

A MICROSCOPE FOR USE IN DENTISTRY

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Microsurgery traces its beginning to Carl Nylén of the University of Stockholm, who, in 1922, used a low-power monocular microscope for ear surgery.¹ For the next 30 years, however, little use was made of Nylén's pioneering work with the microscope. During this period, binocular loupes or loupes mounted on eyeglasses were employed for various surgical procedures. In such cases, magnification of only 2-3× was available, since any greater power decreased the working distance to an uncomfortable level of less than 3 inches.

In 1953, the Carl Zeiss Company of West Germany marketed the first commercial binocular operating microscope.² This microscope and the microsurgical instruments that were developed for use with it, made possible the development of modern otologic surgery in the 1950s. Otologic surgeons used magnifications of 6-10×, which proved comfortable for work on the eardrum (the dimensions of the eardrum are somewhat similar to that of a tooth—9.5 × 9.5 mm).

The next decade was marked by the application of the operating microscope to procedures in the various surgical specialties. Subsequently, microsurgery has become an accepted technique in ophthalmic, vascular, neurologic, urologic, gynecologic, and orthopedic surgery.³

In the early 1960s, one of the authors (G.J.J.) developed the instrumentation and technique for endoscopic microsurgery of the larynx.⁴ In 1962, he utilized the operating microscope in oral procedures, including surgery of the parotid duct and carcinoma of the tongue. In 1949, a Boston dentist, van Leeuwen, employed a Greenough microscope to study the periodontium.⁵ Baumann, an otolaryngologist, mentioned the use of the otologic operating microscope for dentistry in 1977.⁶

Some dentists occasionally use 2-3× binocular loupes or magnifying mirrors in their work, but these low-power devices are inadequate for the precision that some dentists seek. In addition, the working distance is often uncomfortable for both the patient and the dentist. Therefore, in 1978 we began to develop an instrument that could be used for microscopic dentistry, since the optical and mechanical limitations of the otologic surgical microscope in dentistry were realized early. As a result, a special microscope—a dental operating microscope—was produced (Figs. 1-3) along with accessory equipment and instruments, such as precision dental mirrors, black anodized instruments, and arm rests. The design of the microscope incorporates capabilities for still, motion picture, and videotape recording of dental procedures (Fig. 4)

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Received for publication February 23, 1981; revision received July 6, 1981.

0191-3239/0301/0007 \$01.25/0
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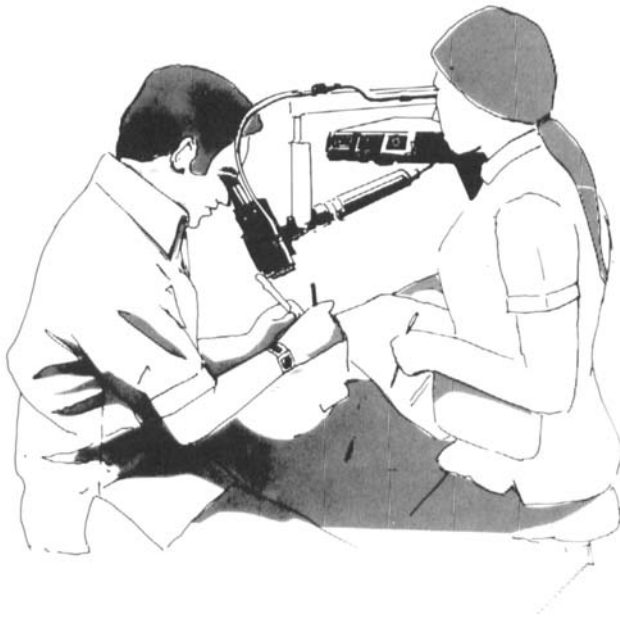


Figure 1. Artist's concept of microdentistry unit.

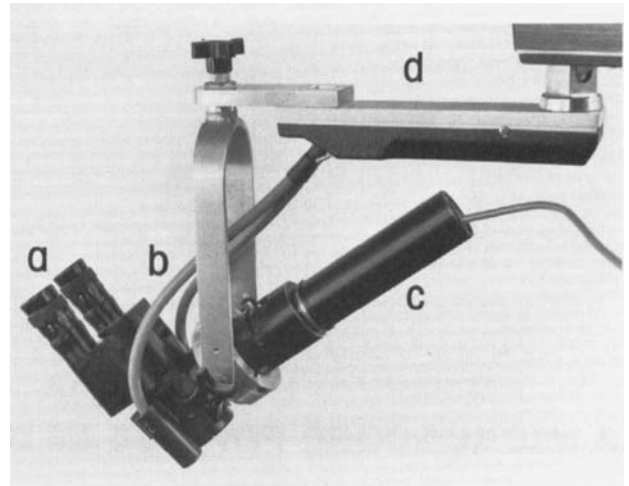


Figure 3. Components of dental microscope: a = Adjustable eyepieces, b = Coaxial fiberoptic illumination, c = Microvideo camera with zoom capability, d = Suspension system with air brake.

and the attachment of a CO₂ laser, an instrument that has many possible applications in dentistry.^{6,7}

GOALS OF THE INSTRUMENTATION

At the beginning of our work it was determined that a dental microscope should provide the following:

1. Stereoscopic and binocular vision.
2. Magnification of approximately 5–10× with high resolution and good contrast.
3. A wide field and flat view.
4. An adequate working distance between the object and the microscope (200–300 mm).
5. Ease of maneuverability with attachment to either the dental unit, the dental chair, a floor mount, or a ceiling mount.
6. Adequate illumination (without the dental light) for direct observation and photographic recording.
7. Compatability with newer technical advances, such as the surgical laser and monochromatic illumination.
8. Moderate cost.

THE DENTAL MICROSCOPE

Two types of stereoscopic microscopes are currently in use. One is the Greenough type (Fig. 5), which is essentially two monocular microscopes arranged side by side at an angle so that the two objectives focus on the same object. The disadvantage of this design is that the user must con-

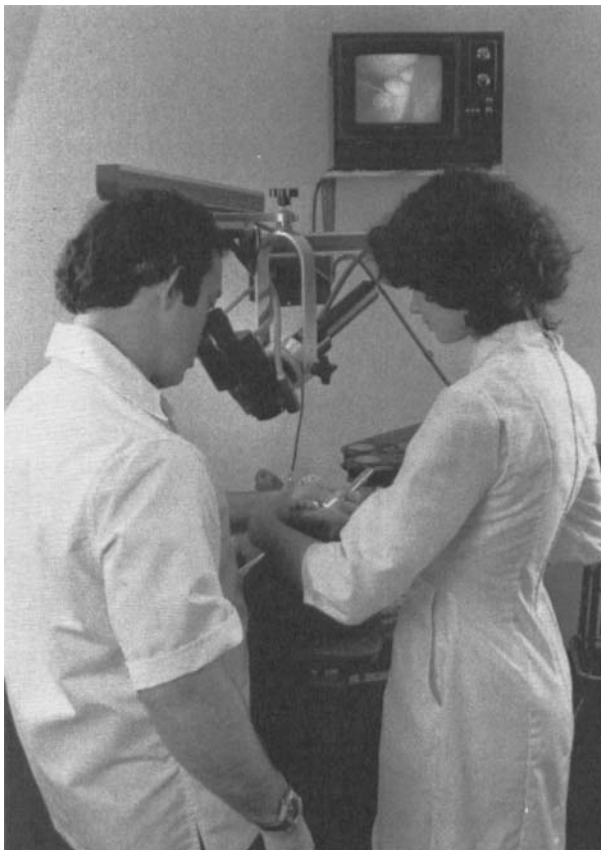


Figure 2. Dental microscope in clinical use. Patient is watching on closed circuit TV.



Figure 4. Photograph taken through dental microscope. Roof of pulp is visible through thin covering of dentin. Endodontic therapy is avoided.

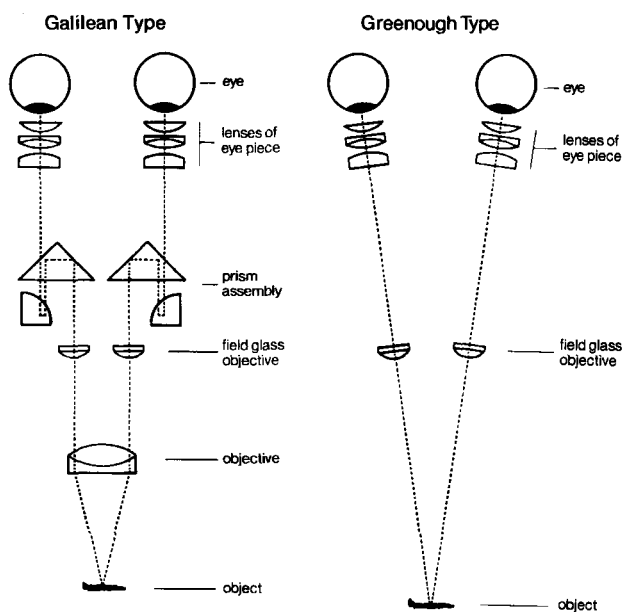


Figure 5. Galilean and Greenough microscope systems.

verge his eyes to view the image, and prolonged use of the microscope can result in eyestrain and fatigue.

The second type, the Galilean type, is based on the application of the magnifying loupe in combination with a binocular viewing system (Fig. 5). The Galilean design meets the above-mentioned requirements for a dental microscope in that it employs parallel binoculars and thereby better protects the user from eyestrain.

The dental microscope is designed on the Galilean principles and incorporates fully-coated optics and achromatic lenses. The operator has a working distance of 200–300 mm as measured from the objective or collimating lens to the subject. Thus, the distance is comfortable for both the patient and the operator. The dentist can sit or stand and work without bending. Meanwhile, the dentist does not intrude into the patient's personal space.

The eyepieces have three very important features. First, the distance between the eyepieces is adjustable so that the microscope can be adjusted to fit the interpupillary distance of different dentists. Second, each eyepiece has its own diopter scale. Hence, if the operator usually wears eyeglasses, he or she most often can set them aside and focus the eyepieces to the required prescription instead. Third, the dental microscope has a high eyepoint. Therefore, the operator's eyes need not be jammed tightly against the eyepieces to gain a good, wide view.

Fiberoptic illumination also is employed in the design. This provides a direct cool beam on the patient, yet the illumination is bright enough to allow documentation with video, motion picture, or still photographic equipment without the need for extra lighting. The optics and illumination provided by the microscope allow the dentist to rest his or her eyes even while operating for several hours at a time. There is a sense of depth perception, the field of view is flat and free from distortion (even at the edges), and the colors are true.

A suspension arm for the dental microscope also was designed and built. This arm allows the microscope to be moved from side to side and up and down in one continuous motion with only one hand. A brake allows it to be locked in any position.

ASSOCIATED INSTRUMENTS AND EQUIPMENT

In addition to the microscope and its suspension system, other equipment and instruments have been developed for use with the microscope.

1. Dental chair (Chayes-Virginia Vision Chair, Chayes-Virginia, Inc., Evansville, IN). The

dental chair for use with the microscope provides comfort for the patient even during long procedures. It has the capability for transverse motion in addition to adjustable back height, which means the dental team wastes little effort in going from the upper to the lower arch.

2. Adjustable arm rest. The arm rest allows the dentist to steady his arm while performing precision work, especially during long procedures.
3. Fiberoptic illumination. Various fiberoptic illuminators are available to provide intense light without heat.
4. Fiberoptic dental handpiece. Several models are available.
5. Instruments. Precision front-surface mirrors, hand-cutting and spoon-excavating instruments are available in a black anodized finish designed to reduce glare.
6. Co-observation attachment. This attachment allows an assistant or a student to observe procedures under magnification.
7. Photographic attachment. This adapter allows still, motion picture, and video tape cameras to be attached to the microscope for documentation, which is useful for student and patient education.

SUMMARY

A special dental microscope has been developed along with support and associated structures. The dental microscope provides an alternative to treatment either by the naked eye or by binocular loupes and overhead dental light. The dental microscope will be moderately priced.

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