Rescuing Hopeless Teeth

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Innovations in materials, equipment, and technique continue to sophisticate endodontic treatment procedures enhancing the incidence of predictable clinical success. Mineral Trioxide Aggregate [ProRoot® MTA, Dentsply/Tulsa Dental, Tulsa OK], resin core obturation materials and resin sealers [Real Seal, Sybron Endo, Orange CA], antibacterial root canal cleansers [BioPure™ MTAD™, Dentsply/Tulsa Dental, Tulsa OK], 4th generation foramenal locators [Elements Diagnostic Unit, Sybron Endo, Orange CA], and differential negative pressure irrigation devices [ZZY-VAC prototype, in development] may contribute a meaningful algorithm to treatment planning and risk assessment in comprehensive patient care (Fig 1). The alchemy of mechanical instrumentation, irrigation, and a microbial control phase based on these innovations in intracanal medication and root canal filling materials, is reinforcing the role played by endodontics in rehabilitative dentistry.

There are no biologic absolutes; there are however, varying degrees and definitions of success. Successful endodontic therapy is perceived to be the resolution and/or prevention of apical periodontitis or the retention of a functional tooth. The perception presents a conundrum to the clinician in treatment planning as the decision to retreat a tooth or extract and place an osseo-integrated implant fixture is based upon the interpretation (Fig 2). The clinical and systemic factors affecting the longevity of a tooth must be factored into the decision making process in addition to the specifics of the location, bone quality and quantity, and the condition of the patient's other teeth.

Retrospective studies (1-3) have shown that the success rate of teeth without apical periodontitis remaining free of disease after initial treatment or those with orthograde retreatment is 92 to 98 percent. The chance of teeth with apical periodontitis to completely heal after initial treatment or retreatment is 74 to 86 percent, and their functionality over time determined to be 91 to 97 percent. The difference in outcome between initial treatment and orthograde retreatment does not appear to be significant.

The outcome of apical surgery is less consistent than that of the non-surgical treatment. The chance of teeth with apical periodontitis to completely heal after apical surgery is 37 to 85 percent, with a weighted average of approximately 70 percent. However, even with the lower chance of complete healing, the functionality of these teeth over time is determined to be 86 to 92 percent. Considering the favorable outcome, conservative endodontic therapy, both non-surgical and surgical, is justified and should be undertaken when a good restorative and periodontal prognosis is anticipated. The case studies that follow will demonstrate the validity of this premise.

Case Studies

Case I: Fig 3
Endodontic Periodontal Lesion (Anterior)

A 58 year old male presented with swelling of the labial mucosa overlying tooth #2.1; probe depths of 16 mm were recorded along the facial and mesial aspects of the tooth. Pus drained through the sulcus; however, the tooth was not mobile. Radiographic examination revealed extensive bone loss about the tooth which was non-responsive to thermal challenge (a,b). A cavity test was performed; no symptoms were reported by the patient upon penetration of the DEJ. The root canal was shaped and cleaned using rotary NiTi instrumentation with 5.25 % NaOCl and liquid EDTA irrigation. Aqueous chlorhexidine (CHX) 2% activated passively with ultrasonics for one minute was used as the final irrigant (4). Calcium hydroxide (Calasept, J S Dental Mfg. Inc., Ridgefield CT) was used as the inter-appointment medication.

After seven days, the soft tissues appeared within normal limits. The calcium hydroxide was removed using copious irrigation, the canal dried and filled with lateral condensation of gutta-percha and epoxy-resin sealer (AH-26® Root Canal Sealer, Dentsply Maillefer, York PA) (c). At the three month follow-up, probe depths were 5 mm along the facial aspect of the tooth and the soft tissues appeared normal. A further examination was performed fourteen months after the initial appointment. Probe depths were 3 mm on all aspects of the tooth which had remained symptom-free since completion of the root canal therapy. Radiographic examination revealed almost complete regeneration of the periradicular tissues (d).

Case II: Fig 4
Endodontic Periodontal Lesion (Posterior)

A healthy adult male patient presented for treatment of an acute abscess associated with tooth #3.7. The mobility status was assessed as M2; periodontal probe depths about the distal root indicated extensive bone loss which extended into the furcal region. The tooth tested non-responsive to thermal challenge. At the first visit, the root canal was shaped and cleaned using rotary NiTi instrumentation with 5.25 % NaOCl and liquid EDTA irrigation. UltraCal® XS(Ultradent Products, S. Jordan UT) was used as the inter-appointment medication and the patient reappointed in one month's time to assess healing (5).

