The surface of monofilament sutures can be smooth or barbed. A smooth surface is traditional. Barbed sutures are a relative newcomers to the suture market. Little nicks along their surface are used to grab hold of the skin, thus increasing the rapidity with which sutures can be placed and obviating the need for knot tying.

Coating

Monofilament sutures are uncoated. Multifilament sutures may be uncoated or coated. Coating decreases the coefficient of friction to allow the suture to slide through tissue with greater ease. It may also decrease the multifilament suture's potential risk for infection.

Antibacterial Coating

Several suture types are available with an antibiotic coating of triclosan. The coating is intended to decrease the risk of surgical site infections by preventing bacterial colonization of the suture. A triclosan-coated suture exhibits a zone of inhibition that is effective against the most common pathogens of surgical site infections—*Staphylococcus aureus*, methicillin-resistant *S. aureus* (MRSA), *S. epidermidis*, methicillin-resistant *S. epidermidis* (MRSE), *Escherichia coli*, and *Klebsiella pneumonia*.[3] Although studies have shown that antibiotic sutures reduce suture colonization, firm data is lacking to show reduced surgical site infection rates.[4]

Color

Adding color to suture makes it easier to visualize. After tissue implantation, the color dissolves over time.

Suture Absorption

A suture material is considered absorbable if it loses most of its tensile strength within 60 days of tissue implantation.[5] A natural suture is degraded by proteolysis, whereas a synthetic suture is degraded by hydrolysis. The rate of absorption can be affected by numerous patient factors. It is accelerated when placed in mucous membranes, in the presence of infection, or if the patient is malnourished or protein deficient.[6] Sutures that retain most of their tensile strength beyond 60 days are considered to be nonabsorbable.

Typically, absorbable sutures are used deep in the defect or subcutaneously to decrease dead space, decrease tension on wound edges, and approximate the wound edges before placing an additional wound closure material (i.e., nonabsorbable or absorbable suture, staples, tissue adhesive) in or on the epidermis. They

provide temporary strength until wound maturation allows sufficient strength to withstand normal stress.

During the first phase of the absorption process, within the first several weeks after implantation, the tensile strength of the suture decreases in a gradual manner. The second stage of absorption may overlap with the first stage, but is characterized by the loss of suture mass. During both phases, a leukocytic cellular response serves to remove the cellular debris and suture material from the wound.[7]

It is important to note that the loss of tensile strength and rate of absorption are 2 separate characteristics. A suture may quickly lose tensile strength but may take a longer time to get absorbed completely. In contrast, a suture may retain its tensile strength quite well until the point when it dissolves rapidly. Overall, the ideal absorbable suture has low reactivity, high tensile strength, slow absorption, and good knot security.[8] It is also important that the absorbable suture exhibit low tendency for knot extrusion. Reagan and Lawrence[9] demonstrated that use of poliglecaprone 25 as deep absorbable sutures resulted in significantly less extruded sutures than does polyglactin 910.

The absorbable sutures that are most preferred by dermatologic surgeons are polyglactin 910 (73%), poliglecaprone 25 (11%), polyglycolic acid (5.5%), and polydioxanone (5.5%). The nonabsorbable sutures most preferred by dermatologic surgeons are nylon (51%) and polypropylene (44%).[10] However, more recent data are needed as the popularity of using the same absorbable suture for both subcutaneous and surface closure increases. Table 2 and Table 3 outline characteristics of the the most commonly used absorbable and nonabsorbable sutures.[1,2,7,11]

Nonsuture Alternatives

Tissue Adhesives

The use of tissue adhesives for repair of traumatic lacerations and surgical wounds was first reported in 1959.[12] Tissue adhesives belong to the family of cyanoacrylates, and their adhesive properties are a result of polymerization that occurs on contact with moisture on the skin. There are various formulations of cyanoacrylates, and their strength and physical properties are dependent on their alkyl side chains. Commercially available tissue adhesives include octyl cyanoacrylate (Dermabond; Ethicon, Somerville, NJ), butyl cyanoacrylate (LiquiBand; Advanced Medical Solutions, Devon, United Kingdom), and N-butyl-2-cyanoacrylate (GluSeal; GluStitch, Delta, Canada).

