Fig. 2. Utility needle for injection purpose or withdrawal of aqueous humor.

Individual mixers have been operated for a period of six consecutive hours without leakage or mechanical failures. Repeated starting of individual mixers has not affected its durability, however, it is suggested that the cleaning wire area between the rubber plunger and motor be kept as horizontal as possible. This will eliminate an elliptical shaping of the cleaning wire which may wear a hole in the rubber plunger during operation (Fig. 3).

Utilizing the same fabrication technique, with a small change in materials, a utility needle for repeated withdrawal of aqueous humor or for injection purposes can be constructed. A No. 24 (1/4 inch) stainless steel needle is flanged inside the hub by a gentle tap from an ice pick or related instrument. The flange will smooth the fusion of needle and hub, eliminate rough spots, and aid insertion of the following No. 31 needle. The rubber tip is then fitted snugly into the hub. A ½ inch or shorter length of stainless steel tube (1.10 mm. O.D.) is gently inserted into the rubber tip and rests on the inside surface adjacent to the flange (Figs. 2 and 3). The tube functions as a guide for a No. 31 (1½ inch) needle which is inserted through the tube, rubber tip, and into the anterior chamber. A fluid can then be injected or withdrawn and upon removal of the needle the self-sealing rubber tip prevents aqueous humor leakage. The insertion of the No. 31 needle requires a little practice, but in a short time one can master the technique. After the No. 31 needle has been inserted through the rubber tip, it is occasionally necessary to twirl the syringe to aid the passage of the needle tip into the No. 24 needle shaft.

A utility needle is described which can be used for repeated injection or withdrawal of fluid in the anterior chamber. The same system is utilized to prepare an anterior chamber fluid mixer.


REFERENCE

Optical properties of gels designed for vitreous implantation. Miguel F. Repojo, and Hanan Zauberman.

In cases of severe vitreous traction which do not respond to injections of air or saline, there is need for a material which will tamponade the retina against the choroid during the formation of chorioretinal adhesion, but will not pass through a retinal break. Gases and liquids can penetrate a retinal break; their usefulness as vitreous substitutes is limited. Liquids of high viscosity are less likely to penetrate through retinal holes. However, the ideal physical properties for a vitreous substitute are those of a gel similar to the natural vitre
ous body of the eye. Such a substitute must be introduced with as little trauma as possible.

Hyaluronic acid preparations form very thick elastoviscous bodies, particularly at a low pH such as 2.5. These differ from true gels in retaining the flowing and the mixing characteristics of liquids. A true gel will not flow, nor will two pieces of a broken gel spontaneously fuse.

Irreversible gels crosslinked by primary bonds, such as biodegradable collagen gels,1 and nonbiodegradable acrylic gels,2 have been used as vitreous substitutes in experimental animals, and in a limited number of patients.3 Acid-soluble proctase-treated collagen was crosslinked upon the combination of free radicals which formed under ultraviolet light in a nitrogen atmosphere.4 The crosslinks were introduced in acrylic gels simultaneously with the polymerization reaction.

We found that the ultraviolet-crosslinked collagen gels cannot be injected into the vitreous cavity with a 26-gauge needle without fragmentation, contrary to previous claims.1-3 In fact, a recent report on the use of similarly prepared collagen gel as a vitreous substitute concluded that the gel cannot be injected into the eye without breaking into several pieces.5 Intactness of an implanted vitreous substitute is essential not only for tamponade, but also to insure that no pieces penetrate behind the detached retina. Moreover, an implant must be intact because of certain optical considerations.

Unfragmented gels have been implanted in the vitreous cavity of experimental animals through relatively small incisions in the pars plana ciliaris. Implanted dehydrated acrylic gels expand inside the eye by absorbing available intraocular fluids.6 However, implantation involves greater trauma than simple injection and is also more difficult to perform.

In our experiments, sparsely crosslinked polyacrylamide gel was used; it has been used before as an experimental vitreous implant.7 We were unable to implant spherical pieces of gel of sufficient large dimensions through needle-sized scleral incisions. The alternative was to inject cylindrical spaghetti-like lengths of gel which fill the vitreous cavity and provide tamponade without hampering vision. This report deals only with in vitro evaluation of the optical characteristics of injectable irreversible gels.

Polyacrylamide gel. Three solutions were prepared. Solution I was prepared by dissolving 3 Gm. of acrylamide monomer and 0.15 Gm. of N,N'-methylenebisacrylamide in 10 ml. of distilled water. Solution II, buffer pH 7, was a 0.125 M. solution of N-2-hydroxyethylpiperazine-N'-2-ethanesulfonic acid (HEPES). Solution III was prepared by dissolving 1 Gm. of ammonium persulfate in 10 ml. of distilled water. The polymer was prepared by combining 0.3 ml. of Solution I with 2.4 ml. of Solution II, and catalyzing the mixture with 20 μl of Solution III, plus 2 μl of N,N,N',N'-tetramethylenediamine (TEMED).

