A Review of Dental Suturing for Optimal Soft-Tissue Management

Abstract: Establishing nontension primary wound closure of various soft-tissue flaps is paramount for optimal postsurgical wound healing. Surgical procedures that require clinical flap manipulation such as those used with traditional periodontal therapy, periodontal plastic cosmetic surgery, hard- and soft-tissue regeneration, and the excision of pathologic tissue also require excellence in execution and thorough understanding of the various techniques of surgery, suturing, and the materials currently available to ensure the desired clinical results. This article will discuss the rationale of specific suturing techniques and suture materials to aid the clinician in obtaining optimal wound closure.

The primary objective of dental suturing is to position and secure surgical flaps to promote optimal healing (Table). When used properly, surgical sutures should hold flap edges in apposition until the wound has healed enough to withstand normal functional stresses. When the proper suture technique is used with the appropriate thread type and diameter, tension is placed on the wound margins so primary intention healing occurs. Accurate apposition of surgical flaps is significant to patient comfort, hemostasis, reduction of the wound size to be repaired, and prevention of unnecessary bone destruction. If surgical wound edges are not properly approximated and are therefore inadequate, hemostasis is present and blood and serum may accumulate under the flap, delaying the healing process by separating the flap from the underlying bone.

During the closure portion of conventional periodontal surgical therapy, the art of suturing allows for the precise positioning of the mucoperiosteal flaps. For instance, certain surgical procedures, such as an excisional new attachment procedure (ENAP) and modified Widman flap procedure, dictate that the surgical flaps be repositioned to their original position. Conversely, other periodontal procedures require that the surgical flaps be placed in either an apical, coronal, or lateral position, depending on the specific surgical objective of the procedure being performed.

In periodontal plastic, cosmetic, and reconstructive procedures, choosing the appropriate suturing technique, thread type, thread diameter, surgical needle, and use of the proper surgical knot for each respective thread material chosen are all critical in obtaining optimal wound healing when tissues are coapted over hard and/or soft tissue, autologous or allograft material, and/or over regenerative membranes. In addition, the art and precise skill of suturing is paramount to the success of all surgical procedures.

Learning Objectives:

After reading this article, the reader should be able to:

- describe the rationale for obtaining primary wound closure.
- discuss various types of suture needles, thread material, and knots.
- explain the criteria for selecting suture needles, materials, and knots.
- discuss examples of absorbable and nonabsorbable suture material.
- discuss why different suture materials and techniques are used when suturing.

1 Dr. Silverstein is the author of the textbook *Principles of Dental Suturing.*
Suture Materials

Suture Thread

The desired qualities of a suture thread include the tensile strength that is appropriate for its respective use, tissue biocompatibility, ease of tying, and that it allows minimal knot slippage. It is important that the clinician select the specific suture thread and diameter based on the thickness of the tissues to be sutured and whether there is the presence or absence of tension-free mobile tissues. Therefore, it seems to this author that suture technique and material selection should be based on a knowledge of the desired goals of the respective surgical procedures and the physical and biologic characteristics of the suture thread in relationship to the intraoral in vivo healing process.

The practitioner has an armamentarium of suture materials from which to select for use both intra- and extraorally. Adequate strength of the suture material will prevent suture breakage, and proper suture knots for the material used will prevent untimely untying or knot slippage. The clinician also must understand the nature of the suture material, the biologic processes of healing, the biologic forces in the healing wound, and the interaction of the suture and tissues. This is vital because the practitioner must ensure that a suture will retain its strength until the tissues of the surgical flaps regain sufficient strength to keep the wound edges together. In those circumstances in which the intraoral tissues most likely will never regain their preoperative strength, or the surgical flaps are not tension-free, the clinician should consider using a suture material that retains long-term strength for up to 14 days and resorbs in 21 to 28 days, such as conventional polyglycolic acid (PGA) sutures.

Conversely, if a suture is to be placed in a tissue that heals rapidly (eg, intraoral tissue), the clinician should select a resorbable suture that will lose its tensile strength at about the same rate that the tissue gains strength. The suture also will be absorbed by the tissue so that no foreign material remains in the wound once the tissue has healed, such as the surgical gut or the new, rapidly resorbable PGA suture material (PGA-FA).

Two mechanisms of absorption result in the degradation of absorbable sutures. First, sutures of biological origin, such as surgical gut (eg, plain and chromic gut), are gradually digested by intraoral enzymes. This suture material is made from an animal protein and potentially can induce an antigenic reaction. When used intraorally, this material loses most of its tensile strength in 24 to 48 hours, unless it is coated with a chromic compound that extends absorption up to 7 to 10 days and extends loss of tensile strength for up to 5 days.

Second, surgical gut sutures may break too rapidly to maintain flap apposition, particularly if used in patients with a very low intraoral pH. A decrease in intraoral pH may be caused by a plethora of physiological events, such as meta-

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Table—Principles of Suturing

<table>
<thead>
<tr>
<th>General Guidelines</th>
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<tbody>
<tr>
<td>Sutures are usually placed distal to the last tooth and in each interproximal space.</td>
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<tr>
<td>Sutures should always be inserted through the more mobile tissue flap first.</td>
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<tr>
<td>A circular form of needle is used because of the restricted space in the mouth.</td>
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<tr>
<td>Suture needles should be grasped only by needle holders and the suture needle should be inserted and pulled through the issue in line with the circle.</td>
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<tr>
<td>Grab the suture needle in the center with the needle holder.</td>
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<tr>
<td>The needle shoulder should be placed a few mm from the tip of the needle holder.</td>
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<tr>
<td>Do not grab the needle at the junction of the needle and suture swaged.</td>
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<tr>
<td>When penetrating through tissues, the needle should enter at right angles to the tissue.</td>
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<td>The goal during suturing multiple tissue levels is to suture periosteum to periosteum and tissue to tissue.</td>
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<tr>
<td>Pull the suture just tight enough to secure the flap in place without restricting the flap's blood supply.</td>
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<tr>
<td>The flaps should not be blanched when tying a suture.</td>
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<tr>
<td>Sutures should be placed no closer than 2 mm to 3 mm from the edge of the flap to prevent tearing through the flap during postoperative swelling.</td>
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bolic disorders (eg, epigastric reflux, hiatal hernia, bulimia). Autoimmunity caused by Sjögren’s syndrome, chemotherapy, radiation therapy, and some medications (eg, maximum acid output inhibitors and angiotensin-converting inhibitors, antipsychotics, diuretics, antihypertensive agents, antipsoriasis medications, and steroid inhalers) also can result in dry mouth and a low intraoral pH.\(^2,6\)

The minimum coaptation time for tissue flaps is approximately 5 days.\(^5\) Therefore, clinicians should select a fast-absorbing PGA suture for indications in which there is a low intraoral pH, when surgical gut sutures are contraindicated. The PGA-FA suture material is manufactured from synthetic polymers and principally broken down by hydrolysis in tissue fluids in approximately 7 to 10 days and is not affected by a low intraoral pH.\(^1,2\) The PGA-FA suture also has a higher tensile strength than surgical gut suture material; however, it absorbs at a rate comparable to that of surgical gut sutures under normal intraoral physiologic conditions.\(^1,2\)

Surgical threads, aside from being classified by the material they are comprised of, also are classified by thread diameter. Thread materials range in diameter from 1 to 10 with the higher number corresponding to the thinner, more delicate thread.\(^7\) With periodontal plastic surgery a 5-0 thread diameter is most often used to secure soft tissue grafts and transpositional/sliding pedicle flaps, whereas a 4-0 thread is used to secure most other periodontal mucoperiosteal flaps. In implant dentistry a 3-0 thread diameter is usually used to secure flaps when a mattress suturing technique is placed and then a 4-0 thread is used closer to the flap edges to coapt the tension free flap edges. A 4-0 thread also is used to secure implant surgical flaps when interrupted, some mattress sutures, and most continuous suture techniques have been performed.

Surgical threads also are fabricated to be either natural or synthetic nonresorbable materials. Classically, silk has been the most universally used material in dentistry and many other surgical disciplines.\(^8\) In this author’s experience, silk is easy to handle, ties with a slip knot, and is relatively inexpensive compared with other nonabsorbable suture materials currently available. However, there are distinct disadvantages when using silk. First, it is nonabsorbable so must be removed, usually a week or so later when the patient is not numb. Second, silk specifically is a multifilament that “wicks” or pulls bacteria and fluids into the wound site.\(^9\) Therefore, in this author’s opinion, silk is not the suture material of choice when any sterile materials are placed under a mucoperiosteal flap (eg, dental implant, bone graft, or regenerative barrier) or when there is clinical evidence of an infection at the surgical site. Instead of
silk, there are other nonabsorbable sutures that can be used in these situations, such as nylon, polyester, polyethylene, polypropylene, or expanded polytetrafluoroethylene (e-PTFE).

