Treatment of compromised teeth: The usual suspects

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Introduction

The unceasing innovations and iterations in dental technologies and materials has taken the sophistication of treatment modalities to an historic level. However, when we are focused on the newness, the thrill of the outcome, we fail to pay attention to the purpose of the activity. Case in point; dental implants were initially considered the gold standard for compromised tooth replacement despite reports that endodontic therapies ensured functionality over time to be in the range of 91 percent to 97 percent.[1] The newness became tarnished by reports that peri-implantitis and peri-mucositis showed a mean weighted prevalence rate of 43 percent across Europe and 22 percent across South and North America.[2] A myriad of factors influences the initiation and progression of the disease, unfortunately, the treatment of peri-implant diseases is at best favorable in the short term with a high rate of persistent inflammation and recurrence.[3] A study by Guarnieri et al[4] showed that in chronic periodontal patients, active periodontal therapy followed by long-term regular periodontal maintenance was successful in keeping the majority of periodontally compromised teeth. In the same patients, a higher tendency for implant loss than tooth loss was found. This series of case reports will provide decision guide categories for best practices which facilitate retention of compromised teeth using endodontic therapies.

Case Report One – Cone Beam Computed Tomography (CBCT) in endodontics

Perhaps the most important advantage of CBCT in endodontics is that it demonstrates anatomic features in 3D that intraoral, panoramic, and cephalometric images cannot. In addition, because reconstruction of CBCT data is performed natively using a personal computer, data can be reoriented in their true spatial relationships.[5]

In October of 2015, a 55-year-old male patient, previously seen for treatment in the office, self-referred for a second opinion regarding the recommended removal of a suspected fractured tooth in the maxillary right quadrant. He reported that a soft swelling had become apparent over the past week. Clinical examination noted fluctuant swelling between teeth #s 1.5 and 1.4, and a 12mm probe defect was detected along the mesial-buccal line angle of tooth #1.5.

The patient provided a periapical radiograph showing a mesial-proximal peri-

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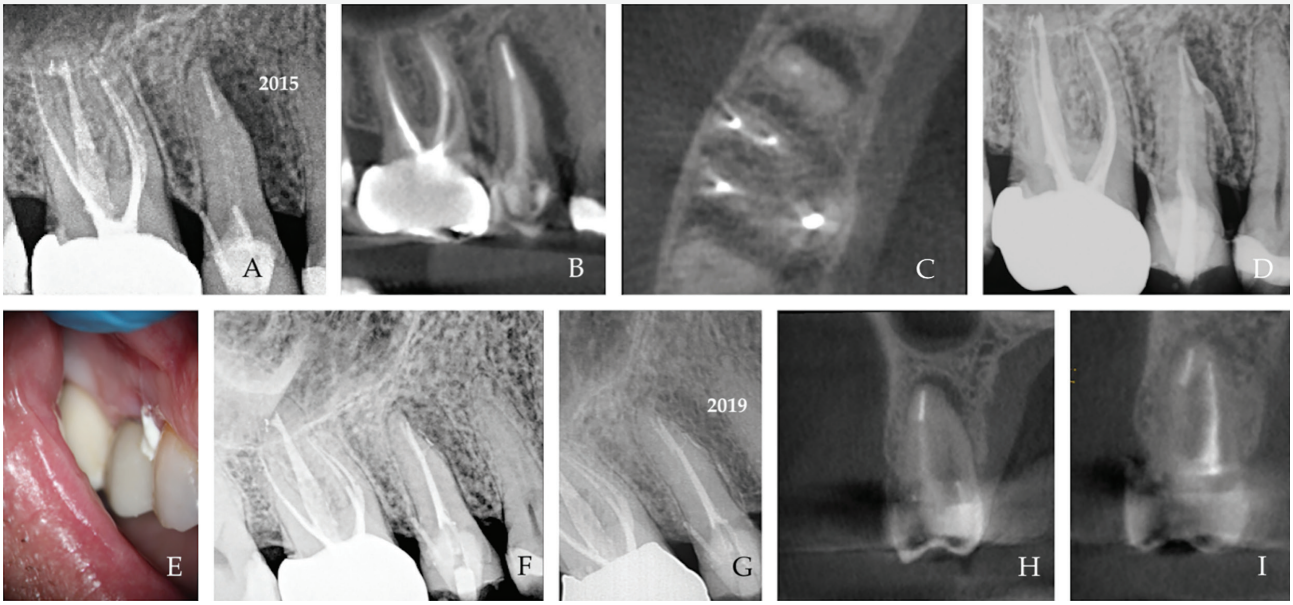


