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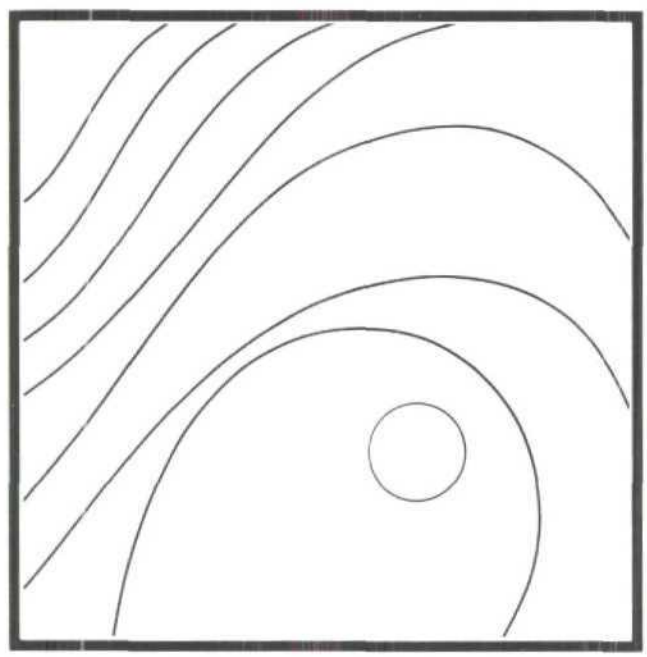

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Modified Coronally Positioned Flap for Obtaining New Attachment in Class 2 and 3 Furcation Defects. Part I: Rationale and Surgical Technique

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A new technique, the modified coronally positioned flap procedure, is described for treatment of Class 2 and Class 3 molar furcation defects in conjunction with barrier membranes. This technique is designed to minimize barrier exposure during the healing phase and to cover and protect the newly formed granulation tissue following barrier removal. Examples are presented and discussed, and modifications for varying situations are described. The modified coronally positioned flap technique is applicable for use with nonresorbable and resorbable membranes. (Int J Periodont Rest Dent 1995;8:463–473.)

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Various clinical techniques for obtaining gain in probing attachment level have been described.[1,2] Human clinical and histologic case reports have documented significant reduction in probing pocket depth, gain in attachment levels, and decrease in depth of osseous defect using nonresorbable membrane barriers.[3–11] These changes have often been accompanied by significant gingival recession and postsurgical exposure of the membrane barrier in studies where these parameters have been documented.[12–15]

Becker et al,[4] using a Teflon membrane barrier, reported a mean gain in probing attachment level of 1.3 mm, 1.5 mm, and 2.3 mm for 11 Class 3, six Class 2, and nine three-wall intrabony defects, respectively. The corresponding mean gingival recession was 1.3 mm, 1.3 mm, and 1.7 mm. The membrane barriers were placed "2 mm apical to the free gingival margin of the flap following flap closure."

Lekovic et al[5] reported a gain in attachment level of 2.86 mm, with a concomitant 1.26 mm of gingival recession in 12 mandibular Class 2 furcations using an expanded polytetrafluoroethylene (e-PTFE) membrane barrier. The corresponding results with the 12 control Class 2 furcations treated by open debridement was a loss of 0.12 mm of attachment, and gingival recession of 1.08 mm. In this study, the flaps were sutured "slightly coronal to their original level."

Caffesse et al,[6] comparing 11 Class 2 mandibular molar furcation defects treated with guided tissue regeneration to sham controls, reported a mean attachment gain of 1.8 mm for membranes versus 0.6 mm for controls. Although no mention was made of recession, with a reported average pocket reduction of 2.8 mm, recession would average 1.0 mm for membrane-treated defects. The authors report that "it was assured that the flaps covered the periodontal material completely."[6]

Long-term results of treatment utilizing nonresorbable membrane barriers have demonstrated that attachment level gains may be maintained in both intrabony and furcation defects.[7-10] McClain and Schallhorn,[10] in a long-term clinical study comparing membranes combined with osseous grafts versus membranes alone, reported new attachment averaging 4.0 mm and 1.8 mm, and gingival recession averaging 0.3 mm (gain) and -0.8 mm (loss), respectively. An earlier publication documenting the surgical technique used in that study noted that "flaps were replaced to their original position or coronally positioned."[11]