Polyester sutures are comprised of multifilaments that are braided into a single strand. This suture is made of a polyethylene polymer and does not weaken when moistened and has a lot of tensile strength. The polyester sutures are usually coated with a biologically inert non-absorbable compound, which aids the suture in passing more easily through tissues. This coating, however, does present a problem in that it also makes knot security an issue because the material will easily untie if not secured with a surgeon’s knot.¹ The e-PTFE suture material is a nonabsorbable monofilament that has high tensile strength, good handling properties, and good knot security, but is expensive compared with all the other nonresorbable suture materials.¹

**Needles**

Aside from the thread type, the other important component of a suture is the needle. The surgical needle is comprised of 3 parts: the needle point, the needle body, and the swaged (press-fit) end. Suture needles usually are classified according to their curvature, radius, and shape. The most commonly used suture needles in dentistry are the 3/8 and 1/2 circle needles.³,⁴ The 3/8 needle allows the clinician to pass from the buccal surface to the lingual surface in one motion. In contrast, the 1/2 circle needle is traditionally used in more restricted areas; for instance, in the buccal of the maxillary molars and the facial aspect of the maxillary and mandibular incisors. In addition, the 1/2 circle needle is routinely used for periosteal and mucogingival surgery.¹⁻⁴

Suture needles also are classified as either conventional cutting or reverse cutting.⁵ In dentistry, the clinician always should use reverse cutting sutures to prevent the suture material from tearing through the papillae or surgical flap edges, which is referred to as “cut out.” Usually, a cut out is caused by a conventional suture needle because it has an inside concave curvature that is sharpened, whereas a reverse cutting needle has a smooth inner curvature and its third cutting edge is located on its convex (outer) edge.⁴ Generally in dentistry, the 3/8 reverse cutting needle with a 3-0 or 4-0 thread diameter and the 1/2 reverse cutting needle with the thinner and more delicate 5-0 or 6-0 thread diameter are the most commonly used needle and thread combinations, according to the author’s private communications with suture manufacturers.

**Knots**

Surgical knot tying is an important component to the art of suturing. It is essential for knot security and to obviate untimely knot untying that the appropriate surgical knot be used for the specific suture material being secured. For instance, when using silk, e-PTFE, chromic gut, or plain gut suture material, a slip (granny) surgical knot should be used. However, with the
synthetic resorbable and other nonabsorbable synthetic suture materials, a surgeon’s knot must be used to prevent untimely knot untying. The type of knot that is used for each material is determined by the mode in which each type of thread is manufactured.

**User-Friendly Periodontal Suturing Techniques**

The interrupted suture encompasses 2 suturing techniques: the simple loop and the figure-8. The simple loop (Figures 1 and 2) is the most commonly used technique in dentistry and is routinely used to coapt tension-free, mobile surgical flaps. For example, the simple loop is useful in edentulous ridge areas, to coapt vertical releasing incisions, for periosteal suturing, and to coapt flaps in ENAP, modified Widman flap, some periodontal regeneration, and some exploratory flap procedures.

The figure-8 technique (Figure 3) is placed similarly to the simple loop on the buccal aspect; however, on the lingual aspect, the needle penetrates through the outer, not inner, surface of the lingual flap. This results in suture thread being interposed between the surgical flaps. Both of the interrupted suture techniques achieve similar results when used for wound closure with tension-free flaps. The figure-8 is useful when suturing on the lingual aspect of the lower molars, especially in a patient with an active gag reflex or a large, cumbersome tongue.

Another suturing technique, which is a variation of the interrupted suture, is the mattress technique. This technique usually is used in areas where tension-free flap closure cannot be accomplished. Mattress suturing techniques generally are used to resist muscle pull, evert the wound edges (this keeps epithelium away from underlying structures), and to adapt the tissue flaps tightly to the underlying structures (eg, bone graft, tissue graft, alveolar ridge, regenerative membrane, or dental implant). When using a mattress suture, usually a 3/8 reverse cutting needle is used with a thicker (3-0 or 4-0) thread diameter. Traditionally, mattress sutures are left in place for 14 to 21 days before dissolution or removal.

