The eyes have it: magnify your sight

Now more than ever, dental assistants need to see more clearly

Shannon Pace, Dental Assistant II

Y ears ago, it was unheard of for an assistant to wear magnification or use surgical telescopes. Now, with the demand for clinical excellence in all realms of dentistry, assistants more than ever need to see more clearly, reduce eyestrain and have a supported balance in the musculoskeletal ergonomics.

Eyesight

The eye is a complex sensory organ that allows us to see and interpret shapes, colors and dimensions of objects in the world by processing the light they imitate or produce. The eye is able to see in bright or dim light, but cannot see objects when light is absent. The iris of the eye can adjust to incoming light to maximize the quality of images. Under bright light, the pupil diameter quickly varies from about 1 mm to 3 mm as the light levels change. This means the eye can easily control the amount of light entering by a factor of 10.2

The increased pupil diameter increases the eye’s resolution capability like a camera. 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

A 1.7x to 2.5x magnification (loupes) or surgical telescope is recommended for a dental assistant for most dental procedures—especially if magnification has never been experienced before. More than that, it will greatly reduce the depth of field. For some endodontics, oral surgery and periodontics, a stationary fixed microscope (Global Surgical Corporation) may be required for greater magnification. If more than 5x magnification is used in either spectacles mounted or headband mounted systems, it may 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 reduce the binocular image quality and often create double images, eyestrain and headaches. High quality coatings will enhance the light transmission.

Types of Magnification

There are four categories of surgical magnifications to choose from.

1. Stationary (fixed microscopes) characteristics
   - Wall mounted or ceiling mounted
   - High magnification (6x to 20x)
   - Confined field at high magnification

2. Low magnification multi-lens system characteristics
   - Spectacles mounted or headband mounted telescopes

3. Single-lens loupes and magnifiers characteristics
   - Very portable and convenient
   - Low to medium magnification range (2x to 5x)
   - Limited depth of field at high magnification

4. Long working distances scalar magnification characteristics
   - Spectacles mounted or headband mounted telescopes
   - High magnification (6x to 20x)
   - Confined field at high magnification

A surgical magnification system creates an on-field/off-field blind spot that is called a magnification scotoma. When the wearer moves an object from her peripheral field of vision (which is unmagnified) to the center of her field of vision (which is magnified), such a blind spot occurs. The reason for this is because only a small portion of the wearer’s total field of vision is magnified. The relation here is proportional too: as the power of magnification increases so does the size and proportion of the blind spot. As a result, a large blind spot may encourage the operator to turn her head sharply to one side to eliminate its effects during instrument movements or exchanges (Fig. 2).

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 doctor, the patient and themselves as instruments are passed through this blind spot. The assistant can learn to compensate by guiding any sharp/pointed instrument edges into the operating site with a gloved finger(s) (Fig. 3) until the instrument is under visual control and in the magnified field of view.
widest articulation range of any binocular for operator comfort. It has adjustable eyecups that can be fully adjusted and maneuvering hands that can be adjusted for the user’s preference. The fine focus feature allows for easy adjustment of objective lens range of 20 mm and allows for easy focus adjustment without moving the microscope.

A Global Surgical microscope has five steps of magnification:

1) Optimal magnification range (Fig. 2) of 2.1x to 19.2. The operator can view an entire arch or increase the magnification for precision and close inspection.

2) Easy movement of the microscope head offers an easy view of the mouth.

3) Ergonomical design allows for comfortable positioning of the operator, thus reducing or eliminating neck and back pain.

**Optical declination angle**

You need to select a system that meets your optical declination angle, working distance and depth of field. The optical declination angle is the angle to which you lower your eyes when positioned in your optimal working position. If the declination angle is not matched to your mus-

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**G6 Magnification Chart**

<table>
<thead>
<tr>
<th>Magnification (x)</th>
<th>2.1</th>
<th>3.2</th>
<th>5.1</th>
<th>8.0</th>
<th>12.8</th>
<th>19.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field of View (diam.-mm)</td>
<td>95</td>
<td>62</td>
<td>39</td>
<td>25</td>
<td>16</td>
<td>10</td>
</tr>
</tbody>
</table>

*Utilizing 10X eyepieces; 250mm objective lens; 160mm binocular

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Note: With selected components, this magnification range can be shifted up or down.