Figure1a. An area of peri-radicular rarefaction is evident along the mesial proximal aspect of tooth #1.5. Previous root canal therapy, a pin-retained post and core supporting a zirconia crown are noted. Fig 1b. The sagittal slice of the CBCT volume shows the lateral lesion extending to the alveolar crest. Fig 1c. The axial slice of the CBCT volume shows the extent of the rarefaction adjacent to the mesial aspect of the root and the presence of an untreated palatal canal. Fig 1d. Selective treatment of the palatal canal was performed. Calcium hydroxide was inserted in the canal space. Fig 1e. The extrusion of the interim Ca(OH)2 medicament through the sulcular area of tooth #1.5 is evident. Fig 1f. A lateral branch of the root canal space containing the obturating medium is shown exiting into the interface of the middle and apical third of the root. Fig 1g. A periapical radiograph taken four years after treatment shows osseous regeneration and the reformation of the periodontal ligament. Fig Ih. The coronal slice of the CBCT volume shows the pre-operative PRRL. Fig 1i. The coronal slice of the CBCT volume taken four years after treatment shows the resolution of the PRRL

radicular radiolucency [PRRL] associated with tooth #1.5. (Fig. 1a) The sagittal slice of the CBCT volume [Carestream CS 9000, Carestream Dental, GA] shows the extent of the lesion. (Fig. 1b) The previous root canal therapy had detected and treated the buccal canal only. The axial slice shows an untreated palatal canal. (Fig. 1d) A fiber post placed in the buccal canal was used to retain the core. The patient was advised of the misdirected anchoring pin extending into the periodontal ligament [PDL]. With the patient's consent, it was decided to selectively treat the palatal canal.

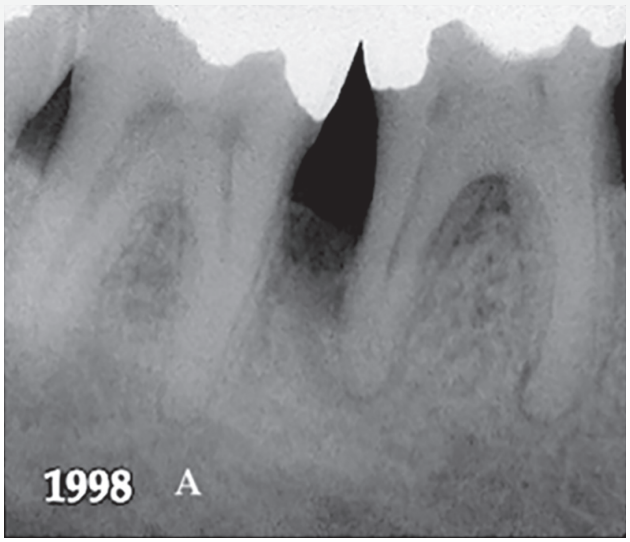
After an interim six-week period of calcium hydroxide therapy [Ca(OH)2, UltraCal™ XS, UPI, S. Jordan UT] (Figs. 1d, 1e),[6] the root canal space was obturated using a warm vertical condensation technique.[7] The obturation media was expressed into a lateral branching portal of exit. (Fig. 1f) A four-year follow-up shows resolution of the lateral lesion. (Figs. 1g, 1h, i) The initial presumption of a fractured root was proven false suggesting that illusory conditions based on insufficient data acquisition are unreliable. The use of CBCT is an imperative in endodontic procedures of any kind provided ALORA principles are followed.

