
Endodontic flap design: Analysis and recommendations for current usage

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An endodontic flap design, which may be used as an alternative to the presently described endodontic flaps, is presented. This flap involves a full-thickness dissection with easily recognizable landmarks and straight-line incisions. A beveled horizontal incision is designed to incorporate the maximum amount of facial keratinized tissue into the body of the flap, while leaving the interproximal tissues untouched. The resultant flap is easily replaced with interrupted sutures to the stable interproximal papillae. Healing is rapid, with excellent esthetic results.

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Indications for periapical surgery is a subject that has been discussed by a host of clinicians in recent years, notably Luebke,¹ Summers,² Fitzpatrick,³ and Ingle.⁴ In addition, the specific surgical designs for these procedures have been frequently presented.

When an endodontic periapical flap is used, there are certain basic principles that must be considered. These principles have been well described by Zola,⁵ Morse,⁶ and Weine⁷ and have direct relevance to all mucogingival flaps, including those used in periodontics, oral surgery, and other areas of dentistry. Several of these specific principles are particularly important for a successful endodontic flap and warrant specific attention.

The most important factor in flap design is consideration of blood supply. To ensure an adequate blood supply and proper healing, the mucogingival flap should be widest at its base. The second factor in flap design that should be given serious consideration is regional anatomy. The location of blood vessels and nerve supply should be thoroughly in mind when one is making the incisions, which should be placed over normal anatomic structures. For example, an incision should not be placed directly over an existing osseous defect or in an area where a defect may be a

consequence of the periapical surgery. In addition, regions with compromised vascular supply, such as bony eminences, fenestrations, or dehiscences, should be avoided where possible since reattachment and proper healing could be a problem in these areas. Methods of dealing with abnormalities in bone have been described. For example, Morse⁶ stresses the use of a split-thickness flap when a dehiscence or fenestration is present. The third principle that needs consideration is closure of the incision. Following the surgical procedure, the flap should be replaced so as to cover all surgically exposed areas. This will minimize any unintentional loss of bone. Location of the incision is an important consideration if one is to avoid critical anatomic structures, allow adequate access, and provide for proper healing. When vertical or oblique releasing incisions are used, it is generally recommended that these be placed at least one tooth mesial or distal to the surgical site in order to adequately cover the surgical area while sutures are placed over healthy osseous structures. If periodontal disease is present in the surgical area, a periodontal consultation is desirable prior to the endodontic flap. In this way, therapy could be coordinated and a realistic prognosis established before the endodontic surgery. The clinician would also be alerted to potential periodontal complications that might arise during surgery.

At least six basic flap designs have been described in the literature.^{4, 7-10} These are the semilunar (curved), the triangular, the rectangular, the trapezoidal, vertical incision, and the Ochsenbein-Luebke flap. These flaps are all primarily full-thickness flaps which can be slightly modified in areas to become

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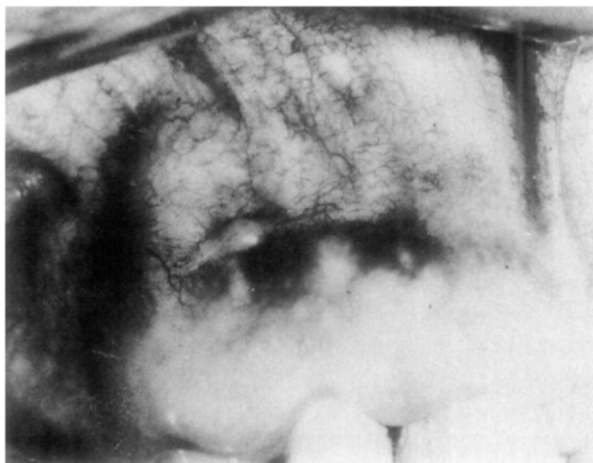


Fig. 1. Postsurgical scar as a result of endodontic flap design limited to the alveolar mucosa.

split-thickness in design. Of those mentioned, the semilunar design has been employed most frequently in the past. The incision is directed to bone without the use of a bevel and should extend a minimum of one tooth on either side of the defect. The location of this incision may be in the attached gingiva⁴ or in the alveolar mucosa.^{10, 11} Use of this flap design is contraindicated when a dehiscence or fenestration is present along the surgical incision line. When this design is used in alveolar mucosa, scarring is frequently noted (Fig. 1). The greatest advantage of the semilunar flap is the preservation of the gingival margin which is important when a fixed prosthetic replacement is present in the surgical area.

