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A Biological Approach to Root Fortification

The management of open apices in permanent immature necrotic teeth has always been a challenge in terms of obtaining an adequate apical seal and providing internal root strength, which may help increase fracture resistance and prolong functionality.[1] The traditional technique is to use long-term non-setting calcium hydroxide to form an apical barrier to which an apical plug of gutta percha can be packed. This technique was further developed following the discovery of MTA (mineral trioxide aggregate) in the mid 1990s, in which a one-step apexification procedure using MTA showed equal clinical and radiographic outcomes when compared to the traditional technique with calcium hydroxide.[2]

During the early 1960s, initial work began by a group of Norwegian researchers to investigate the addition of a blood clot into the root canal space.[3] The experiment failed but it triggered further research in both the animal and human model. In 2004, the first published human study showed favorable results[4] and to date there have been a growing number of case reports presented in the endodontic literature. The aim of this case report is to present a different type of clinical procedure for the management of an open apex using a treatment approach that is termed "regenerative endodontics."

Case Report:

A 10-year-old female presented with a history of a previous facial swelling in the right cheek area. She visited her dentist two weeks prior and received a course of amoxicillin for initial management.

Upon presentation there was no visible or palpable swelling within the extra and intraoral tissues around tooth #45. Vitality testing revealed a necrotic pulp with symptomatic apical periodontitis. The adjacent teeth, #44 and #46 responded to thermal testing yielding a normal response. There was also no associated trismus. Dental history revealed the recent placement of a pit and fissure sealant on #45.

Radiographically there was an apical rarefaction at #45 with an incompletely formed root and an unfavorable crown to root ratio (Figure 1). The adjacent teeth show areas of normal root growth consistent

Figure 1.
Pre-operative radiograph.

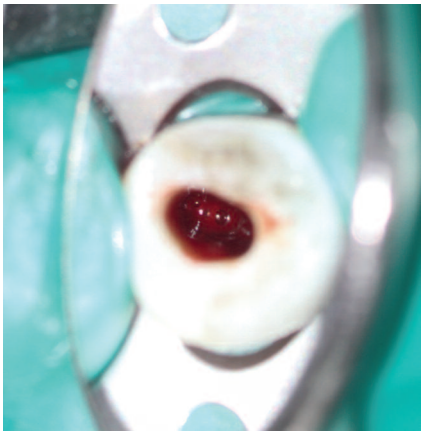

Figure 2A.
Bleeding provoked intracanal.

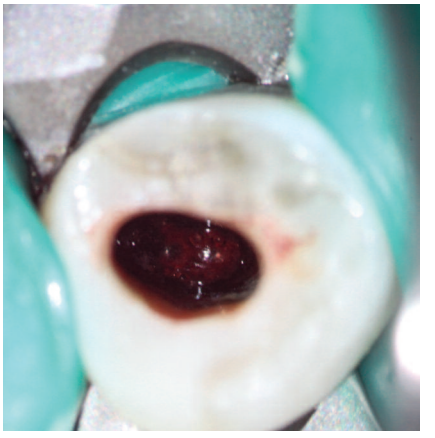

Figure 2B.
Blood clot formed intracanal.

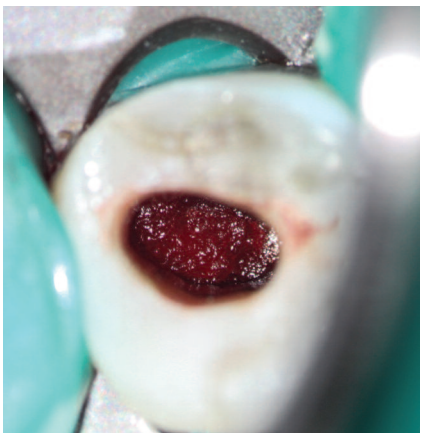

Figure 2C.
Collacote placed over blood clot.

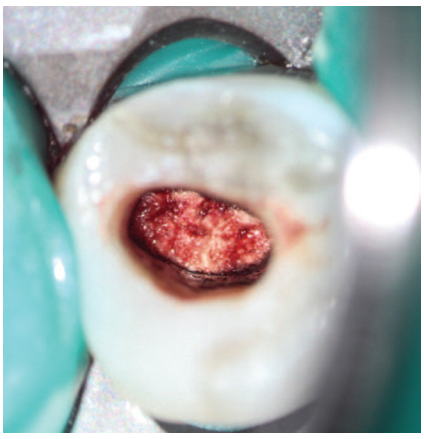

Figure 2D.
Initial placement of WMTA over blood clot.

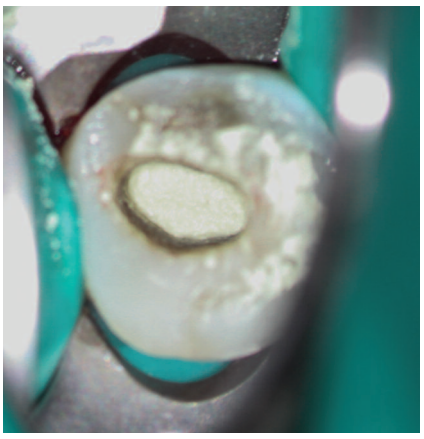

Figure 2F.
Final placement of WMTA.

