Original Article

ROLE OF MAGNIFICATION IN CONSERVATIVE DENTISTRY AND ENDODONTICS

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Abstract

Human aptitude and manual dexterity are very important in clinical dentistry. For dentists, visualising the oral cavity has always been a difficult challenge. In the past, only radiographs could be used to see into a root canal, and endodontic therapies relied on tactile sensation. For a more controlled optimization of quality intervention, greater ergonomic and visual rest for professionals, as well as in the manipulation of instruments in areas previously inaccessible to human vision, optical science, particularly of magnification, has contributed with magnifying glasses, operative microscopes (OM), and intraoral cameras.This review article will persuade clinicians to use magnification in their work for better results.

Keywords: Dental operating microscope, Access cavity, Minimal invasive dentistry.

Introduction

Dentistry is being led by a technological advancement movement that enables clinicians with the necessary training to use the best tools and skills in their daily work, expanding their current know-how and skills and producing the best results with the utmost accuracy[1]. Patients today envisage and demand to receive their therapies in the least painful and invasive way possible. There is far more than what the average eye can see, despite the fact that it is known that the brain can perceive what the eye can see[2]. Effectively enlarging the region of interest is a frequent technique for improving vision[1].

With the help of magnifying glasses, operative microscopes (OM), and intraoral cameras, optical science, particularly that of magnification, has contributed to a more controlled maximisation of quality intervention, providing greater ergonomic and visual rest to professionals[3]. It also allows one to manipulatethe instruments in locations previously inaccessible to human vision[4].

Endodontists have often commented that they can perform a significant portion of their work blindfolded basically on the grounds that there "isn't anything to see." But truly with the appropriate equipment, there is a multitude to see[5].Both nonsurgical and surgical endodontics have been revolutionized by magnification. The use of

magnification in practise indicates greater precision, better handling, and tenderness and completeness in the operations, with minor alteration to the already performed approaches, rather than cognitive revolutions in the currently used methods[2]. In order to encourage readers to embrace magnification, this article gives a quick summary of the use of magnifying equipment in conservative dentistry and endodontics.

Magnification devices in dentistry

Generally speaking, the idea of "magnification enhanced dentistry" entails mainly utilizing four different kinds of optical magnification systems:

- Loupes
- Surgical operating microscope
- Orascope
- Endoscope

Each contributes to accuracy improvement beyond the capabilities of unaided vision, yet each has its own advantages and limitations. Compared to either unaided vision or an entry-level 2.5x magnification, high-powered magnification, such as 4x-6x or more, gives better visual information for diagnosing and treating dental pathology[6].

Use of magnification in conservative dentistry

The introduction of the operating microscope has redefined conservative dentistry. Magnification is the only method for accomplishing the modern goal of preserving as much healthy tooth tissue as possible. A shift toward minimally invasive dentistry has occurred in recent years, allowing cavities to be filled while sparing as much healthy tooth tissue as possible.

The following scenarios call for the advantages of magnification in restorative dentistry treatments:

1) Diagnosis of Cracked Tooth Syndrome: To diagnose tooth fracture, clinicians have always depended on a patient's indications and symptoms. Enamel rods and dentinal tubules respond to injury quite differently because of differences in size, structure, hardness, and to some extent, orientation. When a patient bites onto something hard or receives a blow, an isolated piece of enamel may craze or break. The underlying dentin tooth structure must be resilient and forgiving enough to keep the crown intact despite the immediate discomfort that the damage may cause. The majority of these superficial fractures are typically difficult to see with unaided vision, but when magnified, hairline fissures appear as crevasses[7]. An acceptable magnification level for assessing enamel cracks is generally agreed upon by skilled doctors using a clinical microscope, with a range of x14 to x18, with an ideal magnification range of x16. Treatment of posterior teeth that are asymptomatic but structurally unstable is made possible by the use of the clinical microscope[8].

