Selected Papers on Progress in Recent Ophthalmology

1

Closed Vitreous Surgery

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I

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CONTENTS

Observation and Illumination System for Closed Vitreous Surgery 1
(*Vitreous Surgery & Advances in Fundus Diagnosis & Treatment, pp. 139–147, 1977*)

Observation and Illumination 11
(*Vitreous Surgery & Advances in Fundus Diagnosis & Treatment, pp. 149–152, 1977*)

Illumination System for Vitrectomy 15
(*Vitreous Surgery & Advances in Fundus Diagnosis & Treatment, pp. 153–157, 1977*)

Viewing and Illumination During Intraocular Surgery 20
(*Vitreous Surgery & Advances in Fundus Diagnosis & Treatment, pp. 159–163, 1977*)

Vitreous Surgery Instrumentation 25
(*Vitreous Surgery & Advances in Fundus Diagnosis & Treatment, pp. 165–174, 1977*)

The Underwater Diathermy Electrode 35
(*Vitreous Surgery & Advances in Fundus Diagnosis & Treatment, pp. 175–177, 1977*)

Parameters for Comparison of Vitrectomy Instruments 38
(*Vitreous Surgery & Advances in Fundus Diagnosis & Treatment, pp. 179–181, 1977*)

Instrumentation for Vitrectomy: The Vitreous Infusion–Suction Cutter (VISC) 41
(*Vitreous Surgery & Advances in Fundus Diagnosis & Treatment, pp. 183–184, 1977*)

Vitrectomy Instrumentation 43
(*Vitreous Surgery & Advances in Fundus Diagnosis & Treatment, pp. 185–186, 1977*)

Microsurgical Roto–Extractor Instrument 45
(*Vitreous Surgery & Advances in Fundus Diagnosis & Treatment, pp. 187–193, 1977*)

The Grieshaber–Schepens Nibbler 52
(Vitreous Surgery & Advances in Fundus Diagnosis & Treatment, pp. 195–200, 1977)
Automated Vitrectomy and Lensectomy System 58
(Vitreous Surgery & Advances in Fundus Diagnosis & Treatment, pp. 201–211, 1977)
The Suction–Infusion Tissue Extractor (SITE) 69
(Vitreous Surgery & Advances in Fundus Diagnosis & Treatment, pp. 213–216, 1977)
The Vitrophage 73
(Vitreous Surgery & Advances in Fundus Diagnosis & Treatment, pp. 217–220, 1977)
Vitrectomy Instrumentation System MS7 77
(Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 221–226. 1977)
The Vitrectomy Instrument..83
(Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 227–229, 1977)
Summary of Instrument Presentation..86
(Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 231–237, 1977)
Surgical Technique of Vitreous Membrane Sectioning 93
(Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 239–246, 1977)
Surgical Technique of Mechanical Lysis of Retinal Synechiae............... 101
(Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 247–255, 1977)
Endodiathermy: Surgical Technique and Results 112
(Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 257–261, 1977)
Intravitreous Electrocoagulation and Posterior Vitrectomy 117
(Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 263–270, 1977)
Closed Vitrectomy; Overview of Techniques and Indications 125
(Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 271–278, 1977)

Closed Vitrectomy in Rhegmatogenous Retinal Detachment 133
(*Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 279–290, 1977*)

Pars Plana Vitrectomy in Retinal Detachment 145
(*Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 291–295, 1977*)

Vitrectomy for Diabetic Retinopathy 150
(*Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 297–304, 1977*)

Closed Vitrectomy in Diabetic Retinopathy 158
(*Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 305–313, 1977*)

An Alternative Light Source in Endoscopic Illumination and Support of the Anterior Segment in Closed Pars Plana Vitrectomy 167
(*Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 315–317, 1977*)

Vitrectomy in Trauma: Management of Traumatic Lens Rupture 170
(*Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 319–327, 1977*)

Management of Traumatic Retinal Detachment with Pars Plana Vitrectomy, Scleral Buckling, and Gas Injection 179
(*Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 329–333, 1977*)

Closed Vitrectomy in Trauma: Selected Intraocular Foreign Bodies 184
(*Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 335–344, 1977*)

Closed Vitrectomy for Perforating Ocular Injuries 194
(*Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 345–354, 1977*)

Complications in Closed Vitrectomy 204
(*Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 355–364, 1977*)

Erythroclast Glaucoma Following Vitrectomy 214
(*Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 365–368, 1977*)

Corneal Complications of Closed Vitrectomy **218**
(*Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 369–371, 1977*)
Iris Neovascularization After Pars Plana Vitrectomy **221**
(*Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 373–376, 1977*)
Complications of Closed Vitrectomy **225**
(*Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 377–387, 1977*)
Posterior Lensectomy **236**
(*Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 389–391, 1977*)
Roto-Extractor Pars Plana Lensectomy **239**
(*Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 393–399, 1977*)
Closed Vitrectomy and Lens Removal **246**
(*Vitreous Surgery and Advances in Fundus Diagnosis and Treatment, pp. 401–414, 1977*)

SECTION FOUR

CLOSED VITREOUS SURGERY

12

Observation and Illumination System for Closed Vitreous Surgery

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H. MACKENZIE FREEMAN
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Closed vitreous surgery requires special observation and illumination systems because the vitreous cavity is not accessible to ordinary methods of viewing. The purpose of this paper is to describe these special viewing and illumination systems.

OBSERVATION SYSTEM

Two systems are generally used: indirect ophthalmoscopy and microscopy.

Indirect Ophthalmoscopy

The indirect ophthalmoscope offers a combined observation and illumination system (Fig. 1). Because of its strong illumination, indirect ophthalmoscopy is the preferred system for closed vitreous surgery requiring instruments that have no fiberoptic illuminator. Such closed vitreous surgical techniques include vitreous membrane cutting with scissors, extraction of foreign body with forceps, lysis of retinal adhesions with intraocular balloon, and closed (pars plana) vitrectomy. We prefer to use a head-mounted indirect ophthalmoscopy for closed vitreous surgery instead of a floor-mounted one because it permits the surgeon to hold and manipulate a vitreous instrument with one hand while the other hand holds the condensing lens. In addition, a head-mounted scope permits the surgeon a wide range of mobility around the patient during surgery.

