Biofilms in endodontic infections

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Taylor RD.
Modification of the Brown and Brenn Gram stain for the differential staining of gram-positive and gram-negative bacteria in tissue sections.
Dense aggregates of bacteria sticking to the dentin wall.

"Dense aggregates of bacteria sticking to the dentin wall."
“Microbial biofilms are populations of microorganisms that are concentrated at an interface and typically surrounded by an extracellular polymeric substance matrix”.

Bacteria are also seen in the lumen of the main canal, ramifications, and isthmuses as *flocs* and *planktonic cells*, either intermixed with necrotic pulp tissue or possibly suspended in a fluid phase.
Bacterial flocs in clinical specimens may originate from the growth of cell aggregates/co-aggregates in a fluid or they may have detached from biofilms. Flocs may exhibit many of the same characteristics as biofilms, and are sometimes regarded as “planktonic biofilms”.

The biofilm community lifestyle provides microorganisms with a series of advantages and skills that are not observed for individual cells living in a free-floating (planktonic) state:

- Establishment of a broader habitat range for growth;
- Increased metabolic diversity and efficiency;
- Protection against competing microorganisms, host defenses, antimicrobial agents, and environmental stress;
- Enhanced pathogenicity.
ETIOLOGY OF PULPAL DISEASE

NATURAL
- CARIES
- PERIODONTAL DISEASE
- PERIODONTAL DISEASE / CARIES
- ATTRITION
- PHYSICAL TRAUMA
- NEOPLASM

IATROGENIC
- CAVITY PREPARATION WET / DRY
- MEDICAMENTS
- LINERS
- BASES
- TEMPORARY DRESSINGS
- IMPRESSION MATERIALS
- RESTORATIVE SYSTEMS
Deep caries
Reversible pulp inflammation
Pulp penetration by caries
Pulp penetration by caries
Pulpotomy???
98 days
Periapical lesion formation


Morphological aspects of the biofilm
Conclusions

The overall findings are consistent with acceptable criteria to include apical periodontitis in the set of biofilm induced diseases. Biofilm morphologic structure varied from case to case and no unique pattern for endodontic infections was identified. Biofilms are more likely to be present in association with longstanding pathologic processes, including large lesions and cysts.

Methods

The material comprised biopsy specimens from 106 (64 untreated and 42 treated) roots of teeth with apical periodontitis.

Overall, intraradicular biofilm arrangements were observed in the apical segment of 77% of the root canals.
Bacterial biofilms were visualized in 62% and 82% of the root canals of teeth with small and large radiographic lesions, respectively.

All canals with very large lesions harbored intraradicular biofilms. Biofilms were significantly associated with epithelialized lesions (cysts and epithelialized granulomas or abscesses) ($p < 0.001$). The overall prevalence of biofilms in cysts, abscesses, and granulomas was 95%, 83%, and 69.5%, respectively. No correlation was found between biofilms and clinical symptoms or sinus tract presence ($p > 0.05$).

Extraradicular biofilms were observed in only 6% of the cases.
Lateral canals & apical ramifications
Isthmuses
Ca(OH)$_2$ for 106 days
Ca(OH)$_2$ for 106 days
Ca(OH)$_2$ for 106 days
Exuberant infection in a lateral canal as the cause of short-term endodontic treatment failure: report of a case.

• The root canals were prepared with rotary nickel-titanium (NiTi) files (ProFile in combination with GTX and FlexMaster).

• A #08 K-file was used to assure patency of the apical foramen by taking it 1 mm beyond the WL.

• Irrigation with 5% NaOCl.

• Final irrigation with 10% citric acid to remove the smear layer, followed by a final rinse with 2% chlorhexidine. These solutions were activated with ultrasonics for about 20 seconds each.

• The root canals were filled with gutta-percha and 2Seal using the Schilder´s vertical compaction technique.
18mo
Arnold M, Ricucci D, Siqueira JF Jr

Infection in a complex network of apical ramifications as the cause of persistent apical periodontitis: a case report

Extension of the intracanal biofilm to the external root surface
CASE REPORT

Calculus-like deposit on the apical external root surface of teeth with post-treatment apical periodontitis: report of two cases

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Abstract


Aim To report two cases in which calculus-like material was found on external root surfaces of (1) an extracted root and (2) an apical part of a root, both of which were removed due to post-treatment refractory apical periodontitis.

Summary In each case, there was a fistulous tract, which did not heal after conventional root canal treatment. The first case did not heal even after apical surgery, and subsequent flush extraction revealed calculus-like material on a root surface of complex anatomy. The second case showed radiographic signs of healing after apicectomy. Histology of the apical biopsy revealed a calculus-like material on the external surface of the root apex. It is suggested that the presence of calculus on the root surfaces of teeth with periapical lesions may contribute towards the etiology of failure.

