REVIEW ARTICLE

Sutures, Needles, and Tissue Adhesives: A Review for Dermatologic Surgery

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BACKGROUND Dermatologic surgery generally requires the removal of offending or excessive tissue followed by repair of the resultant defect. The functional and cosmetic outcome is increasingly important as patients' expectations grow and physicians become increasingly aware of surgical materials and techniques that enable them to repair defects in a functionally and cosmetically appealing manner.

OBJECTIVE To perform an updated and thorough review of the literature regarding sutures, surgical tape, tissue adhesives and stitching techniques.

MATERIALS AND METHODS A comprehensive literature review was conducted on-line via multiple search engines and sites using the keywords suture, suture techniques, suturing techniques, surgical techniques, surgical tapes, surgical adhesives, and tissue adhesives.

RESULTS There are numerous articles on sutures, surgical tape, and tissue adhesives, but there are no current articles that review them together in a comprehensive manner and combine the review with a discussion of stitching techniques.

CONCLUSION Suture choice and surgical and stitching techniques may be guided by the TAFT concept of wound closure that recognizes the main function of suture and closure devices: Tension relief; Apposition enhancement; and surface Finishing Touches. The dermatologist's goal is to create functionally and aesthetically pleasing scars for optimal patient satisfaction, which is of ultimate importance considering that the scars patients receive leave a lasting impression of their dermatology experience.

The author has indicated no significant interest with commercial supporters.

Considering defect repair, the author proposes the TAFT concept of wound closure. The TAFT concept is a practical means of looking at wound closure in layers and stands for: deep Tension relief, subcutaneous or surface Apposition enhancement, and surface Finishing Touches.

Deep tension-relieving stitches are used in large or deep defects, and/or defects in areas of high tension. The imbrication,[1] plication,[2] corset plication,[3] ImPli,[4] and guitar-string[5] stitches are examples of deeply placed stitches for relieving tension and eliminating dead space.

Apposition-enhancing stitches include traditional and novel subepidermal stitches, as well as a variety of transepidermal stitches used in situations of extreme tension, of extreme atrophy or when joining more than 2 defect edges. Examples of subepidermal apposition-enhancing stitches include the buried dermal, buried vertical mattress,[6] subcutaneous inverted cross mattress (SICM),[7] and set-back buried dermal stitches.[8] Apposition-enhancing stitches used in situations of extreme tension include the SICM, double butterfly,[9] pulley or tension-dispersed vertical mattress,[10] tension-dispersed horizontal mattress,[11] lattice,[12] and modified winch[13] stitches. The tape buttress stitch, as described below, is an apposition-enhancing suturing technique useful in situations of extreme atrophy. Apposition-enhancing stitches used when joining 3 or more defect edges include the tip, buried tip,[14] spiral,[15] and purse string stitches.

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Finally, the type of surface stitches and finishing touches used by the surgeon can significantly impact the cosmetic outcome. The most common surface suturing techniques used by dermatologic surgeons are the simple interrupted and simple running stitches.[16] However, there are several other finishing options. These options include the running interlocking, vertical and horizontal mattress, half-buried vertical and half-buried horizontal mattress, running horizontal mattress,[17] and running victory mattress stitches.[18] The horizontal mattress stitch is excellent for hemostasis. The vertical mattress stitch allows for good wound edge eversion while minimizing the risk of necrosis. The half-buried horizontal mattress stitch and the half-buried vertical mattress stitch are good for leveling uneven wound edges. The running horizontal mattress stitch is rapid and provides excellent hemostasis and wound edge eversion. Finishing touches that avoid surface sutures include the running subcuticular, zipper,[19] percutaneous buried vertical mattress,[20] percutaneous buried horizontal mattress,[21] running percutaneous buried vertical mattress,[22] and dimple stitches,[23] as well as sutureless options including the buried vertical mattress stitch alone,[24] surgical strips, and tissue adhesives.

Sutures

Sutures provide a temporary means of approximating defect edges to promote wound healing. Typically, they are left in place no longer than 2 weeks, during which the wound achieves only 7% of its final tensile strength. Final wound strength never exceeds 80% of normal skin strength.[25] Therefore, the tendency for scars to stretch or become unsightly is understandable.

