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CBCTs, Endo, and the General Practitioner: Maxillary Molars

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Abstract

Positive treatment outcomes with the usage of CBCT were bolstered with certain treatment challenges faced by the general practitioner when faced specifically with RCT of maxillary molar teeth, such as calcified canals, difficulty detecting and/or navigating the second mesiobuccal canal (MB2), detection of vertical fractures, determination of root morphology, assessment of fill density, presence of internal or external root resorption, and presence of any pathology. Conversely, there were also contradictions present with a subset of studies, which showed flaws in the use of CBCTs as a diagnostic tool. Case studies will be presented which highlight the use of CBCT as an adjunct when traditional therapy with use of PAs has failed. Maxillary molars present unique challenges for the general practitioner, and these cases demonstrate the positive impact of selective CBCT when sub-standard results are achieved during or after initial RCT for the benefit of the patient.

Keywords: ***Community dentistry, CBCT, Maxillary molar endodontics, Endodontics, Radiography.***

1. Introduction

3 D technological advances in digital diagnostics for Endodontics in dentistry, such as use of focal cone beam computed tomography (CBCT), can be a useful tool to identify anatomical root anatomy prior to initiating root canal therapy (RCT) or post-RCT when failure of treatment is noted. The use of periapical radiographs (PAs), whether with film or digitally actualized, has long been considered as the gold standard in the diagnosis, treatment, and post-operative management of endodontic cases. In 1971, computerized tomography (CT) was created by Godfrey N. Hounsfield, heralding what

many consider as one of the most significant medical advancements of imaging in the last 60 years; the creation of a digital 3 D image of internal structures of the body [1]. This in turn led to the development of CBCT scans which are commonly used today in endodontic practices to provide 3 D radiographic data of the surgical site to aid in the diagnosis, treatment, and management of endodontic cases.

Positive treatment outcomes with the usage of CBCT were bolstered with certain treatment challenges faced by the general practitioner when faced specifically with RCT of maxillary molar teeth, such as calcified canals, difficulty detecting and/or navigating the second mesiobuccal canal (MB2), detection of vertical fractures, determination of root morphology, assessment of fill density, presence of internal or external root resorption, and presence of any pathology [2], [3]. Conversely, there were also contradictions present with a subset of studies, which showed flaws in the use of CBCTs as a diagnostic tool. The presence of artifacts, the difficulty in visualizing fracture lines in teeth previous treated with restorative materials, the possibility of overdiagnosis of periapical pathology when none is present (especially in early stages of disease progression), as well as the overall risk vs. benefit of higher radiation exposure and the higher cost that comes with CBCT scans all may work against general practitioners in their pursuit of quality dental care for their patients [3], [4].

When determining hallmarks of endo failure, one can use Strindberg's criteria which includes [7]:

- The presence of clinical signs and symptoms such as pain or swelling.
- Presence or development of draining sinus tract.
- Increase in size, unchanged, or an appearance of a novel peri-radicular lesion.

One should also consider the quality of the obturation or filling as well [8]. There are treatment failures of RCTs that can be attributed to a lack of diagnostic information, such as curved root morphology, undetected canals, voids, or vertical root fracture when limited to a two-dimensional image that PAs provide [5], [6]. More studies need to be done to understand the efficacy of CBCTs as a primary radiographic tool in endodontic therapies. However, the selective usage of 3D technology, in addition to PAs, may lead to improved quality, efficiency, better acceptance of treatment and prognoses for patients.

Case studies will be presented which highlight the use of CBCT as an adjunct when traditional therapy with use of PAs has failed. Maxillary molars present unique challenges for the general practitioner, and these cases demonstrate the positive impact of selective CBCT when sub-standard results are achieved during or after initial RCT for the benefit of the patient.