Tissue adhesive is typically used in place of epidermal sutures, once buried intradermal sutures are in place. It is applied to a clean, dry surgical site by brushing or dropping the liquid directly onto the wound. It is extremely important that wound edges be in direct apposition before application of the adhesive, so that the liquid does not seep between the edges of the defect and inhibit good wound healing (Figure 1). There are numerous advantages to using tissue adhesive. The application is usually faster than epidermal suturing and can be performed by support staff.[13] Tissue adhesive also has innate hemostatic properties and low allergic potential, does not require a secondary bandage or water avoidance after surgery, and alleviates the need for suture removal.[14] The disadvantages of tissue adhesives are that they must be used on perfectly approximated wounds and postoperative bleeding may cause epithelial wound edge separation. The cost comparison between sutures and tissue adhesives varies depending on the specific products used. Generally, single-use tissue adhesive is more expensive than a multiuse vial. One application of the more cost-effective multiuse vial is comparable to the price of 1 rapidly absorbing suture.

Surgical Strips

Surgical strips are placed across the wound and are most commonly used to support the standard sutured wounds or to repair lacerations. They can also be used in place of sutures for epidermal closure in low-tension wounds, after the placement of buried sutures. To increase the length of time of the strips to stay in a place, a liquid adhesive, such as Mastisol (Ferndale Laboratories, Inc., Ferndale, MI), can be placed on the dry skin surrounding the surgical line before the placement of the strips. Using this method, the strips can last 1 to 2 weeks.[15,16]

TABLE 2. Absorbable Sutures[2,7,8,10]

Suture	*Configuration*	*Tensile Strength*	*Strength Retention Profile*	*Complete Absorption*	*Tissue Reactivity*	*Handling*	*Knot Strength*	*Comments*
Surgical gut (plain)	Virtually monofilament	Poor	7–10 d	70 d	High	Intermed	Poor	Unpredictable absorption rates
Surgical gut (chromic)	Virtually monofilament	Poor	21–28 d	90 d	High—less than plain	Intermed	Poor	Unpredictable absorption rates, True allergy possible
Surgical gut (fast-absorbing)	Virtually monofilament	Poor	5–7 d	20–42 d	High	Intermed	Poor	Useful in attaching grafts
Fast-absorbing Polyglactin 910 (Vicryl Rapide)	Multifilament	Good	50% at 5 d	42 d	Low to intermed	Good	Good	
Polyglactin 910 (Vicryl)*	Multifilament or monofilament	Quite high	50% at 21 d	56–70 d	Low to intermed	Good	Good	Easy to handle, high coefficient of friction
Poliglecaprone 25 (Monocryl)*	Monofilament	Quite high	50%–60% at 7 d; 20%–30% at 14 d	91–119 d	Very low	Very good	Good	Highest knot security of synthetic absorbable sutures
Polydioxanone (PDS)*	Monofilament	High	4–0: 35% at 42 d; 3–0: 60% at 42 d	183–238 d	Low	Poor	Poor	Also available in barbed form
Polyglyconate (Maxon)	Monofilament	Very High	59% at 28 d	180 d	Very low	Very good	Very good	
Polyglycolic acid (Dexon)	Multifilament Braided	Intermed	20% at 21 d	60–90 d	Low to intermed	Good	Good	High rate of knot extrusion
Glycomer 631 (Biosyn)	Monofilament	High	75% at 14 d; 40% at 21 d	90–110 d	Very Low	Good	Poor	
Polyester (Velosorb)	Multifilament Braided	Quite high	45% at 5 d	50–60 d	Low to intermed	Good	Good	

*Available with antibiotic coating.

TABLE 3. Nonabsorbable Sutures[2,7,8,10]

Suture	*Configuration*	*Tensile Strength*	*Memory*	*Handling*	*Tissue Reactivity*	*Knot Strength*	*Comments*
Silk	Multifilament Braided	Low	Low	Excellent	High	Excellent	Good for mucosal surfaces
Nylon (Ethilon, Monosof, Dermalon)	Monofilament	High	High	Poor	Low	Poor	Inexpensive
Nylon (Nurulon, Surgilon)	Multifilament braided	High	Moderate	Good	Low	Fair	Inexpensive
Polypropylene (Prolene)	Monofilament	Moderate	High	Poor	Low	Poor	
Polybutester (Novafil)	Monofilament	High	Low	Good	Low	Good	
Polyester (Mersilene, Ethibond Excel)	Multifilament braided	Very high	Moderate	Very good	Moderate		Some have polybutylate coating which is very adherent to suture

Staples

Surgical skin staples are composed of stainless steel and are an efficient means of skin closure. They are most commonly used to close long or high-tension wounds on the scalp. They provide the highest tensile strength of any skin closure materials, have low reactivity, and a lower risk of infection than most sutures.[17] Staples provide good wound eversion and, in comparison to nylon sutures in epidermal closure, staples have been shown to have equivalent cosmetic outcomes.[18–21] The placement of staples is faster than observed in sutures and, factoring in time, is more cost-efficient.[18]

Figure 1. Application of tissue adhesive to a facial wound after intradermal sutures.

