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RESEARCH ARTICLE

ANATOMICAL VARIATIONS AND VARIOUS TECHNIQUES OF IDENTIFICATION OF MULTIPLE ROOT CANALS: A REVIEW

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Abstract

Variations in root canal morphology presents a constant challenge for clinicians in their detection and management. Locating and treating these extra canals is important in order to achieve favorable prognosis in endodontic therapy. This review article presents the anatomical variations, frequency of occurrence of aberrant root canal configuration and methods of identification using advanced imaging techniques like CBCT, DOM and loupes.

Introduction:-

The main objective of successful root canal treatment depends upon identification, negotiation, cleaning and shaping of all canals followed by three dimensional obturation with inert material. The major reasons behind endodontic failure are inability to locate, debride or inadequately fill unusual root canals.[1]

Maxillary first molars are triple root systems with 1 palatal and 2 buccal roots, each having 1 root canal respectively. However, various studies have shown presence of double root canal systems in mesiobuccal root (MB2), reported between 18.6% to 96.1% and distobuccal root (DB2), reported between 1.6% to 9.5%. The incidence of two root canal systems in palatal roots have also been reported ranging from 0.2%-7%. In rare cases, a third mesiobuccal (MB3)/ distobuccal (DB3)/ palatal canal have also reported.[2]

The mandibular first and second bicuspids have also reported the incidence of two or more root canals ranging between 2.7% to 62.5% and 0% and 34.3 % respectively. The maxillary second premolar have shown the incidence of two canals in the apical third reported from 4% to 50%. The lower anterior teeth have also shown the possibility of two or three root canals ranging between 1% to 43%. The major causes for endodontic failure include missing root canals, complex orientation of pulp tissues demanding a thorough mechanical and chemical debridement, distinct morphology of root canals, and failure of canal identification. The treatment of complicated root canal systems has become foreseeable due to advancements in digital imaging, magnification, instrumentation and disinfection.[3,4]

Review of Literature:-

In 2011, Ayranci et al and Du et al found a Sert and Bayirli type XVIII (3-1) and type XV (2-3) configuration of 3 canals in mesiobuccal root of maxillary first molar respectively.[5]

In year 2010, Karthikeyan and Mahalaxmi reported a case of right maxillary first molar with six canals of which 3 were found in distobuccal root presenting Gulabivals's supplemental type III (3-2) canal configuration.[6]

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Degerness et al in 2010 sectioned and inspected 90 uninstrumented mesiobuccal roots of maxillary first molars using stereomicroscope and established incidence of 1.1% in MB3.[7]

Kim et al in 2012 analyzed 458 maxillary first molars using CBCT and described the prevalence of MB3 of 1.3%.[2]
In 2009, Baratto Filho et al reported maxillary first molars with three roots and seven canals. On evaluating 140 extracted teeth he found one tooth which contained three mesiobuccal, three distobuccal and one palatal canal. The rate of occurrence of MB2 was shown based on different results as 92.85% (ex vivo), 95.63% (clinically), 95.45% (CBCT), on the contrary the figures for DB2 were such as 1.15% (ex vivo), 3.75% (clinically) while presence of second palatal canal discussed were 2.05% (ex vivo), 0.62% (clinically) and 4.55% (CBCT).[8]

Cleghorn et al in 2006, reviewed various anatomical studies of root canal morphology of 8,399 maxillary first molars teeth that were allocated in 34 laboratory and clinical studies. In this wide sample, the incidence of one MB canal was 43.1% and two canals MB1 and MB2 was 56.8%. the rate of occurrence of one apical foramen in mesiobuccal root was 61.6% and two separate foramens were found in 38.3%. He also reported the frequency of one canal in distobuccal root as 98.3 % while two canals in 1.7% with 98% cases of single apical foramen. Palatal canal majorly showed single canal and single foramen with frequency of 99% and 98% respectively. In his substantial analysis He also reported the absence of third canal in any of three roots.[9]

Nikhita et al in 2014, reviewed 250 maxillary canines and described the presence of Vertucci type III as 11.6% in Indian population.[3] (Image 1)

