INTRAOCULAR LENS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an intraocular lens, and particularly to a self-centering, posterior chamber lens adapted for mounting in the capsule following extracapsular cataract extraction.

2. Description of the Prior Art

In the human eye, the lens is situated behind the pupil and iris, and functions to focus light entrant through the cornea and pupil onto the retina at the rear of the eye. The lens is a biconvex, highly transparent structure made of slender, curved rod-shaped ectodermal cells in concentric lamellae surrounded by a thin capsule. The lens capsule is supported at its periphery by suspensory ligaments, called zonules, that are continuous with the ciliary muscle. Contraction of this muscle relaxes the zonules, allowing the lens to become more spherical, thereby altering its focal length.

A cataract condition results when the material within the lens capsule becomes clouded, thereby obstructing the passage of light. To correct this condition, two forms of surgery are used. In intracapsular cataract extraction, the entire lens is removed intact. To accomplish this, the surgeon severs the zonules or suspensory ligaments about the entire periphery of the capsule, and removes the entire lens with the capsule and its content material intact.

In extracapsular cataract extraction, an incision is made through the front wall (the "anterior capsule") of the lens, and the clouded cellular material within the capsule is removed through this opening. Various scraping, suction or phacoemulsification techniques are used to accomplish such extraction. The transparent rear capsule wall (the "posterior capsule") remains in place in the eye. Also remaining in place are the zonules, and peripheral portions of the anterior capsule (the "anterior capsule flaps").

Both intracapsular and extracapsular extraction eliminate the light blockage due to the cataract. However, the light now entrant through the cornea and pupil is totally unfocused since there is no longer a lens in the eye. Appropriate focusing can be achieved by a lens (i.e., a contact lens) exterior to the eye. This approach, though generally satisfactory, has the disadvantage that when the external lens is removed (i.e., when the contact lens is "taken out"), the patient effectively has no sight. A preferred alternative is to implant an artificial lens directly within the eye. One objective of the present invention is to provide such an intraocular lens.

Although at present more intracapsular lens removals are performed than extracapsular extractions, there are certain undesirable complications which may result from intracapsular surgery. The first involves "vitreous loss." The entire region of the eye behind the lens normally is filled with a jelly-like material called the vitreous humor. When the lens is removed intact, the vitreous humor comes up through the pupil and may escape from the eye through the incision that was made to accomplish the intracapsular extraction. Adverse side effects can occur.

Another complication of intracapsular surgery is called cystoid macula edema (CME). This is an edema or swelling of the macula of the retina. This may be due to certain enzymes which are released from the iris and migrate through the vitreous humor back to the macula, causing swelling. This is a serious complication. The incidence of both vitreous loss and CME is substantially reduced in the case of extracapsular extraction, since the posterior capsule remains in place and prevents the vitreous humor from reaching the anterior chamber. Thus from the viewpoint of reducing post-surgical complications, extracapsular extraction is preferred, and it is a further object of the present invention to provide an intraocular lens the use of which is particularly advantageous with extracapsular extractions.

Various forms of intraocular lenses are known. Generally these fall into two major classes, the anterior chamber lenses which are situated forward of, or mounted to the iris, and posterior chamber lenses which are situated behind the iris and may be mounted within the cleft or fornix of the capsule which remains in place after extracapsular surgery. The present invention is of the latter type.

Historically, the earliest posterior chamber lens implants were performed by Harold Ridley in the early 1950's. The Ridley biconvex lens was about the same shape, but had approximately 1 mm smaller diameter than the normal human lens. Its weight in air was 112 mg, an extremely heavy weight for an object to be implanted in the eye. The weight and relatively large diameter caused the Ridley lens to exert undue pressure on the ciliary body, the annular structure on the inner surface of the eye surrounding the lens and including the ciliary muscle and the ciliary process to which the zonules are connected. Other adverse side effects occurred. Glaucoma was noted. In come instances, the lens became loose and fell into the back of the eye. Many cases of downward decentration were noted, wherein the lens shifted downwardly so that its axis was no longer centered with respect to the pupil. For all of these reasons, the Ridley lens soon was abandoned.

A related lens designed by Strampelli for use in the anterior chamber also was tried in the early 1950's. This lens seated in the "angle" of the eye, where the cornea and iris are joined. Often, the use of such lens caused destruction of the endothelium, a very thin layer of live cells on the interior of the cornea. This is a very serious complication, and use of this form of angle-fixated anterior chamber lens soon was stopped.

Next came a series of anterior chamber lenses which were mounted to the iris. Amongst the earliest is the so-called Copeland or Epstein iris plane lens. This is a one-piece, cross-shaped structure having a generally plano-convex central lens and four planar blades projecting respectively from the top, bottom and sides of the lens. The lens is mounted in the pupil by inserting two diagonally opposite blades (usually the ones at top and bottom) behind the iris, and allowing the two remaining blades to seat against the front of the iris. Thus the structure actually is fixed directly to the iris. This eliminates the centration problem, since the lens itself is situated in the pupil, and also eliminates the problems associated with lenses that seat against the ciliary sulcus or against the angle. However, dilation of the pupil is difficult with this lens.

Another iris fixated lens was developed by C. