Histologic and Histobacteriologic Observations of Failed Revascularization/Revitalization Therapy: A Case Report

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Abstract

Introduction: Mechanical debridement plays an important role in eliminating intracanal bacteria, such as biofilm on the canal walls and bacteria in the dentinal tubules. Mechanical debridement is not recommended for root canal disinfection in revascularization/revitalization therapy. Here we report a failed revascularization/revitalization case, which could be due to inadequate root canal disinfection without mechanical removal of biofilm and bacteria in dentinal tubules. **Methods:** A 6-year-old boy had a traumatic injury to tooth #9, which was avulsed and replanted within 40 minutes. The tooth subsequently developed a local swelling in the periapical area. The patient was referred to the Postgraduate Endodontic Clinic for revascularization/revitalization therapy on tooth #9. The treated tooth remained asymptomatic for 16 months and then developed pain and local periapical swelling. The oral surgeon extracted the revascularized/revitalized tooth. On request, the extracted tooth was processed for histologic and histobacteriologic examination. **Results:** The tissue in the canal was completely destroyed. Most bacteria were observed in the apical portion and not in the coronal portion of the canal and formed biofilm on the canal walls and penetrated into the dentinal tubules. **Conclusions:** On the basis of histobacteriologic observations, the failure of revascularized/revitalized tooth could be due to inadequate root canal disinfection without mechanical debridement. It may be important to perform mechanical debridement as part of the revascularization/revitalization therapy to disrupt the biofilm on the canal walls and remove bacteria in the dentinal tubules because revascularization/revitalization therapy is able to increase thickening of the canal walls. *(J Endod 2014;40:291–295)*

Key Words

Immature permanent tooth, reinfection, revascularization/revitalization, root canal disinfection

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Bacterial infection is the primary cause of pulpal and periapical disease (1). When the root canal is infected, bacteria colonize the canal walls as biofilm (2, 3) and penetrate into the dentinal tubules (4, 5) and lateral/accessory canals (6) as well as isthmuses (7). The number and depth of dentinal tubules invaded by bacteria are higher and deeper in the teeth of young than of old people (8, 9). Bacteria in biofilm firmly attached to the canal walls and in the canal dentinal tubules are very hard to eliminate by canal irrigants and intracanal medicaments during root canal therapy (10–14). In addition, biofilm can evade the host's innate and adaptive defense mechanisms and resist antimicrobial chemotherapy (15).

Similar to open flap debridement for marginal periodontitis, root canal therapy requires mechanical instrumentation or debridement to remove biofilms, canal walls contaminated by bacteria toxins, and bacteria in the dentinal tubules (16, 17). The current protocol used to control root canal infection of immature permanent teeth with infected necrotic pulp in revascularization/revitalization procedures is by irrigation with sodium hypochlorite and intracanal medication with calcium hydroxide or triple antibiotics without mechanical debridement (18). Regardless of apexification or revascularization/revitalization procedures, effective control of root canal infection is the key to the success of both treatments. Infection/inflammation prevents tissue regeneration and stem cell differentiation (19) and therefore has to be under control for wound healing to take place. It has been suggested that control of root canal infection in revascularization/revitalization procedures might have to be more thorough than that of regular root canal therapy for pulp tissue regeneration to occur (20). No failures of revascularization/revitalization cases have been reported by using sodium hypochlorite irrigation and triple antibiotics intracanal medication without mechanical debridement in human (21) and in animal studies (22–24), which are of short-term observations. These studies give the impression that the clinical outcome of revascularization/revitalization therapy is a 100% success.

We have experienced failed revascularization/revitalization cases by using current root canal disinfection protocol and had to re-treat the failed cases with apexification procedures. The purpose of the present case report is to describe a failed immature permanent tooth with infected necrotic pulp and acute apical abscess after revascularization/revitalization procedures by histologic and histobacteriologic examination. The failure of the present case could be caused by an inadequate control of intracanal infection by using sodium hypochlorite irrigation and calcium hydroxide as well as triple antibiotics paste intracanal dressing without mechanical debridement of the infected canal. Although this is a single case report, we hope that it will call attention to reevaluate the effectiveness of root canal disinfection protocol of revascularization/revitalization procedures *in vivo* to improve the success of revascularization/revitalization therapy.

Case Report

A 6-year-old boy was referred to the Postgraduate Endodontic Clinic at New York University College of Dentistry from a university-affiliated City Hospital for treatment of tooth #9. The patient's medical history was not contributory. Tooth #9 was avulsed and replanted with rigid splint by an oral surgeon at the City Hospital within 40 minutes of avulsion approximately 4 months prior. The general dentist at the City Hospital performed instrumentation of the root canal space because the patient developed a localized swelling in the periapical area of tooth #9 about 2 months after tooth replantation.

The dentist irrigated the canal with 2% chlorhexidine (Steris Co, Mentor, OH), filled the canal with Calasept (Nordiska Dental, Angelholm, Sweden), and closed the access cavity with a cotton pellet and intermediate restorative material (IRM) (Dentsply International, Milford, DE). The patient and his mother were advised to visit the Postgraduate Endodontic Clinic at New York University College of Dentistry for continuing treatments.