The polymerization was allowed to proceed at room temperature for one and a half hours, yielding clear transparent gels as follows: (1) and (2) polymerized in intramedic polyethylene tubing PE 240 (1.65 mm. ID). After gelation, 3 Gm. of the resulting spaghetti-like gel was injected into 5 ml. of 0.9 per cent sodium chloride solution. (3) Polymerized in an ordinary disposable syringe. Fragmented gel was obtained by injecting it through a 23-gauge needle. Fragmented gel (3 Gm.) was injected into 5 ml. 0.9 per cent sodium chloride solution. (4) Same as (3) but the gel was fragmented upon injection through a 20-gauge needle. (5) Polymerized in polyethylene tubing (5.0 mm. ID). The unbroken, cylindrical gel was injected through a 12-gauge needle into 5 ml. of 0.9 per cent sodium chloride solution.

Optical measurements. The gel samples suspended in saline solution were placed in disposable tissue culture polystyrene flasks, which are optically clear, narrow bottles consisting essentially of two parallel walls 3.5 cm. wide and 0.5 cm. apart. A subject read the Armed Forces clinical visual acuity test chart with the bottle containing the sample against one eye; the other eye was closed. The visual path intersected the gel suspended in saline. Light transmission of the gel was determined, using the optical bench described previously by Lancon and Miller.6 Transmitted light was measured with a Gamma 2020 Photometer connected to a fiber-optic probe. Total light transmission was obtained by sending the light beam perpendicularly into the fiber optic probe. Zero was set under dark conditions. The light transmission of the specimens was measured by placing the flask perpendicular to the light beam in the position in which Lancon and Miller placed corneal discs. Ten to 12 readings were obtained for each sample and averaged. Before each measurement, the flask was shaken and its position in front of the light beam varied slightly. The transmittance of light at 550 millimicrons was also determined for the same series of specimens with a standard spectrophotometer. The specimens were measured in quartz cells 1 cm. thick (3 ml. capacity).

The results of the experiments are given in Table I. The transmittance determinations do not differ for the thin spaghetti-like gels and the thicker gels, probably because the light beam of the spectrophotometer crosses roughly the same number of interfaces when these gels are contained in small capacity quartz cells. However, based on the visual acuity test and the light transmission tests, the large diameter gel provides the best transparency. The highly fragmented gel obtained by injecting the polymer through a needle
Table I

<table>
<thead>
<tr>
<th>Medium</th>
<th>Visual acuity</th>
<th>Light transmission (in per cent)</th>
<th>Transmittance (in per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9 NaCl solution with no gel</td>
<td>20/20</td>
<td>80.5 ± 3.2</td>
<td>92</td>
</tr>
<tr>
<td>0.9 NaCl solution with gel 1</td>
<td>20/400</td>
<td>27.7 ± 2.5</td>
<td>83</td>
</tr>
<tr>
<td>0.9 NaCl solution with gel 2</td>
<td>20/300</td>
<td>43.0 ± 4.8</td>
<td>83</td>
</tr>
<tr>
<td>0.9 NaCl solution with gel 3</td>
<td>20/4,000€</td>
<td>3.0 ± 0.0</td>
<td>35</td>
</tr>
<tr>
<td>0.9 NaCl solution with gel 4</td>
<td>20/4,000†</td>
<td>3.3 ± 0.2</td>
<td>40</td>
</tr>
<tr>
<td>0.9 NaCl solution with gel 5</td>
<td>20/50</td>
<td>54.8 ± 6.0</td>
<td>81</td>
</tr>
</tbody>
</table>

*Finger counting at 15 cm.
†Finger counting at 20 cm.

provides the worst optical medium and is the least transparent material.

If a gel is to be injected into the eye without passing through retinal breaks or hindering vision by undue scattering of light, it must be prepared in a suitable injecting device, preferably tubular in shape with a gradually narrowing funnel-like end connecting to the injecting needle. A cylindrical vitreous implant of a highly hydrated gel is very soft and can easily completely fill the vitreous cavity.

A fragmented gel in the vitreous cavity will not hinder observation of the retina with the ophthalmoscope, but vision will be highly impaired by the broken gel. This is the "Nude in the Shower Phenomenon" discussed by Miller. The amount of light scattered by a fragmented gel is proportional to the difference between the refractive index of the gel and the surrounding fluid. The refractive index (1.348) of an acrylamide gel (98.5 per cent water) and of similarly highly hydrated hydrogels is sufficiently different from the refractive index of the vitreous to scatter light at each interface. Thus, the larger the number of interfaces, the higher the scatter of light and, consequently, the lower the transparency of the media.

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REFERENCES


Protein synthesis in ganglion cells of the rabbit retina after intravitreous injection of vinblastine. ANN HEFFINGTON BUNT.

Vinblastine sulfate (VLB) is an oncolytic drug which in vitro binds specifically to tubulin, the protein subunit of microtubules (MT's) and in vivo, causes depolymerization of formed MT's and in some cases the appearance of characteristic paracrystals within cells. In the rabbit retina, VLB in low concentration (10 μg, intravitreous injection) produces a reversible loss of most MT's in the ganglion cells (GC's) and blocks rapid axoplasmic transport of proteins from the GC soma to optic nerve terminals in the superior colliculus. Because of the specific tubulin-binding pattern of VLB and the absence of most axonal MT's in the period when rapid transport remains blocked, these observations lend further support to the suggestion (reviewed by Samson and Ochs) that MT's are involved in the process of rapid axoplasmic transport.