Evaluation of the Purposeful Implantation of Epithelium on Root Surfaces Under Periodontal Flaps*


Introduction

The ideal type of healing after periodontal flap procedures is a true new attachment consisting of connective tissue attachment mediated through new cementum with a minimal junctional epithelium at the most coronal part of the tissue connection with the tooth.

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An often proposed requirement to achieve such healing is the complete removal of epithelium from the inner aspect of the flap in order to achieve a fresh connective tissue surface that is placed in contact with the treated tooth root. Several studies have shown complete removal of pocket-penetrating epithelium with both curettage and internally beveled incisions. Others, however, have not been able to achieve complete removal of the pocket epithelium.

A large number of wound healing studies have demonstrated a long epithelial epithelium lining the tooth surface periodontal flap procedures. One speculation is that there is a race between the marginal flap epithelium and the connective tissue for position on the tooth surface. The epithelial downgrowth, which is normally much faster, races the organizing connective tissue and where they meet determines the coronal-most level of connective tissue attachment. Another possibility may be that epithelial remnants on the inner aspect of the flap (such as amputatedrete pegs) colonize the tooth surface and where they meet determines the desired connective tissue attachment.

Epithelial migration over a wound or other surface is generally quite rapid, approximately 0.5 mm per day after an initial lag of about one to two days. Therefore the potential for epithelium to cover the flap and root surfaces very rapidly is significant to the detriment of a connective tissue attachment. This migration occurs in all directions with equal speed.

It has not been determined if any retained or implanted epithelium on the inner aspect of the flap remains
viable as an island on the tooth surface after flap replacement in the absence of a direct connection to epithelium at the base of the healing sulcus.

If epithelium intentionally placed on the root surface under periodontal flaps survives, proliferates, and migrates laterally, this would suggest that currently used surgical techniques could not be expected to routinely achieve a connective tissue attachment to the root. If, however, such epithelium does not maintain contact with the root, does not survive, and is eliminated by the body, then the mere retention or implantation of such epithelium under the flap would be of little consequence, and presently used surgical techniques could be expected to foster a connective tissue attachment.

The purpose of this study was to evaluate the nature of healing of periodontal surgical wounds with and without epithelium implanted on the root surface under periodontal flaps. Specifically, it was to determine if the presence of such epithelium affects the type of attachment that results.

Materials and Methods

Four crab-eater monkeys were managed while under tranquilization/anesthesia with 0.5 cc Ketamine* and 0.25 cc Acepromazine* initially, followed by 0.25 cc Ketamine at approximately 30 minute intervals as needed. Initially all of the teeth were cleaned and polished until the Gingival Index* approached zero.

Treating one-half mouth at a time, access was gained on the buccal aspect only of the second premolar and the first and second molars, using an horizontal incision. Then, the gingiva with vertical incisions distal of the canine and mesial of the third molar. A full-thickness flap was reflected apically to expose the buccal bone along the entire length of the tooth. A rectangular window was made in the buccal bone over the root surface, taking care not to disturb the cementum or to remove periodontal ligament fibers.

The teeth in each quadrant were randomly treated as follows. One root had no further treatment and served as a control. Two roots were planed with small, sharp brass in order to remove the connective tissue of the periodontal ligament fibers and the cementum. The other two roots were also scaled and planed; a section of alveolar mucosa was then placed, epithelial side against the tooth root, in the window area. The epithelial implant was harvested by cutting a small piece of alveolar mucosal epithelium, gently clearing the surface, and trimming it to fit the window in the bone (Figs. 1 and 2). The flap was replaced at the preoperative level, sutured with 4-0 silk, and coapted with digital pressure to ensure adaption of the implant. The monkeys were given one injection of Bicillin, 300,000 unit IM for prophylaxis after surgery. Animals were sacrificed by pentobarbital overdose at one, two, and eight weeks. The jaws were sectioned into individual tooth blocks, decalcified, embedded in paraplast, step serial cut in 6 μm sections along the long axis of the tooth, and stained with hematoxylin and eosin.
Fig. 1. Diagram of surgical technique, facial view of tooth surface.

A - Alveolar bone
B - Window in alveolar bone

Fig. 2. Diagram of different treatments provided to root surface.

Group A
Control

Group B
Sc + Rp

Group C
Epithelium

A - Alveolar bone
B - Periodontal ligament fibers
C - Root surface

A - Alveolar bone
B - Root planed root

A - Alveolar bone
B - Root planed root

Results

Because of problems with histologic specimen preparation, the number of samples was inadequate to allow statistical analysis. Here are reported observations of the samples that could be observed histologically.

The control group (bone removal only, no root treatment) showed cementum still on the root surface, with occasional nicks where the chisel broke through the bone. New cementum was formed on the root surface and new alveolar bone formation was noted at later time periods. Connective tissue was seen all along the root surface (Fig. 3).

The root planed group showed evidence of resorption on the root surface with new cementum often found in the areas of resorption. Cementum was incompletely removed in some samples and the edges of the bony defect showed evidence of resorption. Immature connective tissue was noted along the root surface, and it tended to migrate from the periodontal ligament space with a parallel orientation to the root surface (Figs. 4a and 4b).

Epithelial implant areas showed several types of healing. Some of the implants appeared as healthy islands in the area of the defect. Other implants showed vacuoles, pyknotic nuclei, and giant cell activity, which would indicate that degeneration had taken place. Still other implants showed evidence of cyst formation with epithelial lined sacs that were isolated from the root surface. Connective tissue was found between almost all of the epithelial implants and the root surface, so that most implants were completely surrounded by connective tissue. Only on rare occasions did any epithelium directly contact the root surfaces (Figs. 5a and 5b, 6a and 6b, 7a and 7b).

There was no evidence in any samples of any of the epithelial attachment to the root surface. No relationship was found between the character of the epithelium and the length of healing time. In other words, there was no apparent progression from healthy epithelium to giant cells to cyst formation, or any other combination.

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Fig. 6a. Implant epithelium (E) situated in the region of root planed notch (between arrows) but some distance away from the root surface. Loose connective tissue lining the root surface has some small islands of epithelium. No untoward inflammatory or giant cell response to the epithelium was noted. (Hematoxylin and eosin, original magnification × 10).

Fig. 6b. Higher powered view of the apical area of the notch showing connective tissue (CT) that may have developed from the periodontal ligament along the cut surface of the tooth. There are possible epithelial remnants (E) adherent to the root at the apical end of the notch. Major part of the epithelium is detached from tooth. (E), Hematoxylin and eosin, original magnification × 25.

Fig. 7a. Epithelial implant specimen at eight weeks. Small island of epithelium (E) remaining in area of the notch. Epithelium appears viable without surrounding inflammation or giant cells, but has been separated from the root by connective tissue (CT) and new forming bone (B). (Hematoxylin and eosin, original magnification × 10).

Fig. 7b. Greater magnification of newly formed cementum (C) and alveolar bone (B) in the notch area with recanalization of the periodontal ligament (FDL) into more functional orientation. Implant epithelium (E) is peripherally to remaining alveolar bone. (Hematoxylin and eosin, original magnification × 25).

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Discussion

Most of the epithelial implants in this study were found to be surrounded by connective tissue and isolated from the tooth root surface. No evidence was seen of proliferation of the epithelium; several samples showed signs of degeneration with pyknotic nuclei and giant cell activity. These observations suggest that epithelial remnants left on the inside surface of a periodontal flap may not actually contact and attach to the root surface and may not endanger connective tissue attachment to the tooth in areas close to the periodontal ligament fibers.

The observations made in this study were in a closed system, isolated from the oral environment, that all but eliminates the possibility of marginal flap epithelium migrating into the experimental site. Stahl has shown that when dentigingival fibers are retained, these fibers will limit the apical proliferation of the junctional epithelium in healing.18 Elleegeard et al. have also shown that by using free gingival grafts to retard epithelial migration there is a greater likelihood of a connective tissue attachment.20

Another study with Millipore* filters showed more connective tissue attachment, which was felt to be due to inhibition of apical epithelial migration.31 If the pore size is small enough, the filter excludes the epithelium and it grows along the filter surface.27 There is also evidence of connective tissue replacing a long functional epithelium over time with good oral hygiene.23 This also tends to suggest that a connective tissue attachment would occur in an area with an isolated epithelial attachment.

Because of ease of procurement, this system utilized alveolar mucosa for its source of epithelium. It would be interesting to speculate what would occur if pocket epithelium rather than oral mucosa were transplanted. Karing et al. have shown that transplanted tissue retains those properties identical to the respective donor tissue.24 Since both alveolar mucosa and sulcular (pocket) epithelium are stratified squamous non-keratinizing, it would seem logical that both would act similarly.

This information would indicate that marginal flap epithelium, not epithelial remnants or amputated rete pegs, leads to a long functional epithelium. The key to getting a connective tissue attachment to the root would seem to be the inhibition of marginal flap epithelial migration and root detoxification.

Again, one can speculate what would occur if roots exposed to the oral milieu were implanted prior to any detoxification procedures. The most logical assumption would be an abscess or absolutely no attachment whatsoever. However, Lopez recently observed that a connective tissue attachment does occur to human roots detoxified by root planing plus citric acid application and transplanted in mucosal pouches.25

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References