The triangular flap design is useful for teeth with short roots. The horizontal incision is often placed in the gingival sulcus, while a vertical releasing incision which extends into the alveolar mucosa is placed interproximally. The ideal location of this horizontal incision varies, depending on the clinician describing the procedure. Peters and Hintz,¹² as well as Summers,² believe that the incision should be made through and including the interdental papillae, while Morse⁶ and others recommend that the incision be placed totally in attached gingiva.

The trapezoidal and rectangular flaps are similar in that a horizontal incision is made in the gingival sulcus, through and including the interdental papillae. Two vertical or oblique incisions are made interproximally at a distance of at least one tooth mesial or distal to the surgical area. It is important that these releasing incisions not be placed directly over a root or bony prominence which may have an inadequate blood supply. One author¹³ indicates that

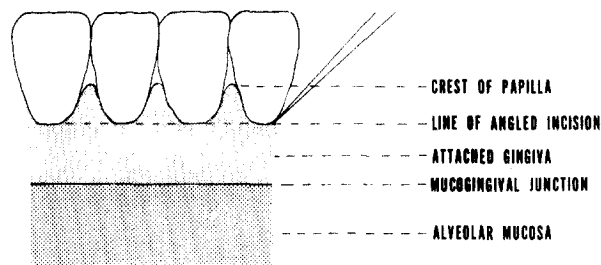


Fig. 2. Diagrammatic representation of relationship of horizontal incision line to crest of papillae.

those oblique interproximal incisions should curve away from the defect.

A single vertical incision to be used in periapical surgery has been described by Eskici.⁹ This incision is made interproximally immediately adjacent to the tooth to be treated. The design is indeed simple to perform; however, it has the disadvantages of limited access as well as the possibility of suture lines being placed across the osseous defect.

The Ochsenbein-Luebke flap consists of a horizontal incision placed a minimum of 2 mm from the depth of the gingival sulcus. The incision line then curves gently to form the vertical components of the flap. This design provides excellent access and vision and an adequate blood supply, and it will not interfere with esthetics at the gingival margin. Its main disadvantage is related to situations in which there is minimal attached gingiva at the surgical site. This could be related either to situations in which there is a minimal occluso-apical width of total keratinized tissue or to the presence of moderate pocketing in the area. With the base of the sulcus as a guide, the horizontal incisions could possibly be within or very close to the alveolar mucosa.

Recently, Vreeland¹⁴ described an endodontic flap which combines both a split-thickness and a full-thickness dissection. A scalloped incision is initiated approximately 1 to 2 mm apical to the crest of the marginal gingiva. From this starting point, a split-thickness dissection leaving connective tissue attachment over bone and root is completed to a point 1 to 2 mm apical to the crest of the marginal bone. At this point a full-thickness dissection is started and continued until proper reflection is obtained. Vertical releasing incisions are used as needed.

It is clear that the dental literature is replete with a multitude of endodontic flap designs. The preceding literature review was by no means exhaustive; however, the major categories of flap design were covered. One may readily note that much controversy and opinion exists as to where to place a horizontal

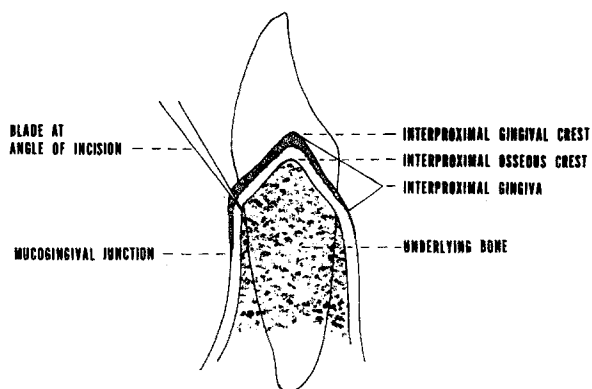


Fig. 3. Facial-lingual representation of incision line to crest of papillae. Note angle of incision.



Fig. 4. Case 1. Starting photograph of maxillary right posterior segment.

incision, whether or not to include the interdental papillae in the reflected flap, where and how to place vertical releasing incisions, and whether the flap dissection should be split thickness, full thickness, or a combination of the two. The purpose of the present article is to correlate the available information about endodontic flaps and to propose the use of a simple, realistic flap design which, when properly used, will provide an esthetic result while adhering to the principles necessary for a successful endodontic flap.

