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Magnification in conservative dentistry and endodontic–A Review

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ABSTRACT

The feasibility and advantages of treating damaged and diseased oral tissues under high magnification levels have recently been recognised by dentistry. Initially, improved vision was limited to the use of prescription bifocals, uncomfortable magnifying loops, and heavy, unwieldy telephoto lenses. The microscope garnered little attention and was swiftly dismissed as just another worthless and expensive dental technology. Dental doctors are increasingly using magnification when doing examinations and treatments. The operating microscope is the greatest tool for this task since it has been proved to improve the quality, longevity, and result of clinical work while also providing better ergonomics for both the dentist and dental nurse. Dentist are currently adapting microscopic and other magnifying lenses to different areas of dentistry, as acceptance leads to growth. Clinical significances-Precision is fundamental to the practise of dentistry. The human eye is capable of recognising fine detail, but it is no match for what can be achieved when a picture is sharpened and expanded. The microscope and other kinds of magnification meet this demand, particularly when performing endodontic operations.

Key words – Magnification, Loupes, Dental operating microscope, Rod lens endoscope, Orascope

INTRODUCTION

Plastic surgery, ENT, reconstructive surgery, gynaecology, and other fields for over 50 years, and are now being used in clinical dentistry. A microscope has been used in dentistry for diagnosis and treatment in areas like as endodontics, prosthodontics, oral surgery, and restorative dentistry over the last 15 years.[1]Traditional root canal therapy is the only discipline of dentistry that is conducted without a good view of the operative field, relying instead on expertise, radiographs, and tactile sense. The advent of the operating microscope was largely regarded as a revolution in endodontic diagnostic and therapeutic quality[2]. Historically, the majority of dental procedures were performed with the unaided eye. Treatment without visual magnification is known as macroscopic, whereas treatment with visual augmentation supplied by the microscope is known as Microscope-aided Precision Dentistry[3]Treatment without the use of visual magnification is referred to as macroscopic, and treatment with visual magnification is referred to as microscopic. As a bridge tool between the naked eye and the microscope, numerous magnification devices have been created. In truth, instruments like an endoscope, magnifying glass, and intraoral camera have been completely replaced by more modern technologies that appear to be more practical and convenient for use, such as loupes and a dental operating microscope (DOM).[4] Endodontists have long sought to improve their field of view. When an image is sharpened and expanded to effectively magnify the region of focus for correct diagnosis and treatment of various dental disorders, the human naked eye with a resolving ability of 0.2 mm is capable of identifying fine detail.[5]

HISTORY

Galileo (15th century) defined lenses and light beams and outfitted his microscope with a focusing device. In 1977, otolaryngologist (ear, nose, and throat [ENT] Specialist) Dr. Robert Baumann revealed the use of microscopes in dentistry. 1981: Apotheker and Jako's Dentiscope, Chayes Virginia Inc., is the first commercially available dental operating microscope. The Dentiscope features an 8-magnification single magnification and twin fibre-optic lamps.

On September 25, 1982, the first training on the actual hands-on usage of the Dentiscope was offered at Harvard Dental School in Boston. The University of Pennsylvania School of Dental Medicine was founded in March 1993. [6]

CLASSIFICATION

1)Based on the number of lens
A)Single lens
B)Multiple lens
a) Galilean optic loupes
b) prism loupes
2) based on the magnification system
a)flat plane, single lens loupes
b)surgical telescope with Galilean optical system
c) surgical telescope with Keplerian optical system
3) Based on the design of loupes
a) through the lens loupes
b) flip – up loupes[3]

Magnifying glasses–Magnifying glasses are made up of two convex lenses set in a frame with a handle. A magnifying glass works by magnifying a virtual picture of the item behind the lens. This occurs only when the distance between the lens and the object is less than the lens's focal length. The focal length of the magnifying glass is 25 cm, and the optical power is 4 diopters.[7]

Fig 1 -Magnifying glasses

Types of magnification system

Two different kinds of optical magnification methods are used in the dentistry that is magnified.
A) Loupes
B) Surgical operating microscope

Simple loupes–A single, positive, side-by-side meniscus lens is used in simple loupes. Each lens contains two refracting surfaces, one for light that enters and one for light that exits. Its primary advantage is its low cost. Its drawbacks include its simplicity, limited capabilities, and susceptibility to spherical and chromatic aberrations, which distort the picture of the object[7].