Final cosmetic results depend on many variables, but suture technique is the most important one. The ideal suture technique should approximate and evert wound edges, provide prolonged support, leave no suture marks, and be easy to place.[6] The ideal scar is a fine, minimally visible line that blends into relaxed skin tension lines and does not adversely affect skin function or form.[26] Additionally, the ideal scar leaves no permanent track marks, the cause of which is debatable. Some surgeons believe that these short lines that run perpendicular, horizontal, or oblique to the surgical line are due to reepithelialization of suture tracts between 3 and 8 days after surgery,[27] whereas others believe that they are due to tension from inadequate undermining and free tissue movement, regardless of the suturing technique.[28] In an effort to minimize the risk of track marks, dermatologic surgeons can avoid placing buried sutures too close to the epidermis, avoid placing simple interrupted or running sutures,[17] minimize the length of time sutures are in place, serially replace sutures,[29] or use one of the aforementioned finishing-touch closure techniques that do not require surface stitches.

The ideal suture material should be easy to handle, form secure knots, have high tensile strength, stretch to accommodate wound edema, and exhibit recoil to return to its original length as the wound retracts.[30] Both suturing technique and suture material contribute to the quality of outcomes, which are important because patients' perceptions of their scars influence their perception of the overall service they receive from their surgeon, even more than complications and complaints related to the surgery.[31]

Classification of Suture

Sutures date back to approximately 3000 BC, at which time they could be classified according to their original source (Table 1).[32] The suture that most closely resembled modern suture was catgut, which was made of sheep and bovine intestines. It acquired its name from the word *kit*, which meant violin or stringed instrument, and catgut signified the string of a musical

TABLE 1. Historical Suture Materials From 3000 BC to the Mid-1800s According to Their Origin[32]

Insect/Animal	*Plant*	*Metal*
Ant/beetle jaws	Fibers	Silver
Hair	Hemp	Gold
Tendons/fascia	Twine	Copper
Intestines	Cotton	Aluminum
Arteries	Linen	Brass
Nerves		Iron
Muscle		Bronze
Wool		
Silk		

TABLE 2. Suture Commonly Used by Dermatologists, Classified According to Primary Intended Physical Characteristics*

	Absorption		*Composition*		*Configuration*		*Surface*	
Suture	*Absorbable*	*Non-absorbable*	*Natural*	*Synthetic*	*Multi-filament*	*Mono-filament*	*Continuous*	*Barbed*
Nylon (Ethilon)		X		X	X	X	X	X
Polypropylene (Prolene)		X		X		X	X	X
Polybutester (Novafil)		X		X		X	X	
Polyester (Mersilene, Ethibond Excel)		X		X		X	X	
Silk		X	X		X		X	
Fast-Abs Surgical Gut	X		X		X		X	
Surgical Gut	X		X		X		X	
Chromic Gut	X		X		X		X	
Fast-Absorbing Polyglactin 910 (Vicryl Rapide)	X			X		X	X	
Polyglactin 910 (Vicryl)	X			X	X	X	X	
Polyglycolic (Dexon)	X			X	X			
Polyester (Velosorb)	X			X	X		X	
Polyglyconate (Maxon)	X			X		x	x	X
Polyglytone 6211 (Caprosyn)	X			X		x	x	
Polydioxanone (PDS, PDO)	X			X		X	X	X
Poliglecaprone 25 (Monocryl)	X			X		X	X	
Polyglactone 72 (Monoderm)	X			X		X		X
Glycolide/lactide (Polysorb)	X			X	X		X	
Glycomer 631 (Biosyn)	X			X		X	X	X

	Color		*Coating*	*Antibiotic Coating*	
Suture	*Undyed*	*Dyed*	*Coated*	*Nonantibacterial*	*Antibacterial*
Nylon (Ethilon)	X	X	X	X	
Polypropylene (Prolene)	X	X		X	
Polybutester (Novafil)	X	X	X	X	
Polyester (Mersilene, Ethibond Excel)	X	X		X	
Silk		X		X	

