A Microscope for Every Dentist: Why and How
by David Clark, DDS

Figure 1a-b: The author Dr. David Clark and partner Dr. Jihyon Kim at work with their microscopes – G6 and Entree Global surgical microscopes.

Figure 2a: Diastema and undersized lateral incisor at 2X magnification.

Figure 2b: Significant detail is shown at 4X.

Figures 2c-g: At 8X magnification the Bioclear Diastema Closure Matrix can be truly appreciated as the gingival apron is inserted gently and deeply into the sulcus. In Fig. 2f, we can see that too much distal pressure is being placed on the matrix and it is beginning to invert. 2g demonstrates the ideal adaptation pressure and the first small layer of flowable composite has been placed and light cured.

Figure 2h: Second phase of staged wedging shown at 4X. If the wedge had been placed before the "hip" of flowable composite was placed and cured, the Bioclear Diastema Matrix would have been smashed resulting in a poor contour.

Figure 2i: 4X magnification view of immediate post-operative result of diastema closure.

Figure 2j: 8X view of immediate post-operative result of diastema closure.

Figure 2k: 6 week view at 8X demonstrates not only that we have cultivated a perfect papilla where there was once a black triangle. Extreme magnification confirms that the tissue is perfectly healthy as the stippling continues along the entire length of the new papilla “If it is pink and stippled, it’s healthy. Period.”

Figures 2l-m: Pre- and post-operative radiographs demonstrate the aggressive yet healthy cervical shape required for the optimal hard and soft tissue interface 3-6.
Part I: Why
Magnification, Advanced Magnification, Extreme Magnification. What does that mean to a general dentist? To help explain lets explore the parallel continuum of magnification and computer processing power. However, because powers of magnification have a squared, not linear relationship to visual information, a seemingly small jump in magnification creates a level of visual information that will profoundly impact the potential for clinical accuracy (Figs. 1a & 1b). Early on, during the advances in the power of computer processing, a prediction was made that every 18 months a ten-fold speed increase would warrant an upgrade in the processing chip. And sure enough we all kept upgrading our computers from 286 to 386 to 486 to the Pentium to the dual processor, etc. Ten-fold power change is key for computer speed as well as visual information.

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The general consensus is that at 3.5X magnification it’s not just better dentistry, it’s different dentistry. Then at 10X it happens again. In other words, at 3.5X you can do things that you simply cannot predictably perform without advanced magnification. See example in the diastema closure/peg lateral series (Fig. 2 mural). At 10X (extreme magnification) another world opens up that is demonstrated in the endodontic images (Figs. 3, 4).

Advanced Diagnosis
In the Fig. 5 mural, everyday diagnosis is challenged by advanced and extreme magnification. As one of the first clinicians in dentistry to document cracks with a clinical microscope, I published the first guide to dentinal and enamel cracks¹ based on 16X magnification. I recommend that everyone read the guidelines – some of which might surprise you (www.bioclearmatrix.com).

Restorative Microdentistry: New Possibilities in Direct Aesthetic Resins Featuring Staged Wedging
Microscopes allow the clinician to see and create new possibilities. The case featured in Fig. 2 is a perfect example. The concept of staged wedging was invented under the microscope. In this example, the patented Bioclear Diastema Closure Matrix is self-wedging and the first increment of flowable composite is placed and cured without a traditional wedge. Once the “hip” or undercut is established, heavy wedging pressure is applied before the contact portion of the composite is placed and cured. The six-week extreme magnification photograph shows a perfectly pink and perfectly stippled new papilla that has grown into the microscopically smooth and round embrasure. While a microscope (10X) magnification is not required to perform the procedure, it was microscopic analysis that inspired the technique and the more clinical magnification used, the greater the ease and enjoyment of the procedure.

Figure 3: A dramatic lateral canal system was discovered, shaped and obturated because of microscopic visualization combined with coaxial shadowless light.
Figure 4: A mercilessly difficult C-shaped canal system that did not branch into the 4 canals until the apical third is photographed at 24X magnification.

Figure 5a: At 2x power we can clearly see that teeth are white and gums are pink. (That’s a joke).
Figure 5b: at 3.5 X we can begin to see a pair of cracks on the mesial marginal ridge of #31.
Figure 5c: At 8X we see a little more detail about the cracks.
Figure 5d: At 12X we jump to the next level of enlightenment. I can see that the second crack is much larger, say 400 or 500 microns wide as opposed to the first crack that is only 40 or 50 microns.
Figure 5e: At 24X we approach the next quantum jump (1000 times the visual content at 33X) and I can clearly see that the larger enamel crack is shallow which indicates that there are no dentinal cracks beneath.

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The naysayer’s point is “Who cares about predicting dentinal cracks? Magnification is for the lab, not the clinic.” The answer to that is patient retention, fee collection and scheduling issues. For example in the case of Fig. 5, I diagnosed pathological cracks in the enamel, but scheduled the appropriate time for a direct intracoronal restoration knowing that the tooth was not cracked (No dentinal crack = tooth is not cracked). If I had misdiagnosed the case and discovered a dentinal crack upon removal of the amalgam, I would have had to “back my way” into collecting a much higher fee for an extra-coronal (crown or onlay) procedure not to mention the aggravation to the staff when the procedure runs overtime.