At the follow-up, the tooth had tightened significantly and probe depths were improved. After explaining the treatment options to the patient once again, it was decided to continue with the suggested treatment. The canals were debrided again using NaOCl and EDTA irrigation, dried and Ultracal XS placed again. The patient was reappointed in 3 months' time at which time the probe depths were determined to be within normal limits. A paper point (6) was used to determine working length in the distal canal due to the apical resorption, and the case filled with vertical compaction of warm gutta-percha and Kerr EWT sealer. A further examination was performed twelve months after the initial appointment. Probe depths were within normal limits on all aspects of the tooth which had remained symptom-free since completion of the root canal therapy. Radiographic examination revealed almost complete regeneration of the periradicular tissues (Fig 4).

Case III: Fig 5
Orthograde and Retrograde Retreatment

The failure of the primary root canal procedure resulted from biologic inadequacies ensuant from technical misadventure and material deficiencies. Solid core obturators (silver cones), separated instruments, and the absence of suitable coronal sealing material all failed to address the vagaries of the root canal space as the seal produced was dependent on ancillary sealing material which readily degrades or oxidizes over

time. The choice of amalgam as the retrograde sealing material after the initial procedural failure, the choice of a round bur in a straight handpiece to address the canal anatomy rather than ultrasonics for retro-preparation and the placement of the retro-sealing material on the root rather than within the apical terminus ignores the biologic imperative of closure of the root canal space regardless of the orthograde or retrograde approach taken (a).

Surgery is very rarely the first treatment option if an apical periodontitis ensues subsequent to root canal therapy as orthograde retreatment has proven to be a highly predictable procedure with a nominal iatrogenic incidence (7). Dissassembly of the prosthetic component using crown removers [WAMkey, Edge Dental, Inc., Traverse City, MI], post removal systems [Ruddle Post Removal System, Sybron Endo, Orange CA] and ultrasonics [Spartan Ultrasonics/Tips, Obtura Spartan, Fenton MO] has become mainstream. In the case shown, the silver cones and lentulo spiral segment were removed using an instrument removal system [iRS™, Dentsply/Tulsa Dental, Tulsa OK] and an array of ultrasonic tips, the canals then shaped, debrided, disinfected and sealed with warm vertical condensation of gutta-percha and sealer (b,c).

The surgical re-entry procedure was necessitated by the appearance of a parulis (d). A full thickness muco-periosteal flap was raised, conventional surgical management performed, the apices resected and retroprepared and Super EBA™ cement [H. J. Bosworth, Skokie IL] retroseals placed (8,9). The healing evidenced in the final image of the sequence occurred within twelve months time (e,f).

Case IV: Figs 6, 7
Coronal Leakage

The patient presented with a recrudescent apical periodontitis resulting from leakage beneath a PFM crown on tooth #4.6. Removal of the crown and underlying core revealed extensive caries of the coronal substructure. The caries was incrementally removed to sound tooth structure (verified with a caries detection solution), the gutta-percha removed from the root canal space and the predictability of a replacement restoration determined. Exploration of the isthmus connection between the MB and ML canal orifices revealed a mid-root canal (10-12), an increasingly common occurrence

with the advent of enhanced magnification and illumination. The root canal system was reshaped, debrided, disinfected and sealed with warm vertical obturation of gutta-percha and sealer and coronally sealed with a core material. The healing demonstrated after a seven year period is all the more remarkable as the PFM restoration subsequently placed was deficient along the distal margin of the tooth preparation.

The quality of the coronal seal has been shown to be of significance relative to periradicular status of root filled teeth in several studies (13,14).To reduce leakage, a variety of alternative methods have been suggested; alternating heat-carriers and compaction (Schilder technique) has been shown to enhance the quality of the coronal seal (15) and the placement of restorative materials over the pulp chamber floor (16,17). The variability in the results of studies used to determine the optimal technique has been attributed to the different techniques and materials used for bacterial and radioisotope penetration over different periods of time (18-20).

Figure 8 demonstrates one of the recommended techniques for coronal sealing. A dentin adhesive layer is placed, air thinned and cured over the etched chamber floor and a layer of Permaflo Purple (Ultradent Products, South Jordan UT), a flowable composite, (used to identify proximity to the floor should re-entry be required), placed to a depth of 2 mm and cured. Varying shades of composite are placed to mask the coloured composite, carved, polished and sealed to complete the endodontic monobloc.

