Absence of Histologic Signs of Chronic Inflammation Following Closed Subgingival Scaling and Root Planing Using the Dental Endoscope: Human Biopsies – A Pilot Study

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Background: The primary goal of periodontal therapy is the reduction or elimination of inflammation. Traditionally, this is accomplished through removal of subgingival tooth-borne accretions using non-surgical and/or surgical treatment modalities. Numerous studies indicated the difficulty in removing these accretions to the point that histologic manifestations of chronic inflammation are eliminated. A companion to the current study demonstrated that subgingival inflammation was associated most often with calculus covered with biofilm, not biofilm alone. This pilot study evaluated the histologic response in humans to removal of calculus and biofilm with the aid of the dental endoscope.

Methods: Twelve teeth in six patients were identified as test teeth, and all subgingival deposits visible with the endoscope were removed in a single treatment by an operator experienced in root planing and the use of the dental endoscope. The 12 teeth and the coronal portion of their periodontal attachment apparatus were removed 6 months after a single episode of closed subgingival scaling and root planing. Biopsies were processed for histologic evaluation.

Results: There were no histologic signs of chronic inflammation. Deposits of calculus and biofilm were seen on one section of one tooth but apparently were deposited after initial therapy. Bone repair and the growth of a long junctional epithelium were observed on previously diseased root surfaces.

Conclusion: Histologic signs of chronic inflammation were absent 6 months after a single course of closed subgingival scaling and root planing using the dental endoscope. *J Periodontol 2008;79:2036-2041.*

KEY WORDS

Calculus; dental scaling; histology; inflammation; periodontitis; root planing.

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Inflammatory periodontal diseases affect a large percentage of the dentate population and are responsible for much of the tooth loss seen in later life.[1] These problems also have been linked to systemic disease.[2,3] The primary extrinsic, etiologic factor for these problems is associated with bacteria.[4] Consequently, treatment of inflammatory periodontal diseases is focused on reducing the bacterial load with personal oral hygiene and professional removal of biofilm and its by-products. However, complete removal of subgingival deposits remains a challenge[5-10] that has led to an approach that abandons the goal of a clean root.[11] A companion study[12] to this article demonstrated a strong relationship between subgingival inflammation and biofilm, as expected, but also showed an even stronger relationship between inflammation of the pocket wall and subgingival calculus covered with biofilm (compared to biofilm alone). This study and the companion study used the dental endoscope.[13]

The pilot study described here was designed to evaluate the histologic response (i.e., level of inflammation) following treatment of severe chronic periodontitis with a dental endoscope.

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MATERIALS AND METHODS

Twelve teeth from six patients (three males and three females; age range: 46 to 63 years) who were selected from the patient population presenting for treatment at a dental school were used in this study. Patients were seen at a private practice in Londrina, PR, Brazil. Selected patients had good systemic health, were able to grant written informed consent approved by an institutional review committee, and were willing to follow pre- and post-treatment instructions. All patients had been scheduled for extraction of remaining teeth in at least one dental arch as a result of severe, chronic periodontitis, and all study sites had probing depths ≥7 mm. All patients were scheduled for removal of alveolar bone to prepare the ridges for complete dentures or implants. None of the patients had known allergies to medications used during therapy and subsequent healing. The guidelines of the Helsinki Declaration of 1975, as revised in 2000, were followed. Volunteers received implant-supported reconstructions for their participation at no charge. Patients were enrolled in the study from May 2001 to October 2001.

Oral hygiene instructions were given before scaling and root planing. On the day of the procedure, each patient took amoxicillin, 1 g, 1 hour prior to treatment and was instructed to continue this medication (500 mg, three times per day) for 8 days. Immediately prior to treatment, the patients rinsed for 30 seconds with 0.12% chlorhexidine digluconate and were instructed to use this rinse twice daily for 6 weeks. Following the onset of local anesthesia, the test teeth in the affected arch were endoscopically evaluated for the presence of subgingival calculus. A #1 round bur in a low-speed handpiece was used to make a groove in the tooth surface, and the relationship of the groove to existing calculus deposits was recorded on digital video for eventual correlation to the histologic evaluation of the teeth.

