

Maxillary First Molar with Three Mesiobuccal Canals: A Case Series

¹Dr Midhun MJ, Postgraduate Student, Government Dental College Thiruvananthapuram

²Dr Anupama S Gopinathan, Assistant Professor, Government Dental College Thiruvananthapuram

³Dr Swathi P, Postgraduate Student, Government Dental College Thiruvananthapuram

⁴Dr Shima Mohan M, Postgraduate Student, Government Dental College Thiruvananthapuram

⁵Dr Aruna VP, Postgraduate Student, Government Dental College Thiruvananthapuram

⁶Dr Gayathri P, Postgraduate Student, Government Dental College Thiruvananthapuram

Corresponding Author: Dr Midhun MJ, Postgraduate Student, Government Dental College Thiruvananthapuram

Citation of this Article: Dr Midhun MJ, Dr Anupama S Gopinathan, Dr Swathi P, Dr Shima Mohan M, Dr Aruna VP, Dr Gayathri P, “Maxillary First Molar with Three Mesiobuccal Canals: A Case Series”, IJDSIR- April - 2020, Vol. – 3, Issue -2, P. No. 161 – 169.

Copyright: © 2020, Dr Midhun MJ, et al. This is an open access journal and article distributed under the terms of the creative commons attribution noncommercial License. Which allows others to remix, tweak, and build upon the work non commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

Type of Publication: Case Report

Conflicts of Interest: Nil

Abstract

Introduction: Successful outcome of surgical and nonsurgical root canal treatment depends on the thorough knowledge of root canal anatomy. The maxillary first molar has a wide variation in respect to the number of canals specifically in the mesiobuccal root. The current case reports show the successful management of three maxillary molars in which the mesiobuccal root had three Canals With Three Different Canal Configurations.

Methods: The first case describes a non-surgical root canal treatment of tooth #3 in a 28-year-old man with aid of radiograph and surgical loupes. The second case describes a nonsurgical root canal treatment of tooth #14 in a 34-year-old woman with aid of radiograph and surgical loupes. The third case describes a non-surgical root canal treatment of tooth #14 in a 50-year-old lady with the aid of CBCT.

Results: In all the three cases the mesiobuccal root had 3 canals (type 3-3 in case 1, type 3-2 in case II and type 3-2-1 in case III) whereas the distobuccal and palatal roots had a single canal. Literature review showed that the overall incidence of 3-canaled mesiobuccal roots in maxillary molars range from 1.3%–2.4% and that the most common root canal configuration type was 3-2.

Conclusions: Extra canals in maxillary molars should always be anticipated by the clinician and all possible advanced tools and imaging techniques must be employed to locate and treat the same. This will ensure optimum treatment outcome.

Keywords: Anatomic variation, surgical loupes, maxillary molars, mesiobuccal root, CBCT, MB 3, root canal system.

Introduction

Favourable outcome of root canal treatment depends on sound knowledge of root canal anatomy and variations occurring in it. Inability to locate and treat all the root canals will result in post treatment failures^{1,2}.

Root canals have three dimensions; hence radiographs fail to identify all the canals. It is impossible to see the buccolingual aspect and generally only the cervical and middle thirds are clearly visible. Moreover, the mesiodistal plane is reduced because of superimposition of other tissues such as dentine, cementum, and cancellous and cortical bone of the alveolar process³. Weine et al said that failures in endodontic treatment of maxillary molars were mostly associated with the mesiobuccal root and that these teeth showed the presence of 4 canals more frequently than 3 canals (51.5% vs 48.5%)⁴. The reason for multiple canals in the MBR is attributed to the broad buccolingual dimension of the root and the presence of concavities on its mesial and distal surfaces. The DBR and PR are more conical in shape and are, therefore, more likely to contain 1 root canal⁵. Knowledge of canal morphology and its frequent variations is a prerequisite for successful endodontic therapy. These morphological variations in root canal anatomy play a significant role in the outcome of root canal therapy⁶.

The first case of maxillary molar mesiobuccal root with three canal was reported by Acosta Vigouroux and Trugeda Bosaans⁷. Since then, number of laboratory studies, clinical studies, and clinical case reports of this anatomic variation have been published in the dental literature. The presence of extra canal should always be suspected by the clinician and should use all available tools and diagnostic aids for management of the same. This case report discusses three case reports of maxillary first molars mesiobuccal root with three types of canal configuration.

Canal Nomenclature

Terminologies used to describe the extra canal in mesiobuccal root varies in literature .Karthikeyan and Mahalaxmi⁸ suggested naming additional canals in a single root starting from the most buccal canal and heading in a palatal direction. Hence the 3 canals in the MBR are referred to as MB (mesiobuccal), SMB (second mesiobuccal), and MBP (mesiobuccalpalatal).

Case Reports

Case 1 : A 28-year-old patient presented with pain associated with right maxillary first molar. Clinical examination revealed a clinically intact temporary restoration of 16 with obvious tenderness on percussion and palpation. Pulp testing revealed negative responses. Pre-operative radiograph revealed a deep restoration with widening of periodontal ligament. Based on clinical and radiographic findings a diagnosis of symptomatic apical periodontitis was made and non-surgical endodontic treatment was planned.

The tooth was anesthetised using 1.8 mL 2% of lignocaine in 1:100000 of adrenaline (Hindustan medicines P LTD, INDIA) and rubber dam isolation was done. The temporary filling was removed and access opening was done under surgical loupes ((OPMI PROergo; Carl Zeiss Meditec AG, Jena, Germany)). After refining the access cavity, 3 canal orifices were detected: mesiobuccal (MB), distobuccal (DB), and palatal (P). Careful exploration of the groove between the MB and P canals under surgical loupes (OPMI PROergo; Carl Zeiss Meditec AG, Jena, Germany) revealed the presence of 2 extra canals: second mesiobuccal (SMB) and mesiobuccopalatal (MBP) canals.(Fig 1b)The 3 MB canals had separate orifices that were located on a straight line. The mesiobuccal root had type 3-3 canal configuration. The working length of all canals were determined using an apex locator (Root ZX; Morita, Tokyo, Japan). The canals were initially

instrumented with #15 stainless steel *k* files (Mani Inc , ochigi , Japan) under irrigation with 5% sodium hypochlorite (Prime Dental Products, Thane). All the MB canals were prepared upto 4% 25 with HyFlex NiTi rotary file (COLTENE) and DB up to F2 and P upto F3 ProTaper Universal files (Dentsply Maillefer, Ballaigues, Switzerland).

At the second visit, the canals were irrigated copiously with 5% sodium hypochlorite followed by a final rinse of 17% EDTA. Then, the canals were dried and filled with gutta-percha and AH Plus sealer (Dentsply Maillefer) using the lateral compaction technique. Finally, the access opening was restored with amalgam restoration. At the 1-year recall visit, the patient was asymptomatic, and the clinical and radiographic examinations revealed the tooth and its surrounding tissues to be within normal limits.



Fig 1a: Preoperative radiograph



Fig 1b: Clinical view of three separate mesiobuccal canal orifices.

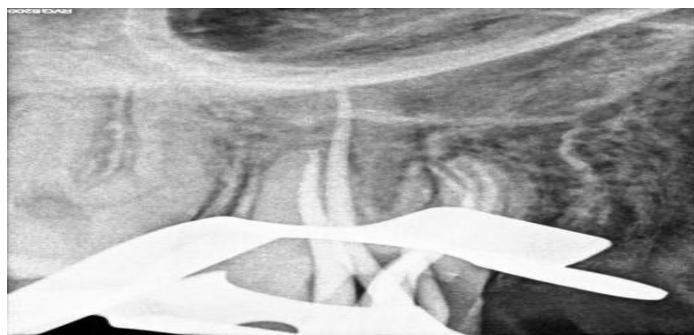


Fig 1c: Mastercone radiograph



Fig 1d: Post obturation radiograph

Case 2 : A 34-year-old woman presented with sensitivity to both hot and cold liquids with continuous throbbing pain associated with left maxillary first molar which keeps her awake at night. Clinical examination revealed deep caries on tooth 26 with exaggerated response to electric pulp testing and excruciating pain that lingers on cold test. Pre-operative radiograph revealed deep caries involving pulp with slight widening of periodontal ligament. Based on clinical and radiographic findings a diagnosis of irreversible pulpitis was made and non-surgical endodontic treatment was planned.

