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CASE REPORT

Spiral CT in Diagnosis of 4-Rooted Maxillary Second Molars Bilaterally: A Case Report

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ABSTRACT

Variations in the root canal morphology are common and permanent maxillary molars are no exceptions. Permanent maxillary molars generally have three roots: one palatal and two buccal. The incidence of a second palatal root is quite rare. This paper highlights the endodontic diagnosis and treatment of a permanent maxillary second molar having an additional palatal root using specialized diagnostic technique- spiral computed tomography.

Keywords: Spiral CT, 4-rooted maxillary second molar, Dentascan

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INTRODUCTION

The aim of root canal therapy is the total obturation of the canal space and complete sealing of apical foramen at the dentin cementum junction, with an inert, dimensionally stable and biologically compatible material.

The hard tissue repository of the human dental pulp takes on numerous configurations and shapes. A thorough knowledge of variations in the root canal morphology, careful interpretation of angled radiographs, proper access preparation and a detailed exploration of the tooth's interior are prerequisites for a successful treatment outcome (1).

An undetected canal will remain untreated and may be a reason for failure. Dow & Ingle have attributed a failure rate of 2.88% to unfilled canals during root canal therapy (2). The diagnosis of variations of the root canal morphology thus becomes a constant challenge for successful endodontic therapy, especially in the multi-rooted teeth.

Permanent maxillary molars are generally described as having three roots with four canals: one palatal, one distobuccal and two canals in mesial root. Christie *et al.* (1991) have reported 16 cases of maxillary molars with 2 palatal roots found during 40 years of clinical practice (3). They proposed a classification system of 4-rooted maxillary molars, based on root separation level and their divergence, describing 3 types (I-III). Type I molars have two widely divergent palatal roots that are often long and tortuous. The buccal roots are often "cow-horn" shaped and less divergent. Type II molars have four separate roots that are shorter, run parallel, have buccal and lingual root morphology, and have blunt root apices. Type III molars are constricted in root morphology with the mesiobuccal, mesiopalatal and distopalatal canals engaged in a web of dentin. The distobuccal root seems to stand-alone and may even diverge to the distobuccal.

It is extremely important that clinicians use all the armamentaria at their disposal to locate and treat the entire root canal system. Radiographs, being the most common and widely used modality, are an important and necessary aid in root canal treatment. Accurate radiographic techniques and proper interpretation are essential for sound diagnosis and treatment. Unfortunately, even the best of radiographs are unable to reveal the complex location and number of root canals in a tooth, as a radiograph is a two-dimensional picture of a three-dimensional object.

Newer techniques like Spiral CT (SCT) or

volume acquisition CT greatly enhance the ability to recognize the true three-dimensional anatomy of the soft tissues and skeletal structures.

The following case report presents an unusual occurrence of a 4-rooted maxillary second molar detected during routine root canal treatment, and confirmed with the help of Spiral CT.

CASE REPORT

A 20 year-old male patient came to the Department of Conservative Dentistry & Endodontics at ITS College of Dental Sciences and Research, with the chief complaint of pain in the upper right posterior region of the mouth since 3 days. The pain was severe, intermittent and radiating in nature. Clinical oral examination revealed carious permanent right maxillary second molar tooth. The tooth was tender on vertical percussion. Radiographic examination revealed caries approaching the pulp chamber. Hence a diagnosis of symptomatic chronic irreversible pulpitis was made and root canal therapy was planned.

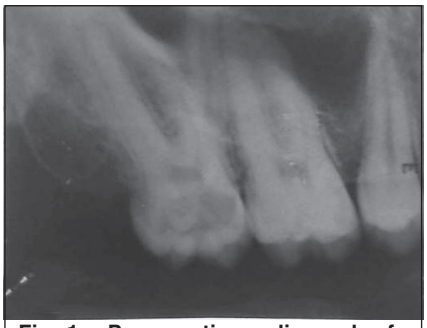

Fig. 1a: Preoperative radiograph of the maxillary right second molar

Fig. 1b: Preoperative radiograph of the maxillary left second molar; Also shows impacted maxillary third molar

Careful examination of the radiographs revealed the possibility of more than 1 palatal root. A diagnostic radiograph of the left maxillary second molar also revealed such possibility (Fig. 1a, b).