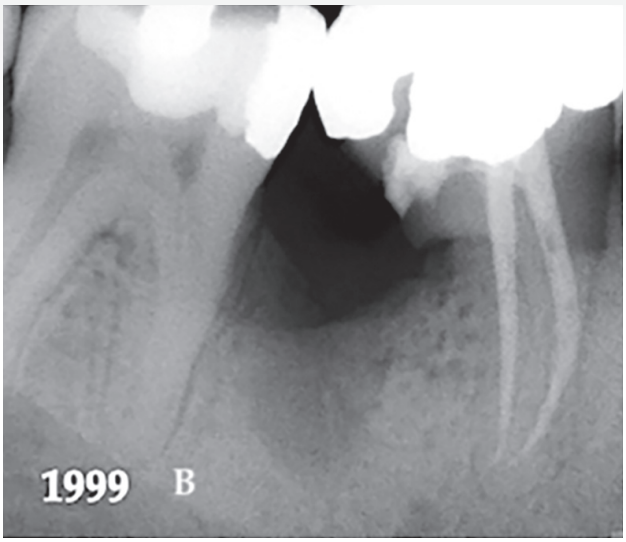
Case Report Two – Root amputation (Perio-Endo Lesion)

Root resective therapy is a treatment option for molars with advanced furcation involvement. In a study by Derks et al, mandibular molars after root resection showed a survival probability of almost 80% even 20 years after root resection.[8]

In October of 1998, a 39-year-old-male patient presented to the office complaining of "gum tenderness" in the mandibular right quadrant. Extensive bone loss was noted inter-proximally between teeth #'s 4.7 and 4.6, however, the periodontal status of the dentition in general was within normal limits. Pulp sensibility testing of the teeth in the mandibular right quadrant identified the pulp of tooth #4.6 to be necrotic. (Fig. 2a) It was explained to the patient that successful treatment of perio-endo lesions was in general questionable/unfavourable, dependent on the severity of bone loss, root trunk length, degree of root separation, the curvature of the root to be resected, the ability to eradicate the osseous defect, pulpal status, and the restorative and oral hygiene procedures required.

With the patient's consent, the distal root of tooth #4.6 was





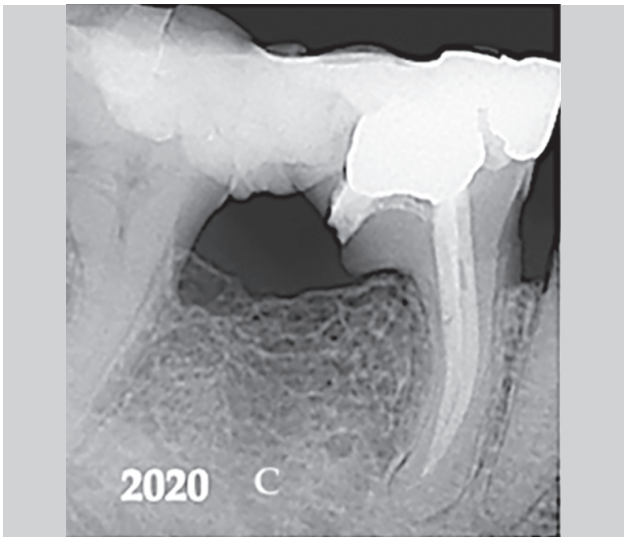


Fig 2a: Loss of bone between teeth #'s 4.7 and 4.6 and the loss of the PDL around the apical region of the mesial and distal root are evident. Fig 2b: The distal root has been resected; the degree of bone loss appears to have increased. Fig 2c: A 22-year follow-up shows regeneration of the lost interproximal bone and cortication of the alveolar crest.

resected and the overlying crown portion retained. (Fig. 2b) At some point after the amputation procedure, the referring dentist [RD] splinted teeth #'s 4.7 and 4.6 with a composite/Ribbond bridge. Twenty-two years after the initial procedure, osseous regeneration and cortication in the furcal region are evident between teeth #'s 4.7 and 4.6. (Fig. 2c)

Advancements in strategies to maintain compromised teeth in concert with a greater understanding of risk factors associated with dental implants invite a reassessment of the benefits of strategic extraction of a tooth with a questionable prognosis or of limited strategic value.[9] With the use of hard and soft tissue augmentation procedures, PRF (plasma rich fibrin), minimally invasive flap design and suturing techniques in conjunction with surgical operating microscopes, it is unreasonable to sacrifice a tooth for an implant when this venerable treatment option shows favorable prognosis and success rates.[10]