FLAP DESIGN

This flap design incorporates straight-line incisions which follow easily identifiable landmarks; a scalloped incision which traces the gingival margin is not used in this technique. The horizontal component of this flap is directed at and along a straight line drawn across the most apical extent of the facial

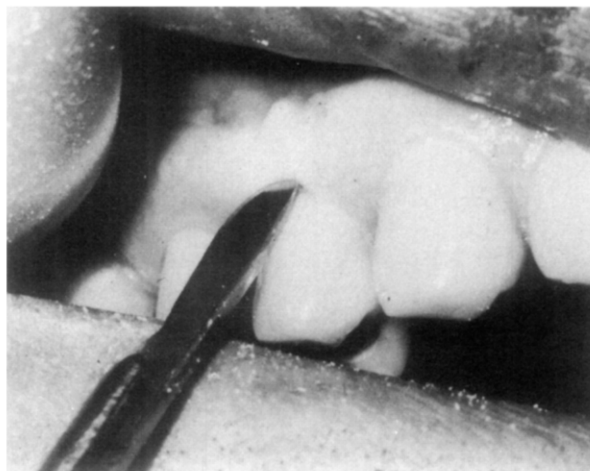


Fig. 5. Case 1. Blade in place demonstrating angle of beveled incision.



Fig. 6. Case 1. Flap reflection. Note vertical releasing incision traversing across interproximal area.

gingival scallop. In other words, the incision would be initiated in the gingival sulcus at the cervical region of each tooth; however, as the sulcus curves coronally in the interproximal area, the incision proceeds in a straight line to connect with the cervical area of the adjacent tooth. Fig. 2 demonstrates the relationship of the horizontal incision line with the crest of the interproximal papillae and the mucogingival junction. This type of straight-line incision will leave the maximum amount of interproximal gingiva untouched while incorporating the maximum amount of facial keratinized tissue into the flap. Fig. 3 demonstrates the angle of the horizontal incision. It is directed apically to create a short bevel between the reflected flap and the remaining interproximal tissues. This flap is primar-

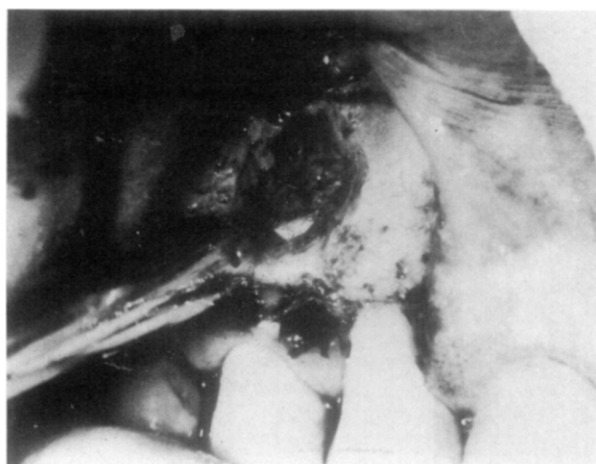


Fig. 7. Case 1. Surgical exposure of second premolar.

ily a full-thickness flap with dissection to bone, and the purpose of the short bevel of the interproximal tissues is to allow a broad bed for flap readaptation in the interdental area. The use of these readily recognizable landmarks as a guide to the incisions avoids the need to evaluate the true level of the attached keratinized tissues at the time of surgery. The presence of a pathologic pocket in the surgical area should have been diagnosed and evaluated prior to surgery. Therefore, the incision as described could be made easily and quickly without the clinician having to stop to evaluate the periodontal status. Fig. 3 also presents a facial-lingual view demonstrating how this particular flap design avoids the interproximal tissues and limits the flap reflection to the facial aspect only.

Vertical releasing incisions are used to allow access to the root apex. Either one or two vertical incisions may be used, depending on the amount of relaxation that is needed. In either case, these should be placed at least one tooth away from the surgical site and in an area where there is no danger of an incision line crossing a root prominence. The reflected flap should always be designed so that the apical base is broader horizontally than the coronal margin.

CASE REPORTS

Two cases will be presented here to illustrate the use of this simplified endodontic flap design and the results that can be obtained.