To ascertain the true anatomy of the tooth, dental imaging with the help of Spiral CT examination was planned. Informed consent was obtained from the patient. SCT imaging was performed using the dental software, DentaScan. The SCT confirmed the presence of four separate roots for the maxillary second molars: 2 buccal and 2 palatal (fig 2).

The tooth was anesthetized and isolated with rubber dam, and access to the pulp chamber was achieved using a round diamond bur. Clinical evaluation of the internal anatomy revealed the presence of 4 root canal orifices: MB: mesiobuccal; DB: distobuccal; MP: mesiopalatal; and DP: distopalatal (Fig. 3). The working lengths were estimated by means of an electronic apex locator, and confirmed by a radiograph. The canals were cleaned and shaped using hand ProTaper instruments (Dentsply Maillefer), under alternate irrigation with 3% NaOCl. After a final rinse with normal saline, canals were dried with paper points and closed dressing was given. At the second appointment, canals were obturated using cold lateral compaction technique with AH Plus sealer (Dentsply Maillefer) and gutta-percha cones.

Final radiographs were taken to establish the quality of the obturation. The tooth was subsequently restored. The tooth was asymptomatic at the end of two years and the recall radiograph did not show any abnormality (Fig. 4).

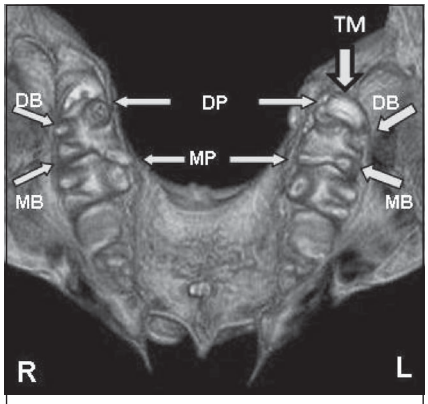

Fig 2a: Spiral CT image of the maxillary arch (superior veiw) showing the presence of 4 roots in the second molars bilaterally (MB: mesiobuccal; DB: distobuccal; MP: mesiopalatal; and DP: distopalatal; TM: third molar)

Fig 2b: Spiral CT image of the maxillary arch showing presence of an impacted left third molar (straight arrow); incomplete apex formation of distopalatal root in right second molar (curved arrow).

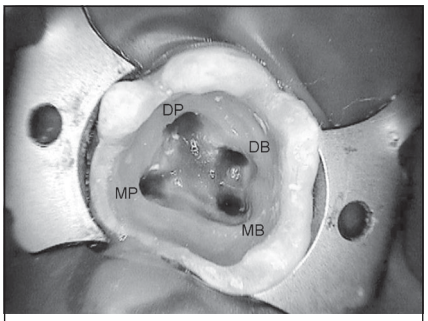

Fig. 3: Access opening of the maxillary right second molar showing 4 different root canal orifices (MB: mesiobuccal; DB: distobuccal; MP: mesiopalatal; and DP: distopalatal)

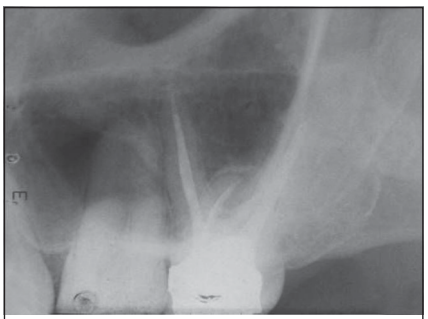

Fig. 4: 24-month recall radiograph showing normal periradicular anatomy

DISCUSSION

Anatomical variations can occur in any tooth, and maxillary permanent molars are no exceptions. The above-mentioned case report highlights the unusual occurrence of an additional palatal root in a permanent maxillary second molar.

Most endodontic and dental anatomy textbooks describe the maxillary second molar as having 3 roots with 3 or 4 root canals. A large amount of data has been published demonstrating morphologic variations in the maxillary molars (3-16). The reported percentage of 2-rooted maxillary molars ranges from 0–12% (4, 5) to 15% (6) . Hartwell & Bellizzi (1982) have reported 0.6% of maxillary second molars with 1 root canal (7).

