

Suturing techniques for periodontal plastic surgery

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In periodontal surgery, the most common method of wound closure uses sutures. The primary objectives of suturing are to stabilize and to secure tissues in their desired locations. Surgical specialties, both medical and dental, have many unique methods and materials for wound closure. Generally, the suturing terminology is universal for all medical and dental uses, and many of the techniques are useful in more than one discipline. Of the medical surgical specialties, plastic surgery techniques and materials are probably the most useful for application in periodontics. Plastic surgery shares some common goals with periodontal surgery, such as emphasis on aesthetics, flap rotation and grafting techniques. In addition, plastic surgery places strong interest in scar revision and scar prevention in the process of reconstruction. Review of the plastic surgery literature shows how the importance of suturing is emphasized in perfecting the final result.

Periodontal surgery incorporates many common issues with plastic surgery but is complicated in many cases by the additional challenge of dealing with the periodontal disease process affecting both soft and hard tissues. Working in the oral cavity presents other unique surgical management challenges. The varied anatomy of the area, the limited access and the conscious patient with an active tongue and swallowing reflex make speed and accuracy important throughout the procedure. Flap stability and durability can also be a problem during the postoperative period. The mouth is a moist, movable, and contaminated environment where healing must take place. At the same time, the patient continues to function by eating and speaking. Many patients also participate in other destructive behaviors such as smoking or poor oral hygiene, which may undo surgical efforts. These unique characteristics of procedures performed in the oral cavity make suturing techniques even more important in insuring optimum healing results.

Suturing can often be the most tedious part of a surgical procedure, and some operators have proposed techniques to eliminate suturing altogether (8). However, applying the basic principles and techniques of plastic surgical suturing can help make suturing more efficient and improve surgical results.

Three main features of periodontal plastic suturing

Intraoral anchor points

A major advantage of performing surgical procedures in the oral cavity is the presence of four main anchoring structures for use in securing movable tissues. The teeth are the easiest to use and the most secure of all the intraoral anchors. Teeth are used typically for sling, or suspensory, suture anchors (11). Bound down tissue, most commonly the gingiva affixed to bone via periosteum, is the second most reliable anchor. This tissue is especially important in securing vertical releasing incisions and in areas adjacent to gingival tissue grafts. Periosteum, either bound down or elevated, can also be useful for positioning movable tissues. Loose connective tissue is the least secure anchorage point in the mouth. Connective tissue in the vestibule is commonly used for suturing mucosal tissues in vestibular lengthening procedures and in securing the apical edge of grafts. The fatty tissue in the retromolar area is another loose connective tissue anchor source.

Mattress suturing

One major feature of plastic surgery suturing techniques is the use of various types and combinations of mattress suturing. Mattress sutures pro-

vide precise flap edge placement and control. They are less likely to tear through the tissue because the tearing forces are directed over several vectors, depending on whether the sutures are vertical or horizontal mattresses. They allow the operator to apply downward (inverting) or upward (everting) pressure at the flap edge. Plastic surgeons generally prefer a slightly everted skin wound edge, because this prevents a depressed scar and prevents skin appendages such as hair follicles and sweat glands from becoming entrapped in the scar (4). Both inverting and everting (14) sutures are useful in the mouth depending on the desired result. Mattress sutures also allow suture material placement away from the incision line, thus minimizing wicking of bacteria into the wound (12).

Continuous suturing

The choice of using interrupted or continuous suturing techniques is usually made by operator preference, and most procedures can be completed using either style. The use of continuous suturing in both plastic surgery (1) and periodontal surgery has many advantages. Continuous suturing allows for placement of fewer knots and enables the operator to avoid tying knots in areas that are difficult to reach. Knot placement can be planned so that they occur in the buccal anterior and premolar regions. The operator can elect to use 360° loops around the teeth during placement of a continuous suture to stabilize the individual sections of a flap (Fig. 1e). Several designs of a continuous crossover behind terminal molars are useful to avoid knots in posterior areas of the mouth (Fig. 4a). Fewer knots also make suture removal easier for the operator and more comfortable for the patient.

In addition, dental assistants can be trained to “catch and pass” the needle as it is moved through the interproximal areas, while at the same time wiping clean and lubricating the suture with a wet gauze. The speed and convenience of continuous suture placement is greatly augmented with a well-trained, attentive assistant. One disadvantage to continuous sutures is that if one suture becomes unsecured, adjacent areas may also be affected. This problem can be decreased by use of continuous mattress sutures and by use of additional 360° loops for stability. Rarely, patients perceive an extra bulk of suture material with their tongue, especially in the maxillary anterior area when periodontal dressing is not used. The routine

use of continuous suspensory suturing is extremely useful in precise flap placement and control (6, 10) especially when combined with mattressing techniques.

General informational guidelines

Tissue handling and positioning

Sutures are generally used to hold tissues passively in the desired position. The movement of flaps either apically or coronally should be primarily accomplished by appropriate flap design and placement of incisions. The use of well-placed vertical releasing incisions and adequate reflection of flaps will allow the tissues to achieve the desired position and drape passively (6), without forcing or stretching. Attempts to use sutures to unduly stretch tissues past their passive positions because of poor flap design or inadequate reflection can result in the suture materials tearing through the flap edges and subsequent retraction of the flaps to less desirable positions. Another complication may be creation of pressure on the tissues, leading to ischemia, necrosis and subsequent tissue slough. The healing course can be complicated and the surgical result may be compromised unnecessarily (4).

Close adaptation of flap edges is sometimes indicated in areas where scarring must be minimized or when perfusion of grafts is critical, but an overly tight closure can create problems. In particular, hemorrhage control should not be attempted with tight suturing alone. Hematoma formation and swelling can result, compromising healing and flap position. Instead, the source of bleeding should be identified and controlled with other methods such as degranulation, bone swedging, arterial ligation, or application of direct pressure before wound closure is attempted. If drainage is compromised by unnecessarily tight or too closely placed sutures, excessive swelling may result, causing premature suture loss from suture pullout, and possible flap displacement. The postoperative course of healing and the surgical result may be adversely affected (4, 9).

The needle entry points, specific suture selection, and knot placement are often overlooked issues in terms of the healing result. Suture material should not pass through tissue too close to the wound edge. The flap edges are often

thin and friable, and any pressure will cause sutures to tear through the flap edge. One tendency is to place the suture too close to the papilla tip, an almost sure guarantee of suture pullout. The use of mattress sutures minimizes tearing as well as “bagging” of the tissues between sutures. “Wicking” is the phenomena of bacteria moving along or within multi-stranded suture materials into the wound. This can be minimized by using coated or monofilament materials and by using inverting mattress sutures that keep the suture materials on the surface of flaps as much as possible (13) (Fig. 4b). Attentiveness to knot placement is also important. Measures should be taken to keep knots out of incision lines and in more accessible areas. With advance planning, knots can be placed toward the anterior and buccal areas of the mouth for ease of placement and removal, and to prevent the patient from manipulating the knot with the tongue.

Sutures can also be used as a tool to retract flaps for photography or to retrieve free gingival or connective tissue autografts. This is probably less traumatic to tissue than handling with tissue forceps (11).

Suture materials and needles

Suturing materials have a long history. Before modern materials, for example, horse hair was commonly used for wound closure. Today, there is a wide variety of suture materials, and choices are determined by the particular working characteristics of the material and the intended use (2). Suture materials vary in size (gauge) from 3-O to 11-O. They come in precut lengths of 18 inches, 24 inches, 27 inches, 30 inches, or in spools of 100 yards for do-it-yourself needle threaders. Suture materials are generally grouped into two categories; nonabsorbable and absorbable.

Absorbable materials are useful in many specific situations in periodontal surgery. Plain or chromic gut sutures are particularly useful in mucosal tissues. Nonabsorbable sutures placed into mucosal tissue are difficult to remove at the postoperative appointment and may cause discomfort. Absorbable suture materials are good choices for palatal donor sites for gingival or connective tissue grafts. These sutures may be used to retain collagen material in the wound or act as a meshwork to help retain cyanoacrylate. Absorbable sutures are always an appropriate

choice in any situation when suture removal may be compromised, from management problems such as very young or uncooperative patients, to areas that are difficult to reach. Absorbable sutures are often the suture of choice in tissue grafting procedures, especially in connective tissue grafts, when some of the sutures may be buried under flaps. The speed of disintegration of the suture material may be another consideration when selecting an absorbable suture material. Absorbable sutures create an inflammatory reaction in healing tissues, which is responsible for the material breakdown. Absorbable suture materials vary from 3 days to up to 6 weeks in the time they remain intact in the mouth (15). Even silk could be classified as absorbable, even though it takes several years to complete the process (13).

Nonabsorbable sutures are traditionally the most commonly used suture materials in the mouth. Black silk suture is unparalleled in ease of placement and handling characteristics. Manipulation is simplified due to the lack of “memory” in silk. Knots are easy to tie and are resistant to slippage after placement. The operator has more control over exactly how long the sutures are retained in the mouth. Good visibility of the black suture also aids in accurate placement and in insuring complete removal of the sutures. One obvious disadvantage, however, other than nonresorbability, is the phenomenon of “wicking”, or movement of bacteria along or within suture material, which occurs particularly with silk, but also with any multistranded suture material. In situations where this problem may be particularly critical, such as bone replacement grafting or guided tissue regeneration procedures, coated multistranded sutures or monofilament suture materials may be more appropriate choices. Coatings minimize but do not prevent wicking and also act as lubricants to make the passage of the material through tissue easier. Nylon and Teflon[®] monofilament sutures are possible choices; nylon monofilament has minimal inflammation associated with healing, but is difficult to manipulate intraorally, especially when tying knots. Teflon[®] suture material is much easier to use in the mouth, and has the unique property of sliding easily upon itself. Teflon[®] is also very nonreactive in tissue. The high cost of Teflon[®] sutures is probably the biggest disadvantage to their general use.

Both plain and chromic gut sutures are usually

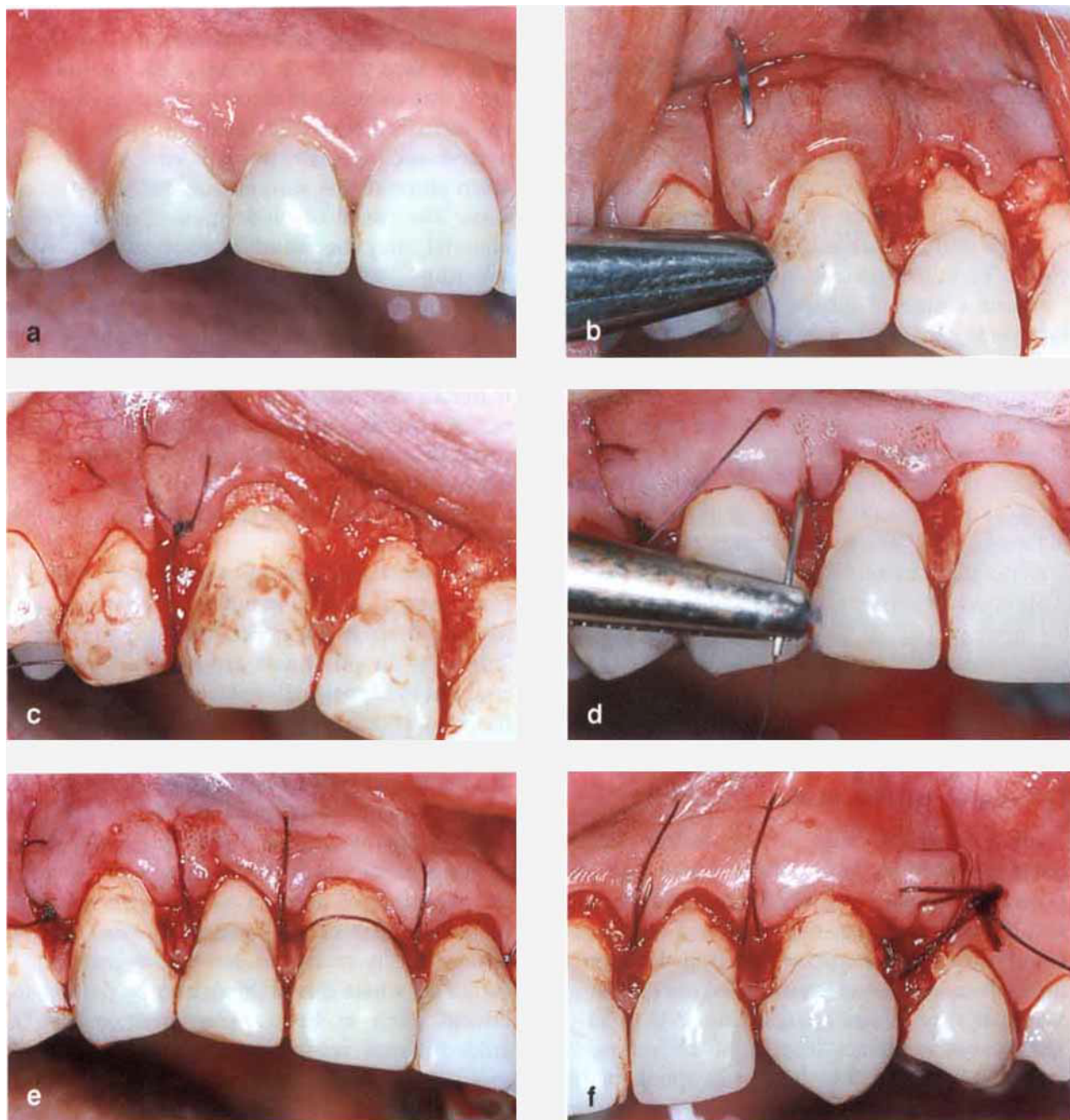


Fig. 1. a. Preoperative view of an altered passive eruption case prior to aesthetic crown-lengthening surgery. b. Most mattress sutures can be accomplished by passing the needle through both entry and exit points in one motion. Precision placement of the papilla tip can be accomplished by making the entry point into the papilla and the exit point near the mucogingival junction. c. Placement of the combination evertor/invertor horizontal mattress suture to close the releasing incision. The knot is placed on the papilla for precise papilla tip positioning. d. The papilla distal to the canine has been secured by piercing the palatal aspect of the papilla with the suture, before suspending

around the canine. Note that by piercing the papilla between the canine and lateral incisor, this papilla area is matted in such a way that the movable portion cannot shift coronally. e. The buccal flap has been sutured in an apical position for the purpose of aesthetic crown lengthening. The continuous vertical mattress slings are further stabilized by completely circling the right central incisor. f. The process of continuous inverting vertical mattresses and papilla pinning continues across the anterior and is terminated at the vertical releasing incision on the distobuccal line angle of tooth 11 with a loop tie incorporated into an inverting horizontal mattress suture.

packaged in alcohol. It is advisable to remove the alcohol from the surface of the suture material by wiping with a saline or sterile water soaked gauze

before use. Additional wipings with the wet gauze during suturing will remove the blood products that tend to coat the suture material and cause the

