International Journal Dental and Medical Sciences Research (IJDMSR)
ISSN: 2393-073X Volume 2, Issue 5 (May- 2018), PP 59-62
www.ijdmsr.com

Role of Dental Operating Microscope in Endodontics

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ABSTRACT: In the last 15 years, for nonsurgical and surgical endodontics, there has been an explosion in the development of new technologies, instruments, and materials. These developments have improved the precision with which endodontics is performed. These advances have enabled clinicians to complete procedures that were once considered impossible or that could be performed only by talented or lucky clinicians. The most important revolution has been the introduction and widespread adoption of the operating microscope (OM).This article reviews on the potential applications of dental operating microscope in nonsurgical and surgical endodontics

Keywords: Microscope, endodontics, magnification, periapical surgery

I. INTRODUCTION

In the 21st century the operating microscope (OM) plays a vital role in endodontics and endodontists have led the way in embracing the OM into daily clinical practice. Endodontic treatments can be very challenging due to the complexity of the anatomy of the root canal system. In the past root canal treatment was performed predominantly by feel. With the aid of the OM, structures can be seen that remain hidden to the naked eye and treatment can be carried out with far greater precision and predictably than ever before. Microscopy in endodontics has become a way of life.

The OM has changed both nonsurgical and surgical endodontics. In nonsurgical endodontics, every challenge existing in the straight portion of the root canal system, even if located in the most apical part, can be easily seen and competently managed under the OM. In surgical endodontics, it is possible to carefully examine the apical segment of the root end and perform an apical resection of the root without an exaggerated bevel, thereby making class I cavity preparations along the longitudinal axis of the root easy to perform.

II. HISTORICAL PERSPECTIVES

Apotheker introduced the dental operating microscope in 1981 [1].The first operating microscope was poorly configured and ergonomically difficult to use. It was capable of only one magnification (8x), was positioned on a floor stand and poorly balanced, had only straight binoculars, and had a fixed focal length of 250 mm. This microscope used angled illumination instead of confocal illumination. It did not gain wide acceptance and the manufacturer ceased manufacturing them shortly thereafter their introduction. Its market failure was more a function of its very poor ergonomic design rather than its optical properties, which were actually quite good. Howard Selden was the first endodontist to publish a paper on the use of the operating microscope in endodontics. His article discussed its use in the conventional treatment of a tooth, not in surgical endodontics.

In 1991 Gary Carr introduced an operating microscope with Gallileanan optics and ergonomically configured for dentistry with several advantages that allowed for easy use of the scope for nearly all endodontic and restorative procedures[2]. This microscope had a magnification changer that allowed for five discrete magnifications (3.5-30x), had a stable mounting on either the wall or ceiling, had angled binoculars allowing for sit-down dentistry, and was configured with adapters for an assistant's scope and video/35 mm cameras. It utilised a confocal illumination module this gave far superior illumination than the angled light path of the earlier scope. This microscope gained rapid acceptance within the endodontic community. The efficient use of

the microscope requires advanced training. Many endodontic procedures are performed at 10- 15x and some requires magnifications as high as 30x.

III. APPLICATIONS OF OPERATING MICROSCOPE IN NONSURGICAL ENDODONTICS

a. Diagnosis

The operating microscope enables the endodontist to assess the marginal integrity of restorations and to detect cracks or fractures. The operating microscope can also be useful to detect radicular cracks and fractures, avoiding the necessity of exploratory surgery.

b. Identification of the floor of the pulp chamber

Insult to the pulp (caries, cracks, restorations) can make the floor of the pulp chamber difficult to identify. Using the OM it is possible to distinguish between pulp stones, reparative dentine and the true floor of the pulp chamber. Differences between calcifications in the pulp chamber (i.e. pulp stones) and the floor of the pulp chamber can be distinguished by colour and texture. Medium to high magnification is recommended.

c. Removal of coronal restorations

Increasingly composite is replacing amalgam as the material of choice for coronal restorations. As the colour of composite can be very similar to that of dentine, its removal can be difficult without a microscope

d. Preservation of tooth structure

The removal of excessive amounts of tooth structure, both coronal and radicular leads to weakening of the tooth. This can result in fracture of either the coronal restoration or root fracture. The OM allows for the strategic removal of tooth tissue during preparation and refinement of the access cavity, the removal of core materials in re-treatment cases and the preparation of canals with a non-circular cross section.

e. Assessment of canal cleanliness after preparation

Not all canals are circular in cross section and when oval canals are prepared with rotary instruments, debris can easily be left behind. The OM can be used to evaluate canal cleanliness after **3** OM in endodontics preparation and post instrumentation irrigation and any remaining debris removed before obturation.

