Advances in Endodontic Magnification

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Abstract

The art of dentistry is based on precision. The human naked eye is capable of distinguishing fine detail, but it is no match for what can be accomplished when an image is sharpened and enlarged. The microscope and other forms of magnification fill that need, especially for accomplishing endodontic procedures. Enhanced magnification and illumination opened the eyes of endodontic surgeons to the intricate and complex root canal system. This advancement resulted in miniaturization of the endodontist's armamentarium. Nowadays, endoscope, orascope, intra oral cameras, dental operating microscopes are used in the field of endodontics

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Introduction

Traditional endodontics has been based on feel not sight. Together with radiographs and electronic apex locators this blind approach has produced surprising success. There is, however, a significant failure rate, especially in long-term. Magnification helps the user not only to see more, but to see well. High levels of magnification increase the aggregate amount of visual information available to endodontists for diagnosing and treating dental pathology.

Endoscope

The term endoscopy is derived from the Greek language and is literally translated as endon (within) and skopion (to see), hence the meaning, "to see within." Early endoscopists such as Hippocrates in 377 BC used primitive tube-like instruments for endoscopy. With major advances in the field of medicine, a breakthrough in optical quality was achieved in 1960 by an English physician, Hopkins, who created a rod lens series that led to important advancements in the field of view, magnification, and focal length of the endoscope, resulting in a clearer image. [1]

The field of endoscopy has expanded further with the introduction of the dental endoscope. The use of rod-lens endoscope in endodontics was first reported in literature in 1979. It was helpful in diagnosing dental fractures.

The traditional endoscope used in medical procedures consists of rigid glass rods and can be used in apical surgery and non-surgical endodontics. The flexible and semi-flexible endoscopes can be very valuable addition to the armamentarium. The endoscope is flexible due to special nitinol coating. The optical part which is 0.9 mm of diameter, is a piece of equipment that enables the practitioner a magnification of up to 20X with clear picture with wide angle. [1]

A 2.7mm lens diameter, a 70º angulation, and a 3 cm long rod-lens are recommended for surgical endodontic visualization and a 4mm lens diameter, a 30º angulation, a 4 cm long rod-lens are recommended for non-surgical visualization through an occlusal access opening.

The rod-lens endoscope provides clinicians greater magnification, greater clarity as compared to the microscopes and the loupes and the non-fixed field of vision. Non fixed field of vision is the ability to view treatment field at various angles and distances without losing depth of field and focus.

The Modular endoscope system (Sialo technology Ltd., Ashkelon, Israel) being based on modern technology of micro endoscopes is used in small channel organs (salivary gland ductal system, tear canals) and is designed to enable the practitioner to work inside the root canal with magnification and instrument access. [1]

The system includes three parts:

- Endoscopic Compact System,
- Optical Part That Includes Ocular Part & The Endoscope, &
- Handpiece with a disposable part.

Uses of Dental Endoscope

Diagnosis: The dental endoscope viewing system (Dental View) is currently available as a diagnostic and therapeutic adjunct to the restorative dentist, endodontist, periodontist, oral pathologist, oral surgeon, otolaryngologist, and dental hygienist.

Enhances Visualization: This dental endoscopic viewing system provides high magnification (24X to 50X) and a light source via a fiber-optic illumination that allows to detect new carious lesion, recurrent caries, inadequate restorations in proximal boxes or class V restorations, intrafurcal fractures, anatomic aberrations, (eg, a palatal groove on maxillary lateral incisors), residual crown and bridge cement, oral pathologic lesions, and root fractures/perforations. [1]

Transillumination: In cases of tooth infraction, the endoscope can provide transillumination as a diagnostic aid. As a fiberoptic light source, it is an excellent tool for fracture detection as light may refract along fracture line.

Apical Surgery: The surgical procedure is performed under the inspection of the endoscope with intermittent irrigation of isotonic saline and suction. The curvature of the hand-piece enables the practitioner to visualize the hidden parts of the cavity preparation, and to inspect for cracks and root fractures in the apical retrograde preparation. [1]

Endoscopic Observations during Endodontic Treatment

The endoscopic observation and treatment usually leads to detection and removal of the remaining dental pulp tissue following cleaning and shaping of the root canal walls .Lateral canals and microscopic root cracks are usually detected with high accuracy, providing better intra operative judgment and facilitating adequate treatment.

Orascope

The recently introduced flexible fiberoptic orascope is recommended for intracanal visualization, has a .8mm tip diameter, 0º lens, and a working portion that is 15mm in length. The term orascopy describes the use of either the rigid rod-lens endoscope or the flexible orascope in the oral cavity. Orascopic endodontics is the use of orascopy for visualization in conventional and surgical endodontic treatment.

The difference between an endoscope and an orascope is that:

- An orascope is made of fibre-optics and
- An endoscope is made up of glass rods. [1]

Both an orascope and an endoscope works in conjunction with a camera, light source and a monitor. The option of a printer or a digital recorder can be added to the system for the documentation procedure.In the past, fibre optic imaging provided superior ergonomics, but suffered from poor image quality. Today a unique lens design and combined with a digital image processing system in a camera allows fibre optics to be on par with the image quality of the endoscope.

Fibre optics are made up of glass or plastic. The advantages of fibre optics in endodontics are significant. They are:

1. Small
2. Lightweight
3. Very flexible

The image quality from fibre optic usage has a direct correlation to the number of fibres and the size of the lens used in an orascope. The orascope has a 10,000 parallel visual fibres. Each visual fibre is in between 3.7 to 5µ in diameter. A ring of much larger light transmitting fibres surrounds the visual fibres for illumination of treatment field.