2. Case #1

2.1 (Case #38)

59 years old female presented with failing bridge spanning from #11-14 (Fig. 1). The medical history was significant for melanoma of the toe, which was diagnosed and treated in 2017, but at the time of dental treatment (2021) patient

was in remission. Since no other conditions were noted, patient was considered ASA I. Upon removal of failing bridge and pre-existing build-up, it was noted that pupal necrosis had occurred on the molar abutment (#14) and RCT therapy was indicated. Pulpal testing was negative for percussion, palpation, and cold testing. Despite the presence of the dilacerated mesiobuccal (MB) root and the possible presence of some calcification of the pulp along the MB root, the root canal was attempted without the aid of a CBCT. During the process of locating, cleaning, and shaping the canal for obturation, only the palatal (P) and distobuccal (DB) were successfully located, cleaned and prepared for obturation (Fig. 2).

The practitioner was not able to navigate instrumentation of the MB canal instrumented to the apex, so a CBCT was ordered to determine the location of the canal. Upon interpretation of the CBCT, there was (Fig. 3):

- No canal noted apical to the preparation in MB canal and complete calcification of the pulpal canal was confirmed.
- There was also an area of low density noted on the distal end of the MB root.
- All other canals and structure of the tooth were reported to be within normal limits.

Subsequently, the P and DB canals were obturated without complication. The patient was informed of the condition of the MB root, and the presence of a lesion present on the distal aspect of the MB root which will require apical surgery to remove. Patient understood and agreed to additional treatment. In the apical surgery about 2 mm of the apex of the MB root was removed and a retro fill restoration was placed. The tooth was then successfully restored as an abutment for a new bridge spanning from #11-14 (Figs. 4 and 5).

3. Discussion

In this case there was no failing RCT to be retreated, however it became clear during the course of initial therapy when navigating all canals to an acceptable working length that a periapical view did not show enough morphological information to identify potential pitfalls. The periapical view did not clearly demonstrate any significant loss of bone density. It was the CBCT that clearly showed the obliterated canal space of the MB root and verified the degree of periapical bone destruction, which indicated a need for additional treatment in the form of an apicoectomy. The patient was counselled before treatment was initiated that a CBCT may be needed at an additional cost if there was any issue to arise during the course of treatment, to which the patient agreed.

With the aid of the CBCT views the dental practitioner was able to confirm that instrumentation the full length of the MB was not possible, and was able to quickly identify the need to treat the periapical lesion via an apicoectomy with retro fill restoration placed on the MB root. It is important to note that periapical cysts, even if asymptomatic, can perpetuate apical periodontitis after root canal therapy. For patients who want to improve prognosis and maximize retention of their natural dentition, apicoectomies provide a viable option versus extraction and replacement [9], [10]. Once the need for this surgery was identified, it further confirmed that the CBCT was a needed expense, giving the

practitioner additional anatomical reference to successfully diagnose and provide anatomical data to support the indicated surgical procedure.

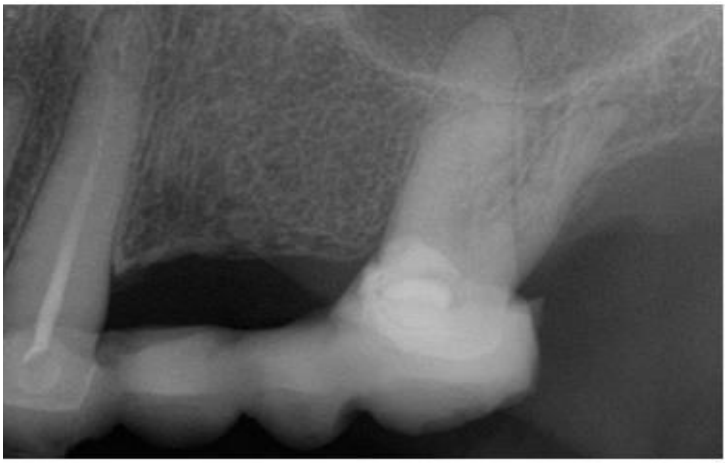

Fig. 1. Pre-op with temporary bridge placed after initial excavation.

