ISSN 2515-8260 Volume 10, Issue 01, 2023

Magnification in Dentistry: A Review

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Abstract: As it works with tiny anatomy, dentistry is restricted to small operating space. Clinicians who handle complex cases thus seem to require stronger visual acuity. In order to bridge the gap between the human eye and the microscope, numerous magnification tools have been developed over time. In actuality, modern gadgets that appear to be more useful and handy for application, such as loupes and dental operating microscope, have essentially replaced tools like an magnifying glass, and intraoral camera. This review aimed to clarify the use of magnifying equipment in dental procedures in order to enhance precision, handling, and thoroughness while eliminating procedural errors.

Keywords: Magnification**,** Microscope, Loupes, Dental Application

Introduction: The only tool used to comprehend traditional endodontic treatment and surgical treatment is the two-dimensional dental radiograph, which is a representation of a three-dimensional biological system. After cleaning the canal space, the foundation of successful endodontic therapy is establishing a hermetic seal. The right magnification and lighting improve endodontic treatment outcomes. In endodontic practise, magnifying tools like loupes,

microscopes, and endoscopes allow the practitioner to more closely focus on a particular treatment location than is possible with the naked eye.[1,2]

Endodontic therapy is now a vision-driven approach rather than a tactile and radiograph-based one thanks to the advancement of magnification technology. In order to magnify the treatment region more than is possible with the untrained eye, endodontists often utilise magnifying tools including loupes, microscopes, endoscopes, and oroscopes. Any dental surgery needs the correct lighting and magnification to be successful. Since 1870, surgical loupes have been in use. The earliest attempts to use the microscope in dentistry were undertaken by Apotheker and Jako in 1978. In 1992, Carr made a point of emphasising the use of the surgical operating microscope in endodontics.[3,4]

Applications for surgical operating microscopes include a variety of endodontic procedures, including the detection of caries, detection of hidden canals, removal of pulp stones and instruments, surgical endodontics, retreatment, perforation seal, etc., as well as minimally invasive surgical methods. Some of the parts that make up the operating microscope include optical elements, objective lenses, binocular tubes, eyepieces, illumination units, and mounting systems. The mechanical optical rotating assembly (MORA) interface, a beam splitter, and a motorised or foot-controlled focal length adjustment are examples of accessories.[2] This review aimed to clarify the use of magnifying equipment in dental procedures in order to enhance precision, handling, and thoroughness while eliminating procedural errors.

Significance of Magnification: Only the level of the canal orifice is visible to unaided eyes. At the age of 40, normal vision would also start to decline.[5,6] This circumstance has been verified by using miniaturized eye charts placed in teeth.[7] The dentistry practice has a difficulty with the lack of knowledge regarding this vision impairment. However, age-related vision impairment appears to be reduced by using a loupe and may be compensated for by using the dental or surgical operating microscope (DOM).[8]

Types Magnification Systems

Loupes: In dentistry, loupes are the most widely utilised magnifying devices. It features two monocular microscopes with shoulder lenses and a holder. These angled lenses create larger images by focusing on an item. Convergent lenses are used in loupes. Magnification is between

1.5 and 10. Loupes for magnification are a preferable place to start because they aid in the operator's eye adjustment.[8]

The improvement of diagnosis caused by a rise in the operator's visual acuity is one of the main causes for clinicians to use magnification loupes. Wajngarten et al. (2019) found higher visual acuity scores when the operators used 3.5 or 4.0 magnifying loupes as compared to those with unaided eyes in a study that used miniature Snellen charts put inside prepared prosthetic teeth.[10] In a previous study by Urlic et al. (2016), this enhancement in visual acuity was also discovered when employing 2.5 magnification.[11]

The use of magnification loupes as a visual aid is suggested as dental practise years grow in order to make up for any typical drop in visual acuity caused by ageing and presbyopia. There is a well-established pattern of decrease in visual acuity in both the general population and dentists.[12]

The most common drawback of utilising loupes is the convergence of the eyes when seeing an image (Keplerian optics), which can cause eye fatigue and draining. The eyesight alterations could even be brought on by prolonged usage of improperly fitting loupes.[9]

Types of Loupes[13-15]

Table no. 1: Types of Loupes

Type	Specification
Simple Loupes	Simple loupes are made up of two meniscus lenses that are each one positive and placed side by side. Two refracting surfaces exist on each lens. Light enters the lens and undergoes two refractions: one as it enters and one when it exits. Simply raising the lens diameter or lens thickness is the sole way to improve the magnification of simple loupes. These gadgets' size and weight restrictions prevent them from having any useful dental applications.
Telescopic Loupes	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. By extending or decreasing the space between the lenses, such loupes are simple to modify to meet clinical needs. Compound lenses may be achromatic, so when choosing a dental loupe, this trait should

	be taken into consideration. The colour accuracy of the images created by these achromatic lenses is excellent.
Galilean Loupes	These loupes are cheap and are simple to operate while compared to other compound loupes. The Galilean loupes typically utilize two lenses: an objective convex lens and a concave eyepiece lens. They provide magnifications on the lower end between 2.0× and 3.5×, which is why Galilean loupes are suitable as general purpose dental loupes or starter magnification loupes for new users.
Prism Loupes	These loupes have prisms that are used to refract light, as suggested by their name. 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. Typically, dentists employ magnifying loupes with a power range of 2.5 to 3.5.