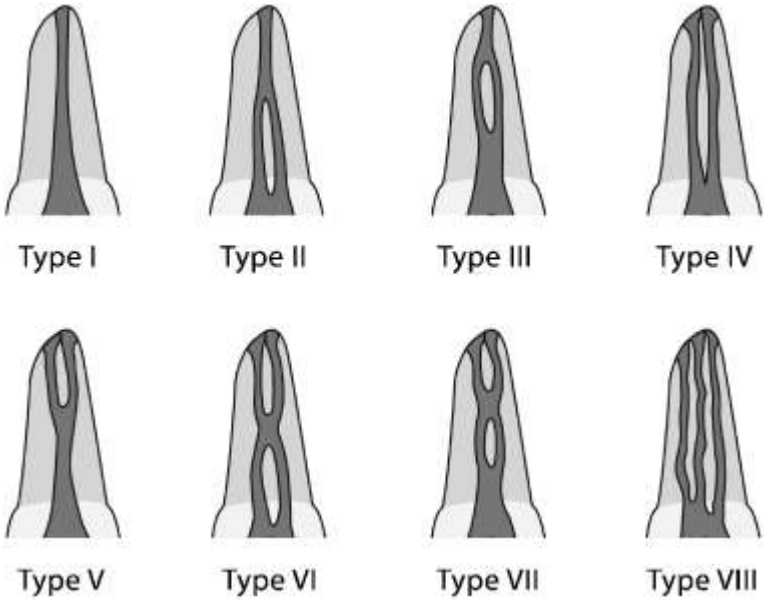

Image 1:- Diagrammatic representation of Vertucci's canal configurations.

Discussion:-

The part of microscopy in endodontics should not be set too low. Buhrley et al determined the practitioner's ability to discover the MB2 canals in maxillary molars using DOM and dental loupes and concluded that occurrence of MB2 canals varies from 71.1% for microscope to 62.5% for dental loupes while 17.2% in no magnification groups. Hence, practitioners should accustom themselves to dental microscopy and new imaging technology like CBCT scanning, that helps to get supplemental anatomic information in endodontic practice.[1]

CBCT has been highly victorious in enabling a better visualization and three-dimensional imaging of unusual anatomy. In contrast to conventional CT scans, CBCT provides higher resolution with reduced radiation dose. in the cases where the principal of 'as low as reasonably achievable' (ALARA) was considered, but the advantage of using CBCT outweighed the risks of additional canals.[3]

While performing the endodontic treatment, the operator must highly consider the anatomy of the tooth as information gathered prior to initiation greatly facilitates the subsequent treatment. An exploration of the floor of the pulp chamber guides the practitioner in finding the type of canal configuration. If there is only one canal, it is found rather easily in the center of the preparation while if one orifice found doesn't lie in the center of the tooth, probably another canal is present that should be explored on the opposite side. The correlation of the two canal orifices to each other is significant. Orifices closer to each other have greater chances of canals joining at some point within the body of the root. If on direct pulpal exposure, a root canal shows a sudden narrowing or disappears, possibly at this point the canals divides into two parts which either remain separate or merge before exiting the apex. In such cases, radiographs taken from various angles with files in place prove to be helpful. Teeth with canal bifurcations generally present problems in treatment. Out of the two canals, the one with the common passage is manageable to proper cleaning and obturating procedures, while for the other canal it gets very difficult. Even though the canal systems appear to be obturated radiographically and clinically, the presence of unfilled canals lead to endodontic failure.[4]

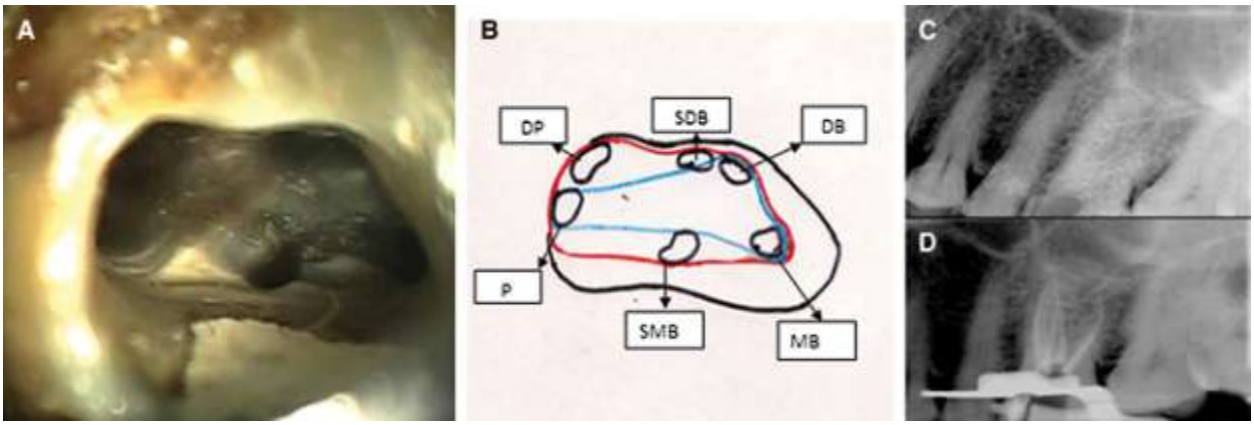

Image 2:- (A,B) Modified (trapezoidal) access cavity of maxillary molar showing 6 orifices (2 palatal, 2 MB and 2 DB canals). (C) Pre-operative radiograph. (D) Obturation radiograph. In (B) blue line shows conventional access outline, red line shows internal outline of modified access, black line is for canal orifice outline and external outline of modified access.