Peikoff *et al.* (1996) had demonstrated six variants of maxillary second molars (8). The six variants found in the study and their frequency of occurrence are as follows: (1) three separate roots and three separate canals (56.9%); (2) three separate roots and four canals (two in the mesiobuccal root) (22.7%); (3) three roots and canals whose mesiobuccal and distobuccal canals combine to form a common buccal with a separate palatal (9%); (4) two separate roots with a single canal in each (6.9%); (5) one main root and canal (3.1%); and (6) four separate roots and four separate canals including two palatal (1.4%).
In a review and radiographic survey of 1,200 teeth, Libfield & Rotstein (1989) have found a prevalence of maxillary second molars with 4 roots (2 buccal and 2 palatal) to be only 0.4%, which is rarer still in maxillary first molars (9) . Caliskan *et al.* (1995) have reported an incidence of 2.1% for the presence of a single canal dividing into two in the palatal roots of maxillary second molars (10). Benanati (1985) has presented a similar case report of 2 palatal canals in the maxillary second molar (11). Baratto-Filho *et al.* (2002) have reported a clinical case of a maxillary first molar that had 2 palatal roots and 2 extracted maxillary second molars that had the same variation(12).

Most practitioners use intraoral periapical radiographs as a means to diagnose root morphology. But, it is extremely difficult to estimate the exact number of additional roots and root canals in an intraoral radiograph because of their superimposition over other roots, and at times might be missed. Teeth with extra roots and root canals pose a challenge in terms of diagnosis and treatment. The exact three-dimensional anatomy of the roots can be assessed with the help of specialized procedures such as CT scan and Spiral CT or Helical CT. Gopikrishna *et al.* (2006) (13) & Sachdeva *et al.* (2008) (17) have eave earlier recommended the use of spiral CT scan for the detection of unusual root morphology.

For the present case, the use of SCT proved extremely helpful. It clearly revealed and confirmed the presence an additional palatal root (Fig. 2a, b). Another interesting fact revealed by the SCT examination is the presence of the maxillary left third molar that is impacted in-between the roots of the maxillary second molar (Fig. 2a, b). The third molar was otherwise giving an appearance of a root stump in the periapical radiograph (Fig. 1b). SCT examination also shows an incomplete apex formation for the distopalatal root of the maxillary right second molar (Fig. 2b). These points further consolidate the recommended use of SCT for proper diagnosis and successful management.

The discussion regarding the exact working mechanism of Spiral CT is beyond the scope of this article. But to put some insight, it works by employing simultaneous patient translation through the x-ray source with continuous rotation of the source-detector assembly. It then acquires raw projection data with a spiral-sampling locus in a relatively short period (18). The data can then be viewed as conventional transaxial images, such as multiplanar reconstructions, or as three-dimensional reconstructions (13).

The present case represents type I variation as per the criterion described by Christie et al. (3) and type 6 variation as per Peikoff *et al.* (8)

The current case demonstrates a bilateral symmetry in the maxillary second molar. Such bilateral symmetry in case of maxillary second molars with 4 roots (2 buccal and 2 palatal), has earlier been reported by Alani (2003) (14).

A proper and adequate access opening is essential for successful endodontic management. Once the diagnosis for an extra root is confirmed, the access opening should be carefully planned before starting and extra cutting is done in the area for the additional canal orifice. For the maxillary second molar with three roots and three canal orifices, the access cavity is a rounded triangle with the base to the buccal. When four canal orifices (with MB2) are present, the access cavity preparation has a rhomboid shape (19). The access cavity of maxillary molars exhibiting 2 palatal roots should be wider than usual on the palatal aspect. The access outline will be square rather than a triangle (14), as observed in the case presented above (fig.3).

CONCLUSION

Newer radiographic techniques like spiral CT scan provide an extra eye for proper understanding of anatomy of dental tissues and accurate diagnosis of dental abnormalities. Anatomic variations can occur in any tooth, and the permanent maxillary second molar is no exception. Root canal therapy for these teeth should be successful, provided the practitioner makes extra efforts to locate and treat all existing canals. The prognosis for success for teeth with such variations should be considered the same as that for routine endodontically treated teeth.

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