CBCT aided detection of 7 root canals in a first maxillary molar

By Dr Antonis Chaniotis, Greece

Introduction

The root canal system of the human teeth consists of a complex anatomic and highly variant network of pulp spaces as seen in micro-CT studies of root canal anatomy (http://rootcanalanatomy.blogspot.com/) (Fig. 1). The thorough cleaning and shaping of this complicated system is considered mandatory for the successful endodontic treatment. The subsequent complete obturation of the cleaned and shaped root canal system with an inert material followed by the appropriate coronal restoration are two important parameters for the longevity of the endodontically treated tooth. Failure to adequately clean, shape and fill this anatomic system to all its dimensions is a major cause of post-treatment disease.

Walton & Vertucci, introducing concepts of internal pulp anatomy, stated that lack of thorough knowledge of root canal morphology ranks second as a cause of treatment failures, only to errors in diagnosis and treatment planning. This means that having a working knowledge of the number of roots, number of canals per root and their location, longitudinal and cross-sectional shapes, most frequent curvatures and root outlines in all dimensions is essential in order to provide high standard endodontic treatment.

Historically, the evaluation and diagnosis of the anatomy of the root canal system in a clinical set up was achieved mostly with conventional intraoral periapical radiographs. Nevertheless, they weren’t completely reliable because of their inherent limitations associated with the two-dimensional imaging. Fortunately, the application of more advanced diagnostic tools such as CBCT scanning for the assessment of unusual root canal morphology has provided three-dimensional imaging, aiding the correct endodontic management of these challenging cases. The CBCT data has become a particularly useful tool in assessing the root and canal morphology of complicated cases. In the present paper, the endodontic treatment of a first maxillary molar with complicated root canal anatomy is reported. The pre-surgical use of CBCT imaging in correlating with the surgical operating microscope led to the detection and negotiation of 7 root canal systems in a single tooth. The aim of the present case report is to highlight the importance of cbct imaging in assessing the root canal morphology of complicated cases. The use of the surgical operating microscope is also discussed.

Case report

A 45-years-old Caucasian male was referred to our Endodontic Private Practice Clinic for the endodontic treatment of his right maxillary first molar. At the time of the appointment, clinical examination revealed an intracoronal swelling on his right maxillary quadrant. The patient was under amoxicillin regimen (1g every 8 hours) for a 10-day period for the treatment of a severe periodontal disease. The patient had a history of toothache and abscess formation of the involved tooth and the associating periapical lesion. CBCT imaging confirmed the presence of the periapical lesion (Fig. 2a). In the transverse axial slices, cbct scan slices revealed an intracoronal swelling of the cleaned and shaped root canal of the complicated maxillary first molar. The outline of the periapical lesion couldn’t be identified from the transverse axial slice 25. Furthermore, a second distobuccal canal was evident inside the palatal canal. The CBCT images provided valuable information for treatment planning of the involved tooth and the associating periapical lesion. At the second appointment, the patient was asymptomatic and the intracoronal swelling had resolved. The tooth was re-accessed under rubber dam isolation and inspected under the microscope (Global G6, Global Surgical Co.). The inspection under the microscope revealed a heavily restored percussion of the involved tooth and the associating periapical lesion. The preoperative periapical radiograph (Fig. 2a) revealed a large periapical lesion associated with the involved tooth. The outline of the periapical lesion couldn’t be identified from the transverse axial slice. A periapical diagnosis of acute apical abscess was made.

The patient was prepared for endodontic therapy and a rubber dam was placed. Access to the pulp cavity was performed using Endo Access and Endo Z burs (Dentsply Maillefer). Once the pulp cavity has been reached, pulpal drainage was noted. After ten minutes, the pulpal drainage turned to hemorrhagic, then to a clearer exudate and finally ceased. Initial access preparation revealed 4 orifices under microscopic visualization (Global G6, Global Surgical Co., USA). Two separate orifices were located in the mesiobuccal root, one orifice in the distobuccal root and one orifice in the palatal root. The root canal system of the maxillary molar was irrigated by using 6% NaOCl solution with surface modifiers (CanalPro Extra, Coltene/Whaledent). Initial enlargement of the root canal system of the maxillary molar was achieved by using the Hyflex Controlled memory rotary instrumentation (Coltene/ Whaledent). The MBs and DB canal were enlarged until a 40/04 Hyfl ex cm rotary file was reached to working length, while the palatal canal until an 40/04. The canals were dried and calcium hydroxide (UltraCal, Ultradent) was used as an interappointment dressing. The preparation of the root canal system for the obturation was achieved by using RM cement (Dentsply). In order to evaluate the situation a decision was made to perform a CBCT imaging of the tooth and the associating periapical lesion. The treatment of large peritracular lesions is very likely to demand a combination of conventional and surgical techniques. The CBCT three-dimensional imaging of a large peritracular lesion is mandatory for the proper pre-surgical evaluation and planning, especially when the outline of the peritracular lesion extends the limits of the peritracular radiograph. An informed consent was given and the patient was referred for a CBCT evaluation and rescheduled.