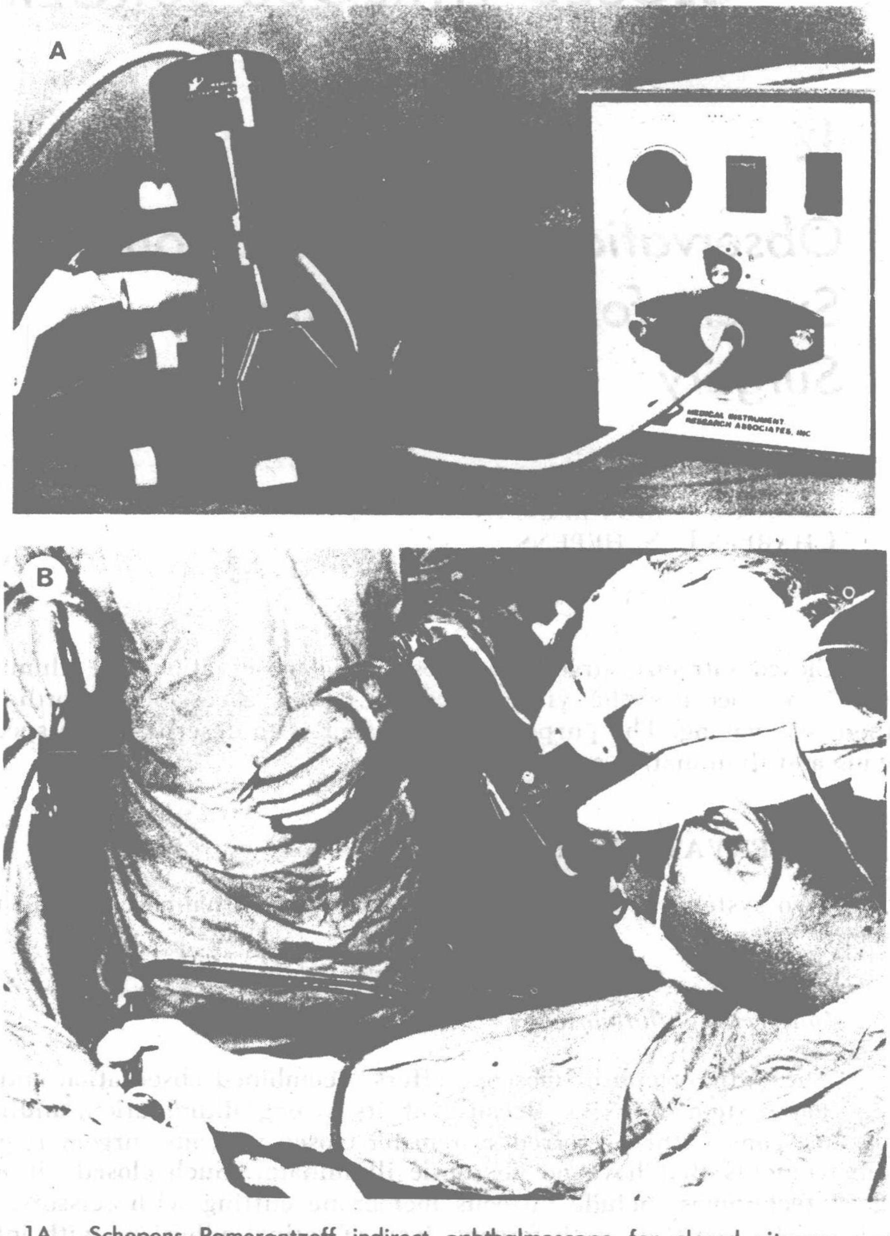

FIG. 1A. Schepens–Pomerantzeff indirect ophthalmoscope for closed vitreous surgical technique. B. Ophthalmoscope in use during membrane cutting.

Advantages of Indirect Ophthalmoscopy. The following are advantages of indirect ophthalmoscopy for closed vitreous surgery. (1) It can be used even though the ocular media are hazy because it has strong illumination. (2) It offers a wide field and stereoscopic view, permitting the surgeon to observe both retina and vitreous simultaneously while the tip of the vitreous instrument is being manipulated inside the eye. (3) It offers great mobility of the surgeon, allowing him to change his viewing position as the need arises. And, (4) it is simple and comparatively less expensive than an operating room microscope.

Disadvantages. Indirect ophthalmoscopy has the following disadvantages as an observation system for closed vitreous surgery. (1) Its lack of magnification does not permit visualization of fine vitreous details. (2) Its use in the vitreous is difficult to master because of inverted imagery in the equatorial plane. (3) Since one hand of the surgeon must hold the condensing lens of the indirect ophthalmoscope, only one hand is left to hold a vitreous instrument; therefore this system is not indicated in a "two-instrument" vitreous surgical technique, unless a stereotaxic micromanipulator is also used.

Operating Microscope

Among the closed vitreous surgical procedures, closed (pars plana) vitrectomy lends itself well to the use of the operating microscope. In addition, closure of new-formed vessels in the vitreous cavity may be done with the aid of the microscope as long as the ocular media are clear.

The operating microscope may be mounted on the ceiling or on a floor stand (Fig. 2A). In the choice of operating microscopes, the following features are essential. (1) The working distance of the microscope (distance from the objective lens to the patient's eye) should be 125 mm; a longer distance reduces the illumination at the operative field. In addition, a working distance greater than 125 mm makes it difficult for a surgeon of short or regular stature to align his eyes with the oculars for viewing and at the same time reach the foot controls of the microscope and vitrectomy instrument while sitting down on a stool. (2) The microscope should have remote power control footswitches for changes in magnification, focusing, height adjustment and x-y movements. (3) It should have a binocular observing tube for an assistant; this feature is mandatory when the surgeon is using a vitrectomy system in which suction is hand-operated by a trained assistant.

Advantages of Operating Microscope. The operating microscope offers high magnification and permits detailed observation of the vitreous structures as they are cut and removed with the vitreous nibbler. Micromanipulation or dissection of vitreous structures is made safe with magnified imagery. Because of direct and upright imagery, the use of the operating microscope is easy to learn. With the use of the flat corneal contact lens that can be retained in the eye, the "two-instrument" vitrectomy technique is feasible.