A fiber-optic bundle on the endoscopic monitor allowed magnification of the subgingival environment at up to ×48. A lens attached to a sterile sheath covering the fiber bundle was placed in the pocket along with an explorer that held soft tissue away from the viewing area. An experienced operator was allowed as much time as needed to clean the root surface, with the clinical endpoint being a root surface free of tooth-borne deposits as seen on the endoscope's monitor. For the first month following treatment, all patients were seen weekly for oral hygiene reinforcement. After the first month, patients were seen monthly for supragingival polishing.

Six months after scaling and root planing, 12 teeth and their surrounding soft and hard tissues were removed en bloc for histologic processing (Table 1). At the time of extraction surgery, all teeth were noted to have corono-apical bony discrepancies that required alveoloplasty for the planned implant and restorative treatment. Hard and soft tissue biopsies were taken just apical to the initial periodontal lesions. Remaining root tips were removed, and additional alveoloplasty, when appropriate, was performed to prepare the bony ridge for implant placement and, later, the final prosthesis. Postoperative healing in all sites was uneventful. Soft and hard tissues were restored to normal form and function, and all restorative treatment was completed as originally planned.

Table 1.
Teeth Treated in This Study

Tooth	N
Maxillary central incisor	1
Maxillary lateral incisor	1
Maxillary cuspid	2
Mandibular incisor	2
Mandibular cuspid	3
Mandibular first bicuspid	1
Mandibular second bicuspid	2
Total	12

Histologic Preparation

The surgical specimens were placed in a mixture of 4% formalin and 1% calcium chloride fixative. A radiograph was taken of each to enable a precise cut on the long axis of each tooth. The specimens were then dehydrated and embedded in methylmethacrylate and cut on the long axis in a mesio-distal direction. Three undecalcified sections ~500 μm thick were obtained from each tooth, glued with acrylic cement to opaque acrylic glass, ground to ~80 μm, and stained superficially with a combination of toluidine blue O and basic fuchsin. The analysis was accomplished with intersection counts, using a grid with parallel sampling lines at a magnification of ×100. Sections were analyzed for the presence of tooth-borne accretions and the presence or absence of cells associated with chronic inflammation.

RESULTS

In all 36 sections (three sections per tooth on 12 teeth), a long junctional epithelium had formed over previously diseased root surfaces (Figs. 1 through 9). Subgingival accretions were absent in 35 of 36 sections. New subgingival accretions representing calculus covered with biofilm were noted in one section (Fig. 9). It was assumed that the accretions had formed following the initial scaling and root planing because their location was within the notch placed at the time of treatment. This patient did not comply with suggested oral hygiene and resumed smoking. There were no

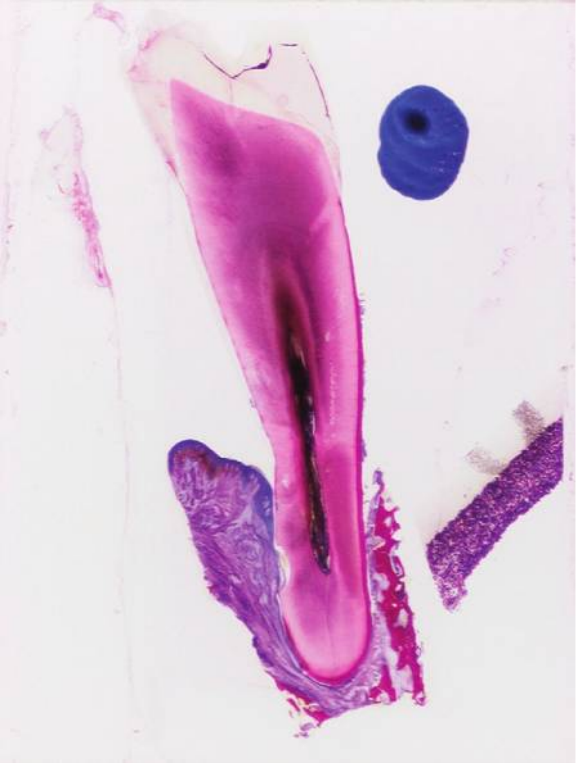

Figure 1.
An overview of one of the study teeth following histologic preparation (original magnification ×3.2).