TABLE 2. (Continued)

Suture	Color		Coating	Antibiotic Coating	
	Undyed	Dyed	Coated	Nonantibacterial	Antibacterial
Fast-Abs Surgical Gut	X			X	
Surgical Gut	X			X	
Chromic Gut		X	X	X	
Fast-Absorbing Polyglactin 910 (Vicryl Rapide)	X		X	X	
Polyglactin 910 (Vicryl)	X	X	X	X	X
Polyglycolic (Dexon)	X	X	X	X	
Polyester (Velosorb)	X	X	X	X	
Polyglyconate (Maxon)	x	x		x	
Polyglytone 6211 (Caprosyn)	x	x		X	
Polydioxanone (PDS, PDO)	X	X		X	X
Poliglecaprone 25 (Monocryl)	X	X		X	X
Polyglactone 72 (Monoderm)	X	X		X	
Glycolide/lactide (Polysorb)	X	X	X	X	
Glycomer 631 (Biosyn)	X	X		X	

*Information obtained from various manufacturers' literature.

instrument. Modern suture material can be classified in several ways. The author chooses to classify suture materials according to their primary intended physical characteristics (Table 2) and to further characterize them by the secondary properties they acquire in response to their composition (Table 3). Advantages and disadvantages of each suture type are outlined in Table 4.

Suture Absorption

Suture material is considered absorbable if it loses most of its tensile strength within 60 days after tissue implantation.[37] Otherwise, it is considered non-absorbable (Table 5). Absorption rates can vary depending on the body part and the condition of the patient. Sutures tend to absorb faster in moist areas and when the patient is ill, febrile, or protein deficient.[38]

Historically, absorbable suture is used to decrease dead space, decrease tension when closing deep defects, and encourage wound edge approximation in the sub-cutaneous space before placement of nonabsorbable sutures or staples to complete wound closure. The 2 absorbable sutures most commonly used by dermatologists are polyglactin 910 (73%) and poliglecaprone 25 (11%).[16] When using these sutures entirely sub-cutaneously, Regan and colleagues[39] reported that poliglecaprone 25 caused significantly less suture extrusion (spitting sutures) than polyglactin 910. However, they showed similar degrees of lumpiness and similar scar appearance at 1 week and 3 months.[38] When Breuninger and colleagues[40] compared polyglactin 910 with polydioxanone using intracutaneous butterfly stitches, they found that polyglactin 910 was associated with greater tissue inflammation and suture reaction, as well as more frequent suture perforation than polydioxanone, which was associated with a slightly higher percentage of scar hypertrophy. Sans and colleagues[41] compared chromic gut, polyglactin 910, polydioxanone, and polyglyconate for absorption, tensile strength, tissue inflammatory response, and knot security. The results showed that chromic gut and polyglactin 910 were absorbed most quickly and had the highest inflammatory response; polyglactin 910 and polyglyconate had the highest tensile strength, and polydioxanone and polyglyconate retained their tensile strength the longest. Molea and colleagues[42] compared polydioxanone, poliglecaprone 25, and glycomer 631 and found polydioxanone to be more tissue-reactive than the other 2 sutures. Debus and colleagues[43] compared the multifilament absorbable sutures polyglactin 910, polyglycolic, and glycolide/lactide and found that glycolide/lactide had the highest tensile strength, best knot security, and best handling.

Surgeons have long believed that absorbable sutures, if placed too superficially, result in increased transepidermal elimination, slow absorption rates, increased epithelialization/tunnels, and increased track marks and cyst formation.[27] However, aesthetic, economic, and convenience considerations have shifted the paradigm away from the use of nonabsorbable suture for superficial closure to the use of absorbable sutures as the sole suture material to close defects.