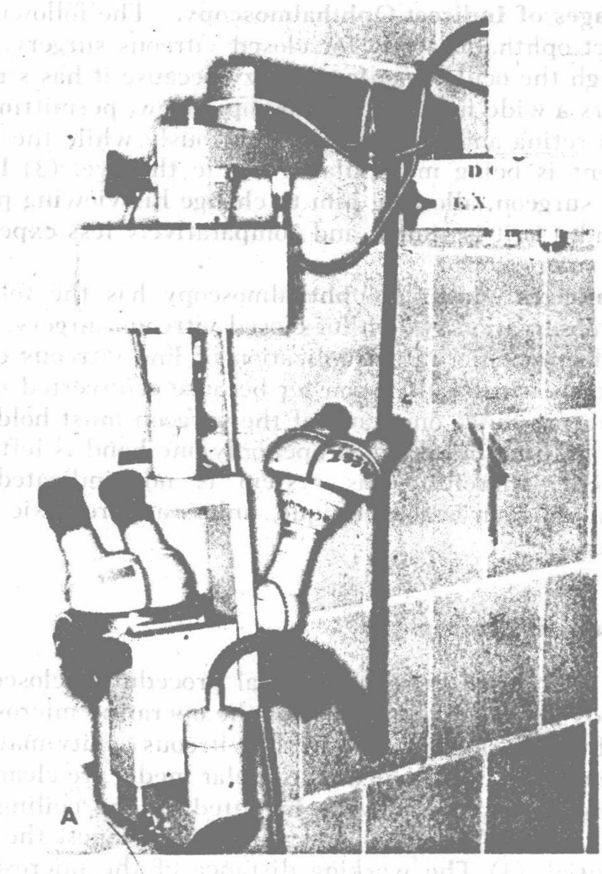

FIG. 2A. Zeiss operating microscope used for closed vitreous surgery.

Disadvantages. The disadvantages of an operating microscope for closed vitreous surgery are minor and include small field of view and inadequate illumination when surgery is done in the posterior vitreous. The problem of inadequate illumination has been circumvented since the advent of fiberoptic internal illumination.

ILLUMINATION SYSTEM

The illumination system of the indirect ophthalmoscope has been alluded to earlier. The system used with the operating microscope will be detailed.

In order to visualize the vitreous structures observed with the microscope, they must be properly illuminated. Illumination of the operative field in the vitreous may originate from an external source through the pupil or

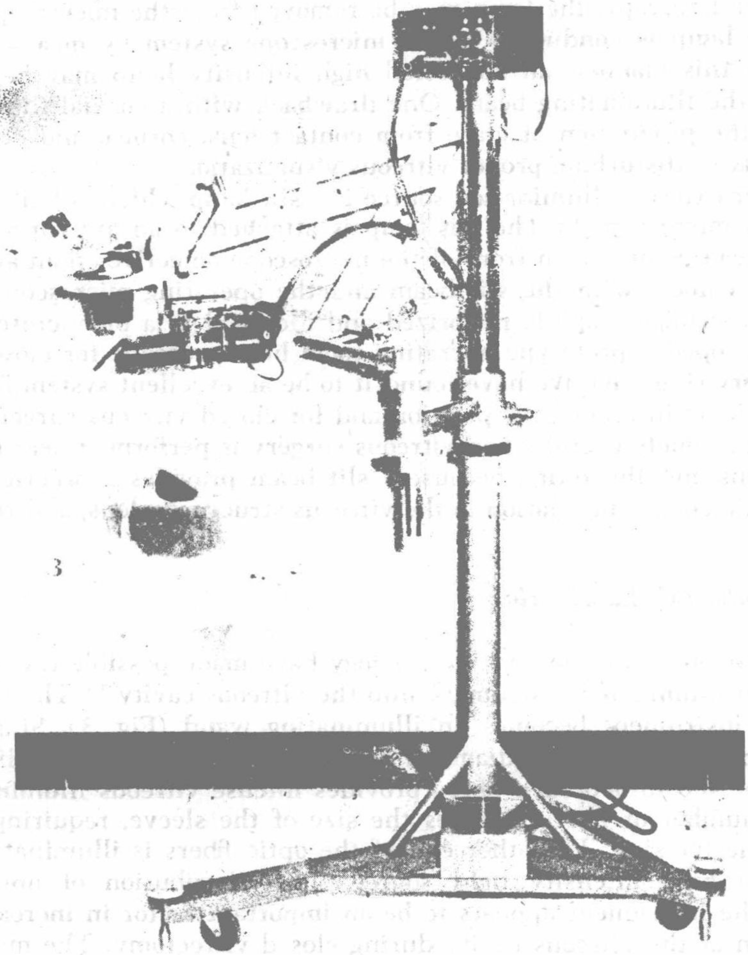

FIG. 2B. Operating room biomicroscope prototype under development by Tolentino and Banko.

internally through optic fibers incorporated in the tip of the vitreous instrument by means of a sleeve.

