Treatment Options for Failing Regenerative Endodontic Procedures: Report of 3 Cases

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Abstract

Introduction: Regenerative treatments in necrotic immature teeth are suggested as alternatives to conventional multiple or single-step apexification procedures. Although case reports and case series provide promising results, the treatment protocol is not yet fully established and regenerative procedure might fail. Once failure is encountered, the apexification treatment options still remain. **Methods:** Repetition of the regenerative procedure after initial revitalization failure has not been suggested yet. Here, 3 cases of failing regenerative endodontic procedures are reported. All 3 cases had been initially treated by single-step disinfection/revascularization procedures. In different time intervals, all cases showed signs of recurrent disease. The first case was managed with renegotiation and apical mineral trioxide aggregate plug placement; the second case was managed with renegotiation and conventional root canal treatment; and the third case was managed with renegotiation, long-term calcium hydroxide disinfection, and repetition of the regenerative endodontic procedure. **Results:** Two years after the second intervention, all cases were considered successful. **Conclusions:** Repetition of failed regenerative treatment procedures might be a viable alternative to conventional apexification procedures. *(J Endod 2017;43:1472–1478)*

Key Words

Biodentine, mineral trioxide aggregate, open apex, regenerative endodontic procedures, re-revitalization

Significance

Occasionally, regenerative endodontic procedures might fail. Once they fail, alternative treatment modalities still remain. Besides apexification procedures, clinicians should be aware that a second attempt of regenerative endodontic procedures is feasible. Disinfection efficacy seems to be the key.

Current regenerative endodontic procedures are suggested as ideal treatment alternatives for immature permanent teeth with necrotic pulp (1). These biologically based procedures aim to restore the anatomy and function of the original tissues that have already been damaged (2). They present similar or better success and survival rates to apexification procedures with the additional advantage of continuous root development and dentin wall thickening of the immature teeth (3, 4).

Although most clinical articles on regenerative endodontic therapy report favorable outcomes (5), few publications exist reporting short-term or long-term failure of the procedure (6). In failed regenerative endodontic procedures, the long-standing nature of periapical disease, the cytotoxic effects of intracanal irrigants, the early stage of root development, and the inadequate control of intracanal infection have been considered as the basic etiologic factors for treatment failure and cessation of root maturation and dentin wall thickening and lengthening (6–9).

It is a common belief that vital tissue cannot regrow into a pulp space that has remained infected and untreated. Bacteria organized in biofilms firmly attach to root canal walls and might resist disinfectants, irrigation techniques, and intracanal medicaments (10, 11). Disruption and removal of intracanal biofilms requires mechanical instrumentation of root canal walls in conjunction with irrigants. Although mechanical debridement techniques might decidedly reduce the number of bacteria in infected root canals (12), usually they are not recommended during regenerative endodontic procedures. According to the considerations for regeneration procedures, root canal disinfection should be achieved by using irrigation solutions and intracanal medicaments with minimal or no mechanical debridement (13). Mechanical cleaning might further weaken the thin root canal walls (14) or it might remove vital tissue remnants that are still present in apical parts of the canal (15). With current noninstrumentation techniques though, it seems questionable whether immature infected root canals can be adequately disinfected. Inadequate disinfection might result in regenerative failure.

In cases of regenerative endodontic therapy failure, clinicians should be capable of implementing alternative treatment modalities. Failed revascularization cases might be associated either with open apical foramina, thin and short root walls and recurrent disease, or with partial dentinal bridging and apical constriction. According to the pattern of initial revascularization failure, different treatment modalities may exist. It is a challenge for the specialty to deal with regenerative endodontic treatment failure.

The aim of the present study was to report 3 cases of revitalization failure and to suggest re-revitalization as a viable treatment option.

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Case Report 1

An 8-year-old boy was referred for evaluation and possible treatment of his permanent maxillary left central incisor (#9). A history of swelling was reported that had been managed with amoxicillin 1 g every 12 hours for 1 week. The dental history revealed that tooth 9 had suffered an enamel dentine fracture after a bicycle accident 6 months earlier. His pediatric dentist had restored the missing tooth structures with composite resin. At the time of the initial appointment, the tooth was asymptomatic and no swelling could be noticed. Intraoral examination revealed a slight discoloration of the affected tooth (Fig. 1*D*). Both electric (Digital Pulp Tester; Parkell, Inc, Edgewood, NY) and cold (Roeko; Coltene Whaledent, Langenau, Germany) vitality pulp testing were negative for tooth 9. Radiographic examination revealed the presence of a periapical lesion associated with an immature root with thin dentinal walls (Fig. 1*A*). The diagnosis was consistent with pulp necrosis and apical periodontitis that had been rendered asymptomatic after 1 week of antibiotic intake. The patient's parents were informed about all the possible treatment modalities, advantages, disadvantages, and expected outcomes. The treatment options suggested were long-term calcium hydroxide apexification procedure, single-step mineral trioxide aggregate (MTA) plug placement, and regenerative endodontic procedures. The parents selected to try to induce root maturation with regenerative procedures. A written informed consent was obtained. Because of difficulties in patient compliance, a single-step regenerative approach was selected over multiple visit approaches.