Comparing absorbable suture to nonabsorbable suture for surface closure of wounds, Gabel and colleagues[44] evaluated polyglactin 910 and nylon for closure of biopsy sites and found no difference in redness, infection, dehiscence, scar hypertrophy, or patient satisfaction. Rosenzweig and colleagues[45] compared poliglecaprone 25 with polypropylene for superficial closures and found no statistical difference in cosmetic results and no reports of infection, hematoma formation, or dehiscence. They concluded that poliglecaprone 25 provided a cost-effective alternative to polypropylene.

TABLE 3. Secondary Properties of Suture in Response to Composition[33]

Property	Description
Handling	Ability to manage and work with the suture
Pliability	Ease with which suture bends
Elasticity	Ability to stretch and rebound
Plasticity	Ability to stretch and maintain length
Capillarity	Tendency for fluid to move along length of suture
Memory	Ability to maintain original shape
	Dependent on elasticity and plasticity
	Perceived as stiffness
Coefficient of friction	Ability to slide through tissue
Tensile strength	Force required to break suture
	Dependent on suture diameter
	Decreased 1,014% when knots are in place
Knot security	Likelihood that a knot will hold without slipping
Inflammatory potential	Likelihood that suture will evoke an inflammatory response
Spitting potential	Likelihood that suture will be extruded from tissue
	Pertains to buried absorbable suture

Several studies have evaluated the use of absorbable suture for both buried and surface closure. Fosko and Heap[46] reported using polyglactin 910 as the sole suture in nearly 500 patients and observed no adverse outcomes and no differences in long-term wound healing compared with nylon. Cordova and colleagues,[26] who described the use of absorbable poliglecaprone 25 as the sole suture used to close subcutaneous and surface tissue, reported continued epidermal alignment, continued tension bearing for up to 4 weeks, and no need for suture removal. Lewin and colleagues[47] described a bilayered repair using poliglecaprone 25 alone and noted excellent cosmesis in addition to cost and time savings because suture removal was unnecessary. This author[48] reports excellent cosmetic outcomes, cost savings, and patient convenience with the use of poliglecaprone 25 alone, calculating cost savings of between $4.13 and $12 per procedure using 1 package of poliglecaprone alone compared with using a combination of one absorbable suture and one nonabsorbable suture. The author has used poliglecaprone 25 as the sole suture both subcutaneously and transepidermally for more than a decade. It allows her to close defects using transepidermal stitches, hidden zipper, or dimple stitches without having to open a second package of suture. For most procedures, 1 package of poliglecaprone 25 suffices, especially because it is available in lengths of both 18 and 27 inches.

Suture Composition

Suture material is composed of either natural or synthetic materials. The most common natural suture materials are silk, which is nonabsorbable, and surgical or chromic gut, which is absorbable and composed of proteins that degrade by proteolysis. Compared with synthetic suture material, natural sutures have a higher inflammatory reaction in tissue and an uneven distribution of strength along the length of the suture. Synthetic sutures are typically copolymers that degrade by

TABLE 4. Suture Advantages and Disadvantages by Type[34–36]

Suture	*Advantages*	*Disadvantages*
Nylon (Ethilon, Nurolon)	High tensile strength	Poor knot security
	Low tissue reactivity	High memory
	Good elasticity	Difficult to handle
	Inexpensive	
Polypropylene (Prolene)	Very high tensile strength	Poor knot security
	Low tissue reactivity	Low elasticity
	High infection resistance	Expensive
	Low coefficient of friction	
	High plasticity	
	Good for running subcuticular (but must be removed)	
Polybutester (Novafil)	High tensile strength	
	High elasticity	
	Low coefficient of friction	
	Easy to handle	
	High pliability	
	Good for running subcuticular (but must be removed)	
Polyester (Mersilene, Ethibond Excel)	High tensile strength	High coefficient of friction
	Low tissue reactivity	Expensive
	Good knot security	
	Easy to handle	
Silk	Good knot security	Low tensile strength
	Easy to handle	High coefficient of friction
	High pliability	High tissue reactivity
	Good for mucosal surfaces	High capillarity
Plain Gut	Maintains strength for 7–10 d	Low tensile strength
Chromic Gut	Treated with chromium salt to slow degradation and maintain strength for 10–14 d	High coefficient of friction
	Good for mucosal surfaces	High tissue reactivity
Fast-Absorbing Gut	Treated by preheating to speed absorption rate	
	Maintains tensile strength for 3–5 d	
	Good for attaching grafts	
Polyglactin 910 (Vicryl)	Easy to handle	High coefficient of friction
Polyglycolic (Dexon)	Good knot security	High knot extrusion (spitting)
Polyglyconate (Maxon)	High tensile strength	
	Low tissue reactivity	
	High knot security	
	Easy to handle	
Polyglytone 6211 (Caprosyn)	Rapid absorption	
	Low tissue reactivity	
	Good knot security	
	Easy to handle	
Polydioxanone (PDS, PDO)	High and prolonged tensile strength	Poor knot security
	Low tissue reactivity	Poor handling

TABLE 4. (Continued)

Suture	Advantages	Disadvantages
Poliglecaprone 25 (Monocryl)	High tensile strength Low tissue reactivity Low coefficient of friction High elasticity Moderately easy to handle	Moderate knot security
Polyglactone 72 (Monoderm)	Knotless	
Glycolide/lactide (Polysorb)	High tensile strength Good knot security Easy to handle	
Glycomer 631 (Biosyn)	High and prolonged tensile Strength Low tissue reactivity Good knot security Easy to handle	

hydrolysis. Their inflammatory reaction in tissue tends to be low, and the distribution of strength along the suture is even (Table 6).

Suture Configuration

The configuration of suture material is either monofilamentous or multifilamentous. The latter is divided into braided or twisted configurations. Monofilament suture is made of molten plastic forced through spinnerets. Compared with multifilament suture, it has higher memory, which correlates to lower ease of handling and lower knot security because the monofilament tends to be stiffer than multifilament. It can also develop weak spots if crimped by a needle driver or forceps. The benefits of monofilament over multifilament are related to the

TABLE 5. Suture Absorption Rates*

Suture	Strength Retention Profile	Mass Absorption
Fast-Absorbing Surgical Gut	5–7 d	21–42 d
Surgical Gut	7–10 d	70 d
Chromic Gut	21–28 d	90 d
Fast-Absorbing Polyglactin 910 (Vicryl Rapide)	50% at 5 d	42 d
Polyglactin 910 (Vicryl)	50% at 21 d	56–70 d
Polyglactin 910 monofilament (Vicryl)	40% at 21 d	56–70 d
Polyester (Velosorb)	45% at 5 d	50–60 d
Polyglyconate (Maxon)	59% at 28 d	180 d
Polyglytone 6211 (Caprosyn)	50%–60% at 5 d	56 d
Polydioxanone (PDS)	4-0: 35% at 42 d 3-0: 60% at 42 d	183–238 d
Polydioxanone barbed (PDO)	67% at 14 d 37% at 42 d	180 d
Poliglecaprone 25 (Monocryl) Undyed	50%–60% at 7 d 20%–30% at 14 d	91–119 d
Poliglecaprone 25 (Monocryl) dyed	60%–70% at 7 d 30%–40% at 14 d	91–119 d
Polyglactone 72 (Monoderm) undyed + dyed	62% at 7 d	90–120 d

*Information obtained from various manufacturers' literature.

monofilament's smooth surface, which results in a low coefficient of friction for ease of passage through tissue, low capillarity, and low inflammatory reaction. The benefits of multifilament are its superior ease of handling and knot security due to its pliability and low memory. However, it exhibits a high coefficient of friction because of its rough surface that causes drag as the suture passes through tissue. Compared with monofilament, multifilament also has higher inflammatory potential and increased capillarity, twisted more so than braided, which increases the risk of infection. To minimize capillarity and inflammatory reactions while improving the ease of passage through tissue, some multifilament sutures are coated to mimic monofilaments (Table 7).

