Connective tissue regeneration to periodontally diseased teeth

II. Histologic observations of cases following replaced flap surgery

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The possibility of obtaining new connective tissue attachment to periodontally diseased root surfaces following replaced flap procedure was studied in seven single-rooted teeth from six patients with advanced chronic periodontitis. Mucoperiosteal flaps were raised and supraeruption soft tissues curedtted from the lesion. In order to establish a landmark for histologic observations located within the periodontal pocket, a notch was made into the root just apical to existing subgingival calculus. A similarly placed notch was used in a previous report (Cole et al. 1980). Following thorough root planing, the flap was replaced and sutured. Four months later block biopsies were removed. The results demonstrated that none of the specimens showed soft connective tissue adhering to the tooth or evidence of new cementum coronal to the notch. A thin junctional epithelium had proliferated to the level of, or beyond the notch. Therefore, among these seven specimens, unequivocal proof of new attachment to diseased root surfaces following conventional full thickness flap procedures was not demonstrated. This is in contrast to the previous report (Cole et al. 1980) wherein new attachment was obtained in all of 10 specimens treated by full thickness flap surgery supplemented with citric acid conditioning of the root surface.

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Introduction

The healing after periodontal regenerative techniques in humans has been evaluated utilizing probing, radiographs, reentry procedures and microscopy after biopsy. Of the four methods, only microscopic examination will allow interpretation of achieved new attachment. (The term new attachment describes reunion of connective tissues to root surfaces previously exposed in an epithelial lined pathological pocket. Reattachment is the reuniting of connective tissues and root surfaces which have been separated by surgery or trauma.) This has become more apparent as a result of studies demonstrating that an epithelial lining may persist postoperatively along the root surface adjacent to newly formed bone (Caton & Zander 1976, Hiatt, Schallhorn & Aronian 1978, Moskow, Karsh & Stein 1979, Listgarten & Rosenberg 1979).

In designing a study to histologically evaluate new attachment, the extent of the original periodontal pocket should be delineated by appropriate reference notches in the root surface. The apical extent of root planing, or a notch placed at the crest of the alveolar bone are not acceptable landmarks. The zone of intact connective tissue
attachment apical to the pocket epithelium will most likely be separated during the therapeutic instrumentation (Ramfjord & Kister 1954). Therefore, what has been claimed to be new attachment coronal to such reference points in previous reports may mainly constitute reattachment of tissues severed during surgery.

Connective tissue regeneration was reported by Schaffer & Zander (1953) in four out of six teeth treated with closed curettage. Hiatt, Schallhorn and Aaronian (1978) observed new cementum in seven of 21 sites treated with flap procedure. Listgarten and Rosenberg (1979) found connective tissue regeneration in one out of three specimens following flap surgery. Bone and cementum regeneration following various osseous grafting procedures have been repeatedly reported (Drago & Sullivan 1973, Froum et al. 1975, Hawley & Miller 1975, Ross & Cohen 1968, Hiatt et al. 1978). Unfortunately, the reported findings of the above studies do not provide conclusive evidence that new attachment has been accomplished due to the questionable location of the reference landmarks.

A clinical feature which demonstrates a pathologically involved root surface is calculus. Cole et al. (1980) made a reference notch in the root surface at the apical extent of existing subgingival calculus. New attachment was attempted by a replaced flap procedure which included conditioning of the instrumented root surface with saturated citric acid. The results demonstrated some deposition of new cementum and a zone of tightly apposed soft connective tissue coronal to the calculus notch in all of the 10 treated specimens. These findings indicate that regeneration of periodontal tissues to a root surface that has become demineralized as a result of chronic periodontitis and that has been covered by calculus, is a biological possibility. However, the study did not establish whether or not acid conditioning of the root surface is a prerequisite for new attachment. The present report describes the histological findings of a limited number of specimens which have been treated with conventional (non-acid conditioning) replaced flap procedure.

Material and Methods

Two men and four women, 35 to 62 year old, participated in the present study. The required some form of periodontal and prosthetic treatment. An informed consent form was obtained from each patient. Seven teeth (five incisors, one canine, and one cuspid) scheduled for extraction were studied (Table 1). All of the experimental teeth exhibited probing pocket depth on an aspect of the tooth of at least 6 mm and presence of subgingival calculus, and the absence of periapical pathology.