On the other hand, two histologic studies utilizing Teflon membranes positioned the membrane "in such a way that the coronal border of the membrane was consistently located around 1 to 2 mm coronal to the flap margin."[16,17] Diagrammed placement of the Millipore Filter (Type GS, Millipore, pore size = 0.11 mm) showed it to be significantly coronal to the level of the sutured flap margin.[18] These histologic studies, as well as histologic case reports from a more recent paper, demonstrate evidence of new histologic attachment in cases where the flap is sutured apical to the exposed membrane.[12]

A review of the various membrane barrier studies reveals conflicting data as to the optimum position of the barrier in relation to postsurgical flap placement. However, in utilizing a nonresorbable membrane (Gore-Tex Periodontal Material, WL Gore) with an "open microstructure collar" designed to ingrow with connective tissue and limit epithelial migration,[19] it makes biologic sense to submerge the membrane apical to the flap margin at the time of suturing. This conclusion was confirmed recently in two separate papers. The first, by Haney et al,[20] utilized e-PTFE membranes to treat surgically created defects in beagle dogs.

The authors noted that "in clinically exposed membrane-treated teeth an extensive inflammatory cell infiltrate dominated the histologic picture; bone regeneration was minimal." They concluded that "complete gingival coverage of the barrier membrane appears critical for optimal healing." The second paper, by Selvig et al,[13] found that the extent of a membrane's contamination was inversely correlated to clinical attachment gain. Moreover, Becker et al[21] advised against supragingival membrane placement because "it has the potential to create oral hygiene problems and may cause gingival recession." In addition, "trauma from brushing may dislodge the supragingival membrane and consequently interfere with new attachment formation." Recently, a histologic study in beagle dogs by Pontoriero et al[22] noted that failure of created Class 3 furcations to completely close was related to the size of the deformity as well as "flap recession during healing, which resulted in the exposure of the

furcation defect." For these reasons, having the membrane remain in a subgingival position until removal is a desirable goal.

Flap designs and suturing techniques have been proposed to achieve this goal.[4-6,21] Unfortunately, even in cases where the gingival flaps were sutured to submerge the membrane, "in most instances the porous collar becomes slightly exposed from 18 to 21 days after surgery."[21] Another study where membranes were completely covered with surgical flaps at time of placement reported that "all membranes were exposed to the oral cavity by 1 to 3 mm at the coronal margins by time of removal."[14] Although the time of membrane exposure was not documented in studies combining the use of membranes and bone grafts, the authors mention trimming or not trimming the membrane "when the membrane exposure occurred with subsequent gingival recession."[11] Thus membrane exposure appears to occur in many cases with the various flap and suturing techniques currently in use.

In exploring alternate regenerative techniques, the literature contains human clinical studies describing the use of citric acid root conditioning in conjunction with a coronally positioned flap to facilitate gain in clinical attachment.[23-25] One biometric study reported on the treatment of 30 mandibular Class 2 furcation defects.[24] All defects received citric acid root conditioning plus coronal flap positioning (CFP). Sixteen of the 30 defects also received decalcified freeze-dried allogenic bone (DFDBA). Gain in probing attachment levels were reported to be 0.1 mm with coronal flap alone and 0.3 mm with the addition of DFDBA. Vertical and horizontal fills were 2.4 mm and 2.6 mm, respectively, with CFP alone and 2.4 mm and 3.0 mm, respectively, with CFP and DFDBA. The authors reported a mean coronal shift (compared to presurgical levels) of the gingival margin until 6 to 12 weeks postsurgery. At the 52-week measurement, however, the mean recession in the two groups was 0.5 mm (CFP) and 0.3 mm (CFP and DFDBA). In another study done by the same authors, less successful results were obtained in the treatment of mandibular Class 3 furcations defects.[25] However, it is interesting to note that 6 months postsurgery there was no reported clinical recession of the gingival margin in the citric acid plus coronal flap positioning group, and a 0.4 mm coronal gain in gingival margin position in the group receiving additional bone grafts.