After rubber dam isolation, the pulp chamber was accessed with a diamond bur and purulent and hemorrhagic drainage was observed. The wide canal was left to drain until it ceased. Root canal disinfection was achieved by using copious apical negative-pressure irrigation (Endo-Vac macrocannula; Sybron Endo) of 3% sodium hypochlorite (NaOCl) solution (Canal Pro; Coltene/Whaledent). The root canal was filled with 3% NaOCl and the irrigant was activated with an ISO 30 K-Ultrasonic file for 3 × 20 seconds. The wide canal was dried with the Endo-Vac macrocannula and filled with 17% EDTA solution (Canal Pro; Coltene/Whaledent). After 2 minutes, EDTA was rinsed with sterile water and the wide canal was dried with the Endo-Vac macrocannula. Using a size #40 K-file, apical tissues were lacerated and bleeding was induced. A blood clot was allowed to form at the level below the cementoenamel junction and MTA angelus white was placed over the blood clot. The MTA was covered with a thin layer of modified glass-ionomer cement (GC Fuji II; GC Corporation, Tokyo, Japan) and restored with composite resin at the same visit (Fig. 1*B*). The 2-year follow-up examination revealed healthy soft tissues and no signs or symptoms. A time-dependant increase of cervical discoloration was noticed (Fig. 1*E*). The radiographic evaluation revealed healing of the periapical lesion but no signs of dentine wall thickening or continuous root development (Fig. 1*C*). The 3-year follow-up clinical and radiographic examination revealed healthy soft tissues but still no signs of continuous root development or dentine wall thickening (Fig. 1*F* and *I*). At the 4-year follow-up evaluation, a sinus tract appeared and the radiographic examination revealed an apical rarefaction (Fig. 1*G* and *J*). The regenerative procedure was considered as failed and a decision was made to renegotiate the wide canal. After infiltration anesthesia, the rubber dam was placed and an access was made through the composite restoration. The MTA was removed with an ET 25 D ultrasonic tip (Acteon group; Satelec) under continuous sterile saline irrigation. After removing the coronal MTA barrier, purulent drainage was observed. The wide canal was rinsed with positive syringe irrigation of 6% NaOCl solution with surface modifiers (Canal Pro; Coltene/Whaledent) and the canal was dressed with calcium hydroxide (Ultracal; Ultradent) and temporized with Cavit G (3M ESPE, Seafeld, Germany); 1 week

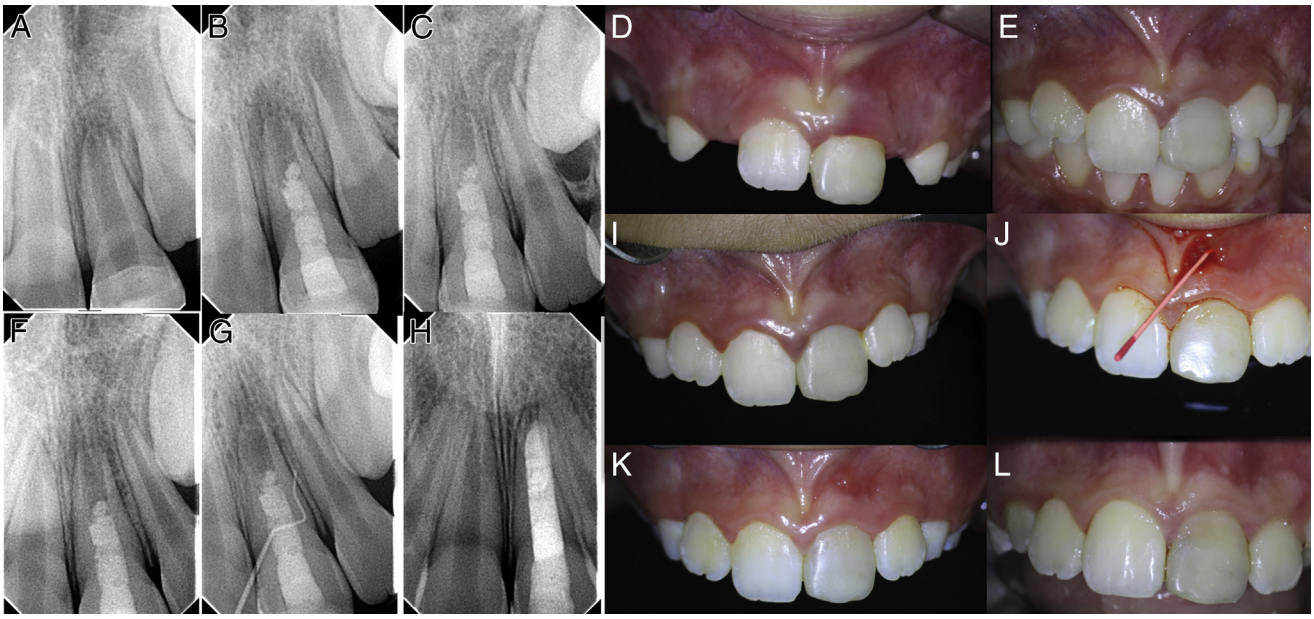

Figure 1. (*A*) Preoperative periapical radiograph of tooth 9 indicating the existence of periapical lesion and thin dentinal walls. (*B*) Postoperative radiograph of tooth 9 after single-step regenerative endodontic procedure. (*C*) Two-year follow-up periapical radiograph showing healing of the periapical lesion and unaltered dentinal walls. (*D*) Preoperative clinical image showing slight discoloration of the crown and healthy soft tissues. (*E*) Two-year follow-up clinical image showing increased discoloration of the crown. (*F*) Three-year follow-up periapical radiograph showing unaltered dentinal walls and unclear periapical tissues. (*G*) Four-year follow-up radiograph with sinus tract showing unaltered dentinal walls and recurrence of the periapical disease. (*H*) Five-year follow-up radiograph suggesting uneventful healing of the recurrent periapical disease after MTA plug placement, possible apical closure below the MTA plug, and thin dentinal walls. (*I*) Three-year clinical image showing healthy soft tissues. (*J*) Four-year clinical image with sinus tract present. (*K*) Four-year clinical image after 1 week dressing with calcium hydroxide showing resolution of sinus tract and healthy soft tissues. (*L*) Five-year follow-up clinical image showing healthy soft tissues and discolored crown.