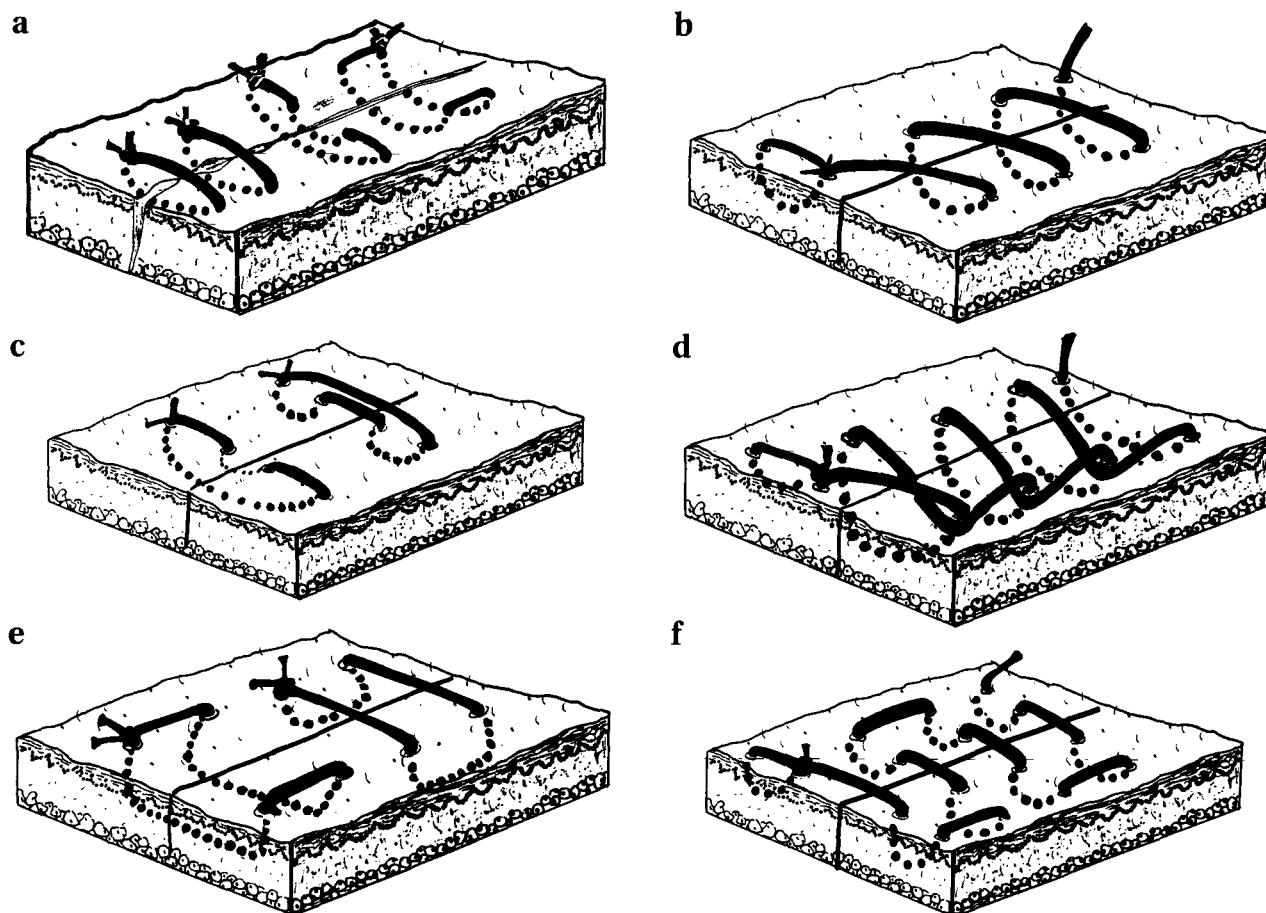


Fig. 2. a. On the left are two interrupted through-and-through sutures which tend to allow wound separation between sutures and provide no flap edge control. All tearing forces are applied at two points and toward the wound edge. The middle suture is a vertical mattress that distributes tearing forces over four points and at the same time everts the wound edge. On the right is a horizontal mattress that nicely approximates while everting the wound edge. It also diverts tearing forces at the four entry/exit points away from the wound edge. b. Left is an interrupted everting vertical mattress. Right is an inverted version, which is used more commonly intraorally, passing between buccal and lingual flaps over papillae tips. c. The left side of the figure shows a single horizontal mattress. The right figure is an inverting version, which can also be mod-

ified to make the surface strands form a criss-cross. d. A continuous through-and-through suture is useful for closing edentulous areas. It is helpful to start the continuous run with a vertical or horizontal mattress to prevent tear out and to keep the knot from rolling over into the incision line. e. A continuous through-and-through interlocking suture will prevent the incision line from bagging open in the middle of the wound. Using intermittent loop ties instead of interlocks will accomplish the same purpose, and is useful in periodontics in situations such as tying down the edges of a gingival onlay graft. f. Continuous suturing can be used with almost any other style of suturing. The diagram shows inverting vertical mattresses sewn continuously. This is the basis for vertical mattress sling sutures used intraorally.

suture to drag as it is passed through the tissue and to stick both to itself and to the needle holder. It is inadvisable to use petroleum products to lubricate suture materials because this practice may introduce the petroleum products into connective tissues, possibly creating an unwanted inflammatory response. Saline or plain water may be a more suitable choice.