The tooth was anesthetised using 1.8 mL 2% of lignocaine in 1:100000 of adrenaline (Hindustan medicines P LTD , INDIA) and rubber dam isolation was done. Access opening was done under surgical loupes (OPMI PROergo; Carl Zeiss Meditec AG, Jena, Germany). 3 canal orifices were detected MB, DB, and P. After thorough probing of the fissure between the mesiobuccal and palatal canals, a soft and sticky area was located. After troughing the

fissure with a #2 round bur and slow-speed handpiece, a file was able to be placed into the groove area. A working film was exposed and instrumentation was commenced. As instrumentation was continuing, it was noted the file appeared to go into another location along the fissure. A second working film was exposed confirming the location of a third canal in the mesiobuccal root of tooth #14.(Fig 2b) The mesiobuccal root had type 3-2 canal configuration with MB and SMB fuses at middle third and opens at apex while MBP opens apically separately. The working length of all canals was determined using an apex locator (Root ZX II, J Morita, Tokyo, Japan) and confirmed radiographically. The canals were instrumented with ProTaper Universal files (Dentsply Maillefer, Ballaigues, Switzerland) to size #F1 in the MB2 canal; size #F2 in the MB, MBP, and DB canals; and #F3 in the P canal using 5% sodium hypochlorite as an irrigant.

At the second visit after 1 week, the canals were irrigated copiously with 5% sodium hypochlorite followed by a final rinse of 17% EDTA. Then, the canals were dried and filled with gutta-percha and AH Plus sealer (Dentsply Maillefer) using lateral compaction technique and a composite restoration was given.



Fig.2 b: Clinical view of three separate mesiobuccal canal orifices.

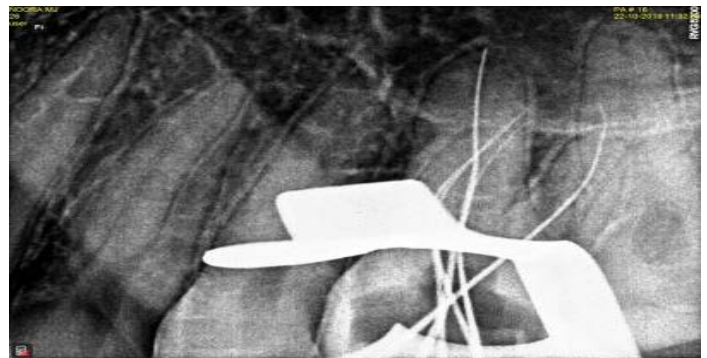


Fig.2 c: Working length radiograph

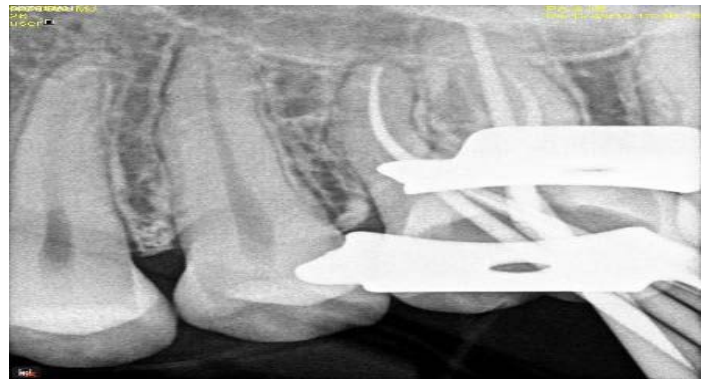


Fig.2 d: Master cone radiograph



Fig.2 e: Post obturation radiograph



Fig.2a: Preoperative radiograph

Case 3: A 50-year-old lady presented with pain on chewing associated with left maxillary first molar. Clinical examination revealed a clinically good composite restoration on tooth 26 with obvious tenderness on percussion and negative response to pulp testing. Pre-operative radiograph revealed deep restoration with widening of periodontal ligament in relation to mesiobuccal root. Based on clinical and radiographic findings a diagnosis of symptomatic apical periodontitis was made and non-surgical endodontic treatment was planned.