External Illumination

Illumination from an external source may originate from a tungsten or halogen lamp. Light rays from the lamp are projected to the objective lens. These rays must pass through the ocular media through the pupil along the observation axis of the microscope. To minimize heat generated near the microscope, the lamp may be removed from the microscope. Light from the lamp is conducted to the microscope system by means of optic fibers. In this manner, an air-cooled high intensity lamp may be used to increase the illuminating beam. One drawback with a coaxial illuminating beam is the production of glare from contact lens, cornea, and crystalline lens surfaces, disturbing proper vitreous visualization.

Another external illumination source is a slit lamp which is built into the operating microscope.[1,2] The slit lamp is attached to an arc support along which it can be moved in front of the microscope objective on an arc whose center is cofocal with the slit beam and the operating microscope. Movement of the microscope is motorized and identical to a biomicroscope. We have developed a prototype operating room biomicroscope for closed vitreous surgery (Fig. 2B). We have found it to be an excellent system for examining patients in recumbent position and for closed vitreous surgery. A slit lamp is extremely useful when vitreous surgery is performed near the crystalline lens and the retina because a slit beam provides a precise view of the instrument tip in relation to the vitreous structures, lens, and retina.

Internal Illumination

Advances in fiberoptic technology have made possible the introduction of an illuminated instrument into the vitreous cavity.[3,4] The tip of the vitreous instrument becomes an illuminating wand (Fig. 3). Single optic fibers measuring .002-inch diameter are embedded around a metallic sleeve. A total of 400 to 600 such fibers provides intense vitreous illumination. A greater number of fibers enlarges the size of the sleeve, requiring a large pars plana incision. The other end of the optic fibers is illuminated by an air-cooled high intensity light source. The distribution of optic fibers around the instrument appears to be an important factor in increasing visualization of the vitreous cavity during closed vitrectomy. The majority of the fibers are placed near the cutting port of the instrument; this concentrates illumination at the cutting portion of the instrument where constant observation is required. This uneven distribution around the instrument tip appears to minimize glare resulting from reflected rays from fibers on the side opposite the cutting port of the instrument. When performing closed vitreous surgery with instruments having external moving parts and no illumination, a fiberoptic illuminating wand may be used as a separate instrument through a second pars plana incision. This technique utilizes a "two-instrument technique" which is more difficult to master than a "one-instrument technique" of vitrectomy.

Our observations have shown that internal illumination with fiberoptics is superior to coaxial or slit lamp external illumination. We have found that pupillary dilatation and clarity of ocular media are not as critical when one is using an internal illuminating system as when one is using an external illumination system.

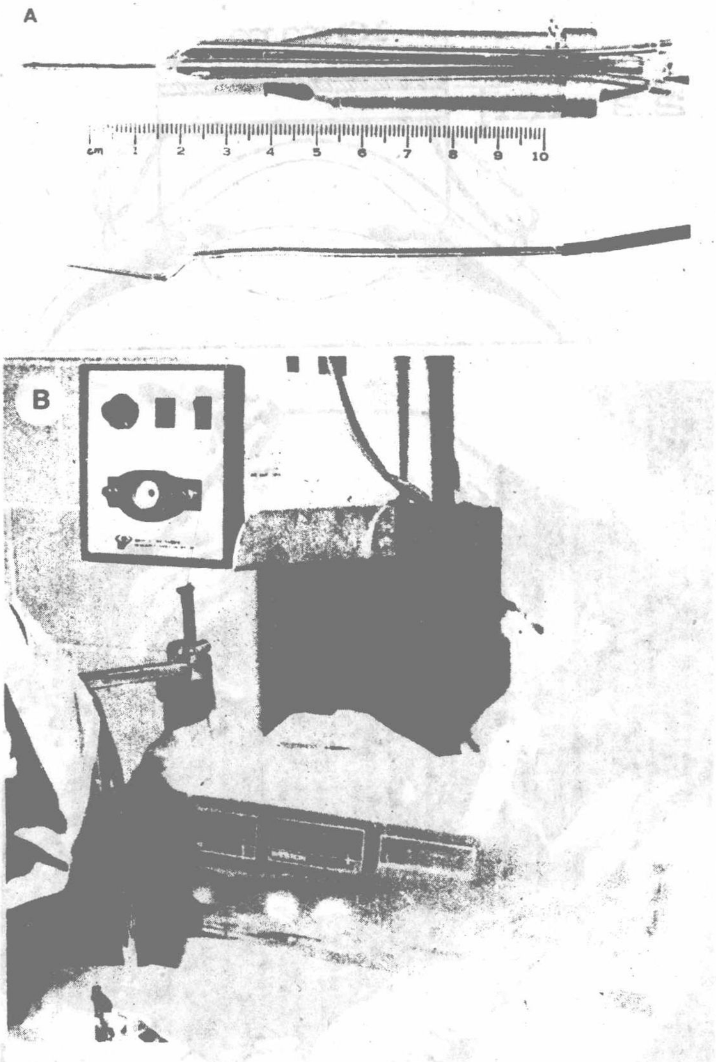

FIG. 3A. A vitreous nibbler with fiberoptic light. Intense light illuminates the vitreous cavity. B. An air-cooled high intensity lamp mounted on vitrectomy machine.

NEUTRALIZING CONTACT LENS

To visualize the deep vitreous with the operating microscope during vitreous surgery, the refractive power of the eye must be neutralized. Neutralization may be achieved on the operating table with a posterior fundus lens with plano-concave surfaces.

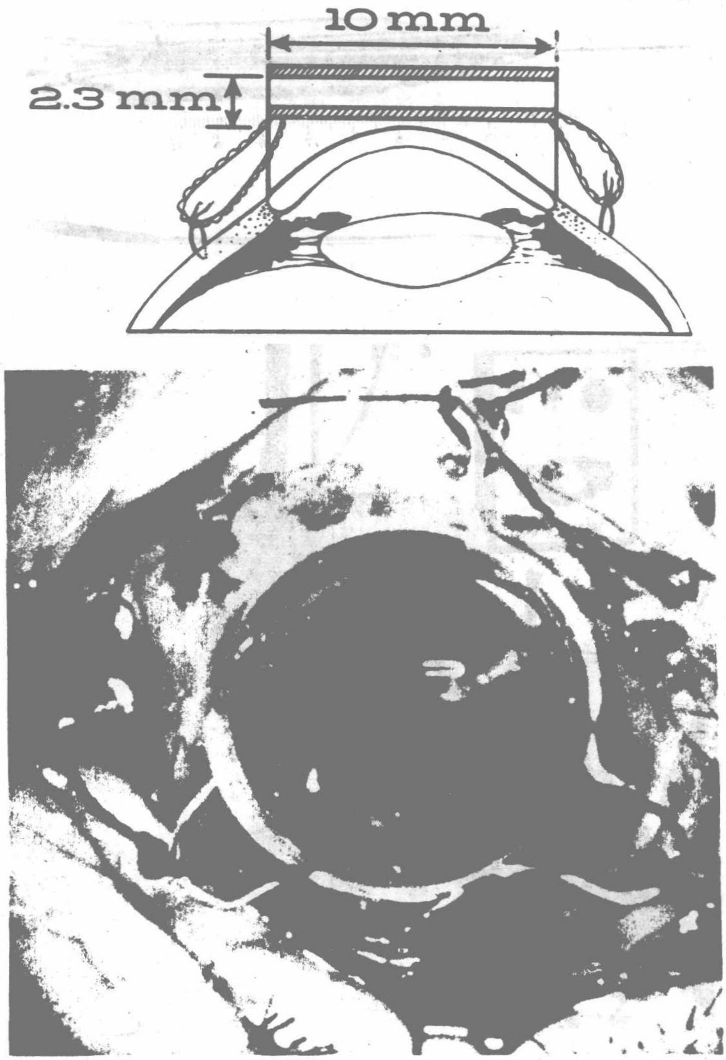

FIG. 4. Contact lens for closed vitrectomy sutured to the globe.

Modified Goldmann Posterior Fundus Lens

This lens has been modified by introducing an irrigating cannula that permits perfusion of the cornea when the contact lens is placed on the eye. The lens may be held to the cornea by slight suction through an irrigating cannula or by holding its funnel-shaped plastic housing with a forceps.