There are variations of the mattress suture technique referred to as the horizontal, vertical mattress (Figure 5), vertical sling (Figure 6), and cross mattress. Unlike the mattress suture technique, interrupted sutures should be used only with tension-free mobile flaps and should have needle penetration 3 mm to 4 mm from the wound edges or at the base of an interdental papilla. In contrast, when performing a mattress suture, the needle penetration through the surgical flap should be 8 mm to 10 mm away from the flap edge or just above the mucogingival junction in keratinized tissue.

The interrupted suspensory suture, commonly referred to as the sling suture (Figure 7), is used when only 1 side, or 1 or more papillae of a flap, is independently repositioned to its original position or coronally repositioned. In the author’s opinion, the sling suture technique is especially useful when performing coronally repositioned sliding flaps.

Continuous sutures can be used to attach 2 surgical flap edges or to secure multiple interproximal papillae of one flap independently of the other flap. Although there is a distinct advantage of the continuous suture in that there are fewer individual suture ties, the disadvantages, in this author’s opinion, of using any continuous suture far outweigh the advantages of its use. This is most likely because there is a tremendous likelihood that one knot or loop will break, resulting in a compromise in the integrity of the entire surgical site. The author believes that most clinicians would have more control using individually placed interrupted, sling, figure-8, or mattress sutures in lieu of placing one large continuous suture.

**Conclusion**

The evolution of suturing material has presented dentists with advancements in sutures designed for specific surgical procedures. With the sophisticated surgical procedures used daily, there is a greater need for knowledge with regard to the various types of suturing armamentarium available to assist in obtaining optimal wound closure. The success of technique-sensitive procedures such as conventional periodontal therapy, dental implant therapy, mucogingival microsurgery, periodontal cosmetic plastic surgery, regeneration of hard and/or soft tissue, and excisional treatment of pathologic tissue depends on the clin-
ician’s knowledge and skill of executing proper suturing for optimal wound closure.

The recent innovations in suturing materials not only eliminate some of the difficulties previously encountered during surgical closure, but also decrease the potential for postoperative infections.

Acknowledgment

Special thanks to David Kurtzman, DDS, a cosmetic dentist located in Marietta, Georgia, for his beautiful illustrations.

References

1. When proper suture technique is used with the appropriate thread type and diameter, tension is placed on the wound margins so:
   a. primary intention healing occurs.
   b. secondary intention healing occurs.
   c. tertiary intention healing occurs.
   d. the knot is directly over the incision.

2. In those circumstances in which the intraoral tissues most likely will never regain their preoperative strength, the clinician should consider using a suture material that retains long-term strength for up to:
   a. 7 days.
   b. 14 days.
   c. 21 days.
   d. 28 days.

3. If a suture is to be placed in a tissue that heals rapidly, the clinician should select a resorbable suture that will lose its tensile strength at:
   a. 7 days.
   b. 14 days.
   c. 21 days.
   d. about the same rate that the tissue gains strength.

4. Sutures of biologic origin are:
   a. nonantigenic.
   b. gradually digested by intraoral enzymes.
   c. made from human protein.
   d. easy to tie knots in.

5. Surgical gut sutures may break too rapidly to maintain flap apposition, particularly if used in patients with:
   a. very low intraoral pH.
   b. very small flaps.
   c. large tongues.
   d. Class III malocclusion.

6. The minimum coaptation time for tissue flaps is approximately:
   a. 1 day.
   b. 3 days.
   c. 5 days.
   d. 7 days.

7. Pulling bacteria and fluids into the wound site is called:
   a. repopulating.
   b. bonding.
   c. wicking.
   d. delaminating.

8. A cut out is caused by a conventional suture needle because it has:
   a. a very large radius.
   b. a very small radius.
   c. an inside concave curvature that is sharpened.
   d. an outside concave curvature that is sharpened.

9. The type of knot that is used for each material is determined by the mode in which:
   a. each type of thread is manufactured.
   b. the attached gingival will be approximated.
   c. the unattached gingival will be approximated.
   d. oral fluids degrade it.

10. When performing a mattress suture, the needle penetration through the surgical flap should be how far away from the flap edge?
    a. 1 mm to 2 mm
    b. 3 mm to 4 mm
    c. 5 mm to 6 mm
    d. 8 mm to 10 mm

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