ISSN - 2394-7721

American Journal of Oral Medicine and Radiology

Journal homepage: www.mcmed.us/journal/ajomr

ENDOSCOPY IN THE CLINICAL PRACTICE OF DENTISTRY: A REVIEW

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Article Info

Received 15/07/2015
Revised 28/07/2015
Accepted 06/08/2015

Key words: - Dental loupes, Endoscope, Operating microscope, Implants, Restorative dentistry.

ABSTRACT

There has always been a quest by clinicians to actually observe and visualize the clinical procedures being carried out by them so they can co-relate with their respective theoretical concepts. As the field of dentistry involves minute and intricate anatomical structures, the naked eye vision provides limited field of observation. This lead to the advent of advancements in the sphere of magnification and illumination. The Endoscope remains as one of the pioneering and most promising tool to achieve this objective. By providing both intense focused light as well as a high degree of magnification, the endoscope, orascope, dental loupes and operating microscopes has become an important part of the armamentarium for many endodontists. The Dental endoscope not only acts as a diagnostic, but also as a therapeutic adjunct to the various disciplines of dentistry including restorative dentistry, endodontics, periodontics, implantology, caries detection and a whole lot more.

INTRODUCTION

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 procedure [1]. 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 [2]. Today`s innovative and high-tech optical systems can deliver amazing depths-of-field and wide fields of view that enable the dentist to view a complete oral cavity in focus without having to move [3]. The use of optical magnification instruments such as endoscopes, orascopes, loupes and microscopes enables the endodontist to magnify a specified treatment field beyond that perceived by the naked eye [4].

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Endoscopes

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 [5]. 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 [6].

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 [7]. 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.

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 [8].

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 [9].

Modular Endoscope System

The Modular endoscope system (Sialotechnology Ltd., Ashkelon, Israel) is designed and manufactured based on the experienced gained from other surgical fields of small channels, especially from salivary ductal system. A rapid development in endoscopic digital and illumination miniaturization led to compact system that fits in a dental operatory [10]. It consists of a camera, a video, a monitor, a light source, and an archive system. 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 practioner a magnification of up to 20 with clear picture with wide angle. This type of endoscope has a 3 channel instrument for endodontic instruments, suction and a channel for the telescope. The central channel contains the endoscope (0.9 mm endoscope 10,000 pixels 120o lens).

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 [11].

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 [12,13].

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 [14,15]. Currently, there are five types of magnification devices and systems to be used in dentistry:

1. Loupes,
2. DOM (Dental Operating Microscope),
3. Orascopes, modular
4. Endoscope system (microendoscopes).
5. Miniature endoscope

The range of magnification of the dental loupes varies from x2 to x6. The DOMs Provide magnification from 4X to 25X. While DOM is different, orascope and endoscope have some similarities.

Miniature endoscope

It includes a handpiece which further consists of three segments, mainly:

1. A semi-flexible examination probe
2. Flexible optical fiber connections for light transmission and image transmission
3. Rigid eyepiece with a cold light source connection and coupler for a high-quality CCD camera. For illumination, a bundle of randomly arranged optical fibres is employed, which transmits the light from the external cold light source to the distal tip of the endoscope.

Restorative Dentistry

The dental endoscopic viewing system enhances the visualization of a new carious lesion, recurrent caries, inadequate restorations in proximal boxes or class V restorations, intrafurcal fractures, anatomic aberrations, (eg, a palatal groove on maxillary lateralincisors), residual crown and bridge cement, oral pathologic lesions, and root fractures/perforations [16].

Once the etiology is determined with the endoscope, then the practitioner can use the enhanced visualization and, with curettes, files, scalers, and explorers, treat the problem with either a surgical or nonsurgical approach. The margins of a casting or restorations can be better evaluated for a precise fit by means of a dental endoscopy system. This provides in depth visualization as the naked eye inspection was limited to the supragingival areas. It was also used to visualize the abutment teeth and proximal areas with subgingival restorations [17]. The endoscope can also provide diagnostic confirmation of a tooth with a

suspected fracture by enhancing the visualization of the root surface [18].

Implantology

The main goal of the endoscopic-assisted dental implantation is to increase the longevity of oral implants by securing proper implant placement into bone of sufficient density. The Modular Dental Implant Endoscope can perform several tasks including the planning of surgery. The bone conditions can be accurately evaluated without causing any pressure necrosis of the bone. In complementary procedures, the endoscope can assist in sinus lifting intervention, and during the operation, endoscopic observation can further assess bone density and implant stability.

Until now, the number of reports on the application of endoscopy in dental implantology has been minimal. At the same time, these publications have reported that endoscopic assistance resulted in minimal invasive surgery, low intraoperative trauma, good implants ability upon placement, few postoperative symptoms, and high success rates after years of loading. The main goal of the endoscopic-assisted dental implantation is to increase the longevity of oral implants by securing proper implant placement into bone of sufficient density [19]. To meet this objective, the Modular Dental Implant Endoscope can perform several tasks. For the planning of surgery, bone conditions can be accurately evaluated without causing any pressure necrosis of the bone. In complementary procedures, the endoscope can assist in sinus lifting intervention, and during the operation, endoscopic observation can further assess bone density and implant stability.

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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