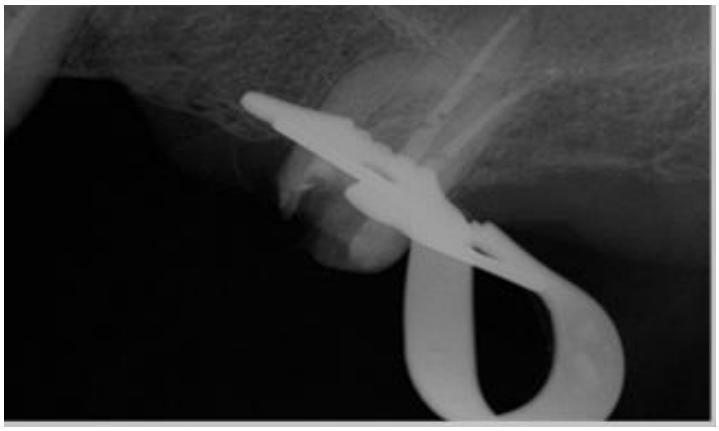

Fig. 2. Incomplete navigation of MB root, leading to use of CBCT.

Fig. 3. Confirmation of obliterated canal via CBCT and subsequent MB obturation that does not reach the middle third of MB root.

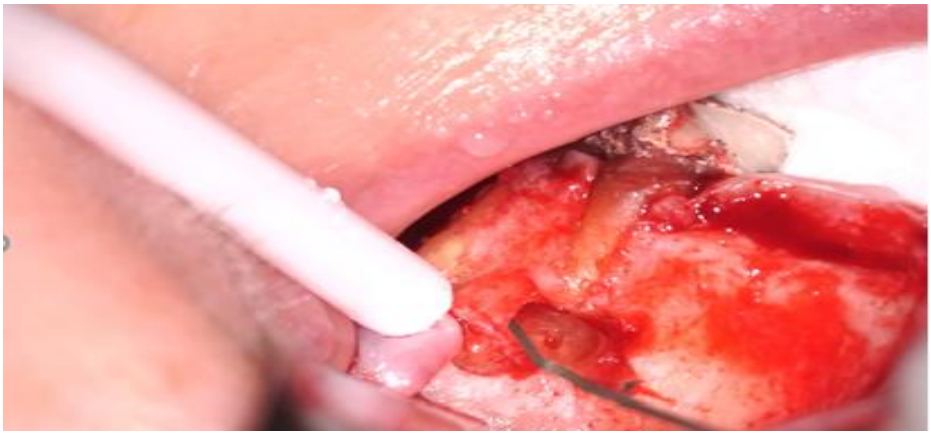

Fig. 4. Apical surgery with removal of about 3 mm of MB root apex and lesion.

Fig. 5. Apical surgery and RCT completed, with bitewing of final restoration.

4. Case #2

4.1 (Case #25)

52 years-old female presents with a previously endodontically treated #3 with amalgam (overhang) restoration in place (Figs. 6-8). Patient reports having the root canal completed in Cuba about 30 years ago by a general practitioner. Patient does not report having any history of pain or sensitivity from the tooth at the time of the appointment. Radiographic evaluation inadequate fill and widened PDL space on MB root. After pulpal testing, patient demonstrated an exaggerated response to percussion and palpation, with no response to cold stimulus. The periapical diagnosis was determined to be symptomatic apical periodontitis (SAP). The recommended treatment was to retreat the root canals of tooth #3.

A discussion with the patient was conducted to recommend that a cone beam CT would be necessary to further evaluate the tooth, and that additional treatment may need to be completed if symptoms do not resolve or return after a period

of time. The patient was allowed to ask questions at this time and expressed understanding, and also agreed to the retreatment of #3 and the CBCT.

Interpretation of the CBCT revealed:

- An existing MOB restoration present
- Radio opaque material in MB, D, and Palatal root canal consistent with a previous RCT completed
- The obturation material in question seems to no respect canal anatomy, as the images shows two canals present in the MB root, but only one was filled, and it ends several millimetres short of the apex.
- Osseous changes include a periapical area of decreased density on the palatal root of #3 consistent with apical periodontitis (Fig. 9).

Subsequent to these findings, the root canal on #3 was initiated. With rubber dam placed, an access was created, the obturation material in question was found to be gutta percha, which was removed with the aid of a heated plugger and rotary files. All canals were located and working length determined, except for MB2. It was subsequently found on the second appointment, instrumented and obturated with the other canals (Fig. 10).