Choosing the Right Suture/Wound Closure Material

The surgeon should use the smallest caliber suture possible to maintain the strength of the wound. Sutures of 5-0 and 6-0 are most commonly used in facial defects and in areas of low tension. In areas of higher tension, a higher-caliber suture that has high and prolonged tensile strength must be used. For example, on areas like the trunk, slow-absorbing and strong 2-0 to 4-0 polydioxanone sutures are useful for deep sutures, whereas polypropylene and nylon are useful as surface stitches. On areas like the face, fast-absorbing and weaker sutures, such as fast-absorbing gut and irradiated polyglactin 910 (Vicryl Rapide, Ethicon), are useful for small facial closures under minimal tension, after the wound is approximated with subcutaneous sutures. They are also useful sutures for simple epidermal closure and full-thickness skin graft fixation and provide a good cosmetic outcome and alleviate the need for suture removal.[22–25]

Traditionally, nonabsorbable sutures have been used for epidermal closure. However, numerous studies have shown the utility of using the same absorbable suture for epidermal closure and for intradermal closure (Figure 2). Specifically, poliglecaprone 25 and polyglactin 910 have been shown to have cosmetic

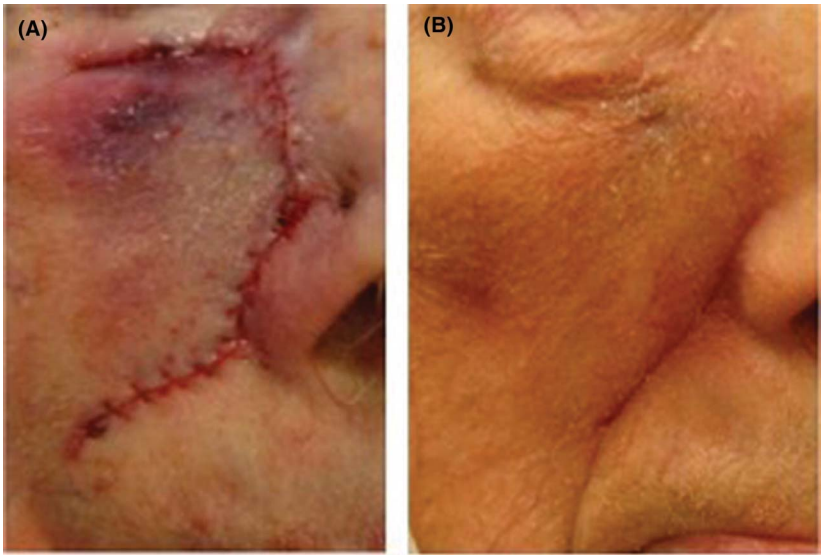

Figure 2. (A) Facial wound closed using poliglecaprone 25 as the intradermal and epidermal sutures. (B) Wound 3 months after suture removal.

results equal to those of polypropylene and nylon, respectively, when used to close the surface of the wound.[26,27] There is a cost savings of between $4.13 and $12 per procedure when using 1 package of poliglecaprone 25 alone, as compared to a combination of 1 absorbable and 1 nonabsorbable suture.[28] It is important to note that the absorbable epidermal sutures were still removed at the standard timeline.

Choosing the Right Suturing Technique

The ideal skin closure technique is the one that reduces tension on the skin edges, provides precise wound edge approximation and eversion, ensures adequate hemostasis, is relatively fast for the surgeon to perform, and leaves few or no lasting suture marks. The best techniques to achieve the ideal closure vary depending on intrinsic characteristics of the skin and the location of the defect. In many cases, surgeons use standard buried dermal or buried vertical mattress sutures and simple interrupted or simple running sutures to close defects. However, the authors will focus on other wound closure techniques to achieve exceptional cosmetic results.

Undue wound tension can lead to wound edge separation and scar widening with time. Deep, tension-relieving sutures are helpful, especially in large defects, to eliminate surface tension. These sutures include the suspension,[29] imbrication,[30] plication,[31] ImPli,[32] corset plication,[33] and pulley sutures. When using the imbrication or plication stitch, or any tension-bearing stitch in general, it is useful to place 2 identical sutures side by side in series before tying off, thus, using the pulley effect. By sharing the tension over multiple points, the workload of tension on each suture in the series is decreased so that the overall stitch holds better and is stronger.

