Magnification: you can't effectively practice minimally invasive biomimetic dentistry without it

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The tenets of minimally invasive biomimetic dentistry (MIBD) in the restorative realm call for the careful diagnosis and removal of diseased tissue while leaving as much healthy tissue as possible. Being able to see the extent of the diseased tissue allows for the precise dissection of those parts of the tooth that are necessary to remove or access pathology in order to create solid bondable surfaces. Whether you are using caries-disclosing dyes to see the extent of a carious lesion, or employing tactile senses with a sharp spoon excavator, carbide bur, ceramic round bur, smart plastic burs, or an explorer to discern an endpoint to the excavation of dental caries, magnification will allow you to see this endpoint with more clarity.

Using the visual examination procedures put forth by the International Caries Detection and Assessment System (ICDAS), magnification also becomes imperative.[1] Whether the dentist is using magnification loupes, microscopes, or video electronics such as a close-up camera system, the visual field is enhanced and chances are that the quality of the caries/disease detection and the concomitant restorations will also be enhanced. Studies have shown that there is a reduction in errors in dental procedures with magnification use.[2,3] The use of microscopes is gaining in the enhanced visualization market, and many new camera-based systems are available that allow heads up positioning while peering at a monitor. Most dentists now are reaching for some level of magnification that will allow them to see and treat their patients' dental needs better. A commonly held belief—that magnification was used only by those clinicians that were losing visual acuity—has given way to the belief that the quality of care is commensurate with how well you can see your field. This new way of viewing the use of magnification has been good for dentistry.

Dental schools are now strongly encouraging their students to use magnification. A great source article on magnification in dentistry was created by Glenn van As, DMD, Vancouver, British Columbia, and is available on his website: www.drvanas.com/pdf/IncorporatingMagnification.pdf.

To illustrate the propensity to diagnose and better treat using a microscope, Fig.1 is a photograph taken to approximate the view that a clinician with 20/20 vision would have in respect to utilizing natural vision at 15 inches. Looking at the distal of tooth No. 20, it is noted that there is a white spot on the marginal ridge. As the magnification is increased, it is apparent that the observed area gives more information on the size, depth, and color of the lesion. Increasing the magnification from 1:2 (Fig. 2) to 1:4 (Fig. 3), and then to 1:6 (Fig. 4, 5) at the same 15-inch distance shows how we can focus in on the area more thoroughly.

Clearly a clinician can see the advantages of magnification in these photographs, as the pathology of the repetitive stress fracture becomes more distinct with each higher level of magnification. Working under this type of magnification allows for not only better diagnostics, but also assists in determining the finish lines and limits of pathology, in order to create more predictable long-term restorations.

Approximately 12 years ago, at the beginning of my work with lasers, I trained with Dr. Mark Colonna on laser uses and techniques. He discussed the benefits of magnification in improving clarity in working areas. At that time, Dr. Colonna was working with 6.0X magnification fixed lens loupes and I was working with 3.5X loupes, and was thoroughly satisfied with my results. After attending his course, however, I decided to see how much better I could see with the 6.0X loupes he recommended. After a week or so of acclimation to the new level of magnification, I realized just how much I was missing in my diagnostics and care with only the 3.5X loupes. After approximately 3 years of using 6.0X magnification, I decided to try to increase the magnification with a microscope, but after a number of attempts, I found that—with the equipment available at that time—I couldn't adapt. I generally adapt quite well to new technology, but I soon realized that I couldn't, at that time, adapt to working with a microscope. Therefore, I have settled in for now with the 6.0X *through the lens* (TTL) loupes.

Fig. 1. Photograph showing an approximated 1:1 magnification view (based on 20/20 vision) of the lower left quadrant, showing tooth No. 20 with a whitened discoloration on the distal portion of the tooth.

Fig. 2. Photograph showing an approximated 1:2 magnification view of tooth No. 20.

Fig. 3. Photograph (mirror view) showing an approximated 1:4 magnification view of tooth No. 20. Note the increased clarity of the lesion and the fracture and cavitation interproximally.

Fig. 4. Photograph (mirror view) showing an approximated 1:6 magnification view of tooth No. 20. Note the depth of the lesion is more apparent.

Fig. 5. Photograph (mirror view) showing an approximated 1:6 magnification view of the finished restoration of the filling on tooth No.20, showing excellent margins, colors, contact, and contours.