An endodontic recall was completed 7 months after completion of the retreatment of #3, which revealed (Fig. 11):

- Patient had no sensitivity to percussion or palpation, with no mobility or discomfort when biting.
- No visible intraoral or mucogingival swelling.
- Patient was afebrile, with no extraoral findings or sign of lymphadenopathy.
- Full coverage restoration was present, and in good condition.
- Periapical radiographs showed signs of periapical osseous healing in #3 in the form of a decrease in radiolucency.

5. Discussion

This case, previously treated by a non-specialist overseas, and was reported as asymptomatic by the patient for about 30 years. Radiographic evaluation using periapical x-rays depicted inadequate obturation of tooth #3 with 3 canals. It was evident that a retreatment was needed due to the presence of positive responses when percussion and palpation stimuli were applied to the tooth. In this case, without the CBCT, location of the MB2 canal would have likely gone undiscovered again in the second attempt to treat this tooth. It is also a probability that the widened PDF present on the MB root could simply have been attributed to the short and inadequate obturation that was already in place. A CBCT in this case became a crucial adjunctive tool to verify if there was any morphological cause of failure of the previous RCT, such as a missed canal. Post-surgery periapical views were utilized to evaluate periapical osseous healing, which tracked positive at 7 months after the RCT was completed with patient no longer feeling discomfort with palpation and percussion.

Fig. 6. Pre-op occlusal view of tooth #3, note the large MOB amalgam.

Fig. 7. Pre-op PA with inadequate obturation and widened PDL.

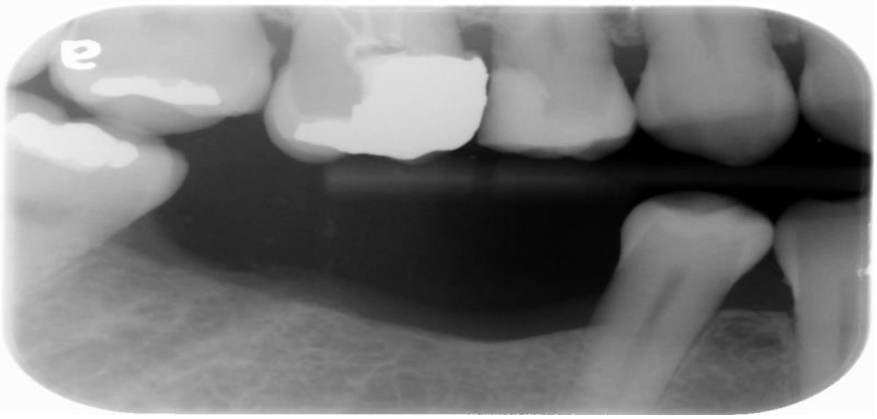

Fig. 8. Bitewing view highlights overhang.

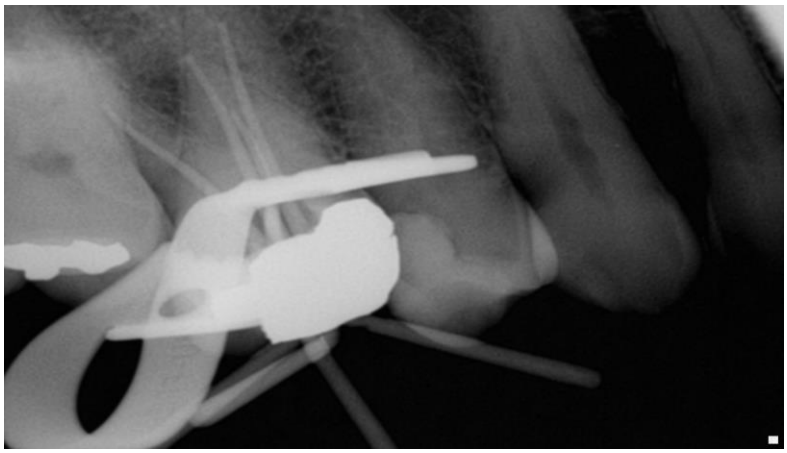

Fig. 9. Obturation process with 4 master cones in place.