Case Report Three – Resorptive Defect

Progressive internal resorption or those instances with perforations of the root can be distinguished from external resorption by varied radiographic techniques. In teeth with internal resorption, the radiolucent lesion "moves" with the canal when the radiographs are taken at different angles, while in external resorption the radiolucent lesion "moves" outside of the canal.[11,12]

In March of 1999, a 47-year-old female patient presented to the office with facial swelling; tooth #1.1 was tender to percussion. A periapical radiograph (Fig. 3a) of the maxillary anterior sextent showed large Class III and IV restorations. Tooth #1.1 exhibited peri-apical rarefaction. Tooth #2.1 showed internal resorption at the mid-root level. The patient reported that tooth #2.1 had been traumatized some 35 years prior. In the absence of CBCT imaging, it was assumed that the resorption perforated the facial aspect of the root and disrupted the overlying cortical bone.

Pulpal sensibility testing of the teeth in the anterior determined that tooth #1.1 was pulpless. The tooth was

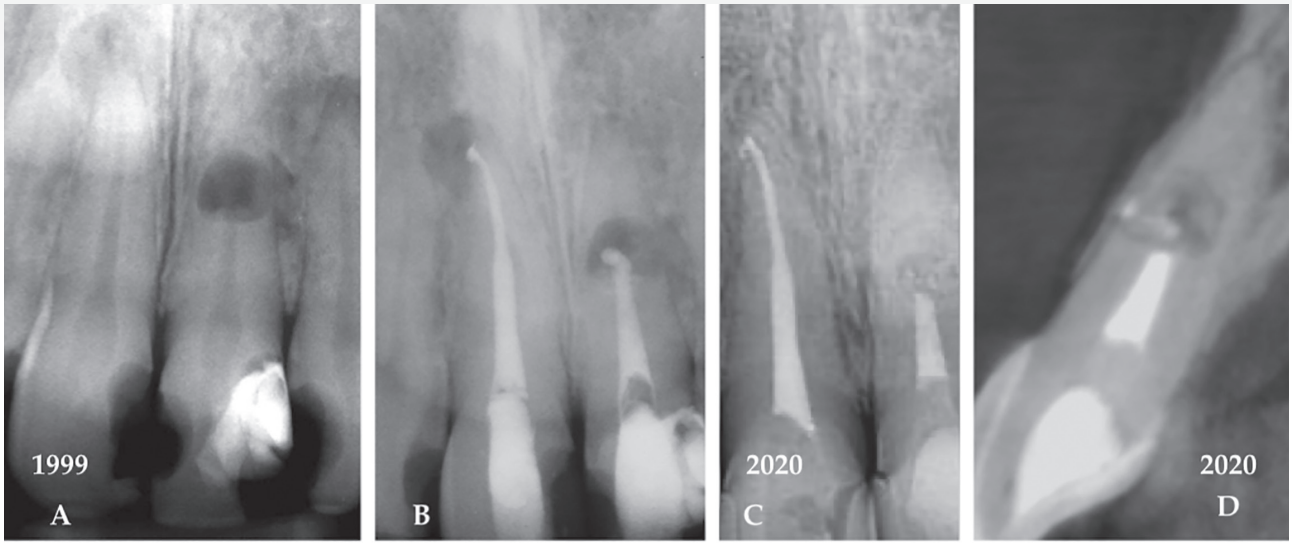


Figure 3a. The intraoral periapical radiograph reveals a PRRL at the root terminus of tooth #1.1. A large area of internal resorption is evident mid-root of tooth #2.1. The resorption has perforated the lateral aspect of the root causing disruption of the interproximal bone. Fig. 3b. A post-operative radiograph shows the endodontic treatment of #1.1. Tooth #2.1 has been sealed with white MTA to the incisal level of the resorptive defect as it demonstrates minimal root discolouration. Were the tooth be treated today, the choice of obturation material would be Endosequence BC putty [Brassler USA, Savannah, GA]. Fig. 3c. The PRRL associated with tooth #1.1 has resolved. The resorptive defect has been reduced in size, radiolucent deposits are evident within the resorptive crypt. Fig. 3d. The sagittal slice of the CBCT volume shows an intact cortical plate. The presence of calcified deposits is evident in the residual resorptive defect which has been significantly reduced.

endodontically treated and obturated using a warm vertical condensation technique. Tooth #2.1 was instrumented to the incisal level of the resorptive defect, and the canal sealed with white MTA.[13] Figs 3a & 3b show the pre-operative and post-operative radiographs taken in 1999. (Figs. 3c & 3d) show the healing after 21 years. Currently, there is a trend towards the use of an injectable platelet-rich fibrin (i-PRF) regenerative approach to resolve internal resorptive defects that shows great potential for long-term healing.[14]

Case Report Four – Cracked Tooth

In a study of 2086 cracked teeth by Krell and Caplan,[15] the most common teeth demonstrating fracture were mandibular second molars (36%) followed by mandibular first molars (27%) and maxillary first molars (18%). There were no statistically significant differences in success based on pulpal diagnosis (irreversible pulpitis, 85%; necrosis, 80%; previously treated, 74%), patients' age, sex, year of treatment, tooth type, restorative material, or number of restored surfaces at the time of examination.

In July of 2014, a 45-year-old female patient presented to the office with a chief complaint of swelling in the distal papilla of tooth #1.4 for a period of 10 days. Clinical examination revealed an occlusal amalgam restoration with a probeable seam in the distal marginal ridge [DMR]. The probe depths along the distal-buccal and lingual line angles of the tooth demonstrated an infrabony pocket of 8mm. The peri-apical radiograph taken showed a small amalgam restoration with a vertically angulated radiolucency interproximally between teeth #'s 1.4 and 1.5. (Figs. 4a & 4b) shows a fracture line extending into the mesial marginal ridge. The tooth was assessed for vitality with thermal and EPT tests which elicited no response.

The treatment options were explained to the patient; 1) removal, 3-unit fixed bridge, 2) removal, soft and hard tissue augmentation, and implant retained restoration or 3) root canal therapy and restoration with cuspal protection. The patient was advised that option 3 had a questionable prognosis; however, for financial reasons, she chose to proceed with that option.

It should be noted that management of cracked tooth syndrome varies based on the severity of the symptoms and depth of tooth structure involved. Endodontic therapy was performed using a warm vertical condensation technique. (Fig. 4c) The access preparation was sealed with a flowable and hybrid composite restoration. The radiograph taken at