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**Photomed Jr**

More clinicians use Global Surgical microscopes for treatment. An inclinable binocular features the
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culoskeletal needs, you may experience eyestrain and/or muscle strain of the head, neck and/or back.

Working distance

The working distance means the distance between the dental assistant’s eyes and the working site. The working distance of the telescope should match your working distance. Telescopes with the same magnification power and working distance will have significantly different depths of field depending on what design criteria were used. This is why it is always better to have a representative of the manufacturer customize the center of depth of field for each assistant’s personal working distance.

Depth of field

Depth of field is the range over which you are able to achieve visual resolution. It is determined by the combination of your vision and your surgical magnification system. It is recorded in terms of the nearest and furthest extremes of distance from the surface of your eye to the object observed (depth of field from 15 inches to 18.5 inches).

A well-centered depth of field of 5 inches 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 her head forward or backward to visualize some area of the oral cavity.

Balanced positioning

Before purchasing surgical telescopes, first determine your most comfortable and natural working posture. A balanced position is best determined by first closing your eyes and relaxing your muscles. Sit in free space on your assistant’s stool without leaning against the backrest, and adjust the height of the stool until it becomes comfortable.

Head tilt and chronic neck pain

Research indicates that many dental professionals have been experiencing musculoskeletal discomfort in the neck, shoulders, and lower back areas. Although working with improved or neutral postures can alleviate or prevent this chronic discomfort, many clinicians do not attempt or recognize the importance of ergonomic benefits gained with a proper working posture. Chronic neck pain may not be immediately evident; working with poor posture over time will strain joints and muscles, which leads to musculoskeletal problems.

Reflectance

The lower the reflectance the better the visual acuity and depth of field given the same magnification and illumination. This is mostly accomplished by an anti-reflective coating on the lenses. Most manufacturers coat with magnesium fluoride, silica, zirconium dioxide, and titanium dioxide.

Light systems

Adequate light must be present for magnification two to three times the size of objects increases as room light increases. Excessive light reduces pupil size, thus obscuring details of the object (presenting glare problems), obscures details of the object, and presents glare problems.

Dental manufactures are turning their attention to the development of low profile, lightweight light sources whose purpose is to provide ideal lighting for dental/surgical needs. Co-axial illumination light systems come in two types: lights mounted to headbands and lights mounted directly to the surgical telescope’s mounting fixture. The separate headband mounting light is generally heavy and cumbersome. A light that is directly clipped onto the telescope becomes an integral part of the telescope, and the illumination direction will always stay in line with the telescope’s and the clinician’s line of sight.

Manufacturers

Some manufacturers of both flip-ups and TTL loupes are:

• Ergovision loupes (Surgitel Systems/General Scientific Corporation)
• Orascoptic Pearls and Dimension-5 (Orascoptic Research, Inc.)
• Surgical Telescopes (TTL loupes) (Designs for Vision, Inc.)
• Global Microscope (Global Surgical Corporation)

Cross contamination

Because these telescopes are positioned on your head, you need to disinfect the loupes with alcohol (isopropyl alcohol 70% by volume) after each patient.

Conclusion

Magnification allows the assistant to more accurately check margins, provisionals can be fabricated with more defined margins, and temporary cement removal and cord packing procedures can all be enhanced with magnification. As with any new piece of dental equipment, frequent use of a surgical magnification system requires techniques that must be practiced and learned. The higher the magnification of the system, the more difficult the transition.

References

3. Ergonomics and the Dental Care Worker. Denise C. Murphy, Dr PHI, Cohn.
4. Dimensions of Dental Hygiene. Susanne Sunell, RDH and Lance Rucker, DDS.

Shannon Pace, a DA II, works with Dr. John Cranham in his private practice and has been a dental assistant for over 20 years. She is the past president of the Metrocina Dental Assistants Society in Charlotte, and is also on the advisory board for the dental assistant program at Central Piedmont Community College. Shannon is also the past Co-Editor-in-Chief for REALITYTEAM “allTie” and Contemporary Dental Assisting with two columns (“Clinical Techniques" and “From the Other Side of the Chair”). In addition, she’s a member of the AAD and serves on the new members committee as well as on the Editorial Board for The Journal of Cosmetic Dentistry. Shannon is an evaluator and advisor for many dental manufacturers. For information on Dental Assistant Programs, please contact her.

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