What does the future hold for high-level magnification in dentistry?

Dr. David Clark

Magnification, illumination, and video magnification continue to evolve as technology changes and our thirst grows for complete visual information. More than 70% of endodontists now use microscopes routinely, and in a decade we will likely see enodondists' numbers coming close to 100%. Using a microscope and loupes in combinations rapidly becoming standard in high-end restorative practices and increasingly common for "hometown restorative dentists" that aspire to greater accuracy and improved outcomes. New to the scene is digital magnification, which is essentially a high-quality video camera connected to an LCD screen with supporting peripheral hardware and software. These digital video systems promise the ability to do virtual dentistry while staring at a screen, not the patient. My experience with these video systems is that they lack depth perception (are not stereoscopic) and are too fuzzy as stand-alone replacements for glass optics (loupes and microscopes). Stereo video shot through a microscope projected on large screens and poloarized glasses for viewing holds more promise, but the cost of at least $60,000 is an issue.

Microscopes continue to be the ultimate means of powerful magnification. You need one, you want one, here's what to look for:

Support, training, and continuing education are as important as any mechanical feature of the microscope.

Articulating (inclinable/declinable) binoculars are a must-have. Without them, it is difficult to maintain proper posture. The good posture and healthy back and neck of the clinician are some of the most important advantages of the microscope.

The objective lens decides how far the microscope will be from your patient. For example, a 200mm lens puts you very close with the advantages of brighter light and higher net magnification. The disadvantages are more potential splatter on the lens, and in my case, I periodically have problems with the distal end of the handpiece running into my microscopes; 225mm or 250mm is more practical.

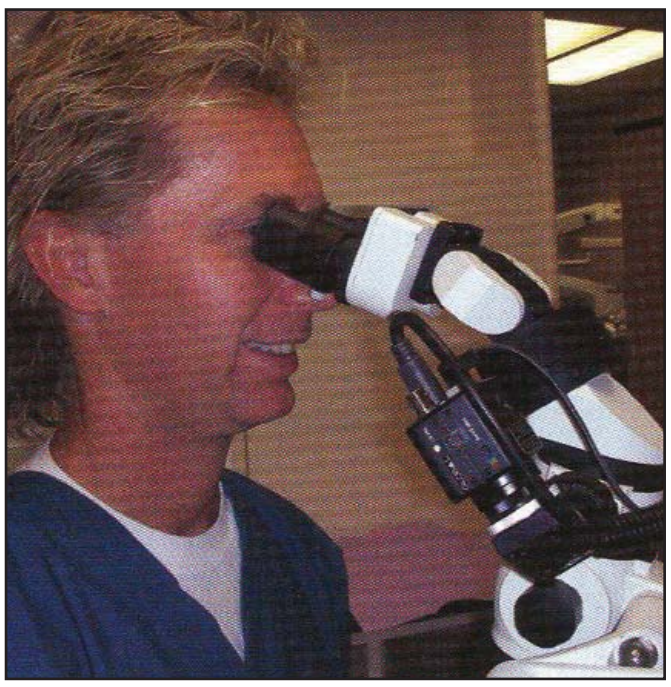

Figure 1. The perfect posture and perfect coaxial shadowless light that are two more benefits of a modern microscope.

Restorative dentists and periodontists need a step magnification at the bottom end of 2.5x. The greater depth of field allows visualization of an entire quadrant without focusing problems. This way the clinician can minimize leaving the microscope to go to loupes.

High-end magnification needs to go to 13x to 16x as a minimum. Diagnosis of early incomplete tooth fracture, finding calcified canal systems, microplastic periodontal surgeries, and elegant aesthetic dentistry, among other areas, demand it. These higher levels of 16x to 40x are more useful in the beginning for brief moments of observation; the bulk of operation is done at lower lower magnification.

An orange filter that allows extended working time for light-sensitive materials such as composites has become a must have.

Stiff, less expensive microscopes are reasonable in endo-only practices; however, for restorative dentistry, the microscope should glide effortlessly with the lightest brush of your hand or face, twisting and rotating on a neutral axis. I enjoy restoring a full quadrant or arch with my microscope, moving constantly and seeing the tooth from many angles.

A beam splitter with a feed to a TV or monitor is a must. Unless the patients and staff see the benefits of microscope accuracy, the microscope will not have the same dramatic effect on the financial bottom line as it will on the level of clinical excellence.

Quality of the microscope and careful installation to avoid drifting and vibration are key to utilization. Compromise here will make long-term, widespread use difficult and frustrating. An out-of-balance fan on the HVAC unit on the roof, for example, can create microtremors that are a macro problem for the microscope that is properly braced.

If you are considering replacing your 3-power loupes with 4.5-power and a headlamp, get a microscope instead and keep your 3-power loupes for less detailed work. Loupes, while helpful, provide crude optics when compared to elegant microscope optics and coaxial shadowless light.

Dr. Clark is the founder of the Academy of Microscope Enhanced Dentistry. Ask the experts: e-mail any questions or requests for advice to drclark@microscopedentistry.com and your questions will be forwarded to a panel of leading authorities from all specialties. Literature and support are available at microscopedentistry.com and lifetimedenstistry.net.