2) Marginal leakage: For retention, restorations rely on mechanical adjustment and/or chemical adhesion. Microleakage at the restorative interface may go undetected during a regular evaluation for a variety of physical and chemical causes, including fit and material deterioration. Caries may therefore continue to develop unhindered under that restoration for a very long time. This condition is more likely to develop when a complete crown is used as a restoration because the metal used in full crowns predisposes to decay and interferes with radiographic

and visual evaluation of the underlying tooth structure. As a result, damage is frequently overlooked until the restoration completely falls out or the patient complains of pain and/or bleeding or swelling beneath the gingival margin. When a small, occlusally angled force is applied to the restoration's gingival edge, it frequently reveals a micromovement that is not visible to the naked eye but is clear and simple to see when seen under a magnification[7]. According to J. Mamoun, using Microscope Level Magnification Combined With Coaxial Illumination (MLMCI) at 6x to 8x rather than unassisted vision and non-coaxial shadow-forming overhead lighting may increase a dentist's ability to prepare, bond, restore, and alter composite restorations.[9]

3) Soft tissue evaluation: Patients frequently complain of pain and other symptoms that point to inflammation or infection, but visual and radiographic assessments cannot always pinpoint the issue. An infected intraosseous lesion may occasionally trephine the labial plate yet elude identification by standard diagnostic techniques. With a gutta percha cone inserted into the aperture of a discrete sinus tract found under strong magnification, a path to the primary site of infection can be promptly identified radiographically.[7]

4) Pulp involvement: Reeves and Stanley, renowned dental pathologists with expertise in pulp biology, claim that bacterial invasion of the pulp occurs when the residual dentin depth is less than 0.2 mm from the pulp tissue.[10] A minute pulp exposure may go undetected and endanger the tooth and any upcoming restorations when dentin, especially at this level, is discoloured from caries and/or prior restorations. High magnification allows for careful cavity floor exploration and prompt implementation of necessary interceptive pulpal treatments (such as pulp caps, pulpotomies, and pulpectomies).[7]

5) Coronal preparation: Restorative dentistry necessitates degree of accuracy, especially when success depends on aesthetics. Even little variations in chamfer finish might cause gingival integrity to be lost and negatively expose the crown-root junction. To avoid negative tissue reactions and to satisfy patients, accuracy is crucial.[7] The installation of rubber dams and the administration of anaesthetic can both be done using the lower range of the microscope's magnification (2.5x to 4x). At this magnification, a quadrant of teeth can usually be seen in its whole. With medium magnification (6.4x to 10x), the tooth structure is reduced completely, and with 16x, the margins are finished. After the margins are finished, the preparation is checked under low magnification to make sure no undercuts were made.[11]

6) Impression quality: The success of indirect restorative techniques depends on getting a clear image of the whole crown preparation as well as the unaltered coronal root junction. Any inconsistency in impression is passed to the dye, resulting in a restorative misfit and, when seated, is prone to marginal leakage. The laboratory guesswork and the disappointment and aggravation of having to perform the restoration at a later date are eliminated when the impression surface is checked for flaws, distortions, and marginal inadequacies under high magnification at the moment the impression is taken. A professional and financially sound choice is to simply reject a poor impression.[7]

7) Evaluation of restoration undersurface: Surface imperfections are common on the underside of metal castings or ceramic baked restorations. These minute flaws, which are invisible to the naked eye but are detectable at extreme magnification, can modify occlusion, interfere with restorative seating, and, if seated, encourage marginal leakage. Even worse, when pressed into place, the uneven crown-tooth interface resembles a wedge and may break the prepared tooth at the site of contact.[7] The marginal adaptation of inlays and crowns to dies in a laboratory setting has been rigorously explored in a number of prior studies.[12-16] Prior to the approval for cementation, endoscopic procedures allow for a laboratory evaluation and can identify areas of the margin that are or may eventually become faulty. Additionally, they have the intriguing potential to allow for a clinical

environment critical evaluation of technique outcomes to see whether what is thought to be occurring is actually occurring.[17]

8) Bonded restorations: The finishing criteria for the bonded restoration are special and more complex, necessitating additional attention and accuracy to produce a margin that is smooth and non-irritating to the gingival tissues. It gets harder to judge the finished crestal edge's surface texture as one moves through the regimen of finer and finer burs and finishing discs. One cannot be sure that the gingival tissues won't swell, bleed, recede, or reveal the crucial root-filling contact until this junction is precisely adjusted under magnification.

