REVIEW ARTICLE

UNRAVELLING THE TREASURE HUNT - CANAL LOCATION TECHNIQUES AND AIDES

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ABSTRACT

A detailed exploration of the interior of the tooth is essential during endodontic treatment for proper chemico-mechanical disinfection of the root canal system. Missing an infected canal defeats the purpose of the treatment often leading to reinfection and retreatment. All efforts should be focused on detection of the canal systems correctly and location of these canal orifices. All negotiable canals should be cleaned and shaped to eventually be sealed using a biocompatible obturating materials. Magnification, illumination and other such aides must be utilized for achieving this goal. This review discusses the importance of various techniques and aides in detection of canals, in order to provide predictable root canal treatment and avoiding endodontic mishaps.

Keywords: *Orifice Location, Magnification, Access opening.*

INTRODUCTION

Endodontic treatment aims at thorough debridement and cleaning of the root canal system of any infected pulp tissue followed by propershaping and preparing of the canal to be filled with an inert material thus reducing or eliminating any chances of reinfection. However, when the endodontic treatment falls short of the standard clinical principles it tends to fail.[1]

Missed canals during routine endodontic treatments are more common than said. The frequency of missed canals is more in molars, where the one root one canal formula is usually not followed, as opposed to the maxillary anteriors (which also present with anatomic variations sometimes). The variation of anatomy sometimes proves as a challenge during detection of all canal opening and thorough debridement of the pulp tissues.The first and most important step in endodontics is proper access cavity preparation. An improper access preparation leads to an inability to detect the canals even by the most accomplished clinician. The inability to treat all the canals, which harbour residual bacteria, is one of the causes leading to endodontic failure.[2] The results of one such study carried out by Wolcott J et al, on 5616 retreated molars showed that failure to locate the Mesio-Buccal 2 (MB2) canal had resulted in a significant decrease in the long-term prognosis of those teeth.[3]

Missed canals are the most common reason for treatment failure in endodontics. The importance of locating, cleaning, shaping and obturating all the canals cannot be overstated. However, nature provides us with some symmetry in pulp chambers, which may help us in locating the canals with more precision.

Inadequate and incorrect access opening often leads to failure of canal detection. According to Witherspoon DE et al,[4] missed canal systems are the most likely basis for endodontic re-treatment of molars. In their retrospective clinical study, missed canals were identified in 64 of the 133 previously treated teeth (48%). Of the total missed canals, 11% involved a maxillary second molar and 44% involved a maxillary first molar. In the mandibular second molars, 29% of missed canals were identified in the distal and 71% were identified in the mesial root. In the mandibular first molars, 86% of missed canals were identified in the distal and 14% were identified in the mesial root.

The following are some aides and techniques to follow for successful location of the canals in the tooth undergoing treatment, ultimately enhancing the prognosis of the treatment.

A. Anatomic Familiarity

1. Laws of pulp chamber familiarity

Krasner and Rankow (2004)[5] proposed nine guidelines or laws of pulp chamber anatomy to help clinicians determine the number and location of orifices on the chamber floor.

1.1 Law of centrality - The floor of the pulp chamber is always located in the center of the tooth at the level of the cemento-enamel junction (CEJ).

1.2 Law of concentricity- The walls of the pulp chamber are always concentric to the external surface of the

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tooth at the level of CEJ, that is, the external root surface anatomy reflects the internal pulp chamber anatomy.

1.3 Law of CEJ - The distance from the external surface of the clinical crown to the wall of the pulp chamber is the same throughout the circumference of the tooth at the level of the CEJ. This makes the CEJ the most repeatable and consistent landmark for location of the pulp chamber.

1.4 First law of symmetry - Except for the maxillary molars, canal orifices are equidistant from a line drawn in a mesio-distal direction through the center of the pulp chamber

1.5 Second law of symmetry - Except for the maxillary molars, canal orifices lie on a line perpendicular to a line drawn in a mesio-distal direction across the center of the pulp chamber floor (Fig. 1)

1.6 Law of color change - Pulp chamber wall is always darker in color than the vertical surrounding dentin wall.

1.7 First law of orifice location- The orifices of the root canals are always located at the junction of the walls and floor

1.8 Second law of orifice location- The orifices of the root canals are always located at the angles in the floor wall junctions.