The choice of needle can also be important. The nomenclature for identifying needle types is extremely confusing and varies from one maker to another. The FS-2 needle on a 4-0 silk is commonly

used for most periodontal flap suturing applications. It is adaptable for edentulous areas as well as long enough to pass the needle interproximally in posterior areas. McGhan Medical Corporation of Santa Barbara, CA makes plastic surgery needles with a laser-drilled hole into which the suture material is inserted. Reportedly, this needle produces less drag when passing through tissues and is less likely to become unswagged during use (17).

For tissue graft placement, a smaller semicircle needle, such as the P-2, is easier to manipulate due

to the smaller arc of rotation as the needle passes through the tissue. Regardless of the needle type used, the needle should not be grasped with needle holders on the swagged part. Repeated pinching of the swagged area tends to cause the suture to fray and detach from the needle. Grasping the needle with needle holders near the tip will dull the cutting edges. The angle of the needle as it is grasped in the needle holder should be at 90°. Attempting to grip the needle at obtuse angles will result in twisting or bending of the needle as it passes through tissue. The needle should be rotated along an arc as it is guided through tissues, rather than forced to go straight. This arc is established by the curve of the needle itself and can be altered slightly but is relatively fixed. Many of the mattressing techniques described involve passing the needle in one hole and out another with one pass when possible (5) (Fig. 1b). The direction of the needle movement depends on the type of mattressing intended, either inverting or everting, but the easiest passes are made from epithelium into connective tissues using the bone to support the flap. Penetration of the flap from connective tissue toward the epithelial surface is easier when the flap is supported by a suction tip or elevator.

