

ALTERABLE REFRACTIVE POWER INTRAOCULAR LENSES

FIELD OF THE INVENTION

Intraocular lenses for implanting inside aphakic eyes are the general province of this invention. This invention specifically relates to intraocular lenses whose central lenticular means has at least one chamber means therein. The chamber means either can be evacuated or can contain a material having a refractive power different from that comprising the central lenticular means, preferably a physiologically compatible material such as silicones, gelatins, polyvinyl alcohols or the like. Lenses having one chamber means therein utilize an exterior face of the central lenticular means as a refractive, rupturable membrane means. Lenses having at least two chamber means therein can use the exterior faces of the central lenticular means as refractive rupturable membrane means, can have the chamber means separated by a refractive rupturable membrane means, or can use both the exterior faces of the central lenticular means as refractive rupturable membrane means and have the chamber means separated by refractive, rupturable membrane means. This design obviates the need to remove an implanted lens that no longer is the correct refractive power. Rupturing an exterior face functioning as a refractive membrane means or the refractive membrane means separating the chamber means eliminates a refractive surface, thus changing the refractive power of the implanted lens. Rupturing an exterior face functioning as a refractive membrane means or the refractive membrane means separating the chamber means is accomplished using currently available, non-invasive techniques, such as laser radiation.

The intraocular lenses of this invention can be implanted either in the posterior chamber or in the capsular bag. After placement in the eye, if it becomes necessary to change the lens' refractive power, non-invasive techniques can accomplish the change. Typically treatment can be conducted on an "out-patient" basis.

BACKGROUND OF THE INVENTION

Currently, cataract extraction is the most common ophthalmic surgical procedure performed in the United States. Roughly, over 450,000 lenses are removed every year. These natural lenses, however, must be replaced with a prosthetic optical device before useful vision can be restored to the operated eye. Light rays no longer are focused on the retina with the lens removed. Vision is very poor without corrective glasses, contact lenses or an intraocular lens.

Corrective eye glasses have been the classic and most common method of correcting aphakia. Unfortunately, corrective glasses, being located in front of the normal position of the human lens, can produce magnification which distorts the shape of viewed objects. Contact lenses cause less magnification and distortion, but very old and very young patients frequently find handling and wearing these small lenses difficult.

There is little or no magnification or distortion with implanted intraocular lenses. Also, there is no need to remove the intraocular lens from the eye or otherwise handle the lens. Generally, intraocular lenses provide good visual acuity at all times, even at night.

Intraocular lenses have definite advantages in terms of vision and convenience over the other methods of aphakic correction. While intraocular lenses have defi-

nite advantages over corrective glasses and contact lenses, intraocular lenses have specific disadvantages.

Intraocular lens implantation surgery is more traumatic than simple cataract extraction alone. Additional handling of the cornea and manipulation inside the anterior chamber during lens implantation add to the amount of trauma to the eye. Extreme care must be exercised to limit trauma to the cornea, structures of the anterior chamber, and other structures.

Generally, during implant surgery, a 7-8 mm incision is made in the conjunctiva just outside the cornea so that the patient's natural lens can be removed and replaced with an implant intraocular lens. Incision length is dictated more by the size of the intraocular lens to be implanted than by the requirement of removing the patient's natural lens. For example, the patient's natural lens can be removed using an ultrasonic instrument which requires an incision much smaller than is needed to insert intraocular lens implants currently available.

The ability to change refractive power of an implanted intraocular lens without an additional surgical operation would be a desired benefit. It is particularly desirable in very young patients. Size and shape of the eyeball in very young patients change as they mature. The distance from the lens to the retina changes as the size of the eye changes. A lens of the correct refractive power when implanted may not later correctly focus light entering the eye and passing to the retina. Changes in the refractive power of lenses in very young patients may be indicated after as little time as one year. It is the antithesis of limiting trauma associated with lens implants when a surgical procedure is dictated within such a short period of time.

A large number of different types and styles of intraocular lenses has been developed. Major classes of lenses can be distinguished based on the method of fixation in the eye. Anterior chamber lenses lie entirely in front of the iris. Iris-supported lenses rely on the structural integrity of the iris to stabilize and support the lens within the eye. Capsule-fixated lenses are inserted into a planned extracapsular cataract extraction space between the iris and posterior leaves of the lens capsule. Common to most lenses in use today are their reliance on haptics, also called feet or loops, emanating from the lenses and intended to support and fix the lens in the eye.

A major concern of ophthalmic surgeons is choosing the correct refractive power for lenses. Patients risk additional surgery for lens removal and replacement if the choice of lens refractive power is or subsequently becomes too much in error. Despite diligence in choosing a lens with the correct refractive power at the time of implant, subsequent ophthalmic changes may dictate the removal of an existing implanted lens and replacement with another prosthetic lens of different refractive power. A risk commonly shared in the use of solid, silicone, and gel-type intraocular lenses is additional surgery since it is the only alternative for changing a refractive power too much in error.

A substantive effort to avoid resorting to replacing an implant should a patient need a different refractive power lens may be found in U.S. patent application Ser. No. 832,335, *Variable Refractive Power, Expandable Intraocular Lenses*, filed Feb. 24, 1986 by Peyman, commonly owned with this application by Gholam A. Peyman, M.D.