Compound loupes–A compound lens is made up of a series of convergent multiple lenses. The air voids between these lenses improve refraction, magnification, working distance, and depth of field. The gap between the lenses on these loupes is easily adjustable to meet clinical needs. Achromatic compound lenses are available, and this characteristic should be considered when purchasing a dental loupe. These achromatic lenses generate color-accurate images .[8]

Prisms loupe– Prism loupes are the most sophisticated optically, having Pechan or Schmidt prisms that extend the light path within by basically folding the light, allowing the barrel of the loupe to be reduced. They generate higher magnification, broader fields of view, deeper depths of field, and longer working distances. Because an achromatic lens is composed of two glass components that are frequently cemented together with transparent resin, it is a trait that dentists should look for when purchasing a magnifying loupe. Each piece's distinctive density adjusts for the chromatic aberration of the following piece.

Fig 2 – prisms loupe

Galilean loupes–When compared to other compound loupes, these are less expensive and easier to use. These loupes have only two or three lenses, making them lightweight and affordable. Their sole downside is that they have limited magnification[9].

Fig3-Galilean loupe

Based on design

Flip-up loupe-The telescope is positioned further away from the eyes, whereas the scope is positioned in front of the lens through a hinge mechanism, resulting in a limited field of vision. It has a better declination angle (the angle at which the eyes look down towards the region being worked on), which the user may modify. The head posture becomes neutral as the declination angle increases. TTL loupes weigh more than flip-up loupes.

Fig4-flip-up

Through The lens–Because they are closer to the eyes, TTL loupes provide greater comfort and a larger field of view. The scope is attached to the lens. It is custom-made for each individual, and the angle of declination is specified in the facility where it is manufactured. It is less heavy than TTL loupes.[10]

Fig 5- TTL

DENTAL OPERATING MICROSCOPE

The operating microscope has fundamentally and profoundly altered how endodontic operations and surgeries are currently conducted. The microscope has a higher magnification range of 3 to 30 and greater lighting. It benefits both the doctor and the patient in terms of ergonomics, clear eyesight, improved prognosis, fewer visits, and cost-effectiveness.

A)The operating microscope consists of three basic components
a)The supporting structure
b)The body of microscope
c)The light source
Supporting Structure

B)The supporting structure stabilizes the microscope. It can be floor, ceiling, or wall mounted.
a)Body of Microscope
b)The body of microscope consists of
c)Eyepieces
d)Binoculars

e)Magnification changerf)Objective lens[11]

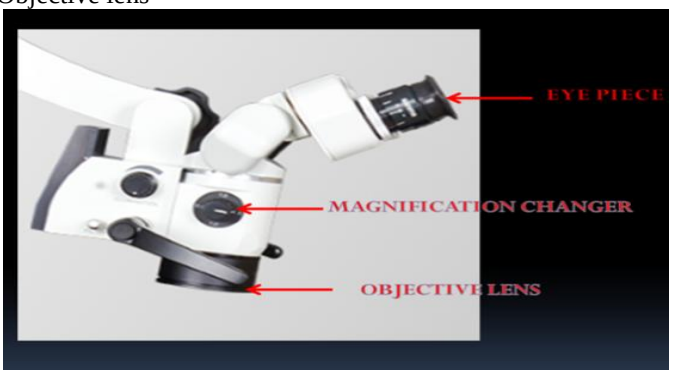

Fig 6– microscope

Eyepiece: Image magnification is the most important function of an operating microscope. The power of the eyepiece determines magnification. Eyepieces are frequently available in magnifications of 10x, 12.5x, 16x, and 20x. To change the accommodation of the lens of the eyes, diopter adjustments should be made in the range of -5 to +5.11.