Special instrumentation

A wide assortment of instruments have been developed for ease and speed of suture placement. Special tissue pickups and needle holders are made for the purpose of delicate suture placement. A periosteal elevator with a hole in the wide end is helpful for supporting tissue for needle penetration. Dermatomes and adjustable scalpels have been designed to aid in graft harvesting. A simple and useful tool is a graft holder made by sharpening the ends of college pliers. It can be used to secure the movable tissue against bone, freeing the operator's hands for suturing (2).

Suture placement nomenclature

Interrupted sutures

Interrupted sutures are the basic single suture. The simplest interrupted suture passes once through each flap, a surgical knot is placed, and the ends are trimmed. Interrupted through-and-through sutures pass through flaps once, a surgical knot is

placed, and the ends are trimmed. They are the first sutures that most students learn to place and often are the only sutures that they use. Placement of interrupted sutures is a time-consuming process, requiring placement of multiple knots in areas that may be difficult to access. They allow movement of flaps when buccal and lingual flaps are tied to each other, rather than to anchor points. Also, excessive numbers of knots increase the chance of the knots getting embedded in the pack material. The interrupted suture can be done in many forms, including through-and-through, sling (suspensory), figure eight, single vertical mattress, horizontal mattress or periosteal tack.

Continuous sutures

Continuous sutures are a series of sutures placed without cutting or knot tying between each suture. They can incorporate any of the same suture forms suggested in the interrupted forms above, from through-and-through to periosteal tacks.

Suspensory sutures

Suspensory sutures attach or "suspend" the flap from the teeth. They can be single interrupted or continuous. They are the most precise way to position a flap because the flap is attached to an immovable anchor (teeth) rather than to another movable flap (Fig. 1). They are also called sling sutures (11).

Through-and-through sutures

A through-and-through means the suture passes through the flap in just one direction (Fig. 2a).

Mattress sutures

A mattress means the suture passes through the flap twice. By using inverting horizontal or vertical mattress sutures, the material does not pass under the incision line, thus minimizing wicking. Everting mattress sutures are useful in papilla preservation techniques in anterior areas (Fig. 2a).

Vertical mattress sutures

Vertical mattress sutures can be used when greater control of the wound edge is needed. There are two main variations on a vertical mattress. The "evert-

ing" vertical mattress is commonly used in closing skin wounds because it prevents hair and pores from being trapped in the scar. The "inverting" vertical mattress is most commonly used in securing periodontal flaps because the bulk of the suture lies on top of the tissue and does not cross under

the wound edge (Fig. 2b). Vertical mattresses are particularly useful in papillae management (14) (Fig. 3a, 4c).

Horizontal mattress sutures

Horizontal mattress sutures are used when more precise apposition of wound edges is needed. Horizontal sutures have less tendency to tear through tissue. There are also two main variations on the horizontal, "inverting" and "everting". Everting mattress are often used in skin wounds (Fig. 2c), whereas inverting are usually used in intraoral wounds. Horizontal mattresses, vertical mattresses and through-and-through distribute tearing forces in 4, 2 and 1 directions respectively (Fig. 2a). The use of a criss-cross as the suture passes through the interproximal provides good control of the flap papilla (Fig. 3b) and keeps the suture out of the healing interproximal sulcus area (16).

Continuous through-and-through sutures

Continuous through-and-through sutures are sometimes used in periodontics in combination with other continuous methods, but they are more commonly used to close edentulous areas. These are sometimes referred to as "running" or "whip-stitch" continuous sutures (Fig. 2d).

Continuous locking

Continuous locking is a variation on the continuous through-and-through (Fig. 2e). These are also sometimes confusingly referred to as continuous mattress sutures, but continuous "blanket" is probably more correct. A double continuous through-and-through vertical figure eight is the classic baseball stitch and is sometimes used for tight closure of subcutaneous layers in general surgery.

Continuous mattress sutures

Continuous mattress sutures can be done as verticals (Fig. 2f) or horizontals, inverting or everting and interlocking depending on the need, and all continuous can be done with intermittent loop ties.