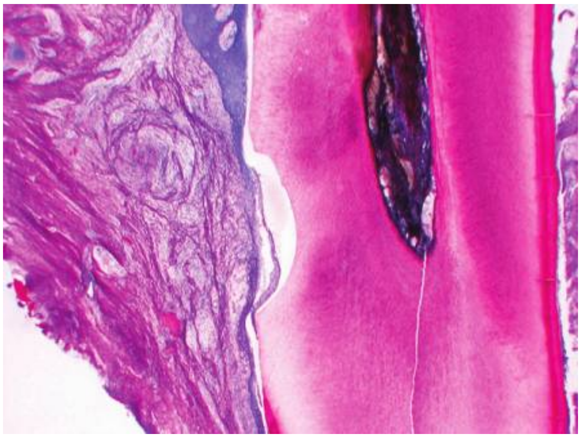

Figure 2.
A higher magnification of the groove seen in Figure 1. The groove in this section was made in a calculus deposit (original magnification ×12.5).

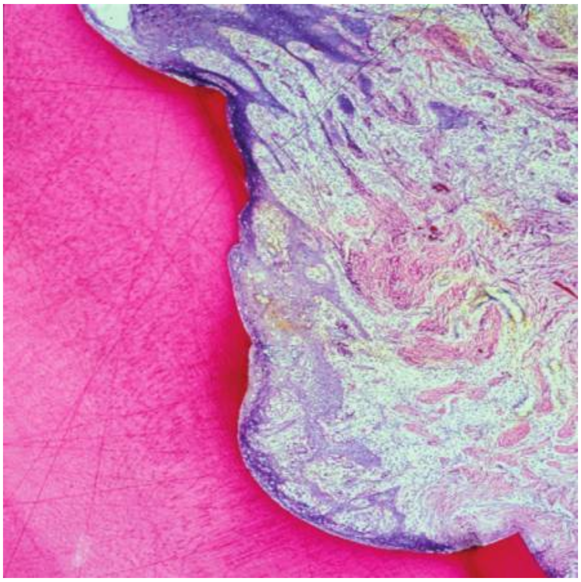

Figure 3.
This section represents a typical section seen in the material from this study. The long junctional epithelium terminates at the apical extent of the notch made in the calculus at the time of closed subgingival scaling and root planing. Minimal inflammation is evident. (Original magnification ×12.5.)

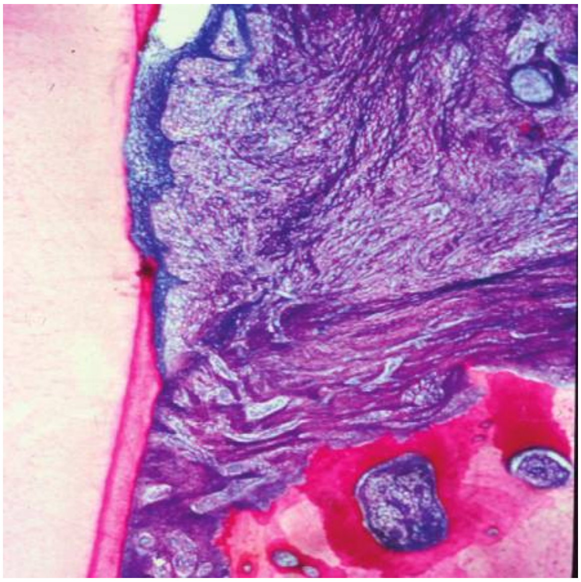

Figure 4.
New bone formation can be seen associated with minimal signs of inflammation (original magnification ×12.5).

histologic signs of chronic inflammation in the 35 sections without new subgingival tooth-borne accretions. There was evidence of bone repair (Fig. 4).