The tooth was anesthetised using 1.8 mL 2% of lignocaine in 1:100000 of adrenaline (Hindustan medicines P LTD, INDIA and rubber dam isolation was done. Access opening was done under surgical loupes. (OPMI PROergo; Carl Zeiss Meditec AG, Jena, Germany) 3 canal orifices were detected MB, DB, and P. Bleeding points were detected in the groove between MB and P canal suggestive of SMB and MBP canal. (Fig 3d) The working length was determined in all identified canals and noted using an apex locator (Root ZX; Morita, Tokyo, Japan). Sterile cotton was placed in the pulp chamber, and the access cavity was sealed with IRM cement (Dentsply De Trey GmbH, Konstanz, Germany). A cone-beam computed tomographic (CBCT) (Kodak 9000; Carestream Dental, Atlanta, GA) scan of the left maxilla was performed with a tube voltage of 70 KV and a tube current of 10 mA for 10.8 seconds to confirm the number of the roots and canals in the disto buccal root in which additional canal was suspected under surgical loupes of the left maxillary first molar .CBCT revealed the presence of MB1 MB2 and MB3 in the mesiobuccal root in which the MB2 and MB3 fuses first and later it combines with the MB1 to exit at the apical third in a 3-2-1 canal configuration. No additional canal was noted in disto buccal root.

At the second appointment, the tooth was anesthetized with 1.8 mL 2% lignocaine. The canals were instrumented with ProTaper Universal files (Dentsply Maillefer, Ballaigues, Switzerland) to size #F1 in the MB2 canal; size #F2 in the MB, and DB canals; and #F3 in the P canal using 5% sodium hypochlorite as an irrigant. Then, the canals were dried and filled with gutta-percha and AH Plus sealer (Dentsply Maillefer) using lateral compaction technique and a composite restoration was given.

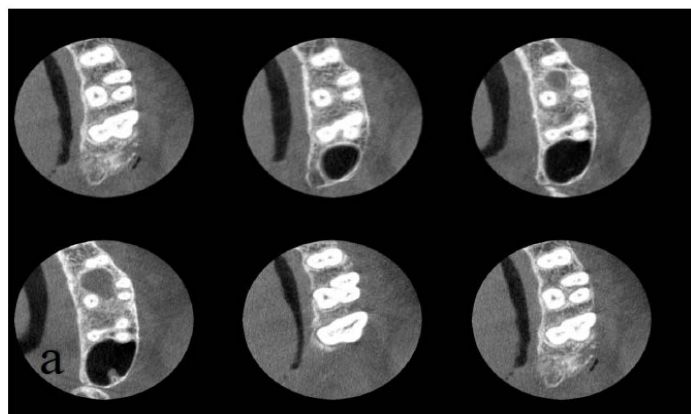


Fig 3a:CBCT image



Fig3b: Preoperative radiograph



Fig 3c – Master cone radiograph



Fig 3d: Post obturation radiograph



Fig 3e: Clinical view of three separate mesiobuccal canal orifices.

Discussion

Adequate knowledge of root and root canal configurations will help in accurate detection and treatment of all root canals during root canal treatment. Anatomic aberrations are not uncommon in maxillary first molars, sometimes ranging from 1 to 8 canals. Failure in identifying the accessory root canal and treating them may adversely affect the treatment outcome. There are more number of undetected second mesiobuccal canal when compared with newly treated tooth⁹.

Preiswerk was the first one to study the internal morphology of teeth using a canal remodeling technique. 10. Since then, several laboratory and clinical techniques were used to investigate the internal anatomy of teeth. The

laboratory methods include root sectioning⁴, radiographic examination³, canal staining and tooth clearing¹¹, microscopic examination¹², and tooth scanning and 3-dimensional reconstruction using micro computed tomographic imaging¹³. The clinical techniques include clinical evaluation during root canal treatment^{6,14}, retrospective evaluation of patients records¹⁵, and radiographic examination using conventional¹⁶, or advanced radiographic techniques such as cone-beam computed tomographic (CBCT) imaging^{17,18}.

