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

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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 clearing 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 pulpal anatomy, stated that lack of thorough knowledge of root canal morphology ranks second as a cause of treatment failure, 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. Fluctuations in the cleaned and shaped root canal anatomy ranks second as a cause of treatment failure, 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.

In the present paper, the endodontic treatment of a first maxillary molar tooth (Images from the root canal anatomy project developed at AL Awad Dental School - University of Sao Paulo for educational purposes) was focused and the morphology this fact is suggestive of merging canals. CBCT axial and sagittal images in combination with microscopic visualization this fact is suggestive of merging canals. CBCT axial and sagittal images in combination with microscopic visualization this fact is suggestive of merging canals.
restoration and monitoring. Surgical excursion of the periradicular lesion is one of the first and most crucial steps in the treatment regimen. CBCT scanning has been shown to reduce the need for surgical exploration and to reduce the risk of infectivity, while eliminating the need for surgical exploration and the risk of infectivity, while eliminating the risk of infectivity.

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. The number, form, and configuration of root canals present in maxillary first molars have been thoroughly investigated in the literature for almost a century. They are the largest teeth in volume and of the most complex in root and canal anatomy. The three individual roots of the maxillary first molar form a tripod. The palatal root generally is the longest, has the larger diameter and offers the easiest access. It often curves buccally at the apical one third and can contain one, two or three root canals in various percentages according to studies of apical canal configurations and case reports. The distobuccal root canal is conical and may have one or two canals. The mesiobuccal root may contain one, two or three root canals and is the most studied root in the mouth. A number of factors contribute to the variation found in maxillary molar anatomy studies. Variations may result because of ethnic background, age, gender or the population studied.

Of the various comprehensive maxillary first molar ex vivo studies in the dental literature, Baratoo Filho et al reported a maxillary first molar with three roots and seven root canals. Recently, Kotter et al reported a CBCT guided endodontic management of a maxillary first molar with seven root canals. Moreover, in another recent case report, Kotter et al reported the endodontic management of a first 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 allows for the diagnosis of endodontic pathosis, assessing root and alveolar fractures, analysis of restorative lesions, identification of pathosis of nonendodontic origin, and presurgical assessment before root canal surgery. CBCT images are reconstructed using significantly lower radiation doses compared with alternative conventional computed tomography scanning. This is because with CBCT scanning 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 elimination of the need for conventional image intensification system used in conventional computed tomography scanners resulted in a huge reduction in radiation exposure. CBCT scanning has been shown to be more consistent with the ALARA approach.

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. Baratoo 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 periradicular lesion. Through 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 (MB1), mesiobuccal (MB2), mesiobuccal (MB3), distobuccal (DB), distobuccal (DBR), 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.

The role of microscopic magnification is well documented in the endodontic literature. Bulley et al. performed an in vivo study to determine the practitioner’s ability to locate the MB1 canal in maxillary molars using the DOM and/or dental loupe. They concluded that when the maxillary first molars were considered separately, the frequency of MB1 canal detection for the microscopic, dental loupe, and magnification groups were 71.1%, 62.5% and 17.2%, respectively. In the present case, successful negotiation of all canals was largely dependent on the use of pre-surgical CBCT mapping 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 endodonic practice.

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