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Magnification in dentistry: A review

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Abstract
Dentistry has become more sophisticated and complex thus requiring precised motor skills and visual acuity. Optical magnification has expanded the horizons of dentistry. In past decades, dentistry has not only evolved clinically but the histological aspects has also played an important part in the development of new materials as well as helped in better evaluation of treatment procedures. Microscope was initially started in ophthalmology, it's benefits in endodontic therapy which was best performed remains unparalleled. These benefits also extend to all aspects of dentistry including periodontics, restorative, prosthetic dentistry, and implant dentistry. Barring the disadvantages of steep learning curve, cost, and maneuverability of the equipment, magnifications are definitely becoming an important aspect of modern‐ day dentistry, owing to their numerous other benefits.

Keywords: magnification, loupes, microscopes, dentistry, advantages and disadvantages

Introduction
Dentistry is leaded by a movement in technological advances which help clinicians with adequate training to incorporate the finest skills and equipment in day–to‐day practice, thus enhancing their existing skills and knowledge and delivering the most ideal outcomes with utmost precision. A necessary attribute in modern dentistry for clinical work is a high level of visual acuity, especially for near vision. A common way to achieve better vision is to effectively magnify the area of interest. Worschech CC *et al*. said that improved lighting, coupled with magnification, provides a clear distinction between surfaces that may look similar in color or texture under traditional working conditions. The clarity and details achieved with magnification are so vivid and revealing that the clinician will immediately recognize the potential for improved precision in both diagnostic and treatment procedures. According to Tascheiri S *et al*. magnification devices are beneficial for patients, in terms of ergonomics, vision, treatment success rate, treatment times, and total costs [1] Magnifications for microsurgery was introduced to medicine during the late 19th century. Carl Nylen, father of microsurgery, in 1921 first used a binocular microscope for ear surgery. The pioneers in dentistry were Apotheker and Jako, who first introduced the use of microscope in dental procedures in 1978. Following this, Carr, in 1992, published an article defining and emphasizing the role of the surgical microscope in endodontic procedures. In 1994, Shanelec and Tibbetts presented a continuing education course documenting the use of surgical microscope in dentistry and called it "Microscope‐ Assisted Precision Dentistry."

Most experienced microscope users comment with amazement about the wonders of working through a microscope. It is well said that a magnified, clear image can speak more for itself than a thousand words put together. Definitely considered as an eye opener to many dental professionals, microsurgery is unfolding to be an interesting concept. In 1979, Daniel defined microsurgery in broad terms as surgery performed under magnification by the microscope

Magnification, illumination, and instruments (Kim 2001) together form the "Microsurgical Triad." Without these, microsurgery is impossible.

Microscope‐ enhanced practice does not indicate conceptual revolutions in existing techniques, however implies an improved accuracy, better handling, and gentleness and thoroughness in the procedures, with slight modification in the already practiced techniques.1

Types and principles of magnification systems

Broadly, the concept of magnification‐enhanced dentistry incorporates the use of two types of optical magnification systems:

a) loupes
b) surgical operating microscope.

Loupes the most common magnification system used in dentistry is the magnification loupes. Primarily, loupes consist of two monocular microscopes, with side‐by‐side lenses, angled to focus on an object to form magnified images with stereoscopic properties that are created by the use of convergent lens systems. Wide ranges of magnifications are available in loupes, ranging from × 1.5 to × 10. It is always ideal to adapt to magnified vision by initially using loupes, which enable the operator to adjust to the eye training exercise and changes in hand–eye coordination. There are three types of loupes commonly used in practice:

Simple loupes: Simple loupes consist of a pair of single, positive, side‐by‐side meniscus lenses. Each lens has two refracting surfaces, with one occurring as light enters the lens and the other when it leaves. Main advantage is cost effective. Disadvantages are primitive with limited capabilities and are highly subjected to spherical and chromatic aberrations, which distort the image of the object.

Compound loupes or telescopic loupes: Compound loupes or telescopic loupes consist of multiple lenses with intervening air spaces, thus allowing adjustment of magnification, working distance (WD), and depth of field without increase in size or weight.

Prism loupes: Prism loupes are optically most advanced containing Pechan or Schmidt prisms that lengthen the light path through a series of mirror reflections within by virtually folding the light so that the barrel of the loupe can be shortened. They produce better magnification, larger fields of view, wider depths of field, and longer working distance. This is a feature that dentists should seek when selecting any magnifying loupe because an achromatic lens consists of two glass pieces, usually bonded together with clear resin. The specific density of each piece counteracts the chromatic aberration of the adjacent piece.

Surgical operating microscope: In dentistry, operating microscopes are designed on Galilean principles. They incorporate the use of magnifying loupes in combination with a magnification changer and a binocular viewing system so that it employs parallel binoculars for protection against eye strain and fatigue. They also incorporate fully coated optics and achromatic lenses, with high resolution and good contrast stereoscopic vision. Surgical microscopes use coaxial fiber‐optic illumination. This type of light produces an adjustable, bright, uniformly illuminated, circular spot of light that is parallel to the optical viewing axis. Due to its shadow‐free light, visualization of pathologies, documentation, motion videography, and management of all dental and surgical procedures can be effectively performed under unobstructed vision. Patients can be counseled better as they can directly visualize the magnified image on the screen due to the beam splitter video camera attached to microscope.

Steps in use of magnifications

With a steep learning curve associated with the use of magnifications, it is imperative to every desiring clinician to master the steps toward achieving complete harmony in hand and eye movements while using these systems.

Working distance: It is the distance measured from the eye lens to the object in vision. There is a multitude of back, neck, and eye problems that dentists suffer from, due to a need to attain short WDs for increasing visual acuity. Depending on the individual's height and length of arms, the WD with slightly bended arms using microscope increases and ranges between 30 and 45 cm. At this distance, posture is perfect, ergonomics is greatly improved, and there is decreased eye strain due to less convergence.

Working range (depth of field): Range within which the object remains in focus. The DOF of normal vision ranges from WD to infinity.

Convergence angle: It is the pivotal angle aligning the two oculars, such that they are pointing at the identical distance and angle varies with interpupillary distance (IPD). Defines the position of extraocular muscles that may result in tension of the internal and external rectus muscles, which may be an important source of eye fatigue.

Field of view: Linear size or angular extent of an object when viewed through the telescopic system.

Interpupillary distance: It is the key adjustment for the use of any magnification system. The ideal way to understand your IPD is to focus both the binocular eyepieces to initially see two images or circles and adjust it to the point, wherein they merge and become one circle. That point would be identified as the IPD and used as a permanent reference for the use of magnifications. The IPD varies with each individual and forms an important aspect in the learning curve of use magnifications.

Viewing angle: It is the position of the binocular optics angled in such a way that it enables comfortable working position for the operator. The shallower the angle, the greater the need to tilt the neck to view the object.

Advantages of microscopes

Higher magnification
Better illumination
Superior optical properties
Galilean optics reduces the need to have the eyes converge to focus and thereby reduces eye strain and fatigue.

Disadvantages of microscopes

Occupies lot of space.
Bulky instrument.
Training regarding its parts and usage is a must before surgery.
Expensive.
Requires high maintainence.

Conclusion

Magnification is a powerful asset for those who seek high clinical accuracy. The increased magnification have improved

the treatment possibilities in various procedures. It provides better ergonomics for longer duration and with increased precision. Better visibility ameliorates the performance of various endodontic procedures. Needless to say, Microscope Enhanced Dentistry is a wonderful revolution and is the direction in which dentistry is moving. 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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