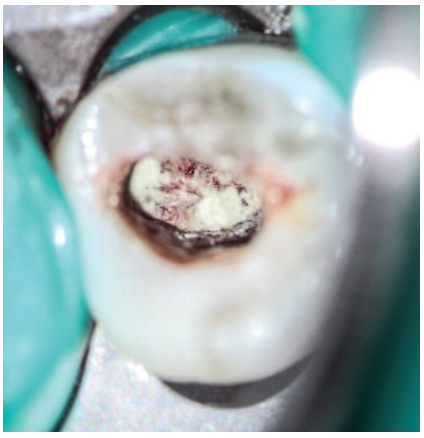

Figure 2E.
Second placement of WMTA over blood clot.

Figure 3.
WMTA placed on blood clot radiograph.

with the patient's age. After discussing the treatment options with the parents a regenerative procedure was selected and informed consent was received.

One carpule of two percent Lidocaine, 1:100,000 epinephrine was administered via an inferior alveolar nerve block approach. A rubber dam was placed and the surgical field was scrubbed with 5.25 percent NaOCl. Access was made into #45 and remnants of the diseased pulp were removed. No instrumentation was carried out. Disinfection primarily consisted of passive ultrasonic irrigation with 5.25 percent NaOCl and 17 percent EDTA. Finally, the main body of the canal was dried and a 3Mix antibiotic paste (ciprofloxacin, metronidazole, minocycline) was introduced using a propylene glycol vehicle. A temporary resin restoration was placed. The patient was provided with post-op instructions and reappointed three weeks later.

At the next visit, following anesthesia and isolation procedures, #45 was re-accessed and the 3Mix antibiotic paste was passively irrigated out using 5.25 percent NaOCl. The main body of the canal was dried and a DG16 explorer was placed beyond the apex to initiate bleeding (Figure 2A). After 15 minutes, a clot had formed within the confines of the coronal root form (Figure 2B). A thin sheet of purified collagen (Collacote, Zimmer Dental) was placed over the blood clot to act as an additional scaffold for the placement of white MTA (Figure 2C). White MTA was placed in two increments and gently compacted with a large paper point between applications for better adaptability (Figures 2D-2F). Finally, a temporary restoration of cavit was placed into the access (Figure 3) and a permanent composite core was placed the day after once the set of the WMTA was confirmed (Figure 4).

Recalls:

Figure 5 shows the one-year recall radiograph. Clinically, the patient was asymptomatic with normal presentation of the clinical tissues. Radiographically, there were signs of healing of the original periapical lesion and a calcific bridge appears to be developing apical to the MTA. The two-year recall radiograph shows the

Figure 4.
Post-op radiograph.

Figure 5.
One-year recall radiograph.

Figure 6.
Two-year recall radiograph.

presence of intracanal calcifications with a complete resolution of the initial periapical lesion (Figure 6). The three-year recall radiograph shows definitive lamina dura, tapering of the root-end and almost obliterated coronal and mid-root areas (Figure 7). The clinical picture showed the colour change within the crown now distinct at the three-year post-op (Figure 8).

Discussion:

Patient compliance is a key factor for regenerative endodontics, especially for the number of treatments visits and subsequent follow-ups to evaluate the outcome. Follow-ups with this patient were well planned and the patient compliance was excellent. Of interest is the Asian background of this patient and the dental anomaly of dens evaginatus, as the prevalence for this has been reported to be as high at 4.3 percent within Asian populations.[5] In this context, the most common cause of pulpal necrosis is contamination of the invagination by oral bacteria directly into the pulp, yet occlusal trauma and deep restorations have also been associated as risk factors.

Figure 7.
Three-year recall radiograph.

The treatment protocol presented for this case was aimed to provide a more biological approach. To date, there have been few documented case reports[6,7] that have used a variety of clinical procedures for regenerative therapy. However, there is still no consensus as to what can increase predictability for all cases.[8] A recent report mentioned a possible standardized protocol[9] derived from clinical publications. Histological data shows that the tissues formed intracanal are an osteo-cementum[10] whilst other reports have also tried to provide radiographic classifications based upon the amount and location of calcific changes.[11,12] In general, the outcome predictors at two years are consistent with increased root thickness and resolution of a previous periapical radiolucency; however, an increase in root length is still debated amongst colleagues.[7] Root thickening may also contribute to root fortification though a biological approach vs. intracanal bonding after traditional apexification procedures.[1] Various reports have also mentioned crown discoloration from the use of 3Mix paste. Some authors have suggested elimi-

Figure 8.
Crown discolouration at three years post-op.

nating minocycline from the interim antibiotic mix[13] whilst others have substituted it with the use of calcium hydroxide.

Conclusion:

This case presents an alternative approach for the management of open apices in permanent immature teeth. Further research is still needed to identify correct case selection and clinical protocols. However, this technique offers a unique approach to managing apical periodontitis and increasing root thickness to maintain functionality.

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