Clinical Microscopes; Luxury or Necessity?

The operating microscope is not just simply higher magnification than oculars (loupes). It is better magnification. Oculars have been very helpful and may always have a role in dentistry, but the optics are crude when compared to the Infinity Corrected Optics of a stereoscopic microscope (Figs. 6-9). When combined with the shadowless coaxial light source, they transform the clinician’s potential for accuracy of nearly every aspect in the different disciplines in dentistry.

Increasing levels of magnification produce a squared, not linear relationship to visual acuity. In other words, a clinician working at 3.5X sees over 10 times more visual information. 10x magnification allows the human retina to acquire 100 times more information. 20x allows 400 times the visual information (Table 2, below).

Tactile Endo vs. Micro-Endodontics; Do We Have Two Standards of Care?

In Fig. 7, we see a huge lateral system that could have easily been missed with traditional tactile (blind) endodontics. The crazy thing about endo is that if this had been a vital case (no lesion) I might have gotten away with missing that lateral system. In fact in a vital case you can often get away with 4mm underfills or even missed canals. I have personally disassembled several cases where the dentist shaped canal systems and somehow forgot to insert the gutta percha into one of the canals and yet the case was succeeding years later. Invariably, these crude yet successful cases were infection free at the obturation appointment.

In contrast, for the lesion case like the one featured in Fig. 3, you can’t be too good. And the research shows that your success rate will be significantly higher if you allow a six-week to three-

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Figure 6: Oculars (loupes) rely on convergent vision that essentially requires an overlap of two images. This form of magnification creates increasing problems and eye strain as magnification power increases. The clinical microscope utilizes a more refined optical system. (16X Magnification).

Figure 7: Features 8X convergent magnification with loupes and a representation of the two images that the brain receives as the eyes begin to focus.

Figure 8: Shows a common occurrence of the incomplete merging of the images seen through a pair of loupes. Both figures 7 and 8 demonstrate the visual noise (blurry peripheries) of loupes optics.

Figure 9: Represents the same case seen with a clinical microscope at 24X magnification featuring infinity corrected optics. There is no eye strain and no visual noise. Loupes magnification at 8X and beyond becomes excruciating for most clinicians. For advanced and extreme magnification, the microscope is a superior and healthier choice.
month calcium hydroxide therapy in infected cases. A first rate CaOH therapy in a lesion case combined with finding all of the canal systems under the microscope is “top shelf” treatment. Unless you only treat vital cases and simple cases; without a microscope, you are a second-class citizen. That said, there are other factors that you will need to address if you want to get to a 98 percent success rate that should be the goal of a general dentist or 93 percent specialist success, which Dr. John Khademi (my co-author and endodontist extraordinaire) shoots for based from analysis of his TDO database (Endodontists treat more complex cases than we should be treating, hence the 98 versus 93).

The final word in endo: Poor, even terrible endo succeeds far too often (almost exclusively in non lesion cases). “Excellent” endo performed under the microscope sometimes fails, often because it was an infected [lesion] case treated in one appointment. Regardless, microscopes are the single most important tool in the pursuit of zero defect endodontics.

**Part II: How**

How do you integrate the microscope? Once you take the plunge to a clinical microscope, how do you integrate it into your routine? Where can you find training? What about patient education and documentation? I will provide a brief outline of how it can work best for you. At the end of the article there is a list of resources for further information.

The following is a roadmap for gradual introduction of the microscope into your practice.

**Step one:** Do a full-day or two-day course with a microscope (Find out first hand if a microscope is right for you. Don’t dismiss the idea without giving it a good try.).

**Step two:** Buy a microscope

**Step three:** Pick one part of one procedure and use the microscope every single time

**Step four:** Once you master that pick another. Don’t go back and forth – it’s maddening

**Step five:** Perform and record all of your new patient examinations through the microscope.

**Step six:** Attend a microscope “boot camp” like the two-day course at NCOFI in Newport Beach, California (For a list of other facilities and courses, visit www.microscopiedentistry.com).

**Step one** is the microscope course. I do dozens of courses every year for endodontics and Bioclear composite techniques using microscopes. The dentists are having such a good time learning the techniques that they forget that they are even using a microscope. By the end of the day they are either “hooked” or they have given up and put on their loupes. These tend to be the best way to become comfortable with a microscope without actually committing.

**Step three,** the one-procedure-at-a-time training, is an interesting approach. Learning to use a clinical microscope is a bit like eating an elephant. Instead of running around the elephant biting off little bites in a haphazard way, sit down and eat the trunk. When that’s gone eat the left ear, and so on. What are the best, most productive and easiest procedures to start with using a microscope? Examples include a Class V on a central incisor, occlusal composites or any procedure that allows you to work on one surface for an extended period, like endo. Cutting a quadrant of crowns or posterior composites needs to wait until you are further along in your progress. Some dentists like Glenn van As jump right in and incorporate the microscope all at once. His approach is discussed below. Most dentists, however, will follow the gradual method mentioned above.

