

Morphology and Associated Pathologies of Maxillary First Molar Using Cone Beam Computed Tomography

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ABSTRACT

Objective: The objective of this study was to evaluate the morphology and associated pathologies of maxillary first molar using Cone beam computed tomography.

Study Design: Descriptive cross sectional study.

Place and Duration of Study: This study was conducted at the Department of Oral Biology, Rehman college of dentistry, Peshawar from 1st March 2016 till 30th April 2020.

Materials and Methods: A descriptive cross-sectional study was conducted using 128 Cone beam computed tomography scans at Rehman college of dentistry, Peshawar. The Cone beam computed tomography scans were evaluated for number of root canals, presence of caries, agenesis, anatomic abnormalities and ectopic eruption using 3D reconstruction of the images. Data collected was analysed by SPSS version 20

Results: In this study, 56.25% of the scans showed four root canals while 43.75% had 3 canals. Mesiobuccal canal-2 was more common in males (74.13%) compared to females. First molar teeth had a 47.65% prevalence of dental caries.

Conclusion: Within the limitations of this study, we conclude that mesiobuccal canal-2 is a common finding in the maxillary first molar with higher prevalence in males compared to females. Due to higher susceptibility of first maxillary molar to dental caries, there is a higher probability of missing the mesiobuccal canal-2 during endodontic treatment. Therefore, careful exploration of pulp chamber should be done to avoid treatment failure.

Key Words: cone beam computed tomography, maxillary first molar, mesiobuccal canal-2, dental caries.

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INTRODUCTION

Maxillary first molar is key to the occlusion and erupt at 6-7 years of age¹. Maxillary first molar is the largest tooth in the maxillary arch, although its occluso-gingival dimensions are smaller compared to other molars². Usually maxillary first molar has 5 cusps and three roots. Several pathologies are associated with maxillary first molars including caries, agenesis, anatomical abnormalities and ectopic eruption³.

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Maxillary first molar is highly susceptible to dental caries because it is the first permanent tooth to erupt in the oral cavity, it has complex tooth surface morphology and post-eruptive enamel maturation time⁴. Untreated caries can lead to pulpitis which may require endodontic treatment. For successful endodontic treatment, knowledge of the external and internal anatomy of tooth and related structures is very important. Maxillary first molars have considerable variations in root canal morphology and missing the extra canal can lead to endodontic treatment failure⁵. Periapical radiographs at different angulations are the mainstay for assessing the length and number of root canals. However, periapical radiographs are affected by image distortion, magnification and superimposition of adjacent anatomical structures over the root which can result in inaccurate measurements and treatment failure⁶. Cone beam computed tomography (CBCT) was initially used to evaluate hard tissues for surgical procedures and implant planning. CBCT is a useful tool in assessing complex root anatomy, extra canals, curved canals and associated pathologies which can greatly improve treatment outcomes⁷. Intraoral radiography results in radiation exposure typically in the range of

1–8 microsieverts (µSv), whereas for CBCT the typical value is 50 µSv for small and 100 µSv for large scanning volumes. The higher doses of CBCT have health and ethical concerns but are considered safe for use in oral and maxillofacial region⁸. Maxillary first molars normally have 3 canals i.e. mesiobuccal, distobuccal and palatal but a second mesiobuccal canal (mb-2) has been reported in some studies⁹. There is even evidence of teeth having 4, 5 and even 6 canals in literature¹⁰.

It is very difficult to accurately assess the internal and external anatomy of teeth with conventional intraoral radiography. CBCT provides undistorted 3-dimensional images of teeth and surrounding tissues which help in clearly visualizing root canal anatomy and relationship with other anatomical structures such as maxillary sinus and root apices. This information is vital for successful endodontic treatment.

The objective of this study was to evaluate the morphology and associated pathologies of maxillary first molar analyzed using CBCT.

MATERIALS AND METHODS

This retrospective descriptive cross-sectional study was conducted at Rehman College of Dentistry, Rehman Medical Institute, Peshawar, from 1st March 2016 till 30th April 2020, after getting approval from the institutional ethical committee. Sample size was calculated using G*Power software version 3.1.9.7. CBCT scans of 128 patients, aged between 21 to 40 years of both genders having maxillary first molars with fully developed apices were included in this study. Teeth showing root canal treatment, resorption, posts or crowns were excluded. The images were taken by “carestream (CS) Germany, model no. 90003D” with 74 kv (male patients), 70 kv (female patients), 10mA. All CBCT scans consisted of standard resolution of 0.3mm voxel and 10.8 s. Images were analyzed by using CS Imaging Browser 7.0.20 software. Number of roots, root canals and associated pathologies i.e. caries, ectopic eruption, anatomical abnormalities and agenesis were recorded by analyzing coronal, sagittal and axial images. Prevalence of mb-2 and its relationship with sex was also determined. Results were analyzed using the SPSS (version 20). Chi square was applied for comparison of male and female groups.

RESULTS

128 CBCT scans of maxillary first molars (n = 128) were analysed. There were 70 women (54.68 %) and 58 men (45.32%) in our study having mean age of 28.77 years ranging from 22 years to 41 years (table I).