DISCUSSION

Reduction of inflammation is always a prime goal of periodontal therapy. To facilitate this goal, dental professionals remove subgingival deposits of bacterial biofilm and by-products, including calculus. Traditional removal techniques involve blind, closed subgingival scaling and root planing or a flap for access surgery, but often the signs and symptoms of inflammation return. Closed scaling and root planing often give good

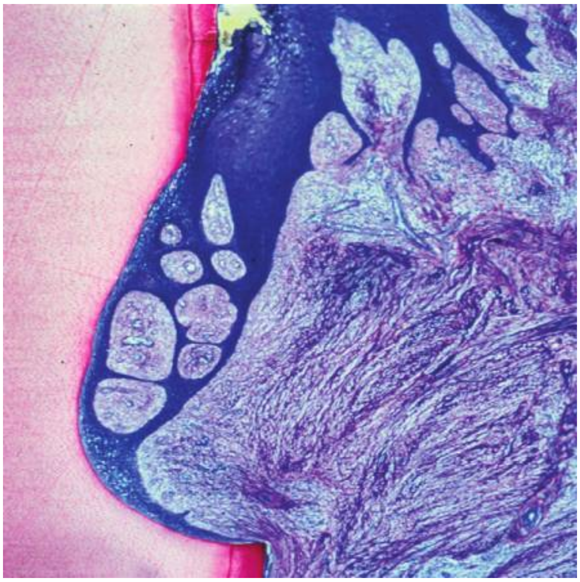

Figure 5.
This section represents an area that had a probing depth of 8 mm at the beginning of the study (original magnification ×12.5).

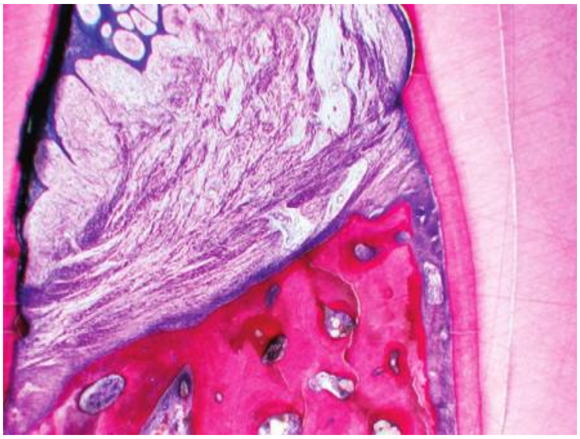

Figure 6.
The interproximal area between two bicuspids (original magnification ×12.5).

Figure 7.
An overview of two bicuspids from the study (original magnification ×3.2).

Figure 8.
A higher magnification of the junctional epithelium seen on the bicuspid on the left in Figure 7 (original magnification ×12.5).

short-term clinical results with shrinkage of pockets and a decrease in gingival inflammation, but symptoms often slowly return. This is often attributed to incomplete removal of subgingival plaque or calculus. Scaling and root planing using an open surgical approach may yield better long-term results, i.e., less recurrence of pockets and inflammation, but it generally has greater post-treatment morbidity and greater recession than non-surgical approaches.

Two studies used histology on human subjects to assess the health of periodontal tissues following closed subgingival scaling and root planing. Dragoo[14] studied 20 teeth from 10 volunteers by taking block sections at 1, 6, 8, and 12 weeks following a single episode of closed subgingival scaling and root planing. He found residual deposits associated with persistent signs of chronic soft tissue inflammation and no signs

Figure 9.
This section is from a bicuspid from a patient who had minimal compliance with postoperative maintenance and oral hygiene and restarted her smoking habit. A dark-stained material on the root surface appears to represent new calculus (produced since the notch was placed in the tooth) apparently covered with bacterial biofilm. This was the only section in this study that had new chronic infection characterized by the inflammatory cells adjacent to these tooth-borne accretions. (Original magnification ×12.5.)