The multi slice CBCT evaluation of the maxilla (NewTom, VGI, 3D, high resolution, slices every 1mm, voxel 0.2375mm) revealed the extent of the peritracular lesion (Fig. 3a-d). Interestingly, when the involved tooth was focused and the morphology was obtained in transverse axial and sagittal sections, the scan revealed seven canals (three mesiobuccal, two palatal and two distobuccal). In the transverse axial slices, the remnants of the calcium hydroxide dressing were evident. In the axial slices 25 (Fig. 2f), the calcium hydroxide dressing was evident inside the palatal canal. All orifices identified from the periapical radiograph (Fig. 2a) were confirmed on the CBCT slices (Fig. 2d,e). The second distobuccal canal with calcium hydroxide dressing was evident (Fig. 2d,e) in the slice 25. The double palatal canal system was evident in the sagittal slices as well (Fig. 2e). The third canal in the mesiobuccal root can be seen only in merged transverse and not in the sagittal ones (Fig. 2b). CBCT images provided valuable information for the identification of the missed MBs and DBs. The MRI and CT scans were negative, suggesting a pulpal infection sensitive first maxillary molar.

http://www.endodontics.net/
Matherne et al. investigated the use consistent with the ALARA concept. A huge reduction in radiation exposure has been achieved by using CBCT scanning. This is due to the elimination of the need for a conventional imaging system (X-ray source and reciprocal detector) and the use of a single sweep of a cone-shaped beam through the patient’s head. The efficiency of CBCT imaging is higher compared to conventional radiographs. CBCT scanning is a relatively new diagnostic imaging modality that has been used in endodontics for diagnostic and presurgical assessments before endodontic treatment. The role of microscopic magnification is well documented in the endodontic literature. Buhrley et al. reported an in vivo study to determine the practitioner’s ability to locate the MB1 canal in maxillary molars using the DQM and/or dental kypus. They concluded that when the maxillary first molars were considered separately, the frequency of MB1 canal detection for the microscope, dental kypus, and magnification groups were 71.1%, 62.5%, and 77.5%, respectively. In the present case, successful negotiation of all canals was largely dependent on the use of pre-surgical CBCT imaging and microscopic magnification, which allowed for the identification of the seven distinct root canal orifices with ease. Hence, clinicians should familiarize themselves with dental microscopy and new imaging technology, such as CBCT scanning, to get additional anatomic information in endodontic practice.

Figure 2a. Pre-operative radiograph 2b. Sagittal slices revealing two canals in the mesiobuccal root. 2c. Sagittal slice revealing two palatal canals in a single root. 2d & 2e. Panoramic slices revealing the extent of the periapical lesion. 2f. Transverse axial slices revealing 7 root canal orifices (yellow arrows). Figure 3a. Clinical microscopic view of the pulp floor suggesting the existence of three roots and seven root canals, namely mesiobuccal (MB), distobuccal (DB), mesiopalatal (MP) and disto-palatal (DP). The negotiation and management of all the canals was accomplished with the indispensable aid of the dental operating microscope.

Discussion

The variability of the root canal system of maxillary molars poses a constant challenge for the dentist who wishes to provide successful endodontic treatment. Numerous factors contribute to the variation found in maxillary molar anatomy studies. Variations may result because of ethnic background, age, gender or the population studied. Baratto Filho et al. reported a maxillary first molar with three roots and seven root canals. Recently, Kottor et al. reported a CBCT guided endodontic management of a maxillary first molar with seven root canals. Moreover, in another recent case report, Kottor et al. reported the endodontic management of a first maxillary molar with eight root canals by using cone beam computed tomography scanning. CBCT scanning is a relatively new diagnostic imaging modality that has been used in endodontics for the effective evaluation of the root canal morphology. Additionally, CBCT imaging aids in the diagnosis of endodontic pathosis, assessing root and alveolar fractures, analysis of resective lesions, identification of pathosis of nonendodontic origin, and presurgical assessment before root filling and surgery. CBCT images are reconstructed using significantly lower radiation doses compared with alternative conventional computed tomography scanning. This is because with CBCT imaging, the raw data are acquired in the course of a single sweep of a cone-shaped x-ray source and reciprocal detector around the patient’s head. The efficient use of the radiation beam and the elimination of the need for a conventional image intensification system used in conventional computed tomography scanners resulted in a huge reduction in radiation exposure. The ideal use of CBCT scanning is consistent with the ALARA concept. Matherne et al. investigated the use of CBCT scanning in identifying root canal systems and compared it with images obtained by using digital radiography. They concluded that CBCT images always resulted in the identification of greater number of root canal systems than digital images. Baratto Filho et al. evaluated the internal morphology of maxillary first molars by ex vivo and clinical assessments using operating microscope and CBCT scanning. They concluded that an operating microscope and CBCT scanning were important for locating and identifying root canals, and CBCT scanning can be used as a good method for evaluation of maxillary first molar internal morphology. In the present case, CBCT scanning was used for the pre-surgical evaluation of a large periapical lesion. Thoroug evaluation of the CBCT imaging resulted in the additional detection of the complex root canal anatomy. CBCT axial images revealed the presence of three roots and seven root canals, namely mesiobuccal (MB), mesiobuccal (MB), distobuccal (DB), mesiopalatal (MP) and disto-palatal (DP). The negotiation and management of all the canals was accomplished with the indispensable aid of the dental operating microscope.

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Dr. Antonis Chaniotis DDS, MDSc is a graduate of the University of Athens Dental School, Greece (1996). In 2003 he completed the three-year postgraduate program in Endodontics at the University of Athens Dental School. Since 2003, he owns a limited to microscop Endodontics private practice in Athens, Greece. For the last ten years, he served as a clinical instructor affiliated with the undergraduate and postgraduate programs at the University of Athens, Athens Dental School, Endodontics department, Greece. In 2012 he was awarded the title of Clinical Fellow teacher at the University of Warwick, Warwick dentistry UK. He lectures extensively nationally and internationally and he has published articles in local and international journals. He current serves as an active member of the Hellenic Society of Endodontology (HSE full member society), a board member of the Academy of Microscope Enhanced Dentistry (AMED) and a certified member of the European Society of Endodontology (ESE).