Periodontal Healing Following Open Debridement Flap Procedures*

II. Histologic Observations

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FOUR TOOTH-CONTAINING blocks were obtained from patients being treated for infraosseous lesions of significant depth as part of their periodontal therapy. Treatment consisted of open flap debridement and professional cleansing at least every 4 weeks. Teeth in block were removed for histologic study 4 to 6 months after surgery. Histologic evaluation of the repair process showed pocket closure by epithelial and connective tissue adhesions in the form of an elongated junctional epithelium, beneath which parallel-oriented fibers adhered to the root for a limited distance. Apical to this adhesion, functionally inserted fibers were present. Since no cementogenesis was seen at these latter areas, it must be assumed that the inserted fibers were present before the surgery and were not significantly affected by the procedure. No significant evidence of crestal osteogenesis was noted. However, comparison of the clinical osseous profile recorded at the time of surgical debridement with the flat crest seen in two of our cases histologically, suggests that significant crestal resorption had taken place postsurgically in some of these lesions.

Recent clinical reports indicate that debridement of the osseous defect and adjacent root surface leads to varying degrees of repair. Although differences have been observed in the extent of the repair responses, the possibility of predictable and significant healing has been clinically demonstrated when optimum levels of plaque control were maintained.[1–5]

This article presents four case reports detailing the histologic repair responses following open debridement of infraosseous lesions.

MATERIALS AND METHODS

Four patients were selected from those participating in a clinical evaluation of the repair response to debridement who required extraction of one or more teeth in a quadrant under treatment. The detailed protocol of this study has been reported.[5–6] The teeth to be extracted were considered hopeless for periodontal or prosthetic reasons at the start of treatment. All patients were informed that the tooth/teeth would be treated and then removed, so that restorative therapy could be completed. Each patient signed an informed consent for these treatment sequences.

Details of periodontal treatment and methods of measurement have been described in the clinical portion of this report.[5] To briefly review the periodontal treatment plan, surgery was undertaken only when the plaque index (Navy Plaque Index) approached zero at the surgical site. In all cases, the surgical procedures consisted of reflecting a full thickness mucoperiosteal flap, debriding all root accretions and soft tissue within the defect, penetrating into the marrow through the osseous wall of the defect, and suturing the flap at or close to the presurgical level of the gingival margin using 4-0 interrupted silk sutures. Periodontal dressing was applied and each patient was placed on antibiotic (penicillin, 1 gm/day) coverage for 1 week after surgery in order to standardize antibiotic therapy for all patients. This was necessary, since some of our patients were required to have an antibiotic cover by their attending physicians. Dressing and sutures were removed 1 week after surgery and the area was scaled. Each patient was recalled no less than every 4 weeks for professional "cleaning" of the surgical site until the tooth was extracted by block section. In each case, removal of the entire tooth or a root portion of a tooth was determined during initial treatment planning, in order to provide maximum dental health for the patient.

Clinical measurements of initial and postsurgical pocket depth and recession were recorded from a fixed

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point, as outlined previously,[4-5] and clinical photographs and radiograms were obtained pre- and postsurgically.

CASE I

Clinical Data

A. L., a 62-year-old male with noncontributory medical history, was seen with a defect and class III furcation involvement on the mesial aspect of the maxillary right first molar tooth. This tooth was part of a fixed splint extending from the maxillary left canine to the right first molar. The missing right second premolar had been replaced by a pontic as part of the splint. The presurgical mesial soft tissue pocket measured 9.4 mm. Reflection of a full thickness flap revealed a wide 2- to 3-wall defect 6.1 mm deep. The defect and root were debrided (Fig. 1A). The root was notched with a curette at the level of the base of the osseous defect and the flap was sutured with 4-0 interrupted sutures. This area was professionally cleaned every 2 weeks after surgery.

Twenty-four weeks after surgery, the pocket measured 5.5 mm with 0.8 mm recession (Fig. 1B). At that time, the mesial buccal root was extracted in block section. Healing was uneventful.

Histology

The histologic specimen showed significant notching of the planed root which led to removal of most of the pocket cementum. The soft tissue portion of the specimen demonstrated a long junctional epithelium which adhered to the root surface. A chronic inflammatory infiltrate was present adjacent to the epithelium lining. The alveolar profile showed a vertical configuration with transseptal fibers rising in a somewhat vertical direction from below the apical base of junctional epithelium toward the crest of bone (Fig. 1C). The alveolar seam demonstrated no significant remodelling or evidence of osteogenesis (Fig. 1D). The tooth wall below the most apical position of the junctional epithelium indicated marked remodelling of the root surface (Fig. 1E). This remodelling was seen along the entire root surface and was not present above the base of the alveolar defect. It is therefore unlikely to have been part of the repair process following surgery, but must be considered as evidence of the continuing adaptation of the root surface to functional stresses experienced at this site during the life span of the patient.

A step serial section from the block demonstrated similar epithelial adhesions to the root after therapy. However, in this section, cemental remodelling was not present, nor was there significant remodelling at the alveolar seam (Fig. 1F).

In summary, this block, after periodontal therapy, depicted a soft tissue adherence to root surfaces which previously had been exposed pathologically. No "osseous fill" or cementogenesis was observed in the area of the treated defect. Closure of the defect appeared to have been essentially by soft tissue.

CASE II

Clinical Data

W. E., a 61-year-old male with controlled diabetes and hypertension, had a 13.2 mm pocket on the mesial and lingual of the maxillary right canine. Prior to therapy, medical clearance was obtained. Reflection of a mucoperiosteal flap revealed a 1-wall trough on the mesial and lingual aspects of the tooth. The defect was 9.0 mm deep from the crest to the base at the mesio-lingual line angle, which was our point of reference (Fig. 2A). The area was debrided and the flap sutured. Professional cleaning of the area was carried out every 2 weeks. At each recall visit, the patient was unable to maintain adequate plaque control. The Navy Plaque Index at 6 months postsurgically scored 16 (maximum possible score being 18). At time of section, the pocket was 7.7 mm deep with 4.1 mm gingival recession (Fig. 2B). Twenty-four weeks postsurgically the tooth was removed in block section. Healing was uneventful.

Histology

Histologically, the block section demonstrated supracrestal healing by soft tissue closure. The alveolar crest was flat, suggesting resorption of portions of the crest (vertical defect) following open flap debridement (Figs. 2C and 2D). Supracrestally, pocket closure consisted of a long epithelial adhesion. Immediately below the most apical position of the junctional epithelium, somewhat parallel-oriented fiber bundles were present (Fig. 2E). Apical to these fibers, crestal fibers were inserted into cementum. Since no evidence of cementogenesis could be seen, it must be assumed that these fibers were inserted at this level prior to surgery (Fig. 2F). One might speculate that they represented fibers which had been inserted at a level near the base of the vertical defect prior to surgery. With resorption of the vertical crest, these fibers appeared as gingival and transseptal fibers. Such a repair sequence presumes considerable remodelling of the connective tissue apical to the present junctional epithelium as part of the repair following surgical therapy.

At the crest, some remodelling was seen, but it was exceedingly limited (Fig. 2F).

In summary, this block section demonstrated soft tissue repair of an infraosseous lesion with closure achieved by soft tissue to tooth adhesion. Crestal resorption appeared to have taken place after surgical therapy. There was no evidence of significant crestal osteogenesis or cementogenesis at the base of the lesion.

CASE III

Clinical Data

W. K., a 43-year-old male with a noncontributory medical history, was seen for routine periodontal care. The maxillary right central and lateral incisor teeth were scheduled for extraction for prosthetic reasons. Both of

these teeth previously had been treated endodontically because of carious exposures.

Presurgically, soft tissue pocket depth between the right lateral and central incisor teeth was 7.1 mm. Reflection of a full thickness flap revealed a 2-wall osseous defect which measured 3.2 mm in depth. The defect and

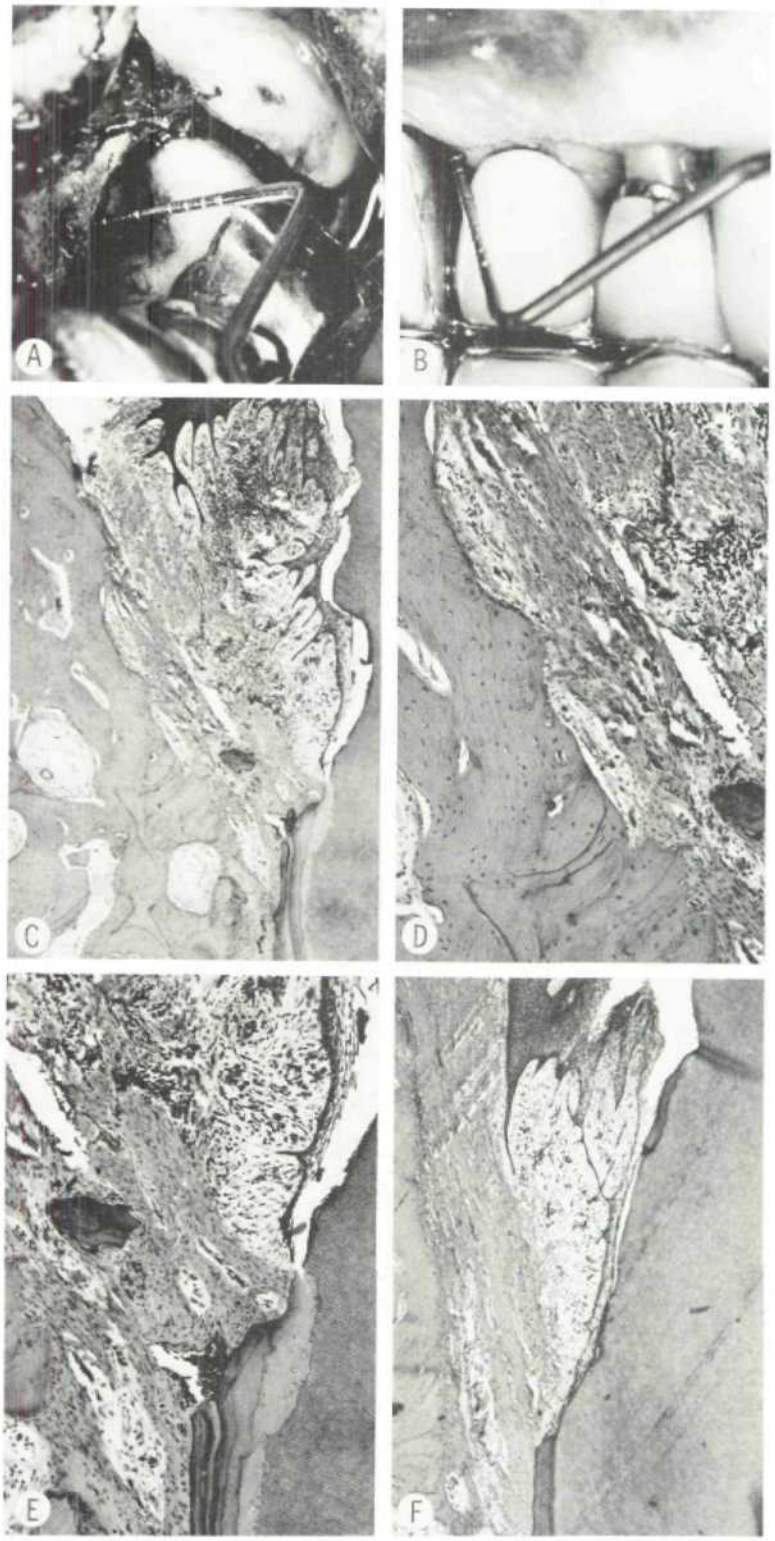

Figure 1A. *Case 1—Clinical appearance of lesion at time of surgical debridement, including mesial furcation site and debrided mesiobuccal root.* **B.** *Clinical appearance 24 weeks after surgery.* **C.** *Histologic overview of a representative section of the block removed 24 weeks after surgical debridement, showing long junctional epithelium, adjacent inflammatory infiltrate and typical infrabony configuration of the alveolar wall.* **D.** *Higher magnification (×25) of an area of section shown in 1C. No osteogenesis is evident at the alveolar seam.* **E.** *Higher magnification (×25) of an area of section shown in 1C. Cemental remodelling is apparent.* **F.** *Serial section of specimen shown in 1C, showing junctional epithelium and lack of cemental remodelling.*

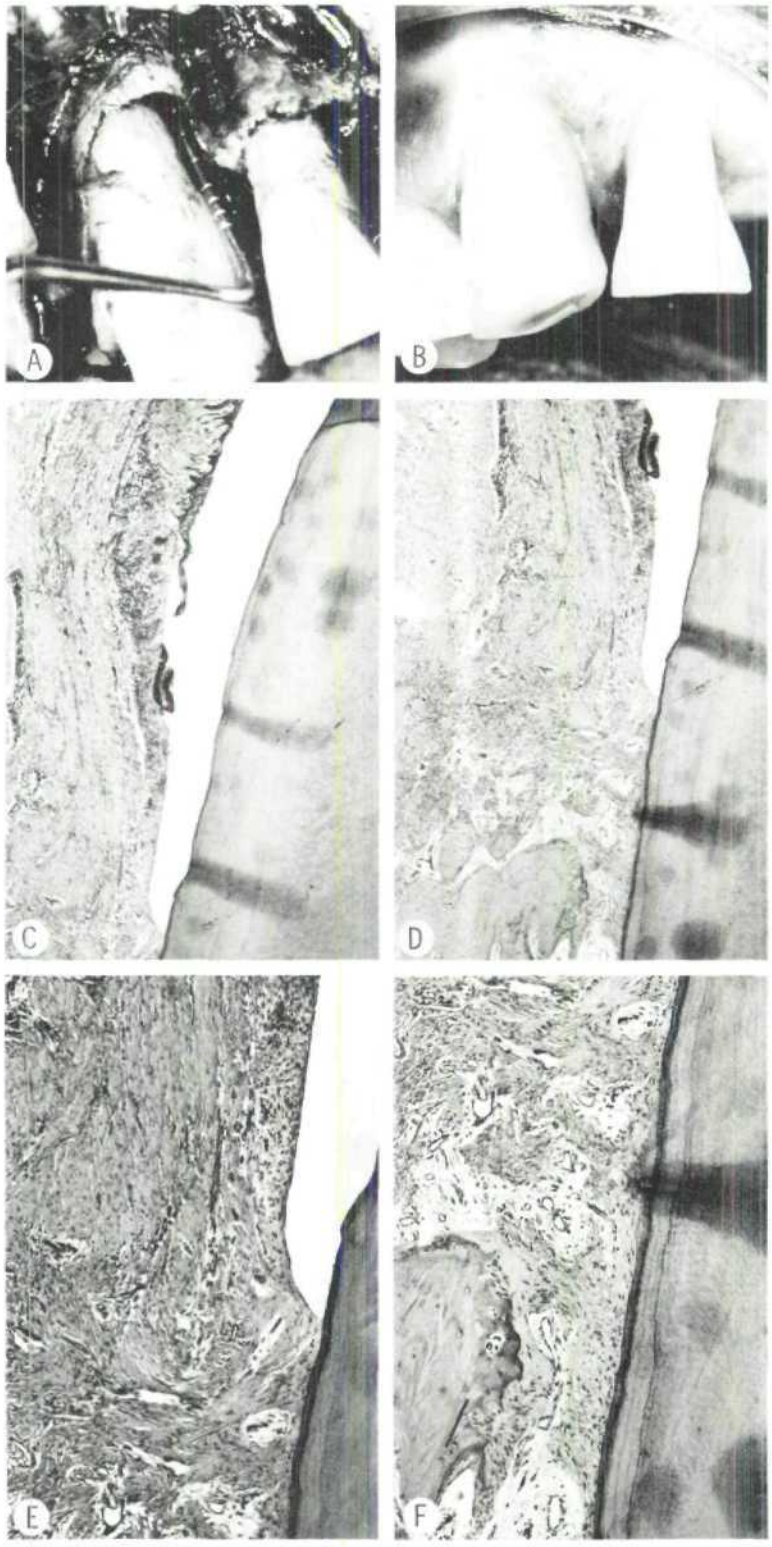

Figure 2A. *Case II—Clinical appearance of lesion at time of surgical debridement.* **B.** *Clinical appearance 24 weeks after surgery.* **C.** *Histologic overview of a representative section of the block removed 24 weeks after surgical debridement. Parallel fiber bundles are apical to long junctional epithelium.* **D.** *Histologic overview of a representative section of the block shown in 2C but at a more apical level to demonstrate the flattened alveolar crest.* **E.** *Higher magnification (×25) of an area of section shown in 2D, with parallel-oriented fibers visible above the functionally inserted fibers.* **F.** *Higher magnification (×25) of an area of section shown in 2D. Inserted fibers are evident above the crest, with no evidence of cementogenesis and slight crestal remodelling.*

root were debrided (Fig. 3A). The flap was sutured with 4-0 interrupted sutures. The area was cleaned every 3 weeks until the tooth was extracted in block section. At each recall visit the patient was unable to maintain adequate plaque control.

At the time of block section (6 months after surgery)

the pocket measured 4.6 mm. Gingival recession measured 2.0 mm (Fig. 3B). After block section the area healed uneventfully.

Histology

Histologically, this block section showed a somewhat elongated junctional epithelium with limited inflammatory infiltrate adjacent to the epithelium. The epithelium adhered to the cementum. There was no evidence of cementogenesis below the most apical position of the junctional epithelium. The alveolar profile showed a vertical configuration with little evidence of osteogenesis at the seam (Fig. 3C).

In summary, this specimen depicted soft tissue adherence to the tooth following open debridement, with no evidence of osteogenesis or cementogenesis at the base of the defect.

CASE IV

Clinical Data

R. B., a 56-year-old male, had a 9.5 mm soft tissue pocket on the mesial of the maxillary right second premolar tooth. His medical history revealed diet-controlled diabetes which had been diagnosed 3 years previously. Reflection of a full thickness mucoperiosteal flap revealed a combination 2- to 3-wall defect 4.5 mm deep (Fig. 4A). The defect and root were debrided and the flap sutured with 4-0 silk with interrupted sutures. The patient returned after 1 week for suture and dressing removal. Thereafter, the area was professionally cleaned every 3 weeks. At each recall visit the patient was unable to maintain adequate plaque control. The modified Navy Plaque Index at 17 weeks postsurgically scored 12 (maximum possible score being 16).

Seventeen weeks postsurgically the pocket measured 6.2 mm with 2.5 mm of gingival recession (Fig. 4B). At that time, the tooth was extracted in block section. Healing was uneventful.

Histology

This block section demonstrated soft tissue closure of the lesion via an elongated junctional epithelium with parallel-oriented collagen fibers beneath it. Marked inflammation was seen adjacent to the epithelium. The crest appeared flat (Fig. 4C). The area of soft tissue/

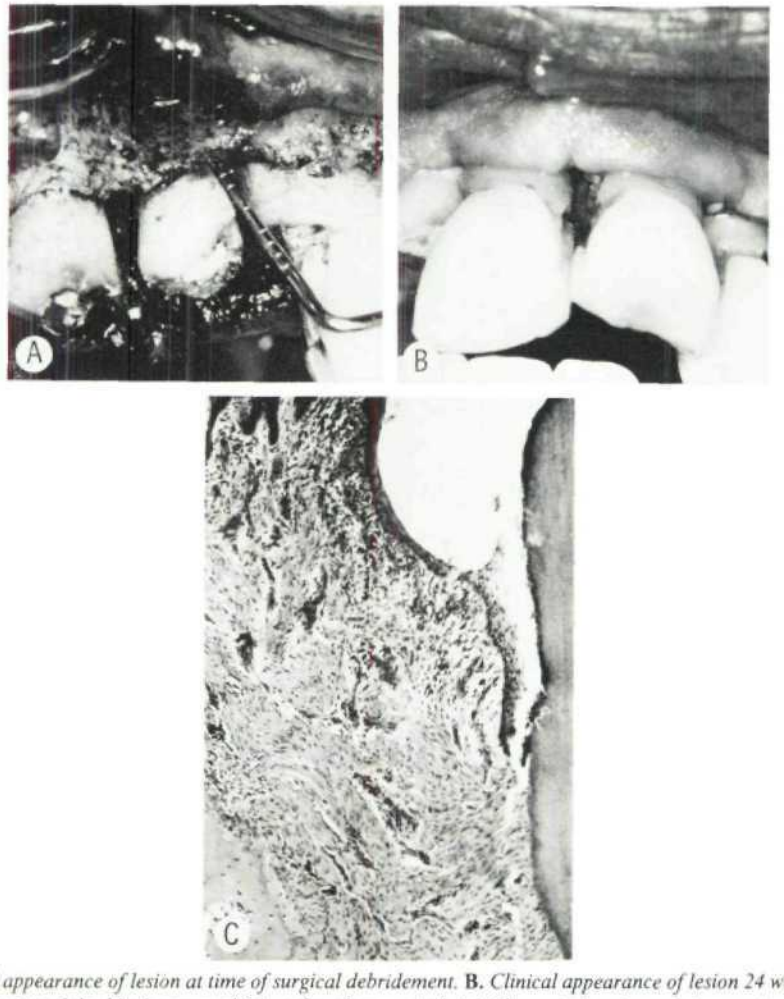

Figure 3A. *Case III—Clinical appearance of lesion at time of surgical debridement.* **B.** *Clinical appearance of lesion 24 weeks after surgery.* **C.** *Histologic overview of a representative section of the block removed 24 weeks after surgical debridement, showing soft tissue attachment and lack of supracrestal cementogenesis. There is little evidence of osteogenesis at the alveolar seam.*