Figure eight and criss-cross sutures

Figure eight and criss-cross allows many variations. A criss-cross single horizontal mattress is

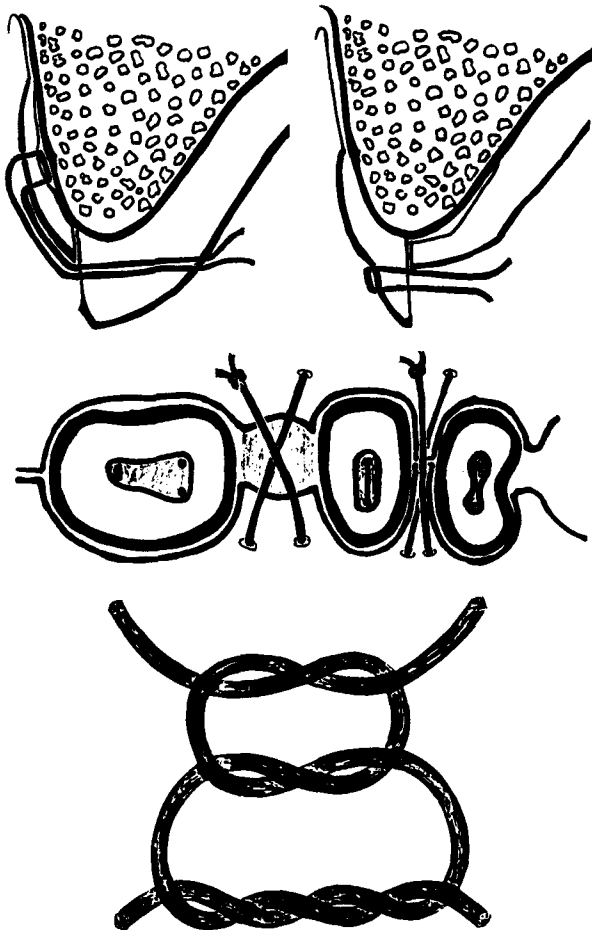


Fig. 3. Top. The left figure demonstrates a vertical mattress used on an apically positioned flap papilla. The suture material passes through the palatal portion, across the papilla tip, mattresses through the papilla and then back through the palatal aspect before being tied off or used in a continuous run. On the right figure, an everting mattress is used to maintain papilla height in an aesthetic papilla preservation application. Center. The criss-cross version of the inverting horizontal mattress is especially useful over extraction sites. In tight interproximal areas it prevents suture material from falling into the interproximal sulcus areas. It is also useful in areas of bone replacement grafts to keep suture material away from the grafted material. Bottom. One variation of a surgical knot. The double throw is used first, allowing slippage to adjust tissue position and suture tension. The second throw in the same direction allows further slippage for additional control of suture tension. The third throw is in the opposite direction, forming a square knot to secure the suture. With some materials, a simple square knot with only two throws in opposite directions is sufficient to stabilize the suture. With suture materials that possess memory, additional throws are needed.