Suture Surface

The surface of traditional suture is continuous, whereas barbed suture was recently introduced to the market. Barbed suture is considered a knotless tissue control device that has symmetrically or spirally arranged nicks along the length of the suture to hold tissue and strengthen wounds. Barbed suture offers several major benefits over standard suture. Suture tension is evenly distributed along the length of the closure. Knot-related complications, such as infection and suture weakness, are decreased. Additionally, closures are completed using a rapidly placed running technique that saves time and increases convenience. Barbed suture is available as unidirectional or bidirectional in nylon, polypropylene, polyglyconate, polydioxanone, polyglactone 72, and glycomer 631.

Suture Color

The addition of dye, such as gentian violet, to various suture materials allows for better intraoperative visualization.[49] Dyed suture materials include polypropylene, polyglyconate 910, and poliglecaprone 25. The addition of dye may enable suture to retain greater strength slightly longer than undyed suture.

Suture Coating

Some multifilament suture is available as coated or uncoated. The purpose of coating is to decrease the coefficient of friction so that the suture easily slides as it passes through tissue. The coating decreases the roughness of the suture surface and secondarily decreases the capillarity and risk of infection associated with multifilament suture.

Antibacterial Agents

Within the past decade, selected sutures became available with an antibiotic coating as noted in Table 2. The coating was designed to decrease the risk of surgical site infections, which are considered to be any wound infection that develops within 30 days of a procedure. Surgical site infections occur in approximately 5% of patients,[50] often because percutaneous suture creates a conduit for bacteria to enter the wound from the skin surface. The suture becomes coated with protein, and bacteria colonize the wound. Microbes adhere to the suture and form biofilms. The knot is the principal site of infection.[51]

Antibiotic-coated suture is designed to prevent colonization by coating the suture with triclosan, the antibiotic frequently used in cleansers and hand sanitizers. Triclosan is an ideal antiseptic because it is nontoxic, biocompatible, broad spectrum with no resistance, and does not interfere with normal wound healing. Reports of contact allergy to triclosan are uncommon. Triclosan is effective against most pathogens commonly

TABLE 6. Comparison of Synthetic Versus Natural Suture*

Composition	Ingredients	Means of Degradation	Distribution of Strength	Inflammatory Reaction	Absorption Rate
Natural	Proteins	Proteolysis	Uneven	High	Rapid
Synthetic	Copolymers	Hydrolysis	Even	Low	Slow

*Information obtained from various manufacturers' literature.

TABLE 7. Qualities of Suture Based on Configuration*

Structure	*Capillarity*	*Inflammatory Reaction*	*Memory*	*Coefficient of Friction*	*Knot Security*	*Ease of Handling*
Monofilament	Low	Low	High	Low	Low	Low
Multifilament/braided	High	High	Low	High	High	High
Multifilament twisted	Highest	High	Low	High	High	High
Coated Multifilament/ braided	Medium	Low	Low–medium	Low	High	High

*Information obtained from various manufacturers' literature.

associated with surgical site infections, including *Staphylococcus aureus*, *S. epidermidis*, methicillin-resistant *S. aureus*, methicillin-resistant *S. epidermidis*, *Escherichia coli*, and *Klebsiella pneumonia*. In vitro and in vivo studies show that antibacterially coated sutures can prevent colonization with *S. epidermidis* and *S. aureus*, both methicillin-sensitive and methicillin-resistant.[52] A cost comparison shows antibiotic sutures to be slightly more expensive than non-antibacterial sutures, but the possible costs associated with infection may compensate for that price difference (Table 8).

Suture Removal

The time at which sutures should be removed depends mainly on the surgical site. It should not depend on the use of topical wound healing or emollient treatments, because in vitro incubation of suture with petrolatum does not significantly decrease the tensile strength of nylon, polypropylene, polyglactin 910, polydioxanone, or poliglecaprone.[54] Based on the author's experience, Table 9 provides a practical time frame for suture removal.