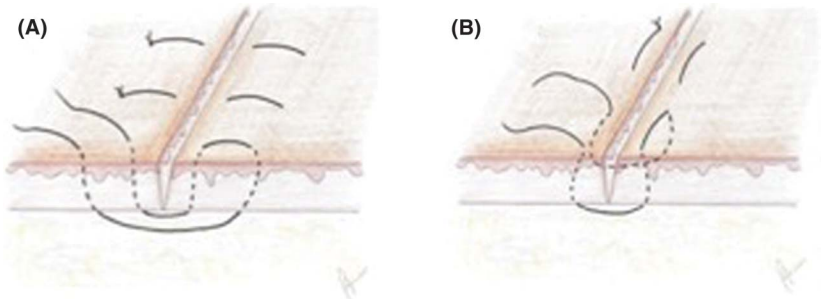

Figure 3. (A) Vertical mattress suture. (B) Horizontal mattress suture.

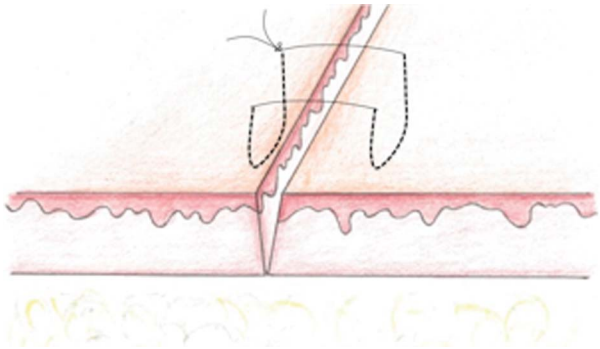

Figure 4. Inverting horizontal mattress suture placement.

After alleviating tension from the wound edges, the surgeon must create proper wound edge apposition. In most cases, especially on the face, apposition with good wound edge eversion is desired to allow the maximal surface area of the defect edges to grow together. Two recent studies examined the cosmetic benefits of wound edge eversion.[34,35] One study concluded that wound edge eversion is not significantly associated with improved overall scar cosmesis, whereas another study concluded that it was. It is likely that the true benefit of wound edge eversion may be site specific—being more important on the face than the trunk. Still, further studies are needed to establish the necessity of wound edge eversion. When desired, eversion is created by both buried and epidermal sutures. The buried butterfly, set-back buried dermal, and subcutaneous inverted cross mattress (SICM)[36] sutures are modifications of the buried vertical mattress suture and create maximal wound eversion. In areas of high tension, it can sometimes be difficult to obtain adequate eversion with buried sutures alone. The vertical mattress or horizontal mattress suture can help better approximate and evert wound edges in such situations (Figure 3). In rare instances, inversion of the scar is desired. The inverting horizontal mattress suture is a modification of the traditional horizontal mattress suture and is a useful suture in this circumstance (Figure 4). This suture lifts the skin on either sides of the incision, limiting potential strangulation of the wound edge, and inverts the wound edges.[37]

Many dermatologic surgery patients are at a higher risk of bleeding because of their anticoagulant state or the location of the defect (i.e., the scalp). Postoperative bleeding can result in hematoma formation, postoperative infection, wound dehiscence, and an overall inferior looking scar. The running locking suture and horizontal mattress suture, both standard and locking, are useful to help ensure hemostasis. One must use these sutures judicially as they all have an increased risk of wound edge strangulation and tissue necrosis.

There are several specialized sutures for specific repair types. The "tip" stitch (both traditional and buried) is useful for securing 3 or more edges of tissue together, while avoiding penetrating epidermal sutures and possible tissue strangulation.[38] It is most helpful for the leading, pointed edge of flaps that are often used in facial reconstruction (Figure 5). Guitar-string sutures and purse-string closures are helpful techniques to decrease the defect size before grafting or flap placement.[39–41] Guitar-string sutures are individual pulley sutures placed in the dermal–subcutaneous plane. Purse-string closure may be used to reduce large defects before allowing to heal by second intention.[42]