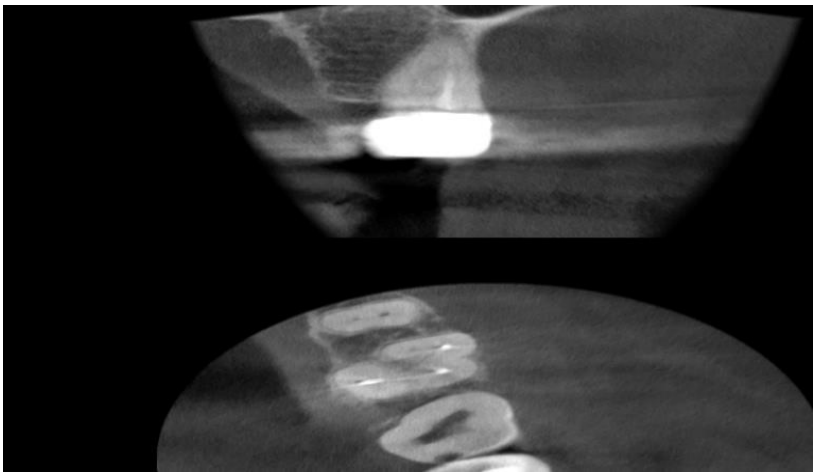

Fig. 10. CBCT image highlighting the 4th canal (missed) located in the MB root.

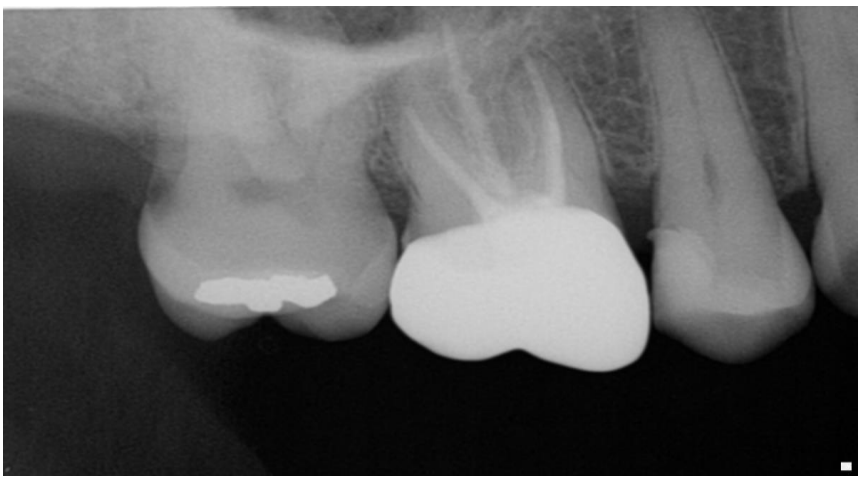

Fig. 11. Endo recall appointment PA with final restoration placed

6. Conclusion

Dental healthcare professionals are and should be dedicated to delivering high quality care for the communities that they serve. Even though one of the case studies highlight initial RCT failure, it did preserve the tooth for many years asymptomatically. It is critical to promote access to viable options that are accessible to patients. The cost of a CBCT in the US varies on average between $150 -700 dollars; financial barriers to treatment options in dental care are pervasive and can be difficult, or even impossible, for patients to navigate and overcome [11], [14]. A recent meta-analyses review of the link between edentulism and fatal cardiovascular disease showed that having less than 10 teeth substantially associated with CVD mortality. This highlights the need to preserve the dentition in order to maintain good oral and systemic health whenever possible [12]. While not infallible, the PA view is a cost efficient first-line diagnostic tool that, when well angulated (and possibly multiple PAs from different angles as well), can provide significant information about a tooth's morphology and possible anatomical features that may prove difficult to navigate. Other properties such as the clarity, magnification, and contrast can also be altered to provide greater insight into tooth morphology [13]. Another recent large scale study suggests that a discerning approach to the application of CBCT imaging is a highly effective when making treatment decisions and providing more detailed diagnostic information. Just over half of the teeth imaged in the study were molars, where it was postulated that the superimposition of other anatomical features (i.e. zygomaticomaxillary anatomy) may limit proper evaluation of these areas, leading to an increased need for the CBCT. It also suggests that more studies on cost impact should be explored, especially since that can prevent a patient from pursuing treatment options that require a CBCT [15].

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