The documented success of two completely different surgical approaches (nonresorbable membrane barriers to allow selective cell repopulation and citric and coronal positioning of the surgical flap to protect "the blood clot/root surface interface and the early time point of healing"[23]), indicated that a combination of these procedures may improve treatment results. Treatment of surgically created recessive-type defects in six monkeys demonstrated that coronally positioned flaps and membranes obtained new connective tissue attachment to a significantly greater degree than the control group (coronally repositioned flap with no membrane), averaging 74.3% versus 36.9%. All membrane-treated teeth retained the gingival margin coronal to the cementoenamel junction (CEJ).[26]

A recent paper tested this hypothesis in humans.[27] Eight suprabony lesions received root debridement and coronally sutured flaps with orthodontic brackets bonded to the facial surfaces. In four sites, nonresorbable membranes were used to cover the exposed root and crest. Results showed 1.7 mm gain of attachment (closure), 2.4 mm probing depth reduction, and 0.9 mm gingival recession at the time of the 8-week block section in the membrane-treated group. The nonmembrane group had corresponding values of 0.6 mm closure, 2.7 mm probing depth reduction, and 2.1 mm gingival recession. From a histologic

point of view, three of four of the membrane-containing sites showed repair cementum and new attachment. No evidence of new attachment was seen in the nonmembrane sites. This histologic finding of regeneration (cementum, bone, and periodontal ligament) with reduced or minimal gingival recession in suprabony defects encouraged the authors to devise a surgical technique facilitating gingival coverage of the membrane for as long as possible prior to membrane removal while relocating the healing gingival margin coronal to its presurgical position. Moreover, the technique may be used following membrane removal to cover newly formed connective tissue. Coverage of this healing tissue has been reported to positively affect the amount of tissue gain and bone fill.[15] Bonding orthodontic brackets or bonding the sutures to the crown with resin, as described previously, was considered to be clinically awkward and an unpredictable method of flap positioning. A flap design and suturing technique were therefore devised to allow for membrane barrier coverage at the time of coronal positioning of the flap. To date, modifications of the coronally repositioned flap techniques, as originally described,[15,24-30] have been performed on 52 periodontally involved sites. This article will discuss surgical procedure and rationale. Results of treatment of 52 defects treated with this technique will be presented in a subsequent report.

Method and materials

The following surgical procedure assumes that cause-related therapy has been completed.

A measurement is made from the CEJ to the level of the free gingival margin at the midbuccal or midlingual aspect of the tooth. This measurement helps determine how far apical to the papillae the initial incisions should be made.

Using this point apical to the papillae, a horizontal incision is made, starting at the distal and extending intrasulcularly on the buccal (or lingual) of the tooth. This incision terminates at a point apical to mesial papillae, equal in coronal apical distance to the termination on the distal papillae. An inverted V-shaped incision is made in the mesial and distal aspects of the flap, and two vertical incisions are carried apically through the alveolar mucosa (Fig 1).

A full-thickness flap is elevated, exposing the defect and extending 4 to 5 mm apical to the crest of bone. Further reflection is performed with a partial thickness flap retaining the periosteum and some connective tissue on the exposed buccal plate (Fig 2).

The mesial and distal interproximal papillae are plastied to remove the epithelium. Root preparation is performed to thoroughly remove calculus and diseased cementum with hand, ultrasonic, and rotary instruments. Root conditioning is performed with citric acid swabs (citric acid, pH = 1) for 3 minutes. The area is then rinsed for 1 minute with sterilized saline or water.

The membrane is fitted to cover the furcation defect and to extend 4 to 5 mm apically beyond the osseous defect (similar to the protocol for membrane use). It is tucked under the periosteum to aid in retention. At this time, the membrane is retracted and a bone graft (decalcified freeze-dried bone) is placed to completely fill the furcation defect. The membrane is then replaced and sutured with Teflon sutures, circumferentially around the tooth for close adaption, according to the standard protocol for membrane use (Fig 3).[31]

Suturing is performed by engaging the flap on the distal aspect, going over the contact point, and then engaging the lingual flap. The suture is then brought back over the contact point and tied onto the buccal aspect. This will coronally position the flap. The same suturing technique is used on the distal aspect (Fig 4). Interproximal

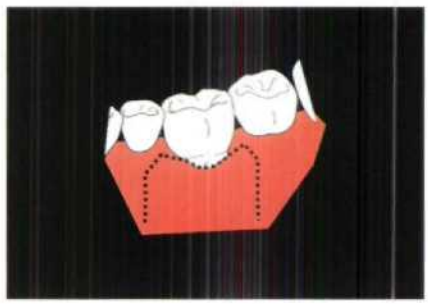


Fig 1 Incisions for the modified coronally positioned flap. Two vertical incisions are made at the line angles of the adjacent teeth. The inverted V-shaped incisions create new papillae.

Fig 2 Reflection of a full-thickness flap exposing the furcation defect and 5 mm of the underlying buccal plate. Inferiorly, a partial-thickness flap is reflected, retaining the connective tissue and periosteum over bone.

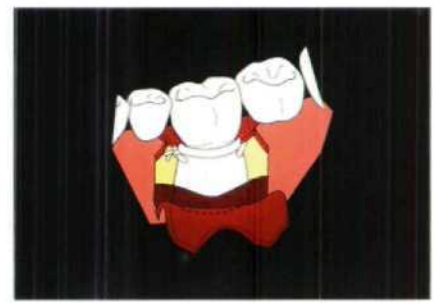


Fig 3 The remaining papillae are contoured to remove the surface oral epithelium. Following root conditioning and bone graft placement the membrane is contoured and fitted to cover the furcation and extend 4 to 5 mm apical to the alveolar crest. The membrane is tucked under the periosteum to adapt it more closely to bone, and is then sutured with an e-PTFE sling suture.

Fig 4 The flap is sutured utilizing e-PTFE sutures. The buccal papillae is engaged and the sutures are passed over the contact point. The lingual papillae is then engaged and the suture is again brought back over the contact point and tied on the buccal aspect. The same suturing technique is used on the distal aspect. Tying these sutures elevates the flap without tension.

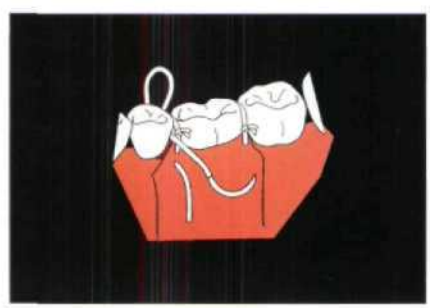


Fig 5 Interrupted interproximal sutures are placed through the mesial and distal papillae to stabilize the flap at the coronal level.

Fig 6 Oblique sutures are used to close the vertical incisions. The sutures are angulated to keep the flap in position and to adapt the tissue more closely to the underlying bone.

sutures are then placed through the flap and plastied papillae (Fig 5). Oblique sutures are used to close the vertical releasing incisions and more closely adapt the flap to the underlying connective tissue and bone (Fig 6). Moist gauze is applied for 5 to 10 minutes to compress the flap and establish a clot. No dressing is indicated, and an antiplaque mouthrinse (0.12% chlorhexidine bid) is begun 24 hours after surgery and continued until membrane removal. Flap sutures are removed 10 to 14 days postsurgery. The patient is monitored on a weekly basis, and the membrane is removed 4 to 16 weeks postsurgery (Figs 7a to 7g).

Fig 7a *Presurgical view of tooth 19 with a Class 2 buccal furcation defect.*

Fig 7b *Flap is reflected, exposing a vertical defect measuring 4.8 mm, and a horizontal defect of 4.5 mm. At the base of the full-thickness flap a partial thickness dissection was performed.*

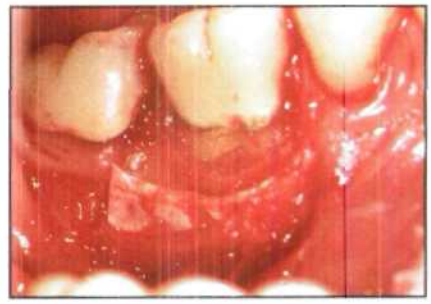


Fig 7c *The root and defect were debrided, and citric acid root conditioning was performed. The membrane is fitted and tucked into the retained periosteal "pouch." Decalcified freeze-dried bone is placed in the furcation defect by retracting the unsutured membrane.*

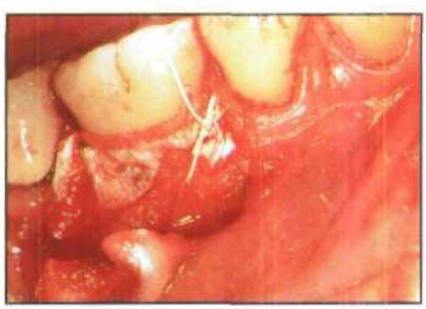


Fig 7d *The membrane is repositioned and sutured with e-PTFE suture material (WL Gore) using a sling suture around the tooth. The periosteum is then sutured over the membrane.*

Fig 7e *The flap is coronally positioned by suturing the "created" papillae with sutures that go over the contact points. Interrupted sutures through the papillae lock the flap at the new position. Oblique sutures close the vertical incisions.*

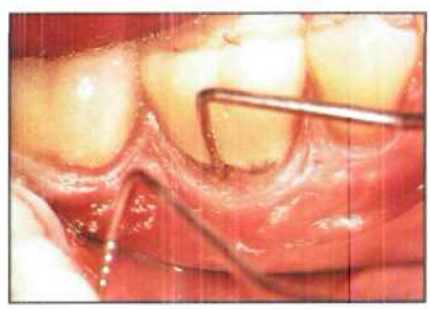


Fig 7f *The area is probed 45 months after initial surgery. Note the limited recession and probing depth. Recession measures 0.7 mm, and probing depth 3.1 mm.*

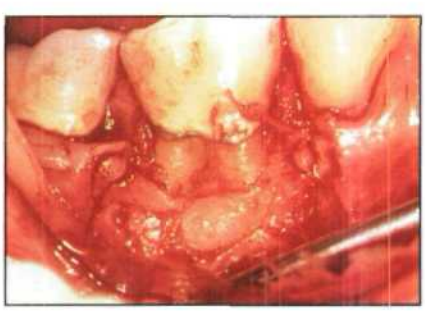


Fig 7g *Reentry reveals complete fill of the furcation.*

Furcated molar with interproximal defects

The modified coronally positioned flap as described is indicated when treating furcated molars where the interproximal is not periodontally involved. If an interproximal defect is present, the vertical incision is made one tooth mesial or distal to the involved tooth, and the interproximal papillae over the defect is preserved.

Furcation defect adjacent to an edentulous space

If there is an edentulous space adjacent to the furcated tooth being treated, a horizontal incision is made along the crest of the edentulous ridge from the proximal surface of the involved tooth. An incision parallel to the first incision is then made with the distance between the incisions equal to the desired distance of coronal positioning of the flap (Fig 8). The remaining incisions and plasty of the papillae are similar to the previously described procedure (Fig 9). Suturing with interproximal sutures engages the lingual papillae and flap margins and coronally positions the flap (Fig 10). Oblique sutures are used to close the vertical incisors as described (Fig 11).

An alternative to these incisions utilizes V-shaped buccal and lingual incisions, creating "new papillae" which, when sutured, coronally repositions the flap margins (Fig 12).

Open or loose contact points

Sites with open contact points can be temporarily closed by the addition of enamel bonding material prior to initial incisions to prevent the sutures from slipping through the contact point. The bonded material can be grooved from the buccal to the lingual aspect with a high-speed bur to allow the sutures to recede into the notch and avoid interference on occlusion. This bonding may be removed at the time of suture removal.

Class 3 furcation defects

Incisions are made on the buccal and lingual aspects of the involved tooth as described above, and two membranes are used to cover the buccal and lingual furcations (Figs 13a to 13g). Obtaining lingual coverage of the barrier is the more difficult procedure. Placement of the flap to cover the lingual aspect of a Class 2 or Class 3 furcation defect and the barrier membrane requires lingual vertical incisions and flap reflection apical to the lingual keratinized tissue. Care must be taken in treatment of the lingual aspects of the mandibular second or third molar teeth in cases where little or no keratinized tissue is present at the flap margin. The modified coronally positioned flap should not be used in these cases.

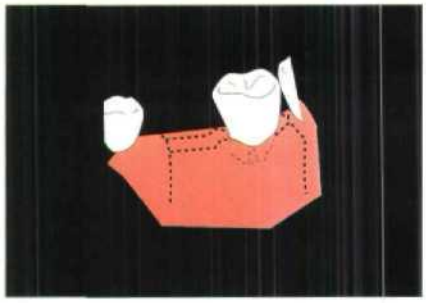


Fig 8 *Diagram of the modified coronally positioned flap utilized to treat a furcated molar with an adjacent edentulous space. Parallel initial incisions on the edentulous ridge are made at a distance equal to the desired distance of coronal repositioning* (buccal view).

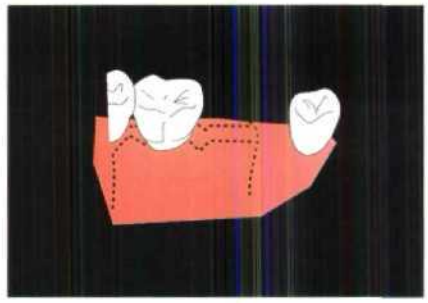


Fig 9 *Lingual view of the incisions, including the distal vertical incision, inverted V-shaped incision on the buccal aspect, and V-shaped incision on the lingual aspect.*

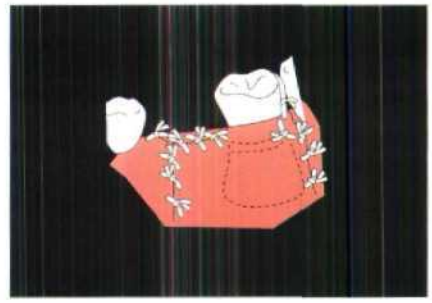


Fig 10 *Following membrane placement, coapting, and suturing, the parallel ridge incisions coronally reposition the flap margins.*

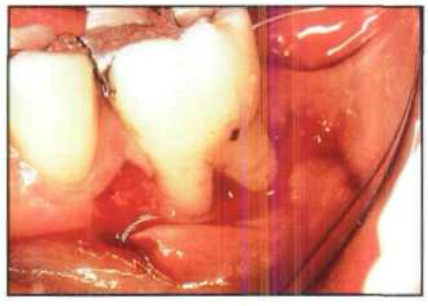


Fig 11 (left) *Lingual view of the sutured flap.*

Fig 12 (right) *Alternative incision technique to treat a Class 2 buccal furcation on tooth 30 where no distal adjacent tooth is present. These incisions create "new papillae" and allow coronal positioning of the flap.*

Discussion

The coronally positioned flap described by Martin et al[23] requires the fastening of a plastic tube on the tooth surface with enamel bonding composite resin, or luting the sutures "directly to the crown with composite resin." Both of these procedures add time to the surgical procedure and risk the possibility of resin inadvertently sliding under the flap. Bonding tubes or sutures to the lingual aspect of a tooth with a lingual Class 2 or Class 3 furcation may also interfere with tongue movement and cause the patient to disturb the sutures.The modified coronally positioned flap (modified CPF) avoids lingual tubes and bonding, allowing less opportunity for disruption of the sutures. Moreover, both the tube and bonded sutures have a tendency to accumulate plaque and are difficult to clean effectively.[27] The modified CPF can be performed as part of the regular flap suturing technique with no additional armamentarium.

Coronal flap positioning described by Martin et al[23] dissects the interdental papillae using vertical incisions. This makes proximal apposition of the flap more difficult and precludes interproximal coverage. Vertical incisions with the

Fig 13a (left) *Class 3 furcation involvement on tooth 19.*

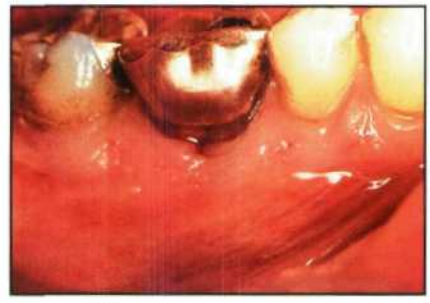


Fig 13b (right) *Reflection of modified coronally positioned flap exposes the defect.*

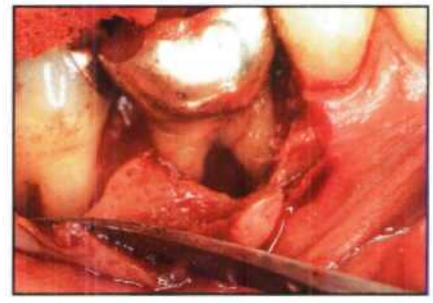


Fig 13c (left) *The furcation is filled with decalcified freeze-dried bone following root and defect debridement.*

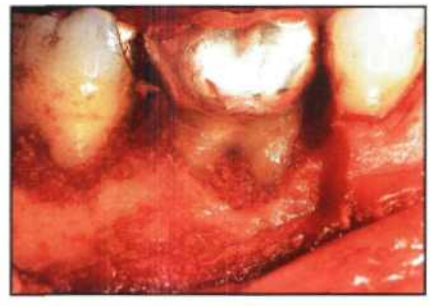


Fig 13d (right) *Fit and placement of membrane on the buccal surface. The same procedure was performed on the lingual aspect of the furcation.*

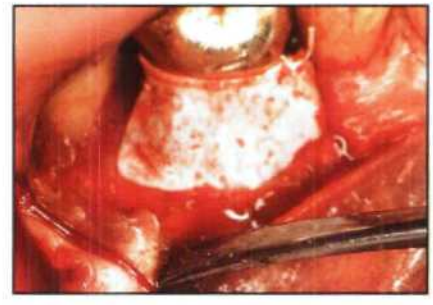


Fig 13e (left) *Suturing to coronally position the flap.*

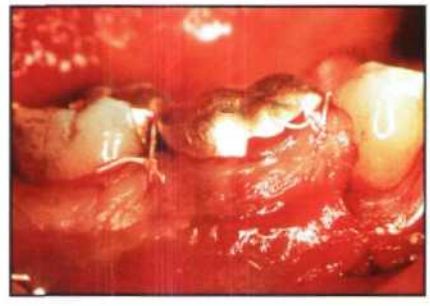


Fig 13f (right) *Twenty-three months postsurgery, buccal probing depth is 3.8 mm.*

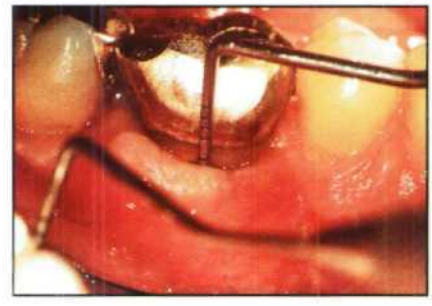
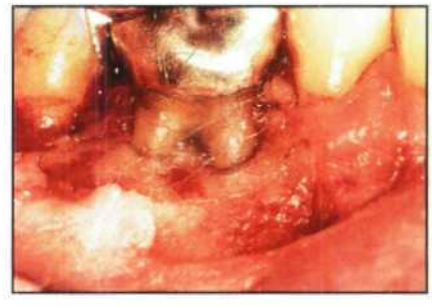


Fig 13g *Reflection of the flap at time of reentry. The furcation is completely filled with bone.*



modified CPF technique are made to include the entire papillae. Thus, the entire interproximal complex, when sutured, covers the interproximal area and can be utilized in treating interproximal defects adjcent to the furcated molars. To date, not one case treated with the modified CPF has resulted in hematoma formation, mentioned by Martin et al as an undesirable side effect of coronal flap positioning. The avoidance of this may be due to the additional interproximal sutures used with the modified CPF which closely adapt the flap to the tooth. Moreover, the partial thickness dissection used with the modified CPF avoids fenestration of the periosteum (as described by Martin et al), leaving the periosteum intact. This allows an uninterrupted blood supply to the flap and bone and may also be responsible for the lack of hematoma seen with the technique presented in this paper.

Conclusion

1. The modified coronally positioned flap technique allows membrane coverage even in cases where recession is present presurgically. By increasing the distance of the flap margin from the defect, it also adds to the membrane's effectiveness in delaying epithelial migration.
2. The modified coronally positioned flap technique allows the clinician to obviate the need for brackets or bonding of sutures to coronally position the flap. It is therefore a "user-friendly" method, employing proven periodontal clinical techniques.
3. By keeping the membrane covered for longer periods of healing time, oral hygiene and plaque control are facilitated, and bacterial population of the membrane may be reduced.
4. When the modified coronally positioned flap technique is repeated at time of membrane removal, the newly formed connective tissue is protected and results are improved.
5. The modified coronally positioned flap may also be employed to keep resorbable membranes submerged during resorption, thus enhancing treatment results.

Acknowledgment

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