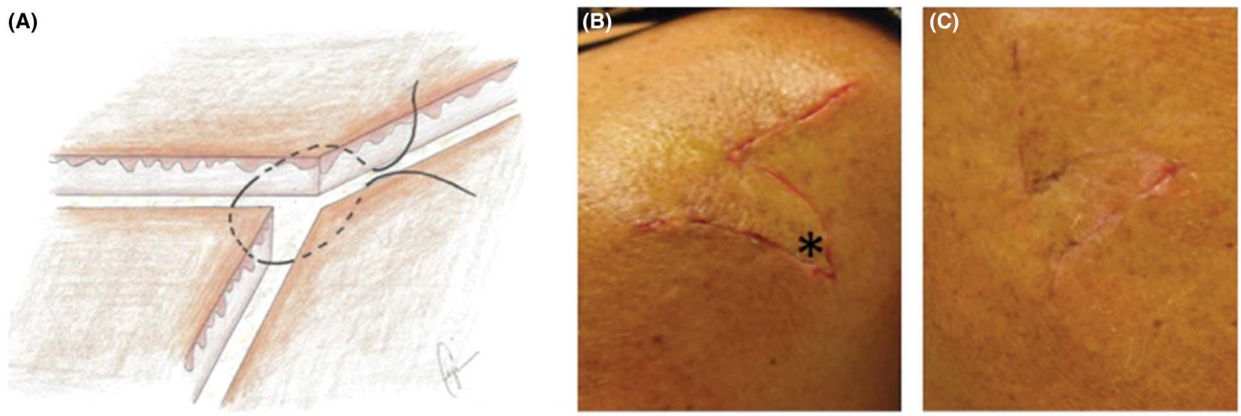

Figure 5. (A) Standard tip stitch placement. (B) Buried tip stitch placed at *. (C) Result in 2 weeks.

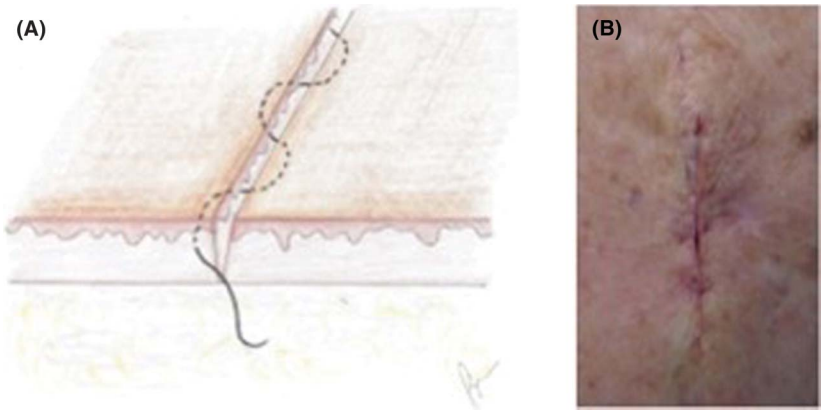

Figure 6. (A) Running subcuticular suture placement. (B) Zipper suture used for wound closure on the trunk.

Many dermatologic surgeons, knowingly or unknowingly, have formed their own standard, regional approach to their suturing technique. The next section will outline useful techniques in common surgical areas. Wound tension and skin integrity are also useful considerations and will be discussed throughout this section.

Figure 7. Running horizontal mattress suture producing wound edge eversion on the nasal bridge.

Choice of Suture and Suturing Technique Based on Location

Scalp

Scalp wounds often present a closure challenge because of the convexity of the surface and the lack of skin laxity. The dermis can be brittle and tear easily. Often the surgeon does not have the opportunity to adjust his sutures because once there is a hole in the dermis made by the suture needle, there is inadequate dermis remaining to replace the suture. Imbrication sutures can be very helpful in reducing inherent wound edge tension and providing deep tension support. To perform it, the galea should be incised along the axis of the defect and the area undermined in the subgaleal plane. At this point, a galectomy may also be performed.[30] Caution must be exercised because this can cause remote bleeding from the incision site, which can be difficult to control. A suture of appropriate weight and strength, the authors prefer 4-0 polydioxanone or 3-0 poliglecaprone 25, is placed by taking a 0.5- to 1-cm bite through the galea and subcutaneous fat.

The far–near–near–far pulley stitch is useful in scalp defects. It is a temporary stitch that can be placed before dermal sutures to promote mechanical tissue creep. Pulley stitches can be left in place, if necessary, to better approximate the epidermis.[43] Otherwise, standard buried dermal sutures, particularly the SICM suture,[36] can be placed before pulley stitch removal. The SICM suture incorporates 2 side-by-side buried vertical mattress sutures placed in series before being tied off and creates an intradermal pulley-like suture that can be left in place.