It presents with wide variations in its anatomy with respect to frequency of occurrence of the number of canals in each root and the number of roots. The major reason for failures in root canal therapy of the permanent maxillary first molars are due to the difficulty in locating and filling the second and/or third mesiobuccal canals¹¹. The higher incidence of multiple canals in the mesiobuccal root when compared to distobuccal canal may be due to the broad mesiopalatally placed root unlike the distobuccal root which is round in cross-section².

The current article presents the 3 cases of mesiobuccal root having 3 root canals with different canal configuration. The first case described the clinical management of tooth #3, which had type 3-3 canal configuration in the MBR. The second case describes the clinical management of tooth #14, which had 3-2 canal configuration and third case describes the management of tooth #14, which had 3-2-1 canal configuration. The internal morphology of 3-canaled MBRs was investigated by a number of clinical and laboratory studies¹⁹. The most common root canal configurations were types 3-2, 2-3, 1-3, and 3-3. More complex configurations such 1-2-1-3, 1-2-3-2, 2-3-2-1-2, 2-3-2-3-2, and 3-2-1-2-1 also have been

reported in some laboratory studies^{20,21,19}. In the clinical case reports, type 3-2 was the predominant

configuration, and it occurred in 3 forms¹⁹. The prevalent form was a separate MB canal and joined SMB and MBP canals followed by a separate MBP canal and joined MB and SMB canals¹⁹. 1 case reported a separate SMB canal and joined MB and MBP canals²². Joining of the 2 canals occurred either in the apical²³ or middle²⁴ thirds of the root. Other root canal configurations were also reported including types 3-3²⁵, 3-1²⁶, and 3-2-1²⁷.

The complex nature of MBR makes it the most difficult root to be treated. The clinician must use all the available tools aids for the proper management of the same. The proper diagnosis by preoperative radiographs and working length radiograph in different horizontal angulation may be helpful in finding the accessory canals²⁸ but usually the accessory canals may be superimposed by the main MB canal⁴. CBCT imaging and computed tomographic image also helps in diagnosing and confirming the aberration in the root canal. However, the routine use of CBCT imaging is contraindicated because of the high radiation dose that is incurred.

When extra canal in MBR are suspected

- The access is slightly extended mesial and results in a trapezoidal shape rather than triangular shape^{29,30}.
- Use road map of pulpal floor to locate canals.
- Use of endodontic explores, round burs and ultrasonic tips for troughing the floor.
- Performing champagne test using sodium hypochlorite, Red line test and White line test to locate the canal orifice.
- Use of operating microscopes or surgical loupes
- Thorough knowledge about the variations that can occur for each tooth and the experience of endodontist.

The success of a nonsurgical root canal treatment depends on thorough debridement, good obturation and a good coronal and apical seal. When 3 separate canals are

present, each canal should be debrided and filled up to its apical end. If all the canals or 2 of them share a common apical foramen, the canal with direct access to the apex is prepared and obturated to the full working length while the other canal(s) are filled to the junction point. Preparing all canals to the full length is not recommended for 2 reasons. First, an hourglass preparation will result with the joining point between the canals being more constricted than the apical preparation, leading to voids in the obturation of the apical area below the constriction. Second, fracture of instruments, particularly rotary files, may occur as they traverse the sharp curvature into the common part of the canal². All the apparent root canal present should be prepared and adequately filled during endodontic surgery. The MBR has a wide buccolingual dimension, and incomplete resection of the root may fail to expose the more palatally located canals. This can be avoided by resecting the root perpendicular to its long axis, staining the root end with a dye, and inspecting it under magnification to delineate the root outline and apical terminus of all root canals³¹. Finally, the relative size of the 3 MB canals should also be considered. The main MB canal is larger and more tapered than the 2 other canals; hence, over enlargement of the additional canals should be avoided to prevent unnecessary thinning of the root walls or the occurrence of lateral root perforation³².