**Step five** is the breakthrough commitment. It is the key to the creation of a microscope centered practice.

The single most important element in realizing significant ROI and to create a microscope centered practice is to allow patient and staff to see the incredible view that the doctor sees. A live and recorded video broadcast is the first step to bring about these fundamental changes. Trust, cost versus value, and patient loyalty are but a few of the principles that are deeply impacted.

Make sure that you have a video camera installed when you purchase your microscope. An inexpensive television or LCD screen is placed in patient’s view and should always be turned on (Fig. 1). The key to the creation of a microscope centered practice is video taping the tooth and soft tissue portion of the comprehensive exam. We present the video later as part of the comprehensive treatment consult. This simple process requires almost no technical learning curve and no interruption of your clinical routine. It will literally transform your practice by revolutionizing the most important appointment; the new patient experience. Just as importantly, you are teaching yourself to visualize every surface of every tooth through the microscope in a low stress (non operative) environment. Microscope clinicians report finding a wealth of subtle disease that they could not see before:

**Micro pathology** – This new term describes important pathology that is either invisible or not compelling at less than 12X. This includes signs of occlusal disease (tell tale facets and enamel loss), early incomplete fractures, micro leakage, early recurrent decay, and isolated periodontal inflammation surrounding crude dentistry that has a violation of the three new parameters of marginal integrity.

**Dramatic Results** – Patient motivation is, in a word, incredible.

**Productivity** – The average adult older than 30 presents with two posterior teeth with fairly dramatic early Incomplete Coronal Fracture that their last dentist never saw. Many of
these teeth have a history of symptoms. In the average practice it will take several years of several procedures per week to treat these teeth.

The Glenn van As Model of Microdentistry

Glenn van As, BSc, DMD, was not the first restorative dentist to use a microscope, but was definitely one of the first to use the microscope for pretty much everything, and nearly all of the time. He inspired me to transition from a “loupes first, microscope second” to a “microscope first, loupes second” routine for my clinical day. Glenn was practicing under the burden of the Canadian fee system where the College of Dental Surgeons of British Columbia sets a fee schedule. That fee schedule is about 40 percent lower than my fees in Tacoma, Washington. Although he had a much higher volume practice (because of lower fees) he beat me to the punch to adopt the microscope as the center of his clinical day. I told myself, “If Glenn can do it, then so can I” and in 6 months it came to fruition. Never underestimate the power of inspiration.

Summary

In 18 years of restorative microdentistry, what have I learned? Here are seven of hundreds of things you will discover on your magnification journey:

1. Early crack diagnosis occurs at 16X.
   Anything less is a guess or end stage diagnosis' (End stage referring to loss of pulp or fracture causing loss of cusp or fracture requiring subsequent extraction).
2. Dentistry is way more complex and way more iatrogenic than I thought before.
3. Tooth colored restorations require far more magnification than metal restorations.
4. Black triangles are unhealthy.
5. Rounded cervical profiles in porcelain and composite can create great health and great aesthetics but magnification is required to pull it off and not leave an overhang.
6. Without a microscope, you might become a second-class endodontic clinician.
7. I sleep far better at night knowing “I truly gave it my all today.”

Author’s Bio

Dr. David Clark founded the Academy of Microscope Enhanced Dentistry, an international association formed to advance the science and practice of microendodontics, microperiodontics, microprosthodontics and microdentistry. He is a course director at the Newport Coast Oral Facial Institute in Newport Beach, California. He is co-director of Precision Aesthetics Northwest in Tacoma, Washington, and an associate member of the American Association of Endodontists. He lectures and gives hands-on seminars internationally on a variety of topics related to microscope-enhanced dentistry. He has developed numerous innovations in the fields of micro dental instrumentation, imaging, and dental operatory design. Dr. Clark has authored several landmark articles about microscope dentistry including Aesthetic Dentistry, Sealants, The Role of Ultrasonomics in Three Dimensional Shaping and Restoration of Non Vital Teeth, Micro-Imaging and Practice Management, and Crack Diagnosis. Dr. Clark is a 1986 graduate of the University of Washington School of Dentistry. He maintains a microscope-centered restorative practice in Tacoma, Washington. He can be reached at drc Clark@micr oscope dentistry.com, drc Clark@bioclear matrix.com or www.bioclearmatrix.com.

NOTE: Dr. Clark will present at least one follow-up article in Dentaltown Magazine detailing techniques developed under advanced and extreme magnification including: Injection Molded Composite Dentistry, Pulpal Microsurgery, Restoratively Driven Papilla Regeneration, and Biomimetic Minimally Invasive Endodontic Shaping.

References

1. Academy of Microscope Enhanced Dentistry. www.microscopec hoodentistry.com
2. Training and DVDs by David Clark. DDS. www.life timedentistry.net
3. Dr. Glenn van As DVDs: glennvanas@mac.com; www.dc vans.as.com