Clinicians who use orascopic technology appreciate the fact that it has a non-fixed field of focus, which allows visualization of the treatment field at various angles and distances without losing focus and depth of field.

Orascopic Visualization Technique For Conventional Endodontic Treatment

The 0.8-mm orascope is used to visualize within the canal system. The small fiber-optic size enables the orascope to actually go down

into a canal. Prior to the placement of the 0.8-mm fiber-optic scope, the canal must be prepared to a size No. 90 file in the coronal 15 mm of the canal. If the canal is not instrumented to this diameter, a wedging of the probe may occur, damaging some of the fibers within the scope. Appropriate preparation also allows the full 15 mm of the orascope to penetrate within the canal. If a canal is curved, the orascope may not be able to visualize around the curve because of limited flexibility. It is important to note that the canal must be dried prior to usage of the 0.8-mm scope.The focus and depth of field of an orascope is zero mm to infinity. This allows the orascope to provide imaging of the apical third of the root without actually having to be positioned within this region of the canal.[1]

Endodontic Visualization System

The recently introduced Endodontic Visualization System (EVS) (JEDMED Instrument Company, St Louis, MO, USA) incorporates both endoscopy and orascopy into one unit. The EVS system allows for two methods of documentation. The camera head used in the EVS system is an S-video camera and, as such, documentation is usually accomplished by recording streaming video onto tape or digitized to DVD.

Now days the EVS II System is introduced. It also combines the fiber optic orascope and a rigid endoscope. It is said to provide optimal illumination and magnification for visualization during endodontic procedures. The system is designed to provide comfort and high quality images, and using it is said to require the same hand-eye coordination and patient positioning for ordinary procedures. The quick-connect camera handpieces can be efficiently switched to meet the needs of the procedure being performed.[1]

Dental Operating Microscope

Initially resisted, there has been a recent surge of interest in microscope enhanced dentistry among endodontists. Despite their higher price tags, however, when the dental operating microscope is fully integrated into an endodontic practice and used to its fullest potential, a return on investment is improved ergonomics and zero defect endodontics. [2]

Advantages

There are five basic advantages in using the DOM and accompanying documentation systems (digital microphotography and videography) for an endodontic specialist include: increased visualization, improved Quality and precision of treatment, enhanced ergonomics, ease of proper digital documentation and increased communication ability through integrated video. [2]

- Increased Visualization
- Improved Quality and precision of treatment
- Improved & Ideal treatment Ergonomics
- Ease of Proper Digital Documentation Capabilities
- Increased Ability to Communicate through Integrated Video

Disadvantages

There are some disadvantages, especially at the initial stages, most important one is the need for specific training: as a DOM has a restricted working field, 11mm -55mm .An operator using a DOM can see only the tip of the instruments, and they are used in delicate movements of small amplitude. Other disadvantages include the relatively high initial cost of the equipment and instruments, the need for retraining of the auxiliary staffs, and an adjustment period for the new treatment paradigms and operator postures, may increase treatment costs and reduce initial productivity, besides the need for rescheduling.

Position Statement of AAE on Use of Microscopes and Other Magnification Techniques, published in 2012 recommends the following procedures in Endodontics can be benefitted /from the use of the microscope :

- Locating hidden canals that have been obstructed by calcifications and reduced in size;
- Removing materials such as solid obturation materials (silver points and carrier-based materials), posts or separated instruments;
- Removing canal obstructions;
- Assisting in access preparation to avoid unnecessary destruction of mineralized tissue,
- Repairing biological and iatrogenic perforations;
- Locating cracks and fractures that are neither visible to the naked eye nor palpable with an endodontic explorer;
- Facilitating all aspects of endodontic surgery, particularly in root-end resection and placement of retrofilling material.

Use of Dental Operating Microscope in Endodontic Therapy

In all areas, from exposure of the access cavity and preparation to three-dimensional obturation and post endodontic management, the microscope provides major advantages over working without appropriate magnification. As a result, the use of the microscope can be expressly recommended for the following specific indications and special aspects: Examination, diagnosis, and treatment planning With enhanced visualization, the clinician's ability to diagnose problems in the earlier stages of a disease process is possible. High-powered magnification allows endodontists to identify a microscopic blemish, colour alteration, tiny amounts of plaque collecting within the grooves, microscopic amounts of chalky white demineralization around the grooves, and tiny amounts of flaking of darkened carious tooth structure within the crevices of these grooves. Treatments also can be performed with a greater level of precision, thereby reducing the occurrence of failures and the need of redos.[3]

Conclusion

Excellence in dentistry is both a choice and a journey, and magnification can be a powerful asset for those who seek absolute clinical accuracy. The operating microscope has revolutionized the specialty of endodontics. It represents a qualitative leap for the profession. Magnification and coaxial illumination have enormously increased the possibility of saving teeth both nonsurgically and surgically. Surgical loupes have a fixed magnification which may not allow a proper visualisation in all surgical steps.

Technological advancements in fiber-optic orascopes and rod-lens endoscopes have allowed for the development and evolution of these devices for use in clinical endodontics. The use of orascopy in conventional and surgical endodontic treatment has enabled clinicians to provide patients with improved and more predictable care.In the end, the excellent visual information can help the doctor to create more precise, more healthful, and more esthetically pleasing dentistry.

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