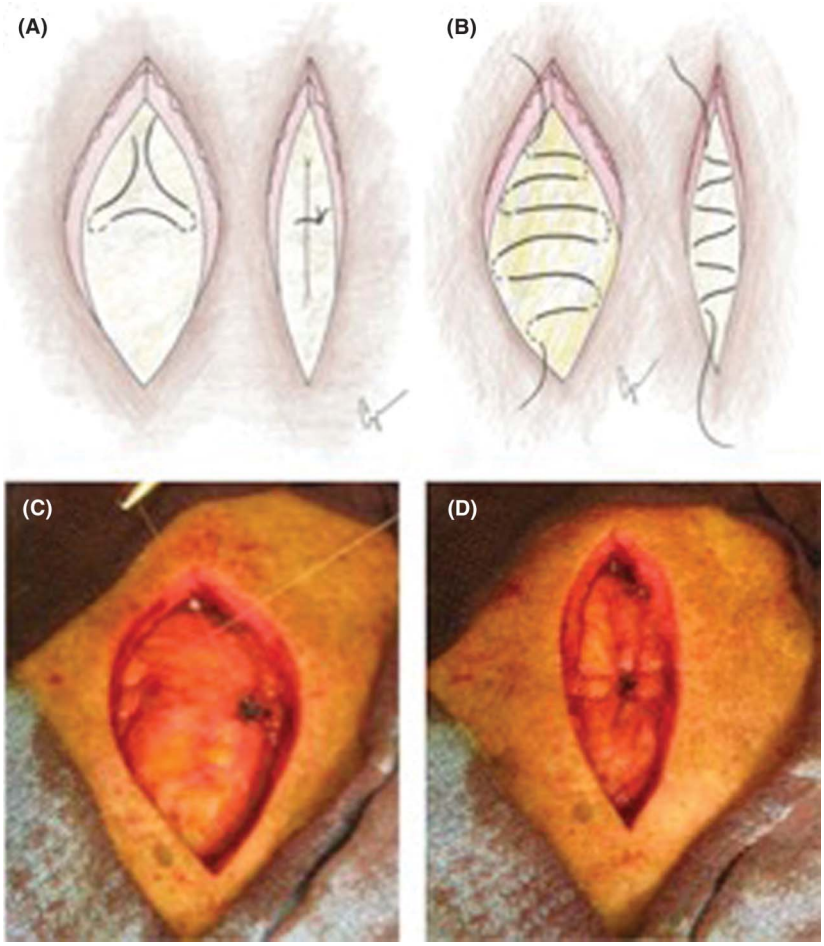

Figure 8. (A) Plication suture placement. (B) Running plication or corset plication suture placement. (C) Plication suture placement in tissue. (D) Resultant tension reduction from plication suture.

Face

Suspension sutures have several important roles in facial reconstruction. They serve to reduce tension on the wound edge, redirect tension away from free margins, and recreate natural demarcations between cosmetic subunits (i.e., nasojugal or nasolabial fold). Suspension sutures are placed between either the leading edge or the midpoint of a flap and a fixed point at the desired position for tissue. The first suture throw should enter and exit through the subcutaneous fat of the moveable tissue, including a bite of the dermis. The second throw should include a large bite of periosteum and soft tissue at the desired suspension point. Preferred suspension attachment points are points of muscle insertion, such as the supraorbital rim of the frontal bone, zygomatic arch, bones forming the nasal vestibule, and mental crease of the chin.[29] Absorbable and nonabsorbable sutures have been reported to be used in suspension sutures. Absorbable sutures reduce the risk of suture extrusion or a permanent palpable knot. Typically, an absorbable suture loses much tensile strength in 1 month and, at this point, there is adequate fibrosis for the tissue to be able to support itself.[29] Another useful stitch in facial reconstruction is the ImPli suture.[32] It combines an imbrication and plication stitch and is useful in flap reconstruction to relieve flap tension and eliminate dead space.

Once tension is relieved and wound edges are apposed, polypropylene can be used for a running subcuticular suture because it exhibits a low coefficient of friction and slides freely at the time of suture removal. After placement, each end of the suture may be knotted onto itself, taped to the skin, or tied to one another and secured with tape. The latter method is helpful to avoid bunching of the wound edge and retraction of knots through the epidermal surface.[44] Another closure

option is to use poliglecaprone 25 for the placement of a zipper suture, which is a subcutaneous closure that involves placement of a series of buried vertical mattress sutures in running fashion[45] (Figure 6).

In well-approximated everted wounds, tissue adhesive provides a fast epidermal closure option. The plastic surgery and dermatology literature has shown tissue adhesives to produce an equivalent or superior cosmetic outcome than suture in surgical facial wound closure.[46–48] In closures and locations where more eversion is needed, such as the nasal bridge, an interrupted or running horizontal mattress suture may be used (Figure 7).[49] In areas of natural concavity, such as the alar crease and scaphoid fossa, wound inversion is preferred and a simple interrupted or inverted horizontal mattress suture is useful.