Dermatologist Choices in Suture Size and Needles

When choosing suture material, it is important to consider personal preferences, taking into consideration not only the intended characteristics and secondary properties of the suture material but also the suture thickness and needle size and shape. The thickness of suture is expressed in numbers according to the United States Pharmacopeia Classification System established in 1937. Originally, suture was sized according to a number ranging from #1 (thinnest) to #6 (thickest). Improvements in manufacturing techniques eventuated in the production of significantly thinner suture, prompting a numbering system whereby the thinnest suture material is identified by the greatest number of zeros. Today, the thinnest suture is identified by 12 zeros or #12-0, which measures 0.001 to 0.009 mm in diameter, and the thickest suture is #10, which measures 1.200 to 1.299 mm in diameter.[55]

Also, needles come in a variety of sizes and shapes. The needle itself is usually made of stainless steel and comprises 3 parts: the eye, body, and point. The eye is the point of attachment to the suture and is the softest part of the needle. In dermatologic surgery, the eye is swaged, or crimped, so that it passes through tissue atraumatically. The body comprises the greatest portion of the needle and connects the eye to the point. It determines the shape of the needle: straight; 1/4, 3/8, 1/2, or 5/8 circle; or compound curve. The needle holder should grasp the needle one-quarter to halfway from the swaged area to the point, because this location is the strongest part of the needle. The point of the needle is described according to its cross-sectional shape. Dermatologic surgeons most frequently use needles with points that have a triangular geometry pointed either to the inside of the needle curve, called a cutting needle, or to the outside of the needle curve, called a reverse cutting needle.

According to data from the largest suture manufacturer in the United States, the sutures most commonly used by dermatologists in 2012 are polyglactin 910 (39.3%), nylon (26.5%), polypropylene (19.5%), poliglecaprone 25 (8.1%), and polydioxanone

TABLE 8. Cost Comparison Between Antibacterial (Abx) and Nonantibacterial (Nonabx) Sutures Most Commonly Used by Dermatologists[53]

Suture Material	Needle Size	MLP Without Abx Coating (US $)*	MLP With Abx Coating (US $)*	% Cost Increase Abx > Nonabx (US $)
Polyglactin 910 (Vicryl) undyed 18″	4.0 PS-2	105.40	113.83	8.0
	5.0 P-3	111.17	120.07	8.0
Poliglecaprone 25 (Monocryl) undyed 18″	4.0 PS-2	145.40	157.03	8.0
	5.0 P-3	149.20	161.13	8.0

*MLP, manufacturer's list price of a single box containing 12 packages of suture.

(4.0%). The needles dermatologists choose most often are 3/8 circle in sizes P-3, PS-2, and PC-1.[56]

Tissue Adhesives

Tissue adhesives are an attractive alternative to sutures for wound closure. The surgeon applies the liquid adhesive directly over apposed defect edges. The adhesive forms an instant chemical bond with the skin to create a seal over the wound edges, thereby protecting the wound from microbial invasion and inhibiting bacterial growth. The adhesive dries rapidly and effectively glues the defect edges together until the adhesive peels off over a period of 1 to 2 weeks.

TABLE 9. Time Frame for Suture Removal*

	Time of Suture Removal		
Location	5–7 Days	7–10 Days	10–14 Days
Scalp			×
Face	×		
Ears		×	
Neck		×	
Chest		×	
Back			×
Shoulder			×
Arm		×	×
Hand		×	×
Leg			×
Foot			×

*Information based on author preference and experience.

Tissue adhesives are identified by their monomer formations, which give them slightly different characteristics. Currently available tissue adhesives include octyl cyanoacrylate (Dermabond), butylcyanoacrylate (LiquiBand), and *N*-butyl-2-cyanoacrylate (GluSeal), the latter of which is available in multiuse packaging. The butyl formulations of cyanoacrylates are more rigid than the octyl formulations, but the butyl formulations dry in about 30 seconds compared with 60 seconds for the octyl formulations to dry.[57]

The application process is fast and easy. Once buried sutures appose defect edges, the surgical site is cleaned with sterile saline and allowed to dry. Then, the surgeon wipes the tissue adhesive directly over the wound, being careful that the wound edges are in direct apposition so that the adhesive cannot leak in between and prohibit edge-to-edge adherence. Original formulations required that multiple layers of tissue adhesive be applied with time allowed for drying between each layer application. Newer advanced formulations of tissue adhesives only require 1 layer of application and dry more rapidly. They also offer more choices in sizes and types of applicators.