1.9 Third law of orifice location- The orifices of the root canals are always located at the terminus of the roots developmental fusion lines.

2. Location of Mesio-Buccal 2 canal

Buhrley et al (2002)[6], conducted a study to compare the frequency of detection of MB2 canal using different magnification aides (dental operating microscope and dental loupes) and no magnification. The study showed that whereas, the frequency of MB2 detection without any magnification was only 17.2%, it was 62.5% with dental loupes and 71.1% using dental operating microscope. The result of this study shows that use of higher magnification leads to significant increase in detection rate. Hence, emphasis should be placed on the importance of using magnification for location of MB2.

MB2 usually is located mesially to or in a straight line connecting the mesiobuccal orifice and the palatal canal orifice. It is present within 3.5 mm palatally and 2 mm mesially from the main mesiobuccal canal.[7]

3. The Middle Mesial canal

Recent focus of research has shifted to the middle mesial canal in mandibular molars. The middle mesial (MM) canal, as the name itself suggests, lies in the developmental groove between the mesiobuccal and mesiolingual (ML) canals.[8] Vertucci and Williams as well as Barker *et al*were the first to report and study the incidence of this canal. A recent study on a section of North Indian population has shown that the frequency of detection of MM canals was.

A. 36.6% in patients 11-30 years old,

B. 22.6% in patients 31-50 years old, and

C. 18.4% in patients >50 years old.

This shows an age related incidence of finding a negotiable MM canal (Fig. 2).

Fig. 1: Middle mesial canal in mandibular first molar

B. Bubble Test: When NaOCl is flooded into the access cavity, it dissociates into Na + and Cl- ions and liberates free oxygen. A positive "bubble," or "champagne" test signifies that NaOCl is reacting with pulpal tissue or viscous chelator, if used.

C. Transillumination: A fiber optic wand may be positioned cervically so that light is directed perpendicular to the long axis of the tooth. Identifying an orifice is, at times, improved by turning off any overhead light source. (TIP – LED curing lights can also provide as a quick hand transillumination alternative)

D. Vision: Vision = Magnification + lightening. The dentist is now practicing a higher level of Microscope Assisted Precision (MPA) Dentistry as opposed to what was the norm a few years ago.

Commonly used magnification aides -

1. Loupes: Practical maximum magnification achieved by loupes is only about 4.5X and loupes with higher magnification are heavy and unwieldy with limited field of view.[9]

2. The operating microscope in dentistry: The dental operating microscope provides us with enhanced magnification and also aids in locating microfractures in the tooth which cannot be seen with the naked eyes, by radiographs or even by loupes. Under 16x to 24x magnification routine diagnostic, restorative, endodontic and surgical procedures are performed.. Methylene blue is used to stain the fracture and locate it under the microscope. The microscope is also an indispensable aid in re treatment cases, where a missed canal (Eg. MB2) needs detection, cleaning and shaping for proper endodontic treatment of the tooth.[10]

3. Orascope: Orascope is a recent introduction from the medical field to dentistry. It is a modification of the medical endoscope for application and use in the oral cavity. As is the principle of the medical endoscope, it uses fibreoptics, hence making it lightweight and flexible. Although ergonomically fiberoptic imaging was much more superior to traditional imaging techniques, but, it had poor image quality. However, this disadvantage was overcome by the orascope, which uses a unique lens design and a digital image processing system. This allows the orascope to provide a higher image quality as compared to the medical rod lens.

   When compared to the dental microscope, the orascope provides additional benefits and advantages. For example, the field of view of a microscope is fixed and cannot be readily adjusted for different angles of an endodontic treatment field. The orascope however being flexible can be readily adjusted and proves to be ergonomically superior.[11]

E. Rod-Lens Endoscope: The rod-lens endoscope allows clinicians greater magnification than what can be achieved with loupes or a microscope with the optical resolution comparable to the microscope and loupes. Although the endoscope can be used as a visualization instrument for conventional endodontic treatment, it can be bulky and difficult to maintain a fixed field of vision as compared to a microscope. This helps in maintaining good eye-hand coordination for the operator during examination or treatment. The clinician and the assistant(s) view the magnified image from the monitor.