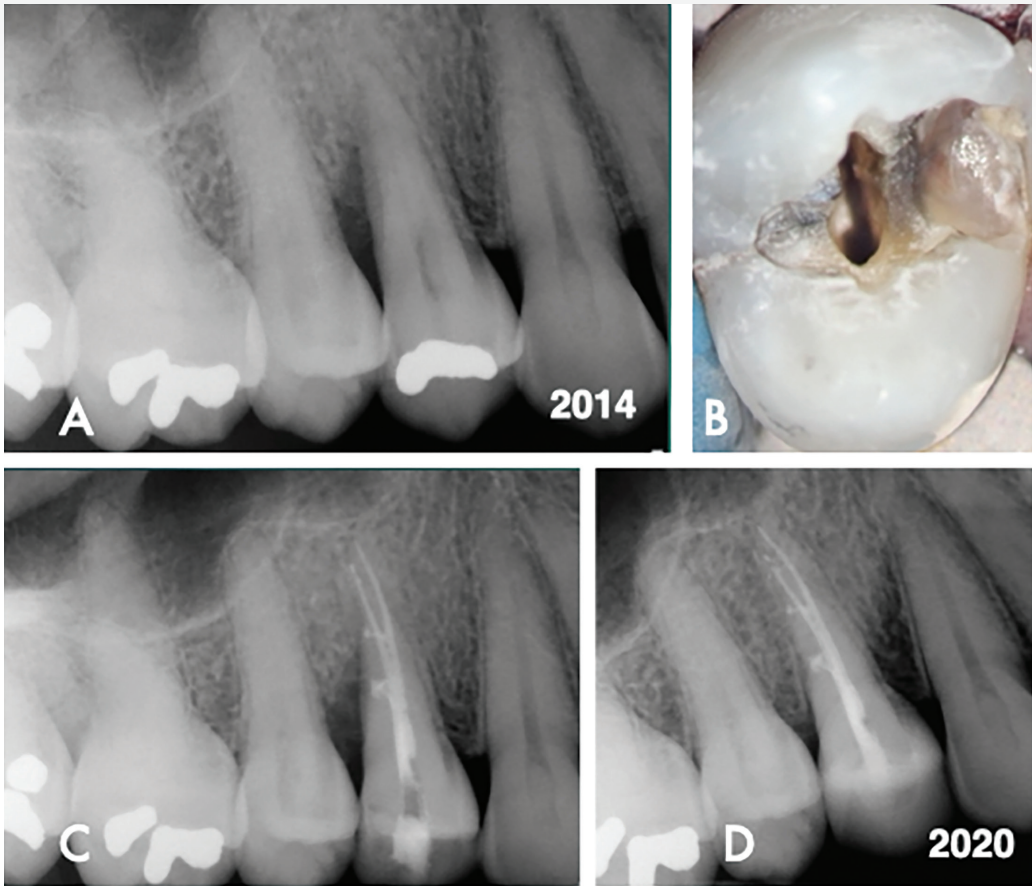


Figure 4a. An 8mm infrabony defect is evident along the distal proximal aspect of the root of tooth #1.5. Fig. 4b. Debris present in the [DMR] of the tooth #1.4 demonstrates a fracture line, however, there is no indication of cuspal separation. Removal of the amalgam revealed extension of the fracture into the cuspal stress plane of the buccal and axial line angle. Fig. 4c. The root canal space was obturated using a warm vertical condensation technique. Lateral branches of the root canal system are noted. The tooth was restored with a bonded composite restoration using the Bioclear Matrix System developed by Dr. David Clark, DDS [Tacoma, WA]. Fig. 4d. A post-operative peri-apical radiograph taken in 2020 shows osseous regeneration and reformation of the PDL in the infra-bony defect along the distal aspect of the root.

a six-year follow-up [2020] showed osseous regeneration in the interproximal area eliminating the periodontal defect.

The treatment planning process demands the inclusion of a myriad of data pertaining to the status of the tooth and root structure. The Decision Guide of the American Association of Endodontics encourages the clinician to consider local and systemic case-specific issues, economics, the patient's desires and needs, esthetics, potential adverse outcomes, and ethical factors. The treatment performed must reflect best practices for the patient's needs [www.aae.org/treatment options.

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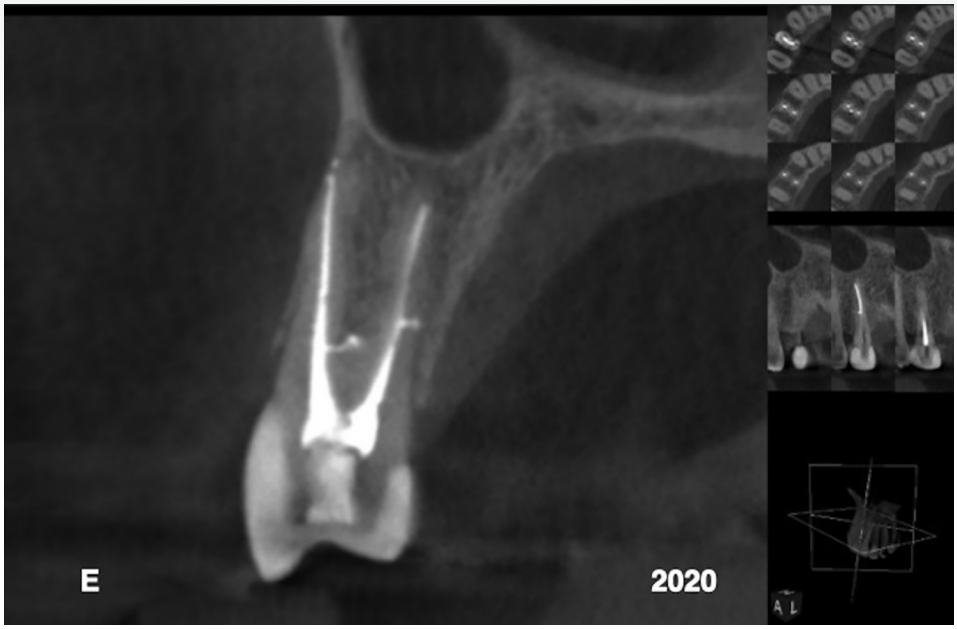

Figure 4e

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