A few years back, as a patient who was ecstatic about the crowns we had just placed gave me a big bear hug of thanks, I heard the oculars fracturing from the lens of the fixed vision *Buddy Holly* loupes (Designs for Vision, Inc.) I was using. After the patient left, I examined the damage to the loupes and immediately called my *Designs for Vision* representative who quickly arranged for me to ship the fractured loupes to the repair facility. For the next 2 weeks, while the 6.0X loupes were being repaired, I tried to work with my old 3.5X loupes but had to cancel or at least postpone several procedures, feeling that I didn't have the visual acuity to which I had grown accustomed. I felt unable to provide the quality of care that my patients deserved. Upon return of the 6.0X loupes, I immediately resumed my normal schedule of care and ordered a second pair of 6.0X loupes in the event I needed a replacement. From that point forward, I realized how important magnification really had become in my practice. Until then, I didn't realize how increasingly reliant my dental care had become on using enhanced vision. I would expect that if a person can get used to the microscope oculars, the quality of care could be increased to another level.

There are conflicting views about which of the currently available modalities—from loupes to microscopes to magnified videographing—is the panacea for providing optimal care. Each of these modalities will enhance the quality of care that a patient can receive. My personal preference is 6.0X TTL optics, while others may prefer 2.5X flip-downs, or 10X or 25X scopes.

No matter which modality is chosen, the use of magnification will improve the quality of care. In the field of MIBD, we need to move to the next level of magnification, so that we can better identify the extent of pathology to save precious tooth structure, and to establish exquisite margins for the long-term success of the restoration of these lesions.[4-6]

Magnification reduces the amount of light that can reach the eyes, so having a lighting system to enhance visual acuity is also important. Lighting systems are included with microscopes and video systems; but in the use of loupes, some form of external lighting source will be necessary. Any light, whether conventional overhead track/ceiling, chair-mounted, headband-mounted, or glasses-mounted, enhances the field of view and depth of field. With the increasing use of LED arrays, lighting patterns can be created that keep the light more easily in the oral cavity than was possible in previous systems. There are now also systems that will allow filtering of the light for use in diagnosing pathology. Headband- or glasses-mounted systems that are light and powerful, with day-long batteries, are now available from many sources.

For clinical and legal documentation, patient education, and communication with third party providers, microscopes and camera systems have long held the advantage over other systems in that they can be set up to take pictures and/or videotape the procedures that are being provided. However, a number of glasses- or headband-mounted camera systems are emerging that will allow clinicians to utilize imaging that is virtually in the line of sight of the practitioner. Creating full procedure videos

using a head mount is difficult, due to the frequent movements of the head, whereas taking single frame images or short videos works quite well. To alleviate head movement, devices such as Magna-Vue cameras (Magna-Vue Advanced Imaging and Testing Solutions) can be placed and adjusted to record valuable information about a procedure or technique. This camera, which is mounted and movable for proper adjusting, has a great depth of field, and allows the clinician to work with magnification with the added benefit of allowing the patient to watch (and better understand the need for) a dental procedure.

Visualization of pathology has gone beyond the limits of magnification and entered the realms of advanced laser and optical diagnostics. As the ability to diagnose and monitor early lesions utilizing diagnostic systems improves, we can intervene earlier to either remineralize or restore and save precious tooth structure.[7] Systems used today for early caries diagnostics utilize either laser fluorescence or optical scanning systems, or a combination of both. Systems that utilize these modalities include Spectra (Air Techniques, Inc.), DIAGNOdent (KaVo Dental), Soprolife (Acteon Group), and DIFOTI (KaVo Dental). Some novel systems, such as the Canary System (Quantum Dental Technologies) will utilize laser and heat to analyze the crystalline structure of the tooth, monitor caries, and quantify how effective remineralization processes are. Another system (in development by S-Ray Incorporated) will utilize ultrasound to detect caries and many other conditions of the oral cavity by presenting a 3D image that can look in and around oral structures. As diagnostics is the driver in MIBD, these varying diagnostic technologies will be featured in future MIBD columns.

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Disclaimer

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References

1. *International Caries Detection and Assessment System*. Available at: http://www.icdas.org. Accessed March 6, 2013.
2. Leknius C, Geissberger M. The effect of magnification on the performance of fixed prosthodontic procedures. *J Calif Dent Assoc*. 1995;23(12):66-70.
3. Zaugg B, Stassinakis A, Hotz P. Influence of magnification tools on the recognition of simulated preparation and filling errors. [in German] *Schweiz Monatsschr Zahnmed*. 2004;114(9):890-896.
4. James T, Gilmour AS. Magnifying loupes in modern dental practice: an update. *Dent Update*. 2010;37(9):633-636.
5. van As G. Magnification and the alternatives for microdentistry. *Compend Contin Educ Dent*. 2001;22(11A):1008-1012, 1014-1016.
6. Friedman MJ. Magnification in a restorative dental practice: from loupes to microscopes. *Compend Contin Educ Dent*. 2004;25(1):48, 50, 53-55.
7. V. Kim Kutsch. Caries Detection Technologies. *Inside Dentistry*. Available at: http://www.dentalaegis.com/id/2010/05/caries-detection-technologies. Accessed March 6, 2013.

Manufacturers

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