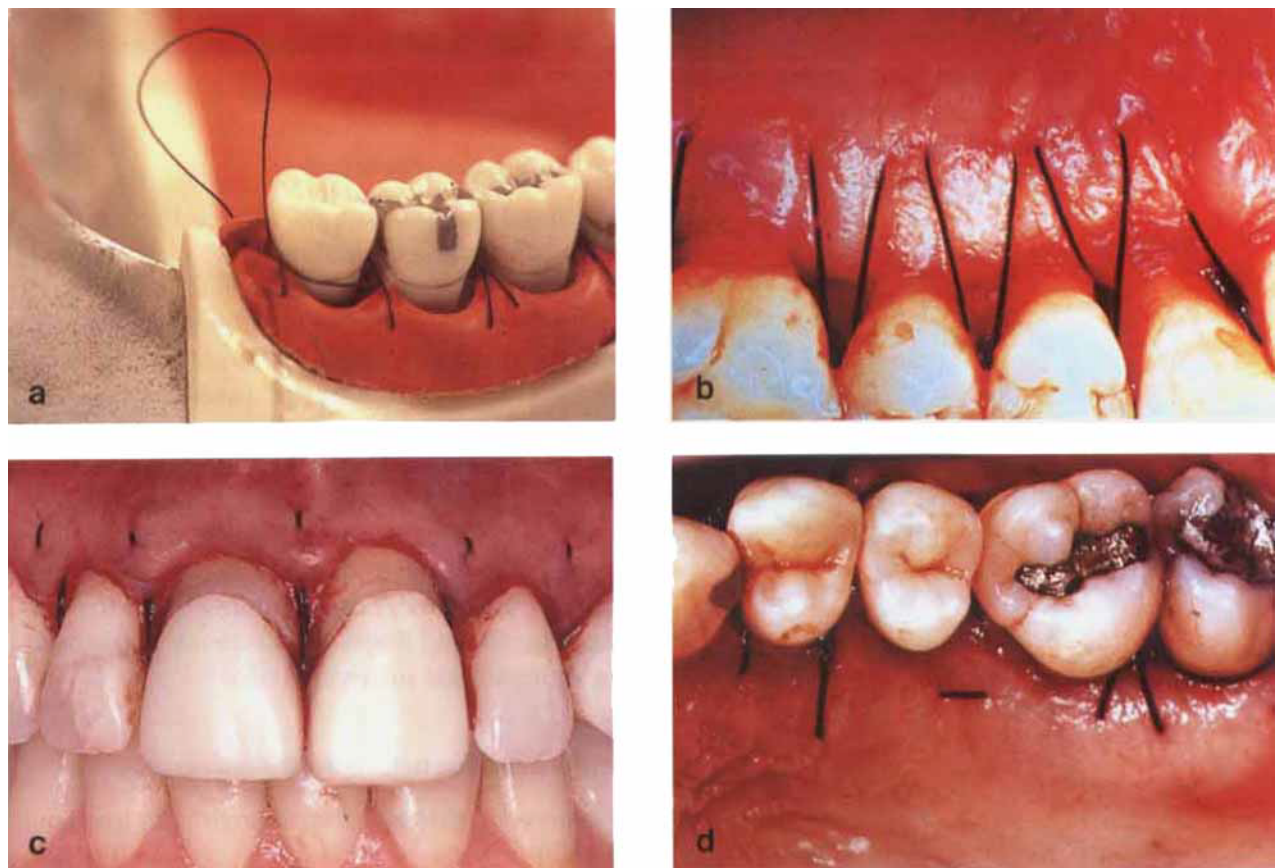


Fig. 4. a. When both buccal and lingual flaps are joined by one continuous suture, some method is needed to make the transition from one side to the other without the use of knots. Vertical figure eights, horizontal mattresses or 360° circles around the terminal teeth are just a few useful tools. If a knot is needed, a loop tie at the distobuccal corner of the terminal mandibular molar is an option. b. Horizontal mattress sutures are used to suspend the palatal flap from the teeth. The sutures act to invert the flap edge and to po-

sition most of the suture material on the surface of the flap, minimizing wicking. c. Everting vertical mattress sutures used to maintain papilla tip height when the palatal portion has been reduced from the treatment of osseous defects. d. Palatal closure on the same patient in Fig. 2 shows from posterior to anterior, a criss-cross inverting horizontal mattress, an everting horizontal mattress, an inverting vertical mattress, and a simple through-and-through.

good for holding gel-foam or dry socket pack or osseous grafts in place (Fig. 3b).

Vertical figure eight sutures

The vertical figure eight suture is useful in periodontics because it will prevent wound edges from overlapping. It can be used in combination with other suturing methods such as suspensory, mattress and continuous techniques.

Periosteal sutures

Periosteal sutures are a method of using the periosteum as an anchorage for controlling more movable tissues. The periosteal tack holds the

flap in an apical position by encircling and constricting a quantity of mucosal tissue in the apical part of the flap. When used in combination with a suspensory technique, the periosteal suture becomes a variation on the vertical inverting mattress suture. The significant difference is that the suture material is secured into the mucosal tissues below the mucogingival junction rather than in the gingival tissues. This supposedly minimizes the tendency for the flaps to hike up around the necks of the teeth, which would defeat the purpose of pocket reduction via apically positioned flaps. The vertical inverting periosteal mattress suture can be placed as continuous sutures to secure buccal and lingual periodontal flaps independently.

Surgical knots

Surgical knots have many variations (7). The essential elements allow for the first part of the knot to give the operator the ability to adjust the tension on the suture before placing the second part of the knot, which is a square knot to secure the entire knot. It requires that the operator remember which direction (that is, right hand or left hand throw) the suture is wound around the needle holder tip each time. A double throw can be substituted for a slip knot, but generally the first and second wind go the same direction (making a slip knot) and the third throw goes the opposite direction (making a square knot). The number of throws and extra square knots may depend on the handling characteristics of the materials (Fig. 3c). General surgeons also use hand ties, which are simply surgical knots tied without the benefit of a needle holder. Hand ties can be useful when making ties on the bracket table or ligating teeth, but are not generally useful intraorally.

Tying a loop tie

Tying a loop tie is essentially the same as a regular surgeon's knot, but it allows the operator to place a knot at the end of a series of continuous sutures (Fig. 1f). A series of loop ties is useful for tying down the edges of a free gingival autograft. These are more secure than continuous locking sutures.

Conclusion

The use of intraoral anchors, combination mattressing and continuous sutures can provide the operator with ease and speed of suture placement while providing precise and secure tissue control. This chapter describes and depicts the use of these techniques for a variety of periodontal surgical applications.

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