Case V: Figs 9. 10, 11
Surgical Repair

The patient was referred for treatment of a parulis in the unattached gingiva distal proximal to tooth #2.2. Radiographic examination revealed an incomplete root canal procedure and an internal resorptive defect exiting mid-root along the distal proximal aspect of the root. An orthograde treatment approach was initiated to determine whether the portion of the canal space apical to the defect was negotiable. It was not technically possible to gain a purchase in the apical segment of the canal space; as such, the treatable section was sealed conventionally with warm vertical condensation of gutta-percha and sealer. After discussion with the patient, it was decided to surgically repair

the resorptive defect and assess options for debridement of the residual component of the root canal space.

An attached gingival flap was designed and retracted exposing an osseous crypt area which was then debrided of granulation tissue and swabbed with a ferric subsulfate agent (Monsel's Solution, Delasco, Council Bluffs IA) to control hemorrhagic weepage. An elliptoid defect in the root structure was evidenced and probing of the superior aspect demonstrated it was possible to access the untreated portion of the root canal space. The residual portion of the canal space was instrumented, irrigated with saline, dried and obturated in a conventional manner. The resorptive defect was sealed with MTA (ProRoot® MTA Mineral Trioxide Aggregate – tooth coloured formula). The flap was coapted, sutured to place and the patient appointed for followup care. Six months postop, the radiographic and clinical evaluation shows normal gingival architecture and regeneration of the osseous tissues in the surgical site.

Case VI: Fig 12
Intra-Coronal Repair

The patient presented with intermittent pain in the mandibular right quadrant and a diagnosis of chronic apical periodontitis was made for tooth #4.7. During access preparation for the root canal therapy, the clinician was unable to identify the portals of entrance of the mesial root and the patient was referred for completion of treatment. A new diagnostic film was taken prior to removal of the temporary restoration which revealed a dramatic alteration in the coronal tooth structure inconsistent with the location of the spatial orientation of the pulp chamber. Removal of the temporary filling demonstrated iatrogenic extra-furcal communication of the buccal and lingual aspects of the inner anatomy during the previous access. The damage was repaired using MTA and the root canal filling microstructurally replicated with thermosoftened gutta percha and resin sealer (EndoREZ™, Ultradent Products, South Jordan UT) allow for the MTA to set for 48 hours.

The misadventure occurred for a number of reasons; the patient's limited access, the clinician chose not to use caries detection agents which can be invaluable in determining location of calcified orifices in the midst of the chroma topography of the pulpal floor (Fig

8a), the need to appreciate that straight line access/glide path is predicated upon orienting the Class I inlay access preparation along an axial orientation that extends to the cusp tip overlying the canal to be identified and the need to pre-calibrate the burs used to do the access by marking the depth of the pulp chamber from a pretreatment bite wing radiograph.

Case VII: Fig 13
Intra-Radicular Repair

A 36 year old female patient presented with pain to percussion on tooth #3.5 and pus draining through the sulcus, mesial to the tooth #3.7. The history provided indicated that #3.6 had been determined to be unrestorable and was removed. It was apparent that the root of #3.5 had inadvertently been nicked during the removal of #3.6. The root canal space of #3.5 was debrided using rotary NiTi instrumentation and disinfected with NaOCl 5.25 % and EDTA. Liquid CHX 2 % was placed intracanal and activated passively with an ultrasonic tip for one minute. The canal was dried and filled with calcium hydroxide for one week.

At the second appointment, the calcium hydroxide was removed, and MTA was packed into the apical third against the granulation tissue of the iatrogenic defect using an operating microscope to visualize the damaged area. A moistened cotton pellet was placed intracanal and the access cavity sealed. At the third appointment, the canal sealed with warm vertical condensation of gutta-percha and sealer. Nineteen months after the initial treatment, the tooth remains symptom free with 3 mm circumferential probe depths evident.

Biomimetics has heralded hope for many with radically debilitated dentitions; however, it is an adjunct to treatment, not a replacement for prevention and treatment of disease of the natural dentition. If the same standard of care and disciplinary integration were taken at the onset of the disease as is mandated by the manifestation of the disease, the need for replacement might well have been rendered mute. A preponderance of the evidence suggests that if successful treatment outcomes are measured as retention of a functional unit, the perception of the superiority of the biomimetic modality to the biologic modality is negated. What remains is the need to establish a more stringent pursuit of staged comprehensive care as the true standard of clinical excellence.

The authors are members of the cybercommunity ROOTS (www.rxroots.com) and presenters and/or coordinators of the annual ROOTS SUMMIT (www.amerootssummitv.com). ROOTS is a online educational forum whose goal is to enhance the provision of endodontic education globally and improve the quality and standard of comprehensive care available to all.

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