Figure A

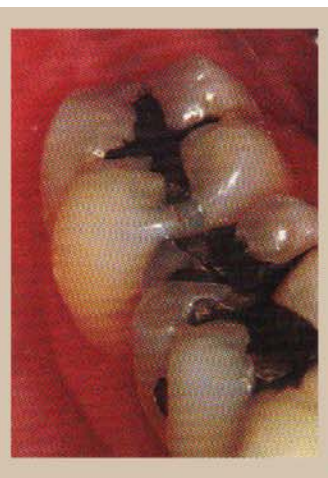

Figure B

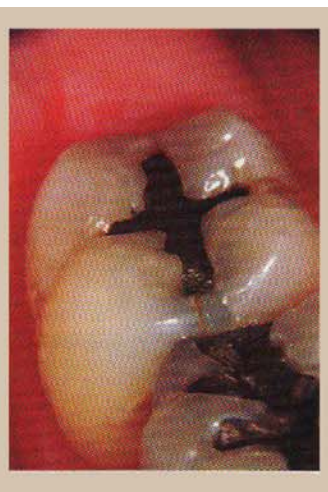

Figure C

Figure D

Figure E

Figure F

Figures A to F show the different levels of magnification (2.5x, 4x, 8x, 12x, 16x, 24x) available with a single operating microscope. Early presymptom diagnosis of cracks is only possible at 10x magnification and above.

Company	Carl Zeiss Surgical	Carl Zeiss Surgical	Expanding Images	Global Surgical	Magnified Video Dentistry	MicroVision Technologies	Seiler Precision Microscopes
Product name	OPMI pico	OPMI PROergo	Opti-Link	Global Microscope (G6 system)	MagnaVu Dental Procedure Scope	The Ultra-lite Microscope	Revelation Dental Operating Microscope
Magnification levels for each step when packaged with the most commonly sold objective lens	5 step; 3.4x to 21.3x	1:6 zoom: 1.5x to 18.2x	3.2x, 5x, 8x, 12.5x, 20x	2x, 3x, 5x, 8x, 13x, 19x	1x to 20x zoom	Ultra-lite 4x, 6x, 10x	Revelation Dental Operating Microscope; 3x, 5x, 8x, 13x, 20x 202/402 Dental Operating Microscope: 5x, 8x, 13x Revelation ZOOM with 250mm = 3x to 20x
Can be adjusted for Rx lenses?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recommended method for infection control	Asepsis kits available or wipe down	Asepsis kits available or wipe down	Disposable sterile drape	Barrier bag	Disposable barriers/ Disinfectant wipes	Microscope can be wiped down with a disinfecting cloth	Drapes or everyday cleaner
Fluid resistant?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dust resistant?	Yes	Yes	Yes	Yes	Yes, with disposable barriers	Yes	Yes
Autofocus?	No	Yes	No	No	No, manual	Yes (intuitive focus)	No
Zoom magnification?	No	Yes	No, step magnification	No	Yes	No	Yes
Removable lens protector?	Yes	Yes	Yes	Yes	Yes	No	Yes
Objective lens distances (distance from microscope to patient) (mm)	200 to 400	200 to 415	187, 200, 250	250, 225, 200	150 to 450, 6 to 18 inches	200, 250, 300, 400	250mm lens = 254mm 300mm lens = 304.8mm 200mm lens = 203mm
Track mount or other system for multi-operatory use?	No	No	Yes	Yes	Yes	Yes	Yes
Total # of ports available for video and still cameras	2	2	2	2+	1	Currently none	2
Binoculars reclinable?	Fully	Fully	Partially	Fully-220º	N/A	N/A	Fully
Available adaptors	Rotating binoculars; angled optics w or w/o beam splitters	Rotating binoculars; angled optics w or w/o beam splitters	Vertical extension arms: 2.5", 3.25", 4"	Carr Binocular Extender – extends the eyepieces toward the user for more comfortable positioning/ Binocular Rotation Ring – allows the microscope head to be rotated left and right (roll axis) +/- 25º/Camera adapters for many types of cameras – Nikon, Canon, SLR type, etc./Dental composite filter/Dual iris diaphragm for adjusting the depth of field	N/A	N/A	Video camera adapter = $995/Digital camera adapter = $1,695/ Binocular extender = $995/Angel rotation device = $395/Tube coupling for assistant's head = $1,295/Laser filter adapter = $695
Continuing education/ Training vouchers included	Free on-site training and equipment in-service	Free on-site training and equipment in-service	Hands-on course 6 AGD credits	2-day training course offered with purchase of microscope (can't be combined with other offers and discounts). The courses are given by seasoned microscope users in many parts of the country.	Offers training seminars/ Optional on-site	On-line tutorials	Will make recommedations
Video system and cost	Integrated single-chip video $4,400	Integrated single-chip video $4,400	Leica IC A microscope video camera, $3000	Price is -$1,500 for the camera. Add'l adapters often are needed, increasing the price to -$4,500	Video system included w/LCD (19"), LCD mount	N/A	Video package = beam-splitter/Video camera adapter/CCD color video camera/17" flat panel monitor for $4,000
Price range	$11,800 to $28,900	$38,000 to $54,700	$6,999 to $9,999	$9,500 to $15,000	$22,000 to $27,000	Under $6,000	$4,495 to $25,750
"Try-before-you-buy" option?	Yes	Yes	Yes	Yes	Yes, in-office demos	Yes	Yes
Warranty period for the body and frame?	2 years	2 years	Lifetime	Lifetime	2 years	5 years	Lifetime warranty
Warranty for electrical portion (light source, fiber optic cables, etc.)	Xenon bulbs (500 hours) other consumable do not have a warranty	Xenon bulbs (500 hours) other consumable do not have a warranty	5 years	1 year	2 years	1 year, bulb not included	1 year