9) Locating the areas of demineralized enamel tissue: Demineralization on the surface of the tooth begins at the start of dental caries as a result of acid exposure that slowly erodes the enamel structure. Given the occurrence of acid-induced bacteria in the oral cavity that disintegrate the tooth structure, dental caries leads to tooth destruction. X-ray analysis used to be the gold standard for the diagnosis of dental caries, however it is difficult to detect the condition in its early stages or tooth demineralization with this technique.[18]Based on the morphological and scattering changes of the tooth enamel surface caused by demineralization, high-resolution optical coherence tomography can be used to detect early stages of demineralization.[19]

10)Identification of old restorations and their less invasive removal: Composite is increasingly taking the place of amalgam as the preferred material for coronal restorations. Without a microscope, it may be challenging to remove composite since its colour can be extremely similar to that of dentine.[20]

Use of magnification in endodontics

The use of magnification instruments offers significant advantages over operating without the proper magnification in all areas, from exposure of the access cavity and preparation to three-dimensional obturation and post endodontic treatment. Consequently, the following specific indications make using the magnification specifically suggested:

1) Coronal access: Amorphic calcified dentin is deposited in layers by the pulp tissue in response to ageing, repetitive restorative operations, damage from injury, and occlusal wear.[21] The risk of perforating the floor during endodontic coronal access increases in a chamber that has obliterated itself with secondary and tertiary dentin. The actual floor of a pulp chamber, reparative dentine, and pulp stones can all be distinguished with the OPMI owing to their color and textural differences. It is advised to use medium to high magnification decreasing the risk of failure.[20]Minimally invasive endodontics has challenged the traditional endodontic method in recent years.[22] A number of access cavity (AC) designs that need the least amount of tooth tissue removal have been created to allow access to the pulp chambers during root canal therapy such as truss, ninja and caries driven access cavity which can only be achieved under magnification.[23]

2) Locating orifices: The idea that a root has a single canal and exit has been dispelled.[7]According to studies, almost every root has the potential for several canals and intracanal communications. Finding and navigating every canal aberration is what separates success from failure.[24] The MB2 canal in maxillary molars and, to a lesser extent, the mid-mesial canal in mandibular molars, the buccal canals of lower incisors, and the second and third canals in premolars are among the canals that are frequently missed.[20]

Signs of anatomical variations are easy to spot with the dental microscope and include:

- Unusual placement or shape of the root canal opening
- Isthmuses and accessory root canals
- C-shaped root canals, and web-like root canals can all be signs of fused roots.
- Evidence of suddenly diverting root canals may include debris remnants driven into laterally progressing endodontic cavities and left on root canal walls.
- Visual control allows for the detection and exposure of branching, isthmuses, or root separation in the depths of the root canal system with the help of a precurved instrument placed into the root canal under magnification.

3) Calcified canals: Locating canals, particularly calcified canals, is one of the biggest obstacles in endodontics. Before the canal is discovered, several millimetres of sclerotic dentine may need to be removed since canals sclerose from coronal to apical. This crucial aspect of endodontic treatment is greatly facilitated by the magnification. When looking for small canals, use maximum illumination and medium to high magnification.[20]Fifty percent of all teeth have some degree of obliterations and calcifications, which severely limit instrumentation or essentially bar the treatment of the canal system.[25]Denticlesa specific form of calcification are quite common, can hinder additional instrumentation or even block the canal opening. A dental operating microscope and ultrasonics can be used to easily locate and navigate denticles.[26] To remove the calcific obstruction, a Start-XTM #3 ultrasonic tapered and active tip (Dentsply Maillefer) was used. It was possible to separate the entire mass from the pulp chamber's walls and its underlying attachment.[27-30]

4) Locating and retrieving foreign objects: The phrase "broken instruments" can refer to any dental component that is still inside the canal, including a sectioned silverpoint, a gates glidden drill, a component of a carrier-based obturator, or any other dental material. It is not just limited to fragmented files.[31,32] In order to apply instrument retrieval procedures, the tooth must be prepared in a fashion that results in an excessive loss of radicular dentine. The ideal method of instrument retrieval is to preserve as much of the natural canal shape as possible while causing the least amount of harm to the tooth and its surrounding tissues.[33]A powerful microscope's enhanced vision and illumination capabilities, combined with a careful and precise circumferential troughing of the approximating dentin with an appropriate ultrasonically powered alloy or diamond tip, are required to locate and remove these canal blocking obstructions without piercing the root. Without magnification, troughing encourages failure and perforation.[7]

5) Repairing iatrogenic and idiopathic restorations: A procedural mishap called root perforation has a significant impact on the treatment's outcome. Perforations are reportedly a frequent reason for endodontic failure.[34] It has been asserted that apart from the availability of a matrix against which the sealing material can be packed to prevent excessive spreading into the periradicular tissues, difficulties in diagnosing the location, shape, and size of the perforation limit non-surgical therapy of perforation.[35]Only with the help of improved vision and lighting provided by a powerful microscope can canal-periodontal ligament connections be located and repaired using a sensitive and accurate intracanal access.[7]

6) In open apex cases: Recent apexification therapies require specialised treatment methods and materials, whose handling is aided by the use of a dental microscope.[25]

7) Endodontic surgery: By implementing the microscopic concept, which Prof. Kim first proposed in the 1990s, into surgical endodontics, it is possible to manage the bone structures better, perform atraumatic, more moderated bevel apical resection procedures, and permit coaxial ultrasonic preparation into the root. This enables minimally

invasive class I retrograde cavity preparation and retrograde fusing.[36,37]The physicians can perform endodontic surgery using microsurgical techniques that involve smaller osteotomies, shallow bevels, preparation of isthmuses, assessment of resected root surfaces, retro-preparation parallel to the root canal, and exact insertion of fresh filling materials. On correct intraoperative diagnosis, though, endodontic surgery's success is largely dependent. Additionally, endoscopy is said to give surgeons excellent vision and ease of usage.[38] Recommended magnification for flap reflection/suturing: 2X, Osteotomy: 2.5X to 6X. 10X to 12X magnification is used to check the stained root's surface for periodontal ligaments. Microscopically examining the surface of the resected root (isthmuses, C-shaped canals, apical microfractures, accessory canals) at 16X to 25X magnification. 9X to 16X ultrasonic root-end preparation. Retrofilling: 10X.[39]

Magnifications used in dental operating microscopes

In endodontics with micro mirrors, the use of surgical operating microscopes (SOM) has been emphasised. Uses for different magnifications include the following:[40]

1) Examining a tooth, orienting a bur, or placing an ultrasonic tip all require low magnification, such as 3x to 8x. Comparisons of the nearby anatomical landmarks are possible because to the expansive field of vision. This level of magnification is employed in loupes so that simple cases can be handled competently.

2) Non-surgical and surgical endodontic procedures use medium magnification (8x–16x) because it offers a good depth of focus and field of view. It is employed to carry out intricate operations like perforation repair, separated tool retrieval, and any surgical process requiring greater precision and accuracy.

3) The majority of close-up evaluations and screenings of minute anatomies, such as calcified canal orifices and micro cracks, employ high magnification, such as 16x to 30x.

Magnification ranges recommended for various stages of non-surgical and surgical endodontic treatment

NON SURGICAL ENDODONTICS	SURGICAL ENDODONTICS
Low magnification: x5-x8	
	Orientation Inspection of surgical site Initial osteotomy Ultrasonic tip alignment Suturing (6.0+) Suture removal
Midmagnification: x8-x16	
Access Orifice identification Fracture identification Obturation	Hemostasis Tissue removal Root tip identification Root tip resection

	Root surface inspection Root end preparation Root end filling Root amputation
High magnification: x16-x30	
Orifice identification Fracture identification Calcified canal location Identification of fine anatomic details Documentation	Root surface inspection Root end preparation inspection Root end filling inspection Identification of fine anatomic details Documentation

Conclusion:

Loupes are the most often used magnifying instruments, and their use in dentistry has been steadily increasing. They also promise improved vision and offer a significant ergonomic benefit, supporting the long-term wellbeing of the professionals. It offers greater ergonomics with increased precision and longer runtime. Various endodontic operations are performed more efficiently when there is better vision. Without a doubt, Microscope Enhanced Dentistry is a fantastic revolution and the way dentistry is going. Ultimately, the good visual information can aid the practitioner in producing dentistry that is more accurate, healthy, and aesthetically beautiful.

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Conflict of Interest:

The authors report no conflict of interest.

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