Oral hygiene instructions were initial given and debridement of non-experimental teeth was performed. When satisfactory oral hygiene was accomplished, each patient was scheduled for surgery of the experimental periodontal lesion. Two of the experimental teeth exhibiting severe mobility were splinted to adjacent teeth using intracoronal, prefabricated steel wire and acrylic.

Prior to the surgical intervention, supragingival reference groove was placed on the aspect of the tooth to be studied. The distance from the apical portion of this groove to the gingival margin was measured to the nearest 0.5 mm using a calibrated periodontal probe. Full thickness flaps were reflected and supragingival calculus and tissue were curedt from the lesion. A dot (using No. 14 round bur) was inscribed in the root surface marking the apical extension of the subgingival calculus (Fig. 1). The coronal aspect of the notch corresponded to the apical extent of the calculus.

Care was taken to avoid horizontal overextension of the notch beyond the width of
REGENERATION OF PERIODONTAL DISEASE

Table 1

Histometric evaluation of periodontal regeneration of the seven specimens under study four months after surgery. Measurements in millimeters.

<table>
<thead>
<tr>
<th>Specimen number</th>
<th>Universal tooth number, surface</th>
<th>Apical calculus to bone crest *</th>
<th>Depth marginal defect *</th>
<th>Gingival recession *</th>
<th>GM-CN</th>
<th>CN-JE</th>
<th>CN-BC</th>
<th>CN-AN</th>
<th>CN-RP</th>
<th>Camerum left on root planed surface coronal to CN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>22 L</td>
<td>2.0</td>
<td>1.0</td>
<td>4.3</td>
<td>0.7</td>
<td>-1.47</td>
<td>0.5</td>
<td>1.8</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>13 MB</td>
<td>1.0</td>
<td>1.0</td>
<td>7.4</td>
<td>0.6</td>
<td>0.8</td>
<td>0.8</td>
<td>1.8</td>
<td>+</td>
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</tr>
<tr>
<td>3</td>
<td>21 MB</td>
<td>0.5</td>
<td>0.5</td>
<td>3.5</td>
<td>1.5</td>
<td>0.6</td>
<td>0.9</td>
<td>1.2</td>
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<tr>
<td>4</td>
<td>13 MB</td>
<td>1.0</td>
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<td>3.5</td>
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<td>0.6</td>
<td>0.9</td>
<td>1.2</td>
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<tr>
<td>5</td>
<td>11 L</td>
<td>2.5</td>
<td>2.0</td>
<td>2.4</td>
<td>0.6</td>
<td>1.2</td>
<td>0.8</td>
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<tr>
<td>6</td>
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<tr>
<td>7</td>
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<td>0.5</td>
<td>3.2</td>
<td>0.7</td>
<td>-1.27</td>
<td>0.8</td>
<td>0.8</td>
<td>+</td>
<td></td>
</tr>
</tbody>
</table>

Mean: 1.2 ± 0.6
Mean ± S.D.: 1.6 ± 0.8

* = Clinical measurements
** = Measurements not taken
*** = Could not be determined due to tangential sectioning
**** = Could not be determined due to bone removal during biopsy
† = Minus sign indicates that BC was coronal to CN

- Clinical teeth with periodontal tissues on the surface under investigation were removed in block section. The biopsy areas were filled with freeze-dried homologous bone grafts and tightly sutured. The block biopsy could be performed without causing additional functional disability or cosmetic disfigurement.

The specimens were fixed in 10% neutral buffered formalin, decalcified in 5% formic acid, dehydrated in ethanol and embedded in paraffin. Longitudinal sections were made at 7 μm and stained alternatively with hematoxylin/eosin and Gomori's trichrome. Five step serial sections at 150 μm intervals, demonstrating a clearly discernible notch, were used for histometric analysis.
Measurements were made with an ocular grid at 100 x magnification from the gingival margin to the coronal extent of the notch (GM-CN); from the coronal extent of the notch to the apical extent of junctional epithelium (CN-JE), to the bone crest (CN-BC), to the apical extent of the notch (CN-AN), and to the apical extent of root planing (CN-RP) (Table 1, Fig. 3). Means of the five, step serial sections of each specimen were calculated.

