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About 10 years ago, a dental assistant wearing magnification or using surgical telescopes was unheard of. With the demand for clinical excellence in all realms of dentistry, assistants now more than ever need to see more clearly, decrease eyestrain, and have a supported balance in the musculoskeletal ergonomics.

Eyesight
The eye is a complex sensory organ. It allows us to see and interpret shapes, colors, and dimensions of objects by processing the light they reflect or produce. The eye is able to see in bright light or dim light, but it cannot see objects when light is absent. The iris adjusts to incoming light to maximize the quality of images. Under bright light, the pupil diameter quickly varies from about 1 to 3 mm as the light level changes. This means the eye can easily control the amount of light entering by a factor of 10.

The increase in pupil diameter increases the eye’s resolution capability, as a camera does. The resolution capability usually diminishes at around 2 to 3 mm because the human eye is not a perfect lens. Brighter illumination can improve the depth of field because the diameter of the eye lens decreases, resulting in better resolution over a longer working range.

Magnification Power
Loupes or surgical telescopes of a 1.7 to 2.5x magnification (Figure 1) are recommended for dental assistants for most dental procedures, especially if magnification has never been experienced before. More than this amount will greatly reduce depth of field (Figures 2 through 4). For endodontics, oral surgery, and periodontics, a stationary fixed microscope may be required for greater magnification. If more than 5x magnification is used in either spectacles-mounted or headband-mounted systems, it can be difficult to stabilize the field of vision. Longer working distances require higher magnification powers to achieve the same visual perception. Make sure to verify the true magnification power with your vendor. Optical performance will vary depending on the precision of optical alignments and the quality of lens coatings. Optical misalignments create the binocular image quality and often create double images, eyestrain, and headaches. High quality coatings will enhance the light transmission.

Magnification Scotoma (Blind Spot)
Magnification Scotoma is the on-field/off-field blind spot created by your surgical magnification system. Because surgical magnification systems magnify only a portion of the total field of vision, a blind spot occurs whenever an object is carried from the peripheral unmagnified field toward the magnified center of the field—the
greater the power of magnification, the greater the absolute size and proportion of the blind spot. A large blind spot may encourage the operator to turn his/her head sharply to one side to eliminate its effects during instrument movements or exchanges. The greatest distress related to magnification scotoma is the risk of poor control when instruments are being moved into or out of the magnified field of view. The assistant must be aware of the dangers to the dentist, the patient, and themselves as instruments are passed through this blind spot. The assistant can learn to compensate by guiding the instrument to the dentist’s operating site with any sharp points or edges guarded with a gloved finger until the instrument is under visual control and in the magnified field of view.

Types of Magnification
There are 4 categories of surgical magnifications to choose from. Those categories are and have the following characteristics:

Stationary/Fixed Microscopes
• Wall or ceiling mounted
• High magnification (6 to 20x)
• Confined field at high magnification
• Limited depth of field at high magnification

Low Magnification Multilens Systems
• Spectacles-mounted or headband-mounted telescopes
• Very portable and convenient
• Low to medium magnification range (2 to 5x)

Single-Lens Loupes and Magnifiers
• Headband-mounted or clip-on spectacles
• Low magnification
• Limited depth of field and working distance

Prescription Lenses and Reading Glasses
• Low magnification
• Limited depth of field and working distance

Selecting the Appropriate Magnification
Optical Declination Angle
The dental assistant needs to select a system that meets his/her optical declination angle, which is the angle to which the eyes are lowered when positioned in the working position. If the declination angle is not matched to the musculoskeletal needs, eyestrain and or muscle strain of the head, neck, and back can occur.

Working Distance
The working distance refers to the distance
between the dental assistant’s eyes and the working site. The working distance of telescopes should match the assistant’s working distance (Figure 5). Telescopes having the same magnification power and working distance will have significantly different depths of field, depending on what design criteria were used. A representative of the manufacturer should customize the telescope, to center the depth of field to each assistant’s personal working distance.