TableNo.1: Age and Gender distribution

Age	Gender
Range: 22-41 years	Male: 58 (45.32%)
Mean (+ SD): 28.7 (+ 5.25)	Female:70 (54.68 %)

Table No.2: Root canals in Maxillary First Molar

Canals	Maxillary first molar
C shaped canal	0
1	0
2	0
3	56 (43.75%)
4	72 (56.25%)
Total	128

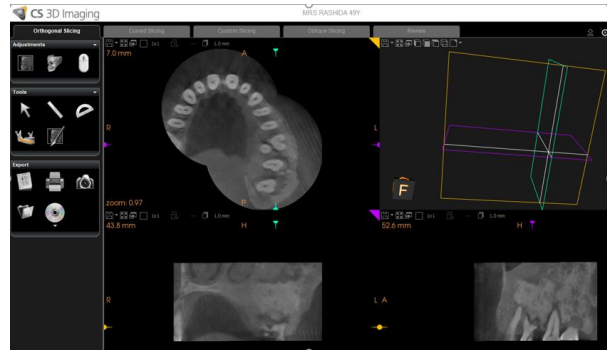


Figure No.1: Maxillary Molars

All maxillary first molars had three roots. Four root canals were most commonly found (n=72, 56.25%) followed by 3 root canals (table 2, figure 1). The presence of fourth root canal i.e. mb-2 in the mesiobuccal root was more common in males (68.7%, n=43) than in females (38.63%, n=29). A statistically significant (p = 0.02) difference was found in prevalence of mb-2 canals in group of male and female patients (table 3).

Table No.3: Presence of mesiobuccal-2 canal according to patients’ gender

Mesiobuccal-2 canal	Male	Female	Total
Present	43 (74.13%)	29 (41.42%)	72
Absent	15 (25.86%)	41 (58.57%)	56
Total	58	70	128

Out of 128 patients, 60 had caries in their first maxillary molars. Only 1 tooth had ectopic eruption and all the maxillary first molars were fully formed. None of the teeth had any anatomical abnormalities (table 4)

Table No.2: Pathologies associated with maxillary first molar

	Caries	Ectopic eruption	Agenesis	Anatomical abnormalities
Present	61 (47.65%)	1 (0.00078%)	0 (0%)	0 (0%)
Absent	67 (52.34%)	127 (99.21%)	128 (100%)	128 (100%)
Total	128	128	128	128

DISCUSSION

Several techniques have been described in the literature for evaluation of maxillary first molars. These include

use of periapical radiographs, Orthopantomograms, tooth sectioning and canal staining¹¹. Tooth sectioning and canal staining are excellent methods for evaluation of morphology of maxillary first molars, but they are in vitro techniques.

Advances in technology has made it possible for computerized tomographic scans to be used in the diagnosis and evaluation of head and neck anatomy. CBCT offers significant advantages over conventional radiographs. They produce undistorted 3-dimensional images of dental structures whereas radiographs can only form two-dimensional images. CBCT is an accurate analysis of the 3-dimensional reconstructed images of dental structures¹². With every imaging modality there is inherent risk of ionizing radiation damage, but risk should always be weighed against benefit. Radiation produced by CBCT is considered safe in the oral and maxillofacial region and it can greatly improve treatment outcomes.

In the current study CBCT was used to evaluate maxillary first molar. Results demonstrate that all the maxillary first molars had 3 roots. These findings correlate with other studies¹³. For successful endodontic treatment, location, number and length of root canals is vital for the clinician. In the present study most maxillary first molars had four root canals (56.25%). The second canal was always found in the mesiobuccal root and therefore called mesiobuccal-2. Although this prevalence is consistent with other studies, Betancourt P et al. found it to be 69.82% in their studied population¹⁴. Mb-2 was more common in males (74.13%) compared to females (41.42%). Alrahabi M et al. also found mb-2 to be more prevalent in males¹⁵. Treatment of MB-2 canal is vital in the success of endodontic therapy. Mb-2 can often remain undetected which can be a persistent source of infection in the periapical area. Shetty et al. reported the prevalence of the MB-2 canal in 80% of maxillary first molars¹⁶. Most of maxillary first molars (77.19%) had an untreated MB-2 canal. Periapical lesions were found in unfilled Mesiobuccal-2 canals in 72.7% of maxillary first molars¹⁶. Since maxillary first molars are the first permanent teeth to erupt and have complex morphology, they are more susceptible to dental caries¹⁷. Prevalence of dental caries in our studied population was found to be 47.65%. Different authors have also found similar prevalence in their studies¹⁸. Agenesis and anatomical abnormalities of maxillary first molars such as 4 roots, change in shape of cusp of carabelli are extensively reported in literature¹⁹, although, we did not find any tooth with these pathologies. Teeth which erupt in abnormal position in the arch are termed ectopically erupted teeth. Our study only found one tooth which had ectopically erupted. Kennedy DB et al. have reported 3-4% of ectopically erupted teeth in their studied population²⁰. These

differences in the results could be due to sample size and demographic variations.

Our study was based on data from a single region and therefore careful interpretation of results should be made. Larger multicentered studies should be made in the future focusing on relationship of external morphology of maxillary first molar with the number of root canals.

CONCLUSION

Within the limitations of this study, we conclude that mesiobuccal canal-2 is a common finding in the maxillary first molar with higher prevalence in males compared to females. Due to higher susceptibility of first maxillary molar to dental caries, there is a higher probability of missing the mesiobuccal canal-2 during endodontic treatment. Therefore, careful exploration of pulp chamber should be done to avoid treatment failure.

Author's Contribution:

Concept & Design of Study:	Arbab Zia ur Rehman Khan
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Final Approval of version:	Arbab Zia ur Rehman Khan

Conflict of Interest: The study has no conflict of interest to declare by any author.

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