At the initial visit, clinical examination showed that tooth #9 was asymptomatic and had a class I mobility. There was no swelling or sinus tract associated with tooth #9. The tooth was not tender to percussion and palpation. It did not respond to pulp tests with cold, heat, and electric pulp tester. No deep periodontal pockets were present. Periapical radiograph revealed that tooth #9 was an immature permanent tooth. It had a wide canal space and an open apex with incompletely formed root. The periapical area of the tooth had a localized radiolucent lesion (Fig. 1*A*). The clinical diagnosis of tooth #9 was previously initiated root canal therapy and asymptomatic apical periodontitis. Treatment options and outcomes including revascularization/revitalization, apexification, no treatment, and extraction were carefully explained to the patient and his mother. They decided to keep the tooth and agreed to have revascularization/revitalization therapy. Informed consent was obtained. Even though tooth #9 was avulsed and replanted, we determined that it was reasonable to perform revascularization/revitalization procedures recommended by the American Association of Endodontists (18, 25) because our concept of revascularization is derived from the studies of revascularization of replanted immature teeth in animals (26, 27).

At the second treatment visit under local infiltration with lidocaine containing 1:100,000 epinephrine (Novocol Pharmaceutical, Cambridge, ON, Canada), the tooth was isolated with rubber dam. The IRM temporary filling and the cotton pellet were removed from the access cavity. The working length was estimated from the radiograph, and Calasept in the canal was gently removed by using a #80 hand file in conjunction with irrigation with copious amounts of 5.25% sodium hypochlorite solution (Sultan Healthcare, Hackensack, NJ). The canal was dried with sterile paper points and filled with calcium hydroxide mixed with saline solution to a pasty consistence to the apical third of the canal with pluggers. The access cavity was closed with a cotton pellet and IRM.

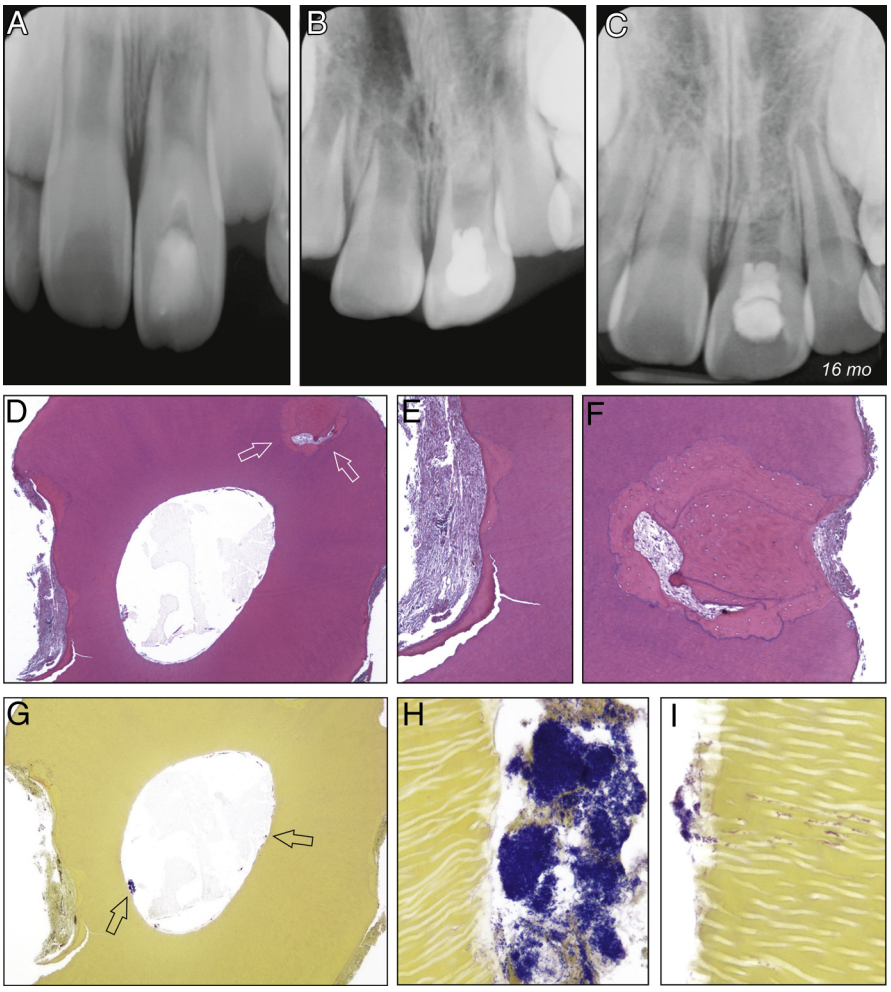

Figure 1. (*A*) Diagnostic radiograph. (*B*) Radiograph taken after completion of revascularization/revitalization procedures and restoration of access cavity. (*C*) Radiograph taken 16 months after treatment, immediately before extraction. (*D*) Crosscut section taken from middle third of the root (hematoxylin-eosin; original magnification, ×16). (*E*) Detailed view of left radicular contour in (*D*) (original magnification, ×50). (*F*) Magnification of area indicated by *arrows* in (*D*). The resorptive defect has been repaired by calcified tissue resembling bone (original magnification, ×50). (*G*) Section not distant from that shown in (*D*) (Taylor modified Brown and Brenn technique; original magnification, ×16). (*H*) High-power view of area of the root canal wall indicated by *left arrow* in (*G*). A bacterial biofilm is present (original magnification, ×400). (*I*) High-power view of area of the root canal wall indicated by *right arrow* in (*G*). Small bacterial aggregate. Bacteria are colonizing some dentinal tubules (original magnification, ×400).