Surgical Operating Microscope: When used in conjunction with regular dental loupes, surgical microscopes offer significantly improved optical performance and magnification. Galilean optics is used in surgical microscopes created specifically for dentistry. To produce the parallel optical axis, they use counteracting prisms to unite binocular eyepieces. Galilean optics enables people to experience stereoscopic vision without any eye strain or eye convergence. In surgical microscopes, the depth of focus and field of vision properties are at their best. The microscope offers greater illumination and magnification ranging from 3 to 30. In terms of ergonomics, clear eyesight, improved prognosis, less appointments, and cost-effectiveness, it is advantageous for the clinician and the patients.[16,17]

Table no. 2: Different Parts of Surgical Microscope[18-22]

Supporting Structure	When in use, the microscope must be stable while also being easily and precisely manoeuvrable, especially when using high power. The wall, ceiling,

	or floor can all be used to mount the supporting framework.
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, 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 focal length of the objective lens determines how close the microscope must be to the working area. A 100 to 400 mm focal length is typical. For 200 mm focal length, the recommended working distance is 20 cm (8 inches). At this distance, the endodontic surgery is most effective. A working area's illumination is maintained by an antireflective coating's assurance that just the tiniest amount of light is absorbed.
Light Source	In surgical microscopes, the three main types of lighting are incandescent, halogen, and fiberoptic. Due to their higher colour temperature than lights utilising regular bulbs, halogen lamps emit a whiter light. There are also xenon bulbs, which can last up to ten times as long as halogen lamps. The light produces unusually brilliant images with sharper contrast because it has daylight properties and is even whiter in hue.

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.[23,24]

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. 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.[26]

Application of Magnification in Dentistry

Examination, Diagnosis, and Treatment Planning: Magnification allows for a better understanding of demineralization around the grooves and small amounts of flaking of darkened carious tooth structure within these grooves, which can be an important factor in the diagnosis and selection of the appropriate course of action.[26]

Endodontic Treatment: Endodontists were the first members of the dental profession to recognise the practical uses of surgical microscopes in both traditional and surgical endodontics. In a variety of therapeutic settings, from the most common to the least, a microscope is used to locate the pulpal chamber canals, permeabilize calcified channels, and remove broken tools from the canals.[27]

Retrieval of Fractured Posts and Instruments: The dental operating microscope's improved eyesight from magnification and illumination enables one to locate damaged instruments and fractured posts with greater accuracy and remove them with the least possible damage to healthy tooth structure.[28]

Periodontal Surgery: The use of magnifying tools like surgical prism loupes and surgical microscopes has revolutionised periodontal surgery. The procedure is now less invasive and minimally invasive because to the improved magnification of the surgery site. When compared to the outcome of a typical kind of surgery, the final appearance of the operated area following the microsurgical technique is simply outstanding.[14]

Oral Surgical Procedure: Oral and maxillofacial surgery greatly benefits from the clinical and practical advantages of microsurgery. In all surgical treatments for treating impacted teeth, but especially in mucogingival surgical procedures to widen attached gingiva by harvesting soft tissue grafts, a clearer and magnified image is particularly crucial. Using microscopes, surgeons can better treat diseases and injuries to the delicate nerves around the mouth. [23] If proper care is not given regarding the lingual flap during lower molar and premolar level oral surgical treatment, or during the surgery of third molars, the lingual nerve and the lower dental nerves are vulnerable to harm. By using high-end magnification in conjunction with microsurgery, this could be effectively avoided.[29]

Pediatric Dentistry: Similar to adult care, the dental operating microscope can be used to its utmost potential on pediatric patients. The DOM is a useful tool for endodontic and restorative procedures.. The DOM can increase the effectiveness and precision of endodontic and restorative treatments for young patients.[30]

Conclusion: Magnification offers possibilities to improve therapeutic results of various procedures. A number of endodontic, periodontal and surgical procedures can be performed using minimally invasive approaches. The improved visual acuity and ergonomics provide significant advantages to those who take the time to become proficient in microsurgical principles and procedures. It is essential to comprehend the physics and principles underlying such equipment before implementing visual magnification technologies, such as microscopes, and successfully using them in dental treatments.

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ISSN 2515-8260 Volume 10, Issue 01, 2023