of osteoblastic deposition in the alveolar crest. Tagge et al.[15] took biopsies from suprabony pockets, with one study group receiving closed subgingival scaling and root planing followed by standard oral hygiene procedures. A second group used oral hygiene alone, and a third group received no treatment. Biopsies were taken 8 to 9 weeks following initiation of the study. A dense infiltrate of chronic inflammatory cells had replaced more than half of the gingival fibers in the untreated controls. Chronic inflammatory cells were seen in the oral hygiene–only group, whereas the group that received scaling and root planing and followed standard hygiene had chronic inflammatory cells confined to the connective tissue immediately underlying the crevicular epithelium.

However, in the current study following a single episode of closed subgingival scaling and root planing performed with an endoscope, there were no histologic signs of chronic inflammation 6 months following therapy.

Surprisingly, a companion study to this article found that calculus covered with biofilm was associated with inflammation of the pocket wall to a greater degree than was biofilm alone.[12] If this finding proves consistent, thorough removal of calculus may be indicated in cases where a significant reduction of inflammation is a therapeutic goal.

The absence of chronic inflammatory lesions, along with evidence of bone repair found 6 months after a single treatment episode in the current study, suggested that thorough removal of tooth-borne subgingival deposits might have a significant role in preventing the recurrence of periodontitis. All study teeth in the current study were deemed to have a hopeless periodontal prognosis with considerable inflammation, calculus, and probing depths ≥7 mm before therapy. The clinical improvements resulting from the non-surgical treatment performed during this study were far more favorable than would usually be expected from non-surgical treatment. This may be due to the fact that in contrast to the results of previous studies, none of the sections in the current study exhibited residual tooth-borne accretions following therapy.

The current study also dovetails with previous findings that closed subgingival scaling and root planing lead to the production of a long junctional epithelium on previously diseased root surfaces.[14,15]

Among other studies that examined the therapeutic efficacy of the dental endoscope, three involved closed subgingival scaling and root planing, and the fourth included minimally invasive periodontal surgery. The first three studies[16-18] examined the efficacy of the endoscope for use in closed subgingival scaling and root planing. The differences in results between these studies and the present study are striking. It is difficult to say why our results are much more favorable than previously reported. We believe that we clearly demonstrated that closed root planing using an endoscope produced a clinically and histologically significant reduction in inflammation as well as evidence of bone repair. A single study[19] using an endoscope for minimally invasive periodontal surgery also produced desirable short-term clinical results, with all post-surgical probing depths measuring <4 mm and no surgically induced recession. Although the current study was not surgical in nature, the results from the minimally invasive periodontal surgery study seem to lend support to the results of the current study.

One can speculate that the difference in results between studies may be related to experience in the clinical use of the endoscope. The operators in the current study and its companion study, as well as the minimally invasive study, have extensive experience in the use of the endoscope. The learning curve for the use of the endoscope can be relatively steep, and the different results obtained from various studies may be a reflection of operator experience. Further studies are indicated to answer this question.

The authors' clinical experience is that subgingival biofilm and calculus are routinely found following blind, closed subgingival scaling and root planing, even after traditional clinical endpoints have been met. These deposits could serve as the nidus for repopulation of subgingival bacteria.[20] This view is supported by the current study because the only chronic inflammation seen was in an area of tooth-borne accretions, which apparently were composed of calculus covered with biofilm. These deposits were found in a groove placed in calculus before therapy, with the absence of calculus and biofilm in that groove confirmed before treatment began with the endoscope. Therefore, the deposits apparently formed following therapy. These deposits were associated with chronic inflammatory cells in the overlying soft tissue, a finding that affirms clinical observations published in a companion study.[12]

CONCLUSIONS

The current study used historical controls; thus, it is presumed that future studies on the subject will benefit from same-study patient controls. However, the results of this study and its companion clearly point out a positive relationship of subgingival calculus and adherent biofilm to gingival inflammation.

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