Trunk

Truncal wounds are often repaired under high tension. Plication sutures alleviate this tension from the wound edge by placing a suture through the deep fat and superficial fascia on either side of the wound at the base.[31] This suture is different from a suspension suture in the fact that it is used to join 2 moveable tissue edges. A running plication suture, described as a corset plication, or 2 side-by-side plication sutures placed in series before tying off can also be used in the same areas (Figure 8).[33] These sutures provide prolonged dermal support until the intrinsic wound strength is gained, preventing scar spread. A 2-0 or 3-0 absorbable suture is ideal for this use.

Scar spread and suture "track marking" are undesired, but somewhat common occurrences in truncal scars.[50] While simple interrupted and simple running sutures are commonly used top-sutures on the trunk, the buried running subcutaneous suture and the zipper suture has great utility in producing a scar with better cosmesis.[10,45,51,52] The zipper stitch is placed after buried vertical mattress, SICM, or set-back buried dermal sutures have produced good wound eversion. A 3-0 or 4-0 poliglecaprone 25 suture is preferred because of its low coefficient of friction and low tissue reactivity. The resultant suture line may feel slightly firm or lumpy because of the superficial placement of sutures, but will settle in time, especially with massage. The zipper suture provides extended epidermal support and leaves no track marks.

The tensile strength of cyanoacrylate sutures is similar to that of a wound closed with interrupted 4-0 poliglecaprone 25 subcuticular sutures.[53] The use of tissue adhesives in high-tension areas, such as the trunk, and the resultant cosmetic outcomes have not been well established. Other specialties have successfully used tissue adhesive for closure of total knee or hip arthroplasty and cesarean section wounds with good cosmetic results.[54,55] However, because they usually do not remove any tissue before wound closure, their wounds are likely under less tension. One of the authors uses tissue adhesive quite frequently for epidermal closure on the trunk with good cosmetic outcomes and no increase in hematoma formation, dehiscence, or infection. However, it must be used, in well-approximated, tension-free wounds. Tissue adhesive requires less wound care than sutures. The patient can wash normally, and no additional dressing is needed. This feature is especially helpful for elderly patients with little assistance at home.

Upper Extremities

Upper extremity wounds are often challenging because of the presence of sun-damaged, atrophic skin. The lack of dermal integrity makes it extremely difficult to place effective subcuticular sutures. Simple interrupted or vertical mattress sutures focus tension across the wound edge and often result in tissue tearing. Such tearing can be prevented by the

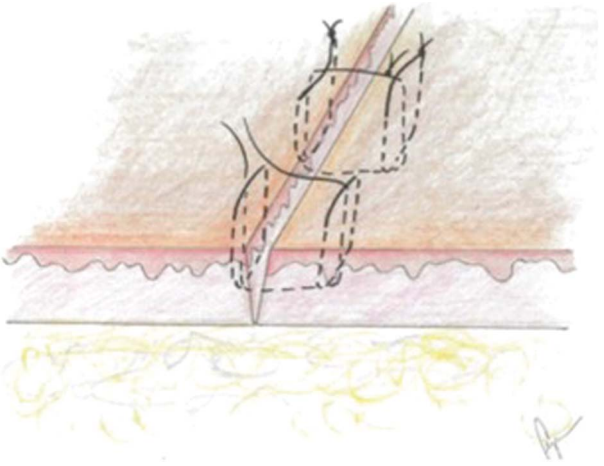

Figure 9. Basic lattice suture placement.

Figure 10. (A) Postsurgical defect. (B) Wound reduction after purse-string closure with polypropylene. (C) Wound at 2 weeks after suture removal. (D) Well-healed wound at 4 months after surgery.

tape buttress technique—first placing surgical strips across or parallel to the axis of the wound bed and then placing simple interrupted or horizontal mattress sutures through the strips that act as a buttress.[56] The basic lattice stitch helps in dispersing the forces across the wound edge in both perpendicular and parallel fashion (Figure 9).[57,58] Tissue adhesive, as discussed previously, can also be a useful tool in this location.