Results

The clinical recordings demonstrated that
all of the specimens had an intrabony morphological configuration which ranged from 1.0 to 4.5 mm in depth (Table 1). The apical extent of the subgingival calculus was located from 0.5 to 2.5 mm coronal to the pretreatment crest of bone (Fig. 2). The gingival margin showed recession during the treatment period ranging from 0.5 to 3.0 mm.

The histologic measurements showed that the base of the junctional epithelium was located apical to the coronal aspect of the notch (CN-JE) in all the specimens extending from 0.6 to 2.4 mm (Table 1, Fig. 3). None of the specimens demonstrated regenerating soft connective tissue or new cementum coronal to the notch.

The root surfaces were planed to a distance of 0.8–2.0 mm apical to the notch (CN-RP). Although the root surfaces had been carefully planed, small areas of cementum remained coronal to the notch on the treated surfaces in three of the seven specimens. In five cases, the base of the junctional epithelium was coronal to the apical extent of the root planing (Fig. 4), whereas in one case it extended to a point below this level. In one specimen, the long thin junctional epithelium measured 8.2 mm (Fig. 5). In this specimen, connective tissue reattachment with new cementum formation had occurred to the apical extent of the notch.

Postoperatively, alveolar bone extended coronal to the coronal extent of the notch in two of the specimens, and apical to it in four of the specimens. There was no evidence of ankylosis or root resorption.

Fig. 4. Specimen number 7. Typical healing response, demonstrating long, thin junctional epithelium. The junctional epithelium extends through most of the depth of the notch (JE). Reattachment of connective tissue has occurred coronal to the apical extent of root planing (RP). BC = bone crest. Hematoxylin and eosin. Original magnification 5 X.
ference point. In that study a notch was placed within the confines of the calculus at its very apical extent. The amount of new connective tissue attachment was then measured from the apical extent of the notch. Criticism of this method has arisen in light of the possibility that the notch environment may somehow be conducive to new attachment. Therefore, a modification of notch placement was utilized in the present study, whereby the coronal aspect of the notch corresponded to the apical extent of the calculus.

The present case reports aimed at studying the biological possibility of obtaining new connective tissue attachment in human teeth involved in chronic destructive periodontitis. The requirement that subgingival calculus must be present limits the number of specimen candidates for study. Also, the demands of block biopsy limit the experimentation to those teeth which have been condemned. For these reasons, only a small number of specimens can be reported.

Morphological angular osseous defects were present on all surfaces studied, although none of the subcacular notches were located subcrestally. Most of the specimens, however, had notches placed in very close proximity to the bone crest and should be considered suitable candidates for new attachment attempts. For example, the specimen of Fig. 4 appears to have good potential for connective tissue regeneration, but resulted in a long junctional epithelium instead. Likewise, none of the other specimens showed new attachment.

The results of the cases of the present report differ from the findings of Cole et al. (1980) wherein the experimental root surfaces were treated with topical application of citric acid at the time of surgery. Histologic examination revealed new attachment in all of the 10 specimens of that study. A comparison of the case selection of the present report and the study by Cole et al. (1980) does not indicate that the cases selected in the present report should have had any less potential for new attachment. In fact, out of the 10 treated surfaces of Cole et al. (1980), six were strict supracrestal lesions. Still, new attachment was accomplished in all of them.

Certainly, comparison between the results of the present report and the study by Cole et al. (1980) should be made with caution. The specimens originated from different patients and the surgical and postoperative procedures were performed by different operators. In spite of all reservations about possible differences between the studies, the clearcut discrepancy in results suggests that citric acid conditioning of the root surfaces did facilitate new attachment and that corresponding results may not be possible without acid treatment.

This suggestion has been demonstrated in dogs by Crigger et al. (1978), where through-and-through furcation defects were treated surgically with and without citric acid application. After six weeks healing, 21 of the 24 acid-treated furcations showed connective tissue closure of the furcation, whereas all of the non-acid treated teeth still revealed a patent epithelialized furcation defect.

In conclusion, then, it must be stated that although attempts at new attachment were unsuccessful in the seven specimens of the present report, this does not mean that new attachment cannot be accomplished with conventional techniques. Given better conditions, this may still be biologically possible; however, it may not be likely that new attachment regularly occurs after these clinical procedures.

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evidence of reattachment of periodontal

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