Conclusions

An accurate knowledge of the morphology of the pulp cavity is essential before an endodontic procedure can be approached rationally. The frequency with which root canals unite should be considered during enlargement and filling procedure¹¹.

Although the incidence of 3 root canals in a single MBR in maxillary molars is low, this anatomic variation must be considered while performing surgical and nonsurgical root canal treatment of these teeth. The clinicians should

always assume the presence of extra canals and use all the clinical and radiographic diagnostic tools to locate and treat them. Failure in locating and debriding extra canals may often result in treatment failure.

References

1. Weine FS, Healey HJ, Gerstein H, Evanson L. Canal Configuration in the Mesio Buccal Root of the Maxillary First Molar and Its Endodontic Significance. J Endod [Internet]. 2012 Oct;38(10):1305–8.
2. Vertucci FJ. Root canal morphology and its relationship to endodontic procedures. Endod Top [Internet]. 2005 Mar;10(1):3–29.
3. Pineda F, Kuttler Y. Mesiodistal and buccolingual roentgenographic investigation of 7,275 root canals. Oral Surgery, Oral Med Oral Pathol. 1972;33(1):101–10.
4. Weine FS, Healey HJ, Gerstein H, Evanson L. Canal configuration in the mesio buccal root of the maxillary first molar and its endodontic significance. Oral Surgery, Oral Med Oral Pathol. 1969;28(3):419–25.
5. Luke D. Wheeler's dental anatomy, physiology and occlusion, 7th edition. 1394.
6. Stropko JJ. Canal morphology of maxillary molars: Clinical observations of canal configurations. J Endod. 1999;25(6):446–50.
7. Vigouroux SAA, Bosaans SAT. Anatomy of the Pulp Chamber Floor of the Permanent Maxillary First Molar Number of Root Canals Position of Pulp Chamber Floor in Relation to Lateral. J Endod. 1978;4(7):214–9.
8. Karthikeyan K, Mahalaxmi S. New Nomenclature for Extra Canals Based on Four Reported Cases of Maxillary First Molars with Six Canals. J Endod [Internet]. 2010 Jun;36(6):1073–8.
9. Wolcott J1, Ishley D, Kennedy W, Johnson S, Minnich S MJ. A 5 yr clinical investigation of second mesio buccal canals in endodontically treated and retreated maxillary molars. J Endod. 2005;Apr;31(4):
10. Preiswerk G. Die Pulpaamputation, eine klinische pathohistologische und bakteriologische Studie. Österreichisch-Ungarische Vierteljahresschrift für Zahnheilkunde. 1901;17:145–220.
11. Vertucci FJ. Root canal anatomy of the human permanent teeth. Oral Surgery, Oral Med Oral Pathol. 1984;58(5):589–99.
12. James Gilles DDS, MS (Assistant Professor) a Al Reader DDS MP. An SEM investigation of the mesiolingual canal in human maxillary first and second molars. Oral Surgery, Oral Med Oral Pathol. Volume 70 (Issue 5): Pages 638-643.
13. Jong-Wook Park DDS, PhD a Jong-Ki Lee DDS, MS D b Byung-Hyun Ha PhD c Jeong-Ho Choi DDS, PhD d Hiran Perinpanayagam DDS P. Three-dimensional analysis of maxillary first molar mesio buccal root canal configuration and curvature using micro-computed tomography. Oral Surgery, Oral Med Oral Pathol Oral Radiol Endodontology. Volume 108 (Issue 3): Pages 437-442.
14. Louis J. Buhrley DMD Michael J. Barrows DDS Mse ABSW. Effect of Magnification on Locating the MB2 Canal in Maxillary Molars. J Endod. Volume 28 (Issue 4): Pages 324-327.
15. Elmer J. Neaverth DDS 1 Lawrence M. Kotler DDS 1 Robert F. Kaltenbach PhD 1. Clinical investigation (in vivo) of endodontically treated maxillary first molars. J Endod. Volume 13 (Issue 10): Pages 506-512.
16. Hartwell G, Bellizzi R. Clinical investigation of in vivo endodontically treated mandibular and maxillary molars. J Endod [Internet]. 1982 Dec;8(12):555–7.