Lower Extremities

Lower extremity wounds are commonly under high-tension because of surface convexity and lack of tissue elasticity. They also provide a unique challenge because daily activity and poor circulation can stress this area and increase the risk of dehiscence. Second-intention healing is useful but is a slow process and requires consistent patient follow-up. Purse-string closure is ideal to reduce the wound size for second-intention healing and decrease the risk of dehiscence.[42] The suture was first reported using a high gauge polypropylene suture that was removed 10 to 14 days after surgery but can also be performed using an absorbable suture that is left in place (Figure 10).[59] Significant undermining is not needed (reducing bleeding risk), and any pleating caused by cinching the wound

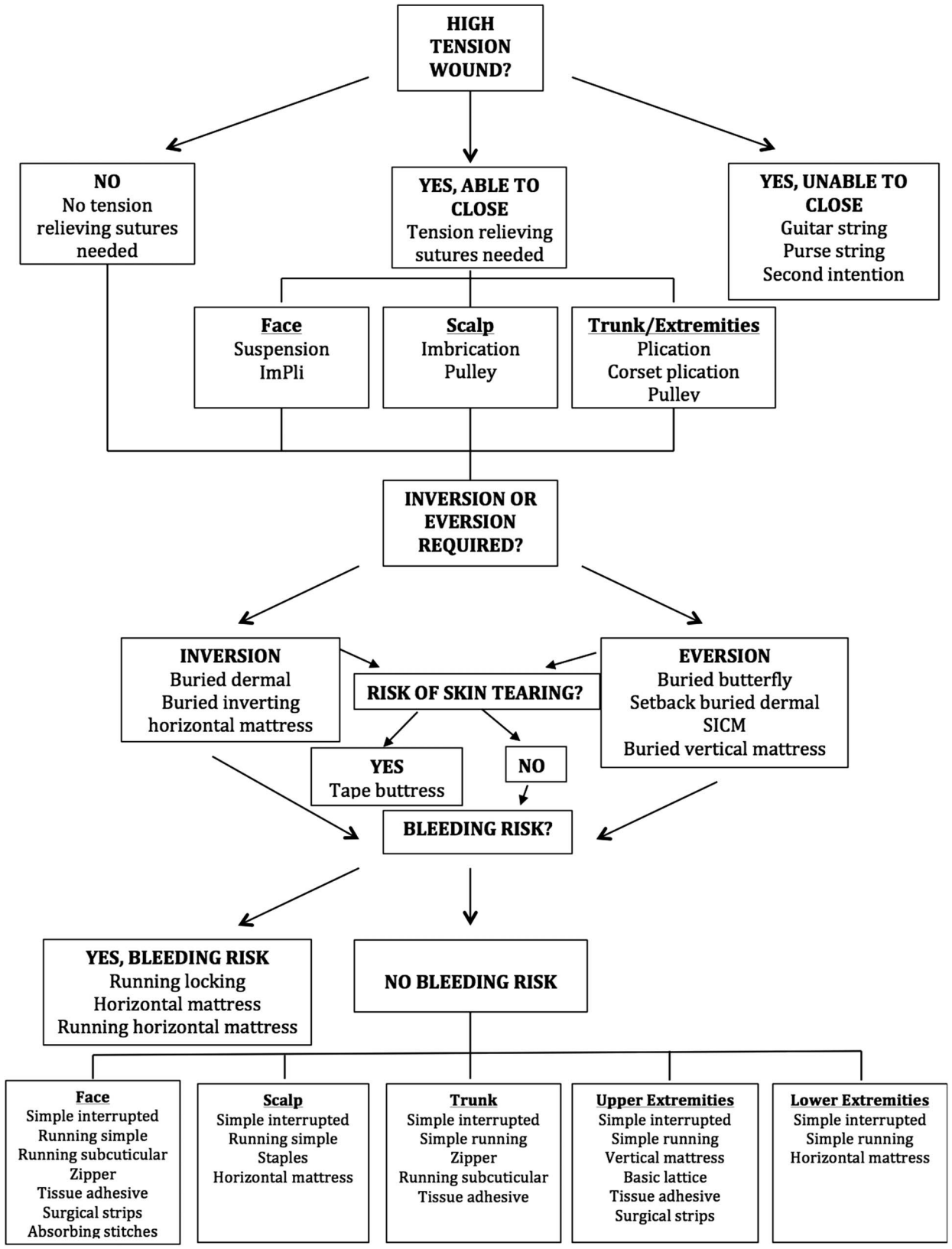

Figure 11. Decision tree for wound closure.

settles out with time. Cuticular and percutaneous buried modifications have also been reported.[60–62]

Discussion

The choice of wound closure material and technique is dependent on numerous factors, including wound tension, desire for wound edge eversion/inversion, desired hemostasis, repair type, ability of patient to care for the wound and return for suture removal, skin integrity, and wound location. The dermatologic surgeon should consider all of these factors when planning a repair and Figure 11 is a helpful tool in this decision-making process. There is no 1 "right" choice for wound closure. Careful consideration of all factors for individual patients and proper technique will result in optimal and reproducible scar cosmesis.

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