f. Identification of internal cracks

The dentist should always look for internal vertical coronal and radicular cracks and fractures when using the OM. These would be difficult or impossible to detect without the high magnification and illumination provided by the OM.

g. Canal location

The root canal anatomy of teeth can be very variable and missed canals are a major cause of failure of root canal treatment. The OM plays a vital role in helping to identify accessory canals at whatever level they may be. Commonly missed canals are the MB2 canal in maxillary molars and to a lesser degree, the mid-mesial canal in mandibular molars, buccal canals of lower incisors and second and third canals in premolars.

h. Calcified canals

One of the greatest challenges in endodontics is locating canals, especially calcified canals. Canals sclerose from coronal to apical and several millimeters of sclerotic dentine may have to be removed before the canal is found. The OM tremendously facilitates this important part of endodontic treatment. Use medium to high magnification and maximum illumination when searching for small canals [4].

i. Evaluation and management of perforations

The ability to visualize and determine the exact extent of a perforation helps determine treatment options and prognosis and makes it possible to repair the site.

j. Obturation of the canal

Most canals are not circular in cross section and obturating them under the control of the OM ensures that the canals are filled with the root filling material in all dimensions.

k. Non-surgical Re-Treatment:

Endodontic re-treatment is considered to be one of the most challenging procedures in endodontics. In these situations the OM is essential. Following are the uses of the OM in non-surgical re-treatment:

- Removal of existing restorations, posts and core materials (especially useful for removal of composite cores
- Location of missed canals
- Removal of existing root filling materials
- Evaluation of the condition of the canals after removal of root filling materials
- Removal of necrotic tissue and residual root filling materials after re-preparation of the root canals
- Evaluation of the canal walls for cracks
- Overcoming ledges and blockages
- Removing fractured instruments
- Evaluation and repair of perforations

l. Apical plug with MTA

MTA is an excellent material for repairing perforations and sealing large apical foramina. The material can be placed with a great deal of control when using the OM to ensure that there are no voids

m. File evaluation

Evaluation of stainless steel hand and NiTi rotary files under magnification and enhanced illumination is an excellent and quick way to determine if files are weakening and are at risk of separating. The dentist should look for overwound file flutes (flutes too close to each other) or unwinding flutes (the space between the flutes increases, which makes it appear shiny under enhanced lighting). Identifying this helps reduce the chance of file separation. It is much easier to identify these weak points in a file under magnification.

IV. APPLICATIONS OF OPERATING MICROSCOPE IN SURGICAL ENDODONTICS

Surgical endodontic procedures under OM along with microsurgical instruments, can be performed much more conservatively. For instance, the amount of apical bone removal/osteotomy size does not need to be large when using the OM. Hence, the procedure could be considered as minimally invasive. The smaller apical osteotomy / access improves hard-tissue healing and success rates. The OM enables the dentist to locate isthmuses (often infected) joining adjacent canals (ie isthmus between MB1 and MB2 in maxillary molars or MB and ML canals in lower molars) [5] The OM enables the identification of fractured instruments at the root apex.

Using an OM enables the dentist to diagnose/locate root-end microfractures. Root-end canal preparation can be done more precisely and conservatively with use of micro-ultrasonic tips made specifically for surgery. For this, one should use high magnification and high illumination. Flaps are improved with the ability to make incisions more precisely with micro-scalpels. Suturing under the OM should be more precise and less traumatic. This is made possible since very fine sutures (i.e. 6-0) could be better visualized under the OM. This is especially important in the aesthetic area. [6,7,8]

V. THE FUTURE

The next stage in microscopic endodontics will involve the use of even finer microscopic instruments and the development of even more sophisticated techniques. Eventually, endodontists will be able to re-vascularize the pulp and grow dentin. These procedures will most certainly be microscopic in nature and will be quickly embraced by a specialty already well trained in microscopic procedures. In the meantime, microscopic procedures are being adopted by the other specialties in dentistry with impressive results. Restorative dentists and periodontists will be the next disciples to embrace a microscopic approach, and then it will be only a matter of time before all of operative dentistry is performed microscopically

VI. CONCLUSION

The operating microscope has revolutionised the specialty of endodontics. The increased magnification and the coaxial illumination have enhanced the treatment possibilities in non-surgical and surgical endodontics. Treatment modalities that were not possible in the past have become reliable and predictable with help of OP. As today we cannot imagine a dental office without the X-ray machine, in the same way we can state that the day is not far away when dentistry will be entirely and diffusely performed under the operating microscope.

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