There are many advantages in using tissue adhesive rather than suture, including fast and easy application, hassle-free wound care, no need to keep the surgical site dry postoperatively, decreased risk of bacterial infection, and no need for suture removal. There is also low likelihood of allergic contact dermatitis to liquid adhesives, therefore patients prone to latex allergies or irritation from bandaging are likely to benefit from their use.

The primary disadvantages in using tissue adhesives relate to cosmesis. Tissue adhesives were initially intended to treat lacerations and fine surgical incisions under no tension. However, dermatologic surgeons usually remove tissue before closing a defect, creating tension at the edges. The tissue adhesive can seep between edges that are not properly everted and directly apposed, and the resultant scar may be wider than it would be if sutures were used. Using subcutaneous suturing techniques, such as the buried vertical mattress stitch[6] or the SICM stitch,[7] which promote proper wound edge eversion, may decrease the likelihood of tissue separation and spread scars.

Preference regarding the use of liquid adhesives is inconclusive. Sniezek and colleagues[58] compared high-viscosity 2-octyl cyanoacrylate (Dermabond) with interrupted polypropylene sutures for closure of facial wounds in 14 patients. They identified no cosmetic difference in outcomes, but found that all patients preferred octyl cyanoacrylate because of the ease of postoperative care. Vanholder and colleagues[59] compared closure of rat skin with ethyl cyanoacrylate versus suture and reported slightly better cosmetic outcomes with tissue adhesive and increased incidence of abscesses and inflammation in sutured wounds. Tierney and colleagues[60] compared 2-octylethylcyanoacrylate to fast-absorbing gut suture for linear closures in 8 patients. They reported that scar thickness, wound approximation, patient outcome, and preference were similar, but there was slightly better cosmetic outcome on the side of the scar closed with rapidly absorbing gut and an increased incidence of dyspigmentation in defects closed with tissue adhesive.

Surgical Strips

Another option for wound closure that eliminates the need for transepidermal sutures is to place surgical strips over defect edges directly apposed with buried stitches. These strips can be left in place for a week or more depending on the mobility of the surgical site, the type of strip used, and whether a preapplication liquid adhesive was used before strip placement. Strips last longest if the surgical area is carefully cleaned, dried, and prepared using a liquid adhesive, such as Mastisol, which is up to 10 times stickier than tincture of benzoin. This technique is excellent for areas under low tension where tissue movement is limited. Kolt[61] compared the use of continuous absorbable subcuticular suture with and without strips with the use of strips alone and found that the combination of running subcuticular suture and strips had a slight better cosmetic result compared with the sutureless stripped technique.

Davis and colleagues[62] describe an alternative use of surgical strips to reapproximate wound edges in lacerations on thin skin, laying strips perpendicular to the laceration line and placing interrupted stitches through the strips to reinforce the strength of the skin. Lin[63] responded to Davis's article by describing her method of laying the strips parallel to the laceration line and placing interrupted sutures through the strips and skin in much the same way. Lin prefers parallel strip placement to provide even tensile strength along the entire length of the laceration.

Like Lin, this author[64] uses surgical strips to reinforce atrophic skin when closing surgical defects on atrophic skin. She places strips immediately adjacent to the planned excision line prior to lesion extirpation, then uses horizontal mattress sutures to appose and properly evert the defect edges. She refers to this method as the tape bolster technique because the tape reinforces the atrophic skin so that, even in the presence of tension, the suture does not tear through the skin.

Discussion

There are many options available to enable the dermatologic surgeon to close surgical defects. Likewise, there are many suturing techniques that the dermatologic surgeon can use to suit the individual needs of patients and their own practice preferences. Suture choice and closure technique may be guided by the TAFT concept of wound closure that recognizes the main function of suture and closure devices: Tension relief; Apposition enhancement; and surface Finishing

Touches. The goal of the dermatologist is to create an aesthetically pleasing scar in a cost-conscious way that is convenient to both the physician and the patient. Patient satisfaction is of ultimate importance because the surgical scar leaves a lasting impression of their dermatology experience.

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