Binocular Tubes: Depending on their use, binocular tubes can be straight or tilted. In dentistry, only slanted, swivelling tubes with continuously adjustable viewing are used. Furthermore, because the operator may change the tubes without changing his head, neck, or back posture, improving ergonomics becomes more practicable[11].

Magnification Changer-It is situated within head of the microscope and is available as 3-5-, or 6-step manual changer, or a power zoom changer.

Objective Lens: The objective lens's focal length controls the working distance between the microscope and the operational field. The focal length extends from 100 to 400 millimetres. When the focal length is 200 mm, the operating distance should be 20 cm (8 inches). This is a suitable distance for endodontic operations. A layer of antireflective coating guarantees that just the necessary quantity of light is absorbed to keep the operating field illuminated.

Light source– The two most common light source technologies are halogen and xenon. The most common source is a 100-watt xenon halogen bulb. Its intensity is controlled by a rheostat, and it is kept cool by a fan. Since light is focussed between the eyepieces, no shadows are seen[12].

Fig 7- Light source

Magnification Range

Low magnification range: (3x – 8x) Surgical field orientation enables thorough field-of-view examination.
Magnification in the middle range: (8x – 16x). Surgery involving curettage of the granulation tissue, excision of the root tip, preparation of the root end, and filling of the root end.
High magnification range: (16x - 30x). Seeing the smallest features and recording them.

Magnification

Total magnification TM =ft/fo Me Mc TM, Total magnification Ft, binocular lens focal length, Fo, objective lens focal length13 Me, eyepiece magnification Mc, magnification factor[13]

Advantage–: Three key benefits of using magnification equipment in endodontics have been identified: (1) Greater visualisation, (2) improved working position, and (3) increased referral [14].

Disadvantage: Using an operational microscope necessitates particular training and improved manual skills. It also needs a longer period of adjustment and training. Surgical microscopes are more costly than loupes[15].

Recent advances in magnification

Rod lens endoscope–A rod-lens endoscope has a higher magnification than loupes. It is made out of glass rods. It is equipped with a camera, a light source, and a monitor. Rod lens endoscopy has the disadvantage of being rigid; therefore, it cannot be used to see curved root canals.

Orascope -An orascope is a fibre-optic endoscope that is used for intracanal imaging. Fibre optics is a thin, light, and flexible material. The number of fibres and the size of the lens employed have a direct relationship to image quality. Orascope is made up of 10,000 optical fibres.[6]

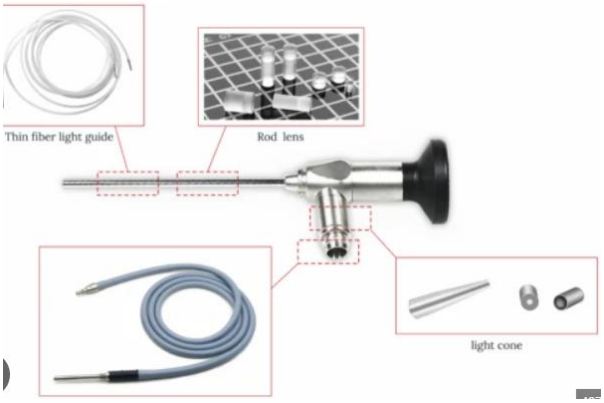

Fig 8- a)Rod lens endoscope b) rod lens endoscope

Fig9 –Orascope **Fig 10 – Head mounted microscope**

Zeiss OPMI PROErgo–It includes a motorised or foot-operated focal length adjustment function. Even if the therapy lasts several hours, this produces the least amount of disruption and ideal ergonomic work.

Head -Mounted Microscope- The magnification range of the head-mounted microscope is 2.9 to 7.0. It has autofocussed and includes an autofocus camera. It also features built-in light optics. It provides shadow-free lighting and a field of vision of 1.18 x 8.82 inches.[17]

CONCLUSION

The use of a dental microscope is a well-studied and accepted approach of improving root canal therapy. As a result, diagnostic and therapeutic accuracy has increased, and treatment choices have significantly expanded. With the use of a dental microscope, many treatment issues may be effectively addressed or prevented totally. Increased magnification and lighting have improved treatment options for both surgical and nonsurgical treatments.

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