Key learning points
- Biofilm on the external root surface has been implicated in the failure of apical periodontitis to heal, despite adequate root canal treatment.
- Calculus-like material was found, in two cases, on the root surface of teeth with post-treatment apical periodontitis, where the only communication externally was a sinus tract.

Keywords: apical periodontitis, calculus, endodontic failure, extracoronal infection.

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Introduction

The major microbiological factor for the development and the maintenance of apical periodontitis is the colonization of microorganisms (bacteria and fungi) in the root canal system.
Extraradicular Infection as the Cause of Persistent Symptoms: A Case Series

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Abstract

Introduction: This article describes 3 cases of persistent symptoms after inappropriate endodontic treatment. Histopathologic and histobacteriologic investigation were conducted for determination of the cause.

Methods: Three cases are reported with persistent symptoms after endodontic retreatment (cases 1 and 2) or treatment (case 3). Periapical surgery was indicated and performed in these cases. The biopsy specimens, consisting of root apices and the apical periodontitis lesions, were subjected to histopathologic and histobacteriologic analyses.

Results: Case 1 was a mucosal cyst with necrotic debris, heavily colonized by budding bacteria, in the lower. No bacteria were found in the apical root canal system. Case 2 was a granuloma displaying numerous bacterial aggregations through the inflammatory tissue. Infection was also present in the dental tubules at the apical root canal. Case 3 was a cyst with bacterial colonies floating in its lumen; bacterial colonies were also seen on the external apical root surface, filling a large lateral canal and other apical ramifications, and embedded layers of cementum detached from the root surface. No bacteria were detected in the main root canal. Conclusions: Different forms of extraradicular infection were associated with symptoms in these cases, leading to short-term endodontic failure only solved by periradicular surgery. (J Endod 2015;41:265-273)

Key Words
Endodontic retreatment, extraradicular infection, post-treatment apical periodontitis, treatment outcome

Post treatment apical periodontitis is usually caused by persistent or secondary extraradicular infections (1, 2). It has also been suggested that infection located beyond the confines of the root canal system, either in the form of a biofilm attached to the external root surface (3, 4) or as cohesive colonies present within the mass of the inflammatory lesion (5, 6), may be responsible for post-treatment disease in some cases. One of the most debatable issues in the field of endodontic microbiology is whether or not infection can establish itself outside the canal system (except for abscess cases) or whether it is the independent cause of post-treatment apical periodontitis.

Cultures dependent (7-11) and culture-independent studies (12-16) have reported the extraradicular occurrence of a complex microbiota associated with apical periodontitis lesions that have not responded favorably to the root canal treatment. One important discussion on this topic refers to whether contamination can be effectively ruled out during surgical sampling of apical periodontitis lesions for microbiological analysis. Bacteria located in the very apical part of the canal may be displaced into the biofilm specimen during surgical procedures and be regarded as “extraradicular” by culture and molecular studies (17). Most previous studies have not evaluated the bacteriologic conditions of the apical part of the root canal, making it difficult to ascertain whether the extraradicular infection was dependent on or independent of an intraradicular infection (18). As a consequence, there is no sufficient evidence suggesting that an extraradicular infection can exist as a self-sustained process independent of an intraradicular infection (19). In a histologic study, Ricucci et al (20) evaluated several root canal-treated teeth with apical periodontitis and found no case of independent extraradicular infection. In the few instances that bacteria were observed outside the root canal system, a concomitant intraradicular infection was present.

Histologic analysis of block specimens composed of the lesion attached to the root apex in their original spatial relationship can circumvent most of the shortcomings of previous studies because it may prevent one to distinguish infection from contamination, detect artificial bacterial displacement into the lesion, and reveal the microbiologic conditions of the apical part of the root canal. This article is intended to contribute to the knowledge of the causes of endodontic treatment failure by reporting 3 cases of post-treatment apical periodontitis showing persistent symptoms associated with different types of extraradicular infection.

Case Series

Case 1

This case relates to a 35-year-old man with a history of repeated abscesses in the anterior mandible with severe pain and swelling. The medical history was non-remarkable. His general dentist had initiated treatment of the 2 mandibular central incisors, which had necrotic pulp and were associated with a large perapical radiolucency. The canals (1 per tooth) were instrumented and medicated with an iodine-based paste. Clinical symptoms did not resolve even after 2 sessions of instrumentation and intracanal medication with sodium hypochlorite. At this point (6 months after beginning of the treatment), the lesion had increased in size (Fig. 1A), and the patient was then referred to an endodontist. At the first visit with the endodontist, signs of severe irritation were noted for all the anterior teeth. The patient denied any acute traumatic event. The access cavities on both
Thank you for your attention
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