The major occurrence of multiple canals in the mesiobuccal root is due to root being broader buccolingually as compared to round or ovoid cross-section of distobuccal canal. Occasionally, fusion of distobuccal root with palatal root may be due to former being broader buccolingually and may lead to additional canals in the root.[2]

Endodontic access provides direct path to the apical third of the root canal system as abnormal root canal morphology especially in multi rooted teeth can be a challenge for successful treatment. The practitioner should visualize coronal third of the root canal systems. In order to achieve straight line, access the standard triangular access cavity can be altered into many shapes like clover leaf like (shamrock), heart, trapezoidal, rectangular, rhomboidal, and ovoid shapes, varying according to the clinical situation.[10] (Image 2,3)

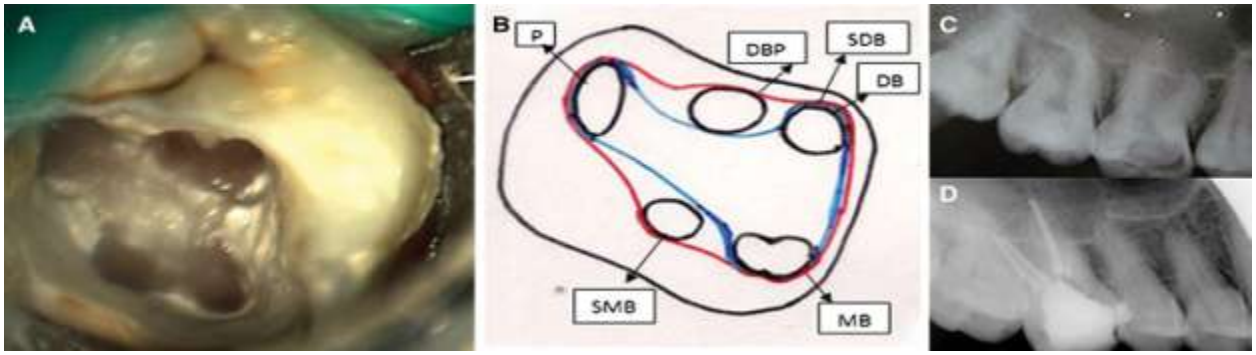

Image 3:- (A, B) Modified (rhomboidal) access cavity of case 3 showing 5 orifices (1 palatal, 2 MB, and 3 DB canals; DB and SDB had same orifice). (C) Preoperative radiograph. (D) Obturation radiograph. In (B) blue

line indicates internal outline of conventional access, red line indicates internal outline of modified access, and black line is for canal orifice outline and external outline of modified access.

Methods of Detecting Additional Canals

Different methods of locating extra canals have been discussed by many authors:

1. Additional off-angle radiographs (at least 3 radiographs at varying horizontal angles).
2. Use of computed tomography.
3. Use of magnification (loupes and dental operating microscopes).
4. Examine dental map minutely and use DG 16 to explore the floor of the pulp chamber.
5. Look for hemorrhagic spots (indicate the presence of extra canals).
6. Perform champagne or bubble test with sodium hypochlorite.
7. Staining the pulp chamber with dye (e.g.,1% methylene blue).
8. Use of ultrasonic tips, special round burs, and thin tapering finishing burs to remove a small amount of tooth structure or calcification and trough the line angles of the pulp chamber with help.
9. Modify the conventional outline form to include the extra canals.
10. Ensure adequate straight line- access to improve visibility.

Increased operator experience and time per appointment help in identification and root canal morphology.[10](Image 4)

