

the coating during the application step. The lens with the dehydrated coating is encased in a microbial barrier package and then sterilized. Thus, the sterile precoated lens with its dehydrated protective layer can be stored and shipped to the ophthalmologist. Because many different types of packages could be used, it is not believed necessary to schematically illustrate a package nor to illustrate the sterilizing equipment.

In FIG. 3, the dehydrated coating 8 has been submerged in an aqueous medium, such as a balanced salt solution. After a few minutes in the aqueous media, the dehydrated coating rehydrates and swells to a thickness at least $\frac{1}{2}$ greater than its dehydrated thickness. This swollen coating has a property of sluffing off outer portions of the coating during sliding contact with the corneal endothelium. It also protects the endothelium from contact with the lens' optical section 1 during static touch contact to the endothelium.

The sectional view of FIG. 4 shows a schematic of a human eye with the optical section 1 implanted and retained by loops 2 and 3 which are secured behind the iris 11. In FIG. 4, the optical section 1 is shown in the eye's anterior chamber. It is understood that this invention could be used on anterior chamber lenses, posterior chamber lenses, and lenses that use retention means other than iris loops.

Once the intraocular lens is implanted, aqueous humor within the anterior chamber 12 protects the corneal endothelium layer 13 and provides a cushion between such endothelium and the optical element of the lens. The cornea, which includes the endothelium, is shown generally at 14. In FIG. 4, the coating 8 has been completely dissolved off optical element 1 after implantation. It is estimated that this dissolution takes place within about 2-24 hours.

In addition to an intraocular lens, the coating can be applied to ophthalmic surgery tools, such as the tip sections 15 and 16 of a forceps. A typical forceps might be a Von Graefe iris forceps. In FIG. 5, the coating on such forceps is shown at 17 and 18.

The coating described above has a dissolution rate sufficiently slow so that at least 40% of the coating remains on the lens or the surgical tool for at least 30 minutes when submerged in a water bath simulating the surgical environment. During surgery, the lens is at approximately room temperature, although at times it might be slightly higher, i.e. at body temperature. This slight temperature change is believed to be insignificant much of the time during surgery the lens and tools are exposed to air temperature.

After the coating is applied to the lens or the like, it is dehydrated until it is substantially dry and has a thickness of from 5 to 300 microns. Very successful results have been obtained with coating of approximately 100 microns thick. Plural coatings can be applied to build up this thickness. Once rehydrated by the ophthalmic surgeon, the coating swells to a thickness of from 10 to 1000 microns. The hydrated coating is preferably at least $\frac{1}{2}$ thicker than the dehydrated coating.

TEST PROCEDURE

A test was performed to determine the dissolution time of various water-soluble polymers coated on a PMMA intraocular lens as a function of time in a volume of liquid approximating that of the anterior chamber. Percent of weight loss of the coating as a function of time in the volume of water was calculated. The procedure involved placing a coated lens into a volume

of approximately 0.2 ml distilled water. After a specified time, the lens was removed and placed on a filter pad and dehydrated for 2 hours and weighed. Weight loss was calculated and the procedure repeated until the coating had completely dissolved. The water bath was replaced with clean water after 1 hour of accumulative soak time to simulate the biological flushing action of the eye. The representative cumulative weight loss percents were plotted against cumulative time in the water bath. The following are the test results.

Material	Thickness	No. of Coats	% Coating Remaining After 30 Minutes
PVP	156 μ	2	25%
PVA	108 μ	3	75%
HPC	122 μ	4	50%
HPMC	98 μ	4	50%
Dextran	200 μ	1	0%
HES	236 μ	1	0%
MC	Poor film former; beaded up to expose edges of lens; and dissolved very quickly.		

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Because methylcellulose as tested by Dr. Kaufman and other would not stick to the lens, it was disregarded as a proper coating. It may be possible to blend methylcellulose with other adherent film formers or to specially treat the lens to get better adherents to approximate the coating film described in the present invention. It has been shown unaltered methylcellulose applied to an unaltered PMMA lens as in the work by Dr. Kaufman and others is a poor lens coating for the reasons specified above.

While the most successful tests to date have been made with polyvinyl alcohol, other water-soluble and swellable polymers meeting the above criteria of the applicants could be used. Possible other polymers are hydroxypropyl methylcellulose, hydroxypropyl cellulose, and Jaguars. Jaguar is a trade name of Stein-Hall Specialty Chemicals for their guar gum and guar derivatives. It is also possible to use mixtures of materials to form a coating that is both (1) an adherent film former and (2) has a slow dissolution rate to maintain at least 40% of the coating on the lens or the like for at least 30 minutes according to this invention.

During portions of the surgery, the coated intraocular lens or surgical tool is not in the wet surgical site, but is exposed to air. It is important that the coating in its swollen hydrated state does not quickly dehydrate when subjected to air. It has been found that the polyvinyl alcohol coating will maintain its swollen hydrated state for at least 20 minutes when exposed to ambient air.

The intraocular lens or surgical tools can be conveniently coated by dipping into a 5% aqueous solution of polyvinyl alcohol. Preferably, two dip coats are applied allowing the lens or tool to air dry between dips.

In the above description, a specific example has been used to illustrate the invention. However, it is understood by those skilled in the art that certain modifications can be made to this example without departing from the spirit and scope of the invention.

We claim: