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Magnification in Dentistry: A Boon

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Abstract

Dental technology has advanced dramatically over the past few decades, moving from traditional hand files to rotary systems and from direct vision to magnification. Magnification tools like the orascope, dental loupes, and dental operating microscope are used to acquire the clarity and details. The information is very precise and illuminating so that endodontists can make accurate diagnoses, administer effective treatments, and analyze the ultimate results of the process. The use of magnification is constantly improving, enabling higher levels of precision and quality. To improve precision, handling, and thoroughness while reducing procedural errors, this review sought to clarify the use of magnifying equipment in dental treatments.

Keywords: *Dentistry, Magnification, Dental loupes, Microscope.*

Introduction

The two-dimensional dental radiograph, which is a representation of a three-dimensional biological system, has been the sole medium used to understand conventional endodontic treatment and surgical treatment. The foundation of effective endodontic therapy is creating a hermetic seal after cleaning the canal space. The success of endodontic treatment is increased by appropriate magnification and lighting. The use of magnifying instruments in endodontic practice, including as loupes, microscopes, and endoscopes, enables the practitioner to magnify a specific treatment area more than is possible with the human eye.[1,2]

The development of magnification technology has transformed endodontic treatment from a tactile and radiograph-based to a vision-driven process. The use of magnifying instruments in endodontic practice, such as loupes, microscopes, rod lens endoscopes, and oroscopes, enables the physician to enlarge the treatment area more than is possible with the unaided eye. Magnification and the right lighting are essential for any dental procedure to be successful. Surgical loupes have been in use since 1870. In 1978, Apotheker and Jako made the first attempts to use the microscope in dentistry. Carr emphasized the use of the surgical operating microscope in endodontics in 1992.[3,4]

Numerous operations in endodontics, such as caries identification, for hidden canals, pulp stone removal, instrument removal, surgical endodontics, retreatment, perforation seal, etc., as well as minimally invasive surgical techniques are some of the applications of surgical operating microscopes. Optical components, objective lenses, binocular tubes, eyepieces, illumination units, and mounting systems are some of the working microscope's component parts. Accessories include a beam splitter, mechanical optical rotating assembly (MORA) interface, and motorised or foot-controlled focal length adjustment.**[**2**]** In order to improve precision, handling, and thoroughness while reducing procedural errors, this review sought to clarify the use of magnifying equipment in dental treatments.

Magnification devices in dentistry

Magnification is a phenomenon of visually amplifying and availing an enlarged, exaggerated, intensified view of an object or an image or a model. The surgical operating microscopes unlike loupes offer several different options of magnification within the same instrument. Such instruments used by the dentists for microsurgery has six steps of magnification (2.5x, 4.0x, 6.7x, 10x, 16x, and 24x). Generally speaking, the idea of "magnification enhanced dentistry" entails mainly utilizing four different kinds of optical magnification systems5:

- Loupes
- Surgical operating microscope
- Orascope
- Endoscope

Dental Loupes: Loupes have been around for a while.6 To solve the issues of proximity, a narrower field of view, and eyestrain brought on by being closer to the topic, magnifying loupes were developed. Dental loupe magnification typically ranges from 2X to 6X. Loupes tend to get heavy when the magnification is greater than 5X, and a microscope would be a preferable choice.7

Types of Lopes

Simple lopes: A pair of single, positive, side-by-side meniscus lenses make up a simple pair of loupes. There are two refracting surfaces on each lens. When light enters the lens, it undergoes the first refraction; when it exits, it undergoes the second refraction. Simple loupes only have two ways to increase their magnification: by thickening the lens or expanding the lens diameter. These gadgets' limitations in terms of size and weight mean that they cannot be used in dentistry.**[**8,9**]**

Compound lopes: Telescopic loupes are made up of many lenses with basic air gaps, allowing modifications to working distance, magnification, and depth of field without adding to their size or bulk. [8,9]

Galilean loupes: Additionally called a multi-lens optic system. A multiple lens system that should be used between 11 and 20 inches away from the subject produces an enlarged viewing image. Two lenses - a convex objective lens and a concave eyepiece lens - make up the Galilean telescope, with the eyepiece lens having greater strength than the objective lens.10 Their only disadvantages are limited magnification (2.5- or 3.5-fold) and a blurry peripheral border of the visual field.[7]

Keplerian loupes: The most optically sophisticated type of loupe magnification available today are Keplerian loupes, also referred to as prism loupes. These loupes are known as rooftop or Schmidt prisms because they have a prism mounted to the top. The light path is lengthened by these prisms as it travels through a string of switchback mirrors positioned in between lenses. Therefore, this method offers superior magnification and greater depths of field. The users are also guaranteed lengthy working distances, and when compared to other loops, their fields of vision are bigger. Therefore, these loupes are the most technologically advanced sort of magnification tool now available. These loupes have magnification strengths ranging from 1.5x to 6x. [12]

Advantage of Loupes [13]

- Small in size, takes up little room, and is simple to use and store
- No formal training is required as it can be easily operated.
- Surgeon's position is not restricted.
- When very high magnification and illumination are not required, it is sometimes more practical than a microscope, especially in preliminary procedures.
- It is not as costly as a microscope.

Surgical Microscope: Operating microscopes are made according to Galilean principles for dentistry. For protection against eye strain and tiredness, they use parallel binoculars while incorporating the usage of magnifying loupes, a magnification changer, and a binocular viewing system. Additionally, they include high resolution and good contrast stereoscopic vision, as well as completely coated optics and achromatic lenses. Coaxial fiber-optic lighting is employed by operating room microscopes. A circular spot of light that is parallel to the optical viewing axis and is changeable in brightness and uniformity is produced by this kind of light.[14]

The lens design of the surgical operating microscope allows for stereoscopic vision and excellent working area illumination at magnifications of roughly 4–40. The convergence and straining of the eye muscles, particularly the lateral rectus, are eliminated when a light beam falls along a line and strikes the observer's retina.**[**15-17**]**

Table no. 1: Different Parts of Surgical Microscope [18,19,20]

Supporting Structure	The supporting framework keeps the microscope steady. It may be wall, floor, or ceiling mounted.
Body of Microscope	**The body of microscope consists of** **Eyepieces:** Magnification is determined by eyepiece power. Eyepieces are often offered in 10, 12, 16, and 20 power options. The range of diopter settings for accommodating the eye's lens is from -5 to +5. **Binoculars:** Binoculars' primary use is to hold the eyepieces in place. The focal plane of the eyepieces receives an intermediate image that is projected by it. It is available at several focal lengths. The magnification increases with focal length length, while the field of view narrows. **Magnification changer:** It is located inside the microscope's head and comes with a power zoom changer or a 3-, 5-, or 6-step manual changer. **Objective lens:** The working distance between the microscope and the working field is determined by the objective lens's focal length. The focal length is in the 100–400 mm range. The ideal working distance is 20 cm/8 inches when the focal length is 200 mm. The endodontic operation is best performed at this distance. Antireflective coating guarantees that only the smallest amount of light is absorbed, maintaining the illumination of the working area.
Light Source	Halogen and xenon light are the two most often used light source technologies. The most typical source is a 100 W halogen light. A fan cools it, and its intensity is controlled by a rheostat. Line of sight and illumination are on the same axis, focusing light such that there are no shadows between the eyepieces.

Advantages of Microscope [21-23]

- Higher magnification
- Better illumination
- Microfracture diagnosis
- Enhanced ergonomics
- Case documentation
- Superior optical properties
- Galilean optics reduces the need to have the eyes converge to focus and thereby reduces eye strain and fatigue

Disadvantages of Microscope [21-23]

- Difficult to fit in a small operative room because of its size
- Steep learning curve
- Bulky instrument
- Training regarding its parts and usage is a must before surgery
- Expensive
- Requires high maintenance
- Need for expertise by auxiliary staff and adaptation is quite difficult

Orascope: The freshly released flexible fiberoptic orascope, which has a 15 mm-long working part and 0.8 mm-diameter working tip, is advised for intracanal viewing. The use of a flexible orascope or a rigid rod-lens endoscope in the oral cavity is referred to as orascopy. The use of orascopy for visibility during traditional and surgical endodontic therapy is known as orascopic endodontics.24, 25

Endoscope: Endoscopy reportedly provides the dentist with excellent vision and ease of use. It also provides a better intraoperative visualization in comparison with micromirrors. Further development of endoscopy made it possible to combine magnification, light, irrigation/suction and surgical microinstruments in one device. This combination could lead to an advanced root canal treatment technique.26 Endoscope provides greater magnification than loupes. It consists of rods of glass. It has a camera, a light source, and a monitor. Disadvantage of rod lens endoscopy is that the instrument is rigid, so it cannot be used in visualizing curved root canals. The difference between an orascope and an endoscope is that an orascope utilizes fiber optics and is flexible, whereas the endoscope utilizes rigid rods of glass.

Application of Magnification in Dentistry

Diagnosis: An endodontist should be a skilled diagnostician by virtue of the speciality. Any tool or procedure that makes a diagnosis easier should be valued. Magnification can be quite helpful in determining how far these fracture lines run and where they finish in situations like cracked or vertically fractured teeth.**[**19**]**

Nonsurgical Endodontics: Magnification aids in traditional root canal therapy by helping to prepare and complete the access cavity, precisely shape the root canal, and fill the system entirely in three dimensions. Other applications include finding missed canals, removing broken instruments and posts, and repairing perforations. Magnification tools offer a higher possibility of finding MB2 canals than the human eye. But when it comes to finding MB2 canals, an operating microscope performs better than a pair of loupes. A more efficient technique for removing fracture instruments than the traditional way is the combination of operating microscope and ultrasonics.**[**28,29**]**

Adhesive Dentistry: Bonded dentistry ideal restorative margins form the key of successful restorations with longevity. Due to the shadow-free light, caries adjacent to the pulp can be excavated by identifying even the tiniest portion of infected dentin. This can protect pulp exposures and spare dentin that has been damaged. Under the scope of this procedure, precise margin preparation and outline for a crown or veneer preparation can also be achieved.

Minimally Invasive Surgical Technique: Harrel and Rees initially discussed minimally invasive surgery (MIS) in periodontology literature in 1995. The technique incorporates a surgical access that reduces tissue stress from reflection and manipulation, improving blood clot stabilisation with less surgical morbidity.**[**30**]**

This method, which comprises the least reflecting of short buccal and lingual flaps with coronoapical and mesiodistal extensions and exposure of the coronal part of the remaining ridge with defect, was specifically developed for isolated infrabony defects for periodontal regeneration. The papilla preservation flap is provided in the restricted interdental areas. With the aid of mini-curettes and sonic or ultrasonic tips, scaling and root planing are carried out after reflection of the flap. Small interdental access to the defect is provided by the modified minimally invasive surgery method, also known as MMIST, from the buccal side only with the application of regenerative material. Numerous case reports and studies have confirmed that the approach used for periodontal regeneration surgery has a high clinical success rate. **[**31.32**]**

Conclusion

Magnification aims to reach the highest level of precision, improved prediction, and treatment. The use of magnification has improved the dentist's capacity for better diagnosis and treatment, as well as their ability to spot anatomical variances in teeth and supporting structures as well as microfractures, auxiliary canals, and canal orifices. Without a question, the trifecta of equipment, lighting, and magnification improves the accuracy of diagnoses and therapeutic outcomes.

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