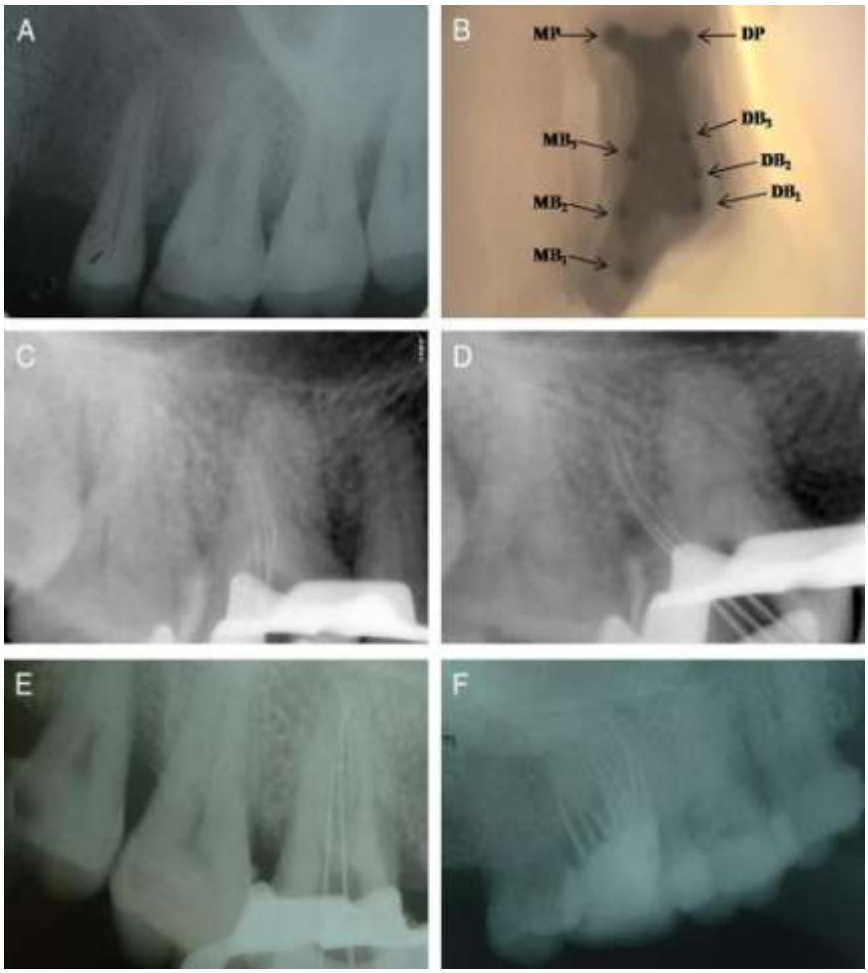

Image 4:- (A) A preoperative radiograph of tooth #14. (B) Access opening showing the eight root canal orifices. (C–E) Eccentrically angulated radiographs of tooth #14 to confirm the working length in the (C) mesiobuccal, (D) distobuccal, and (E) palatal roots. (F) A post-obturation radiograph of tooth #14 in eccentric angulation showing the root canal system of the tooth.

Conclusion:-

Amongst all the 8 different permanent teeth, the maxillary molar has proven to have the complex root canal anatomy with mesiobuccal canal showing soaring chances of diversity. A dental practitioner should have a precise knowledge of the normal morphology of the pulp cavity and the arrays possible in the tooth keeping in mind the classification of different root canal system. A clinician should be aware of occurrence of bifurcations and merging canals during canal enlargement and filling, if therapy fails unexpectedly. Dental radiography with different angulations and orientation is a useful tool, however, different advancements such as dental microscope, dental loupes, CBCT can increase the efficiency of diagnosis.

References:-

1. Endodontic Management of a Maxillary First Molar with Eight Root Canal Systems Evaluated Using Cone-Beam Computed Tomography Scanning: A Case Report. JOE 2011; 37:715-19.
2. Endodontic management of a maxillary first molar with three roots and seven root canals with the aid of cone-beam computed tomography. RDE 2015: 241-248
3. A Case Report on Endodontic Management of a Rare Vertucci Type III Maxillary Canine. HINDAWI; VOL.2019:1-5.
4. Root Canal Anatomy of the human permanent teeth. Oral surg. 1984; 58:589-99.
5. Ayranci LB, Arslan H, Topcuoglu HS. J Conserv Dent 2011; 14:436-37
6. Karthikeyan K, Mahalaxmi S. New nomenclature for extra canals based on four reported cases of maxillary first molars with six canals. J Endod 2010; 36:1073-78.
7. Degerness RA, Bowles WR. Dimension, anatomy and morphology of the mesiobuccal root canal system in maxillary molars. J Endod 2010; 36: 985-989.
8. Baratto Filho F, Zaitter S, Haragushika GA, et al. Analysis of the internal anatomy of maxillary first molars by using different methods. J Endod 2009; 35: 337-42.
9. Cleghorn BM, Christie WH, Dongg CC. Root and root anal morphology of the human permanent maxillary first molar: a literature review. J Endod 2006; 32: 813-821.
10. New Nomenclature for Extra Canals Based on Four Reported Cases of Maxillary first Molars with Six Canals. JOE 2010; 36: 1073-78.