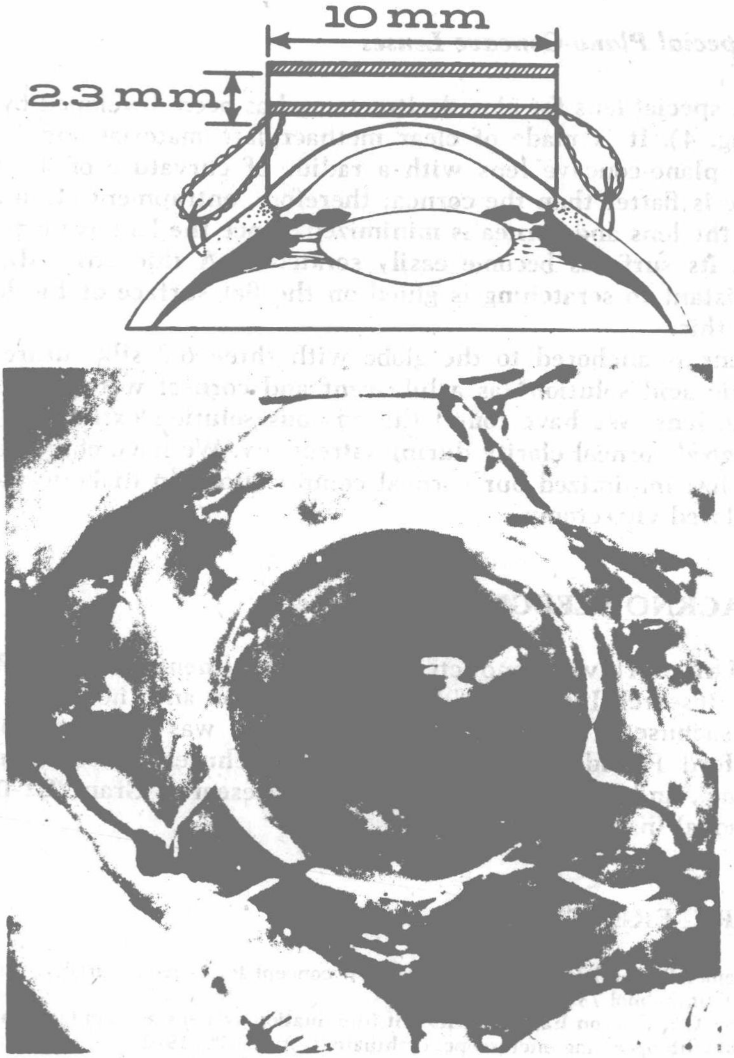

FIG. 4. Contact lens for closed vitrectomy sutured to the globe.

Modified Goldmann Posterior Fundus Lens

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Special Plano-Concave Lenses

A special lens for closed vitrectomy has been developed by these authors (Fig. 4). It is made of clear methacrylate material and is a 10-mm diameter plano-concave lens with a radius of curvature of 8.0 mm. This curvature is flatter than the cornea; therefore, entrapment of an air bubble between the lens and cornea is minimized. Since the lens is made of plastic material, its surfaces become easily scratched. A thin cover-slip made of glass resistant to scratching is glued on the flat surface of the lens to circumvent this.

The lens is anchored to the globe with three 6-0 silk sutures. We use hyaluronic acid solution* as a lubricant and corneal wetting agent underneath the lens. We have found this viscous solution extremely helpful in keeping good corneal clarity during vitrectomy. We have observed that this solution has minimized our corneal complications in diabetic patients following closed vitrectomy.

ACKNOWLEDGMENTS

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13

Observation and Illumination

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INDIRECT OPHTHALMOSCOPY

The indirect ophthalmoscope is a useful adjunct to vitreous surgery. The wide field, depth of focus, good illumination, stereopsis, and ability to visualize the peripheral retina are all significant advantages of this viewing mode.[1] The usefulness of indirect ophthalmoscopy in vitreous surgery is limited by certain significant disadvantages. First, image inversion is a major obstacle when holding the intraocular instrument by hand. Second, one needs a free hand to hold the condensing lens. Third, it is difficult for the assistant to view the operative field simultaneously while the surgeon is using the indirect ophthalmoscope. Fourth, the position of the eye is unstable. Finally, there is limited magnification. The indirect ophthalmoscope is used routinely at UCLA for the major portion of most of our vitrectomy procedures. This is possible because many of the above disadvantages are solved with the stereotaxic micromanipulator and the vacuum control device.

THE STEREOTAXIC MICROMANIPULATOR

The stereotaxic micromanipulator (SM) (Fig. 1) has two functions.[2] It stabilizes and holds the eye in a fixed position and it holds the intraocular instrument and permits the surgeon to direct movements within the eye by rotating three control knobs.

SURGICAL TECHNIQUES

Under general anesthesia, the patient is placed over the base plate and the head is fixed loosely with three adjustable skull clamps (Fig. 2). A Flieringa ring is sutured to the sclera and is stabilized with the ocular