Periapical electrolytic corrosion in the failure of silver point endodontic restorations: Report of two cases

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Electrolytic corrosion is part of a broader electrochemical phenomenon that is responsible for oral galvanism. Because several physiopathologic manifestations are associated with the electrochemical phenomenon of galvanism, making the differential diagnosis can be difficult. In endodontically treated teeth, periapical electrolytic corrosion phenomena with associated symptoms can easily be misinterpreted, and the clinical presentation may be accepted as a diagnosis rather than a symptom. The purpose of this paper is to describe two cases of symptomatic periapical electrolytic corrosion resulting from the creation of “active” bimetallic galvanic cells involving silver points. The treatment involved the placement of a retrograde seal into the apical part of the root canal, which controlled the unwanted effect of leakage into the canal space. With the electrochemical activity attenuated, periapical healing and remission of symptoms occurred. (Quintessence Int 1995;26:629-633.)

Introduction

Electrolytic corrosion arises from an electrochemical process whenever metallic restorative materials are placed in the oral environment. The restoration, acting as the electrode, forms a galvanic cell. The electrical potential of the restoration or the net difference in the electrical potentials between restorations generates a current. Intraoral galvanic current is unidirectional and is the by-product of an anodic reaction (oxidation) and a cathodic reaction (reduction) at or between the exposed surface(s) of the involved restoration(s). The electric current is conducted through an electrolyte, such as saliva, bone, dentin, or pulp fluid. As a result, a restoration with metallic composition can participate in electrolytic corrosion.

The electrochemical phenomenon of electrolytic corrosion occurs specifically via either a concentration cell or a bimetallic galvanic cell. The concentration cell facilitates oxidation of the exposed surface of the metal restoration acting as the anode. Metallic ions from the corroding restoration are released into saliva or other tissue fluid. The difference in electrical potential moves electrons from the anode to cathode. It is the movement of the electrons that is thought to be responsible for a multitude of galvanic symptoms.

Two types of “active” bimetallic galvanic cells have been reported in teeth with living pulps. In one cell, the current level is constant with time and accelerates the electrolytic corrosion process. In this situation, two or more metal restorations are typically coupled in direct contact to one another, resulting in “oral galvanism.” When the circuit is active, pain sensation is constant, moderately severe, and perceived as a burning feeling.

In the other bimetallic circuit, severe symptoms of “galvanic shock” have been reported when two metal restorations come into occlusal contact. For most people, galvanic shocks are infrequent and of short duration. Shocks occur only when certain conditions...
Endodontics

Fig 1a Stained alveolar tissue with a draining sinus tract (arrow) adjacent to the apex of the left first premolar.

Fig 1b Evidence of apical root resorption exposing a silver point into the periapical lesion. The restoration is a fixed partial denture over a post that is touching the silver point.

are satisfied. Dissimilar metallic restorations with large net electrical potential differences are often involved in this phenomenon. The demonstration of a causal relationship in galvanically induced disorders is paramount to a diagnosis. In some cases, the onset of alleged galvanically induced oral mucosal disorders have been traced to the insertion or presence of a metallic restoration(s). Following the removal of the presumed offending materials, remission of the symptoms is reported. Although infrequent, periapical electrolytic corrosion can be associated with pain in endodontically treated teeth. The following case reports describe the occurrence of pain as the result of periapical electrochemical corrosion. Active bimetallic cells were suspected, involving a gold crown, a metal post, and a silver point.

Case reports

Case 1

A 41-year-old woman complained of a foul taste. She believed that her left maxillary fixed partial denture was the cause of her problem. The mucosal tissues over the maxillary left first premolar abutment were deeply stained and draining from a sinus tract (Fig 1a). Percussion of this abutment elicited sensitivity as did palpation of the stained tissues. Periodontal probings around the tooth revealed an intact sulcus.

Radiographic examination revealed endodontic treatment failure. There was evidence of external apical root resorption that had completely exposed a silver point to periapical tissue fluids. The patient disclosed that the premolar was endodontically treated more than 8 years previously and a fixed partial denture had been constructed 3 years later. Endodontic re-treatment was not considered at that time because the tooth had been asymptomatic. The radiograph revealed that the tooth had been restored with a metal post placed against a shortened silver point (Fig 1b). A type III gold alloy fixed partial denture with plastic facings had been fabricated over the post and buildup. Over the following 5 years, the patient noticed a gradual increase in the sensitivity of the tooth and soft tissue.

An apparently disintegrating silver point observed on the radiograph (Fig 1b) was thought to be the source of the soft tissue discoloration, and the foul taste was caused by the existing sinus tract. Because of the integrity of the coronal margins and the acceptable functioning of the prosthesis, surgical management rather than orthograde re-treatment was selected as a practical treatment modality.