F. Surgical Length Burs: Use of safe tipped Endo Z bur or Endo Access bur is advised. Long length burs like LN burs, move the visually obstructed head of the handpiece further away from the occlusal table. Long length round burs improve the line of sight along the shaft of the bur, promoting safety when searching for canals.

G. Micro-openers: Micro-openers are flexible, stainless steel hand files attached to an ergonomically designed off-set handle. Micro-openers provide unobstructed vision for initially penetrating and enlarging an offshoot that divides deep within a canal

H. Explorer pressure: Endodontic explorers like DG 16 are handheld explorers with strong, thin, and durable pointed tip. Firm explorer pressure provides a safe way to punch through a thin layer of secondary dentin and expose a hidden, receded, and more mineralized canal.

I. White line test: In necrotic teeth, dentinal dust frequently moves into any anatomical space, such as an orifice, fin, or isthmus, when performing ultrasonic procedures without water. This dust can form a white dot or line that provides a visible roadmap to, for example, an MB2 orifice/canal.

J. Red line test- In vital teeth, blood frequently emanates from an orifice, fin or an isthmus area. Like a dye, blood serves to map and visually aid in the identification of the underlying anatomy below the pulpal floor.

K. Dyes: Methylene Blue is a water- soluble dye that can be irrigated into a dry pulp chamber. The dye is absorbed into orifices, fins, and isthmus areas. The technique serves to visually "map" hard-to-find orifices or certain coronal fractures.

L. Restorative Disassembly: Removing a full coverage dental restoration provides direct visualization of the underlying tooth preparation. Coronal disassembly improves the predictability of safely entering the pulp chamber and identifying any given orifice.

CONCLUSION

Anatomic variations are present in all teeth, including but not limited to, extra canals and variation is canal anatomy. One of the most common endodontic mishaps seen in retreatment cases is missed canals. Efforts should be directed to apply the discussed techniques and aids to minimize these. The newly available dental microscopic instruments (microdebriders, micropeners) along with magnification provide us with a chance to practice predictable and successful endodontic treatment.

REFERENCES

1. **Siqueira JF.** Aetiology of root canal treatment failure: Why well-treated teeth can fail. Int Endod J. 2001;34:1-10

2. **Tabassum S, Khan FR.** Failure of endodontic treatment: The usual suspects. Eur J Dent. 2016 Jan-Mar; 10(1): 144-147.

3. **Wolcott J, Ishley D, Kennedy W, Johnson S, Minnich S, Meyers J.** A 5 yr clinical investigation of second mesiobuccal canals in endodontically treated and retreated maxillary molars. J Endod. 2005;31:262–4.

4. **Witherspoon DE, Small JC, Regan JD.** Missed canal systems are the most likely basis for endodontic retreatment of molars. Tex Dent J. 2013 Feb;130(2):127-39.

5. **Krasner P, Rankow HJ.** Anatomy of the pulp chamber floor. J Endodon 2004; 30(1):5.

6. **Buhrley LJ, Barrows MJ, BeGole EA, Wenckus CS.** Effect of magnification on locating the MB2 canal in maxillary molars. J Endod. 2002 Apr;28(4):324-7.

7. **Cantatore G, Berutti E, Castellucci A.** Missed anatomy: Frequency and clinical impact. Endod Top. 2009;15:3–31.

8. **Zhang R, Wang H, Tian YY, Yu X, Hu T, Dummer PM.** Use of cone-beam computed tomography to evaluate root and canal morphology of mandibular molars in Chinese individuals. Int Endod J 2011;44:990-9.

9. **Carr GB, Murgel CA.** The use of the operating microscope in endodontics. Dental Clinics. 2010 Apr 1;54(2):191-214.

10. **Kim S, Baek S.** The microscope and endodontics. Dental Clinics. 2004 Jan 1;48(1):11-8.

11. **Bahcall JK.** Visualization in endodontics. Eur J Gen Dent. 2013;2:96-101.