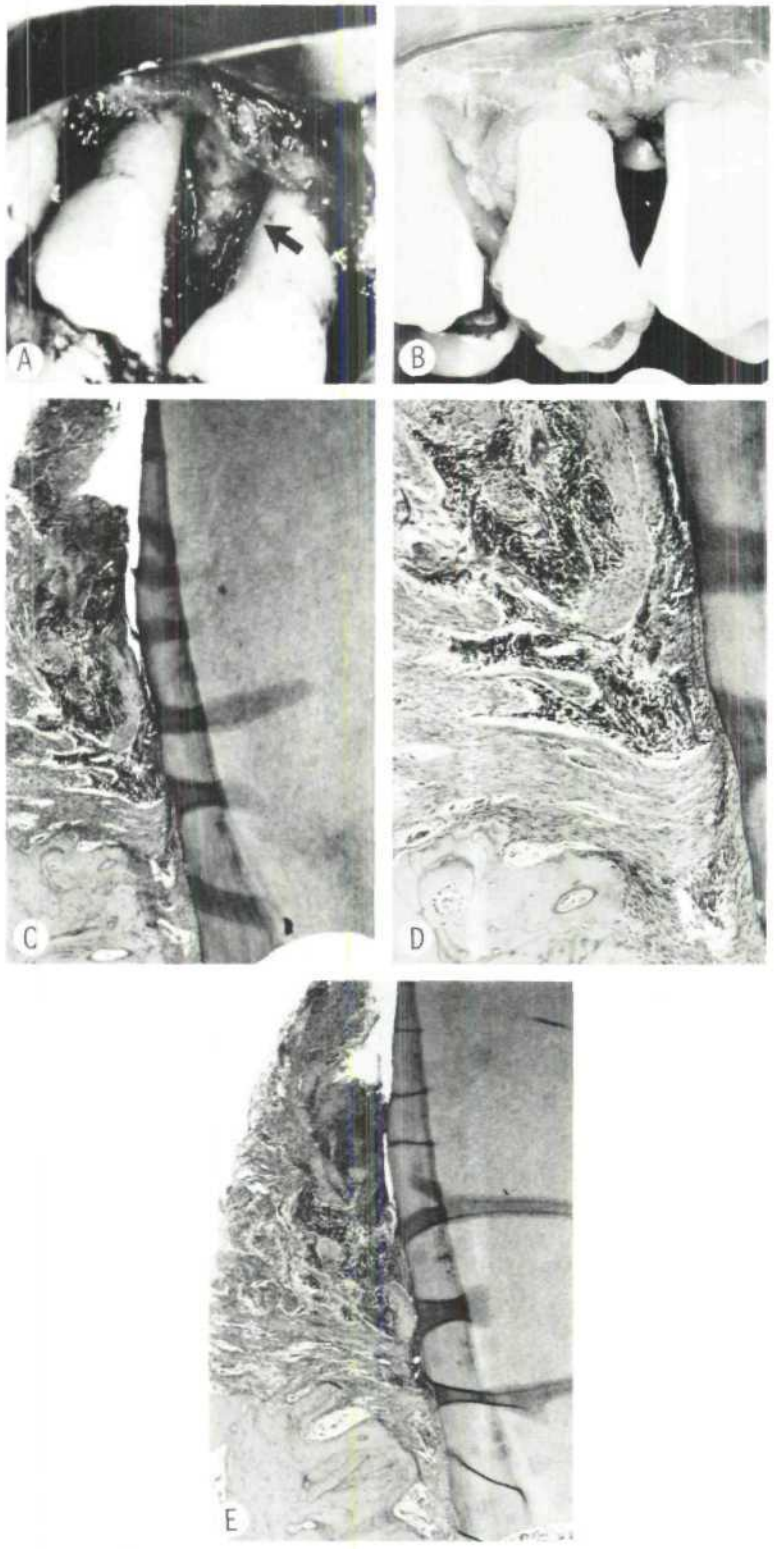

Figure 4A. *Case IV—Clinical appearance of lesion at time of surgical debridement. Lesion is mesial to maxillary second premolar tooth.* **B.** *Clinical appearance of lesion 17 weeks after surgery.* **C.** *Histologic overview of a representative section of the block removed 17 weeks after surgical debridement, showing soft tissue adhesion and flattened alveolar crest.* **D.** *Higher magnification (×25) of an area of section shown in 4C. Inserted transseptal fibers are apparent. No cementogenesis is evident at this site and the alveolar crest appears flat.* **E.** *Histologic overview of step serial section from block shown in 4D. Long soft tissue adherence and limited crestal remodelling are evident.*

tooth interface clearly showed the epithelial adhesion and parallel orientation of fibers in this area. Immediately below the site, transseptal fibers were inserted into cementum. Since no evidence of cementogenesis was present in this area, we must assume that this insertion existed prior to surgery (Fig. 4D). A possible rationale for this assumption is presented in the histologic description of Case II. In this specimen, as in Case II, the

alveolar crest appeared flat, suggesting that crestal resorption probably occurred after surgery. The alveolar crest showed limited evidence of remodelling but no significant osteogenic activity (Fig. 4D).

A step serial section from this block depicted essentially the same histologic responses described above, although crestal remodelling was somewhat more evident (Fig. 4E).

In summary, this block again demonstrated closure of an infrabony defect by soft tissue adhesion. The flat appearance of the alveolar crest was in contrast to the clinical preoperative picture demonstrating the typical osseous defect. This suggests that considerable crestal resorption occurred postsurgically. As in the other cases, no evidence of supracrestal cementogenesis was noted, which may indicate that the closure of these lesions is by soft tissue adherence only.

COMMENT

Four block sections of healed infrabony defects have been described. These lesions were treated by open debridement and surgical sites were cleaned at least every 4 weeks thereafter. Specimens were removed 4 to 6 months after surgery. At that time, clinical evaluation showed significant gingival recession in most cases and pocket closure at some level below the presurgical level of the gingival margin.

Histologically, the healing of these lesions mirrored the clinical findings. Our sections frequently demonstrated a flattened alveolar crest denoting postsurgical crestal resorption and closure by soft tissue adhesion. The adhesion was in the form of an elongated crevicular and junctional epithelium and a limited collagen fiber (parallel-oriented fibers) adhesion. At no time was significant crestal osteogenesis or cementogenesis observed. Such healing patterns have been described previously.[7]

The present healing response differs somewhat from that seen with the use of autogenous grafts in the treatment of infrabony defects. In those specimens, osteogenesis, cementogenesis (repair cementum) and a reconstructed, functionally oriented periodontal ligament have been observed. The difference in response may be accidental, since relatively few human blocks are available at present. On the other hand, the presence of an osseous graft may enhance the local milieu for repair, so that *a periodontal attachment apparatus may reform on a limited basis.* Based on histologic observations in humans, this response seems biologically possible. On the other hand, open debridement alone, while at times showing a similar healing tendency, more often demonstrates soft tissue adhesion as its primary healing response.[6,8–11] Periodontal repair potential therefore is evident as a response to various treatment procedures, both clinically and histologically. However, current research must focus on identifying the ideal milieu in which the regenerative potential of the periodontal tissues can be therapeutically challenged to provide maximal responses.

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