**Depth of Field**

Depth of field is the range over which one is able to achieve visual resolution. It is determined by the combination of vision and the surgical magnification system. It is recorded in terms of the nearest and farthest extremes of distance from the surface of the eye to the object observed (depth of field average from 13 to 18.5 in). A well-centered depth of field of 3 in is the minimum sufficient for visualization of structures from the nearest point (central incisors) to the farthest (a reflected view of a distal molar) in the average adult mouth. Less depth of field will certainly require the assistant to tip his/her head forward or backward to visualize some area of the oral cavity.

**Reflectance**

Reflectance is defined as how well the teeth reflect light. The lower the reflectance is, the better the visual acuity and depth of field given the same magnification and illumination. This is mostly accomplished by nonreflecting coating on the lenses. Most manufacturers coat lens with magnesium fluoride, silica, zirconium dioxide, or titanium dioxide.

**Light Systems**

Adequate light must be present for the human eye. As the amount of room light increases, the visibility of objects also increases. Excessive light obscures details of the object and presents glare problems. The reduced pupil size resulting from the excessive light will increase the depth of field but will in turn decrease the eye’s resolution capability. Dental manufacturers are turning much attention to the development of low profile, lightweight light sources that provide ideal lighting for dental and surgical needs. Co-axial illumination light systems come in 2 types: lights mounted to headbands and lights mounted directly to the surgical telescope-mounting fixture. The separate headband mounting light is generally heavy and cumbersome. With light that is directly clipped onto the telescope, the illumination direction always stays in line with the telescope and therefore the user’s line of sight.

**Loupes**

There are 2 types of loupes available for uses in the dental practice. The first type is the flip-up loupes, which is mounted on a bracket and attached to the frame of the eyeglasses. The attachment may be either a single hinge, or a vertical attachment hinge. Both hinges will allow the assistant to flip up the microscope when it is not needed. The eyeglasses themselves may or may not have corrective lenses. The second type is through-the-lens (TTL) loupes, which are less bulky and more esthetically pleasing. TTL loupes are also referred to as fixed telescopes.

**Advantages of Flip-Up Loupes**

- They can be worn at all times (simply flip out of the field of vision when necessary).
- Other team members can use them.
- Flip-up loupes are less likely to interfere with the use of intraoral or digital photography.
- Because the declination angle is adjustable, flip-up loupes promote better ergonomics.
- They can be repaired faster than custom systems.

**Disadvantages of Flip-Up Loupes**

- They weigh more than TTL loupes.
- Because they are adjustable, the screws may get loose and stripped causing them to flip down at inappropriate times.

**Advantages of TTL Loupes**

- They are lighter than flip-up loupes.
- They will not get out of adjustment because they are custom designed for each assistant.
- Because the telescopes are closer to the eyes, the field of view is larger.

**Disadvantages of TTL Loupes**

- They must be removed if you want to leave the field of view, for instance, to talk to the patient or another team member.
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Be More Effective

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Microscopes
Dental professionals increasingly use microscopes for treatment. Some advantages to using a microscope are:

**Advantages of Microscopes**
- They feature the widest articulation range.
- They have adjustable eyecups that can be fully adjusted.
- Maneuvering handles can be adjusted to the user’s preferred position.
- The fine focus feature allows for easy adjustment.
- Lens range of 20 mm allows for easy focus adjustment without moving the microscope.
- Optimal magnification range of 2.1 to 19.2x.
- They allow for comfortable positioning, reducing or eliminating neck and back pain.
- They will accommodate upgrades and retrogrades without high costs.

**Disadvantages to Microscopes**
- The feeling of disorientation and loss of field perspective.
- Because the field can be magnified from 2.1 to 9.2x, it may take the assistant a little longer to get use to.
- It is harder to communicate to the patient with the microscope over their face. Communication must be done before the microscope is in place.
- Difficult to see the expressions of the patient. Asking the patient to raise their hand or use a clicker to make the dentist and the assistant aware of any discomfort.
- Passing of instruments must be practiced because of field perspective.

**Conclusion**
Magnification allows the assistant to check margins of an impression more accurately. Provisionals can be fabricated with a more defined margin. Temporary cement removal and cord packing procedures can be enhanced by magnification. As with any new piece of dental equipment, frequent use of a surgical magnification system requires techniques that must be learned and practiced. The higher the magnification of the system, the more difficult the transition will be.

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**References**