- Available from: [https://doi.org/10.1016/S0099-2399\(82\)80016-2%0A](https://doi.org/10.1016/S0099-2399(82)80016-2%0A)
17. Zheng Q, Wang Y, Zhou X, Wang Q, Zheng G, Huang D. A Cone-Beam Computed Tomography Study of Maxillary First Permanent Molar Root and Canal Morphology in a Chinese Population. *J Endod* [Internet]. 2010 Sep;36(9):1480–4.
 18. Lee J-H, Kim K-D, Lee J-K, Park W, Jeong JS, Lee Y, et al. Mesio Buccal root canal anatomy of Korean maxillary first and second molars by cone-beam computed tomography. *Oral Surgery, Oral Med Oral Pathol Oral Radiol Endodontology* [Internet]. 2011 Jun;111(6):785–91.
 19. Ahmad IA, Al-Jadaa A. Three root canals in the mesio Buccal root of maxillary molars: Case reports and literature review. *J Endod* [Internet]. 2014;40(12):2087–94. Available from: <http://dx.doi.org/10.1016/j.joen.2014.07.034>
 20. SERT S, BAYIRLI G. Evaluation of the Root Canal Configurations of the Mandibular and Maxillary Permanent Teeth by Gender in the Turkish Population. *J Endod* [Internet]. 2004 Jun;30(6):391–8.
 21. Gu Y, Lee JK, Spångberg LSW, Lee Y, Park CM, Seo DG, et al. Minimum-intensity projection for in-depth morphology study of mesio Buccal root. *Oral Surgery, Oral Med Oral Pathol Oral Radiol Endodontology* [Internet]. 2011 Nov;112(5):671–7.
 22. Ibrahim S. An unusual maxillary first molar with six canals: a case report. *Leban Soc Endodontology*; 2009.
 23. Martínez-Berná A, Ruiz-Badanelli P. Maxillary first molars with six canals. *J Endod* [Internet]. 1983 Sep;9(9):375–81.
 24. Kottoor J, Velmurugan N, Sudha R, Hemamalathi S. Maxillary First Molar with Seven Root Canals Diagnosed with Cone-Beam Computed Tomography Scanning: A Case Report. *J Endod* [Internet]. 2010 May;36(5):915–21.
 25. Beatty RG. A five-canal maxillary first molar. *J Endod* [Internet]. 1984 Apr;10(4):156–7.
 26. Ayranci LB, Arslan H TH. Maxillary first molar with three canal orifices in mesio Buccal root. *J Conserv Dent*. 2011;14:436–7.
 27. Arora A, Acharya SR, Saraswathi MV, Sharma P, Ather A. Dilemmas pertaining to three canals in the mesio Buccal root of a maxillary second molar: a case report. *Restor Dent Endod* [Internet]. 2013;38(3):172.
 28. FAVA LRG, DUMMER PMH. Periapical radiographic techniques during endodontic diagnosis and treatment. *Int Endod J*. 1997;30(4):250–61.
 29. Garg AK, Tewari RK, Kumar A, Agrawal N. Endodontic treatment of a maxillary first molar having three mesio Buccal canals with the aid of spiral computed tomography: a case report. *J Oral Sci* [Internet]. 2010;52(3):495–9.
 30. Kottoor J, Velmurugan N, Surendran S. Endodontic Management of a Maxillary First Molar with Eight Root Canal Systems Evaluated Using Cone-beam Computed Tomography Scanning: A Case Report. *J Endod* [Internet]. 2011 May;37(5):715–9.
 31. Kim S, Kratchman S. Modern Endodontic Surgery Concepts and Practice: A Review. *J Endod* [Internet]. 2006 Jul;32(7):601–23.
 32. Degerness RA, Bowles WR. Dimension, Anatomy and Morphology of the Mesio Buccal Root Canal System in Maxillary Molars. *J Endod* [Internet]. 2010 Jun;36(6):985–9.