The surgery took place 5 months later. Within this short period of time, the exposed silver point had disintegrated completely (Fig 1c). Surgery involved the thorough curettage of the periapical lesion, resection of the root, and retrosealing of the canal space with a zinc-free amalgam, as suggested by Omnell.

Examination 6 months postoperatively revealed complete healing of the surgical site. The sinus tract had resolved. With the source of periapical corrosion removed, the appearance of the stained tissue was
improved. The recall radiograph demonstrated osseous healing of the periapical lesion (Fig 1d). The patient was symptom free.

Case 2

A 45-year-old woman complained of bleeding and constantly sensitive gingiva around an endodontically treated maxillary right lateral incisor. The patient brought with her a referral note from her dentist, explaining his unsuccessful attempt at improving the "chronic periodontal tissue problem" around the tooth. He suspected that a hairline fracture of the root could be involved.

The patient revealed that onset of her present problem began soon after all four maxillary incisors were restored with crowns. The gingival tissues surrounding the left lateral incisor had subsequently become irritated and started to bleed on brushing. She stated that this lateral incisor had been endodontically treated 30 years previously. Because the tooth and surrounding soft tissues had been asymptomatic until now, she suspected possible allergy to the metals in the crown.

Intraoral examination revealed good oral hygiene but anemic gingival tissues around the maxillary incisors, except for the right lateral incisor. The gingival tissues around this tooth were uniformly and circumferentially inflamed (Fig 2a). Although a vertical root fracture was suspected, such a diagnosis could not be confirmed. The gingival sulcus was found to be intact on probing.

A radiograph of the apex of the lateral incisor revealed osseous breakdown and a 2-mm segment of a silver point extending into the periapical tissues (Fig 2b). The tooth had been crowned and had a metal post adjacent to a silver point, which exhibited signs of disintegration at its apical portion.

Re-treatment options were explained as the ideal management. The patient opted instead for endodontic surgery. A modified semilunar attached gingival flap was used to expose the apex. The periapical lesion was thoroughly curedtted, and the root tip was resected. The silver point was shortened so that it did not extend beyond the root, and a retrograde seal of zinc oxide-eugenol cement was placed in the canal space.

At the 6-month postsurgical examination, the patient was free of pain and gingival symptoms. The sulcus remained intact and produced little bleeding on probing. The free gingival margin remained at the presurgical level with no evidence of recession. The recall radiograph revealed nearly completed osseous healing of the periapical lesion (Fig 2c).

Discussion

Periapical electrolytic corrosion of silver point endodontic restorations can be part of the broad spectrum of clinical presentations of oral galvanism. This phenomenon derives from the interplay between numerous passive and active galvanic circuits. In most instances, local symptoms of alleged galvanism include, foul metallic taste, mucosal tissue dysplasia, burning sensations, and painful shocks, can be traced to an underlying dental or medical disorder.
The primary goal of successful endodontic treatment is to achieve and maintain the hermetic seal of the apex from leakage. Yet, when silver points are removed from teeth following many years of service, significant corrosion can be observed as the result of apical leakage, regardless of the treatment outcome.\textsuperscript{15,16} In conjunction with apical leakage, the overextension of the silver point into periapical tissue is also a factor in some failures of endodontic treatment.\textsuperscript{17-19} Thus, leakage into the root canal and overextension of the silver point represent biologic obstacles to success of endodontic treatment and provide the ideal local environment for electrochemical activity with electrolytes in periapical exudate.

Therefore, as the reported cases illustrate, pulpless teeth that have received otherwise clinically successful endodontic treatment should be examined for the type of root canal restoration and possibility of leakage before the coronal restoration is replaced. In addition, the possibility of bimetallic contact between the coronal metal prosthesis and metal post with a silver point inside the root canal should be avoided. In the presence of leakage, active electrochemical activity could occur. Nonsurgical endodontic re-treatment with gutta-percha or another noncorroding material is the appropriate treatment whenever possible.

In the patients in the reported cases, active bimetallic galvanic cells were probably created between the crown and metal post and a silver point. This caused electrochemical activity with periapical tissue exudate and corrosion of the silver point. The accelerated disintegration of the exposed portion of the silver point following restoration of the premolar with a crown in case 1 confirms Holland's findings\textsuperscript{20} that corrosion is most severe whenever the surface area of the anode (silver point) is comparatively smaller than the cathode (post, crown, and fixed prostheses).

The definitive management of a suspected galvanic process involves uncoupling the circuit. Elimination or replacement of the metallic restoration is one method of achieving this goal.\textsuperscript{1,10,12} However, in endodontically restored teeth, this approach may be unwarranted or impractical. Uncoupling the electrolyte from the circuit, as was done in the reported cases, is the other method of treatment.
References