CASE 1

Fig. 4 shows the initial photograph of the maxillary right first molar, second premolar, and first premolar in a

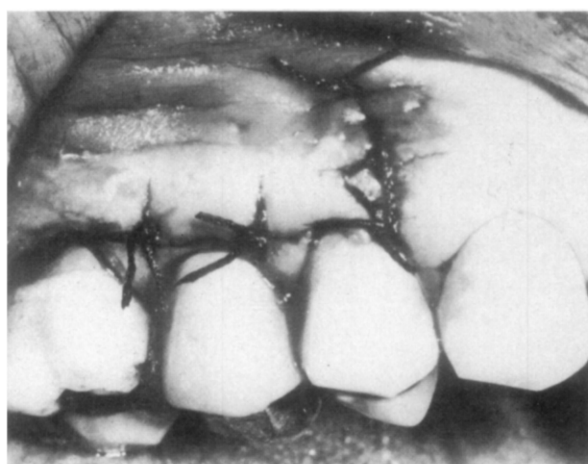


Fig. 8. Case 1. Sutures in place, with stable interproximal tissues as anchoring points.

29-year-old man. The second premolar was scheduled for a surgical root amputation with retrograde amalgam. The angle of the scalpel for the initial beveled horizontal incision is demonstrated in Fig. 5. The placement of a vertical releasing incision is illustrated in Fig. 6 along with the reflection of the flap. Note how the vertical incision line traverses from the mesial aspect of the first premolar along a line across the interdental area toward the canine but without crossing any root prominences. This design will create a flap which has a base that is wider than the coronal portion. In this particular case, only one vertical incision was needed for adequate exposure. The surgical exposure of the second premolar root was easily accomplished, as illustrated in Fig. 7. The beveled facial aspect of the interproximal papillae can be observed, as well as the fact that the flap margins are well removed from the surgical site. Closure of the wound was accomplished with interrupted sutures attached to the remaining papillae and across the vertical incision line with 4-0 silk (Fig. 8). The 1-month postoperative photograph (Fig. 9) illustrates that the incision lines are still visible but that there is excellent readaptation with unaltered interproximal papillae.

CASE 2

This case is presented to illustrate the final results that can be obtained with this design; the surgical procedure will not be described. The initial photograph of the maxillary left posterior segment of a 39-year-old man shows a sinus tract from the periapical region of the maxillary left first molar (Fig. 10). The flap design previously described was used in this case. Closure of the wound by the previously illustrated procedures provided excellent anchorage of the flap to the interproximal tissues. The 1-month postsurgical photograph (Fig. 11) illustrates the excellent readaptation that can be obtained with this flap design. Incision lines are still slightly visible, with the arrow indicating the initial horizontal line of incision.



Fig. 9. Case 1. One month postoperative healing. Note unaltered interproximal papillae.

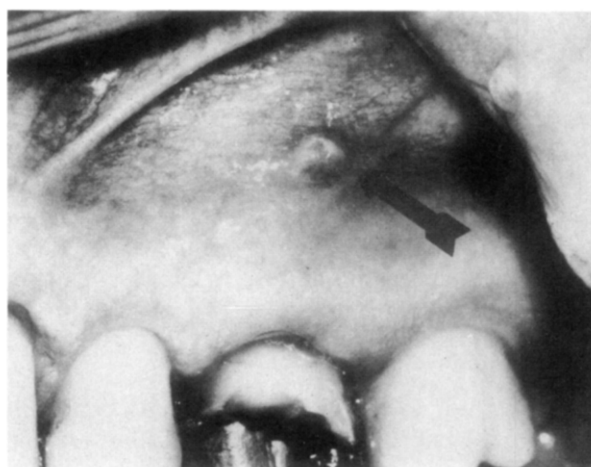


Fig. 10. Case 2. Starting photograph of maxillary left posterior segment. Note sinus tract (arrow).

DISCUSSION

We have presented an endodontic flap design that can be a valuable addition to the body of widely used endodontic flaps. However, one important fact must remain uppermost in the clinician's mind when performing this type of surgery: It is not the specific technique or design that ensures success but, rather, the intelligent use of the technique in the individual case. Any flap design must be tailored for the individual circumstances. In this total context, the flap design presented in this article has certain advantages and disadvantages.

Advantages

1. The interdental papillae remain untouched and are not incorporated into the flap. Healing of the interdental area is therefore not needed, since interproximal contours remain unchanged. In the traditional full-thickness flap which includes the papillae, healing of this area can result in abnormal interproximal contours, such as gingival craters or flattened papillae. In addition, the interproximal region is the most common site for initiation of periodontitis; therefore, it would be preferable to leave healthy interdental areas alone if possible.

2. With the use of straight-line incisions without incorporation of a scalloped form, this flap is rapidly accomplished, easy to reflect, and easy to reposition. The interproximal papillae serve as a stable landmark to facilitate suturing, and the technique may be used effectively in both the anterior and the posterior regions with equal ease.

3. The primary reflection of this flap is via full-thickness dissection. The horizontal incision goes to

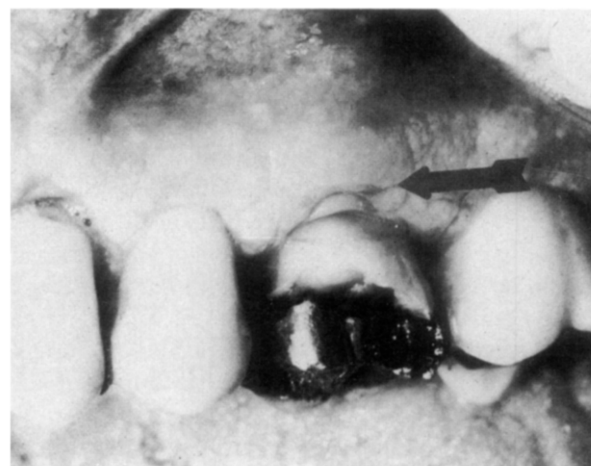


Fig. 11. Case 2. One month postoperative photograph. Note unaltered interproximal papillae. Arrow demonstrates initial horizontal incision line.

bone rapidly, and the periosteum is thereby incorporated into the main body of the flap. This allows for the maintenance of a maximum number of blood vessels within the flap, thereby helping to ensure viability. A split-thickness dissection leaving connective tissue over bone and roots is often very difficult to obtain, especially when the gingiva is fairly thin.

4. The incision lines as described will provide a flap incorporating the maximum amount of surface keratinized tissue available. This allows the flap margins to be as far away from the surgical site as possible, with closure almost always guaranteed to be over healthy osseous tissues. The likelihood that sutures will be needed directly over the surgical site

is remote, even if the osseous exposure is wider than originally anticipated.

5. The beveled incision along the interproximal regions allows a broad area for flap readaptation at the incision line. If there is any postoperative swelling, the overlapped design (bevel) provides a margin of safety to preclude the flap from breaking down along the incision line. The beveled flap also helps to ensure proper blending of the tissues, which aids in maintaining an esthetic result.

Disadvantages

1. The use of a full-thickness dissection with incorporation of the periosteum into the body of the flap will produce a situation in which fenestrations and/or dehiscences over the root surfaces are a possible consequence of the flap reflection. As previously stated, it is best to diagnose and plan ahead. If a fenestration or dehiscence is suspected or anticipated, it would be best to either design the flap to avoid the area or modify the flap to use a split-thickness dissection in that particular area. If a defect of this type is inadvertently exposed, however, there is still an excellent chance for reattachment if the defect was not pathologically exposed. For example, if the root surface had not been acted upon by bacterial toxins, etc. for an extended period of time, then it should be assumed that the root still has connective tissue elements on its surface. In this case if the inadvertently exposed root is left alone and not scaled at the time of surgery, reattachment of the gingiva to the root is likely.

2. Since this flap design involves the reflection of the gingival margin at the cervical region of the tooth, there is a possibility that the esthetic result in this specific area could be compromised. This is especially important when there are cast restorations in the surgical site and the collar was placed into the intrasulcular area for esthetic reasons. We have found that the esthetic result has been excellent in the vast majority of patients in whom this flap design has been used.

SUMMARY

An endodontic flap design that can be an effective addition to the body of endodontic flap design has been presented. In principle, this flap involves a full-thickness dissection that uses easily recognizable landmarks and straight-line incisions. A beveled horizontal incision is designed to incorporate the maximum amount of facial keratinized tissue into the body of the flap while leaving the interproximal tissues untouched. The resultant flap is easily replaced with simple interrupted sutures to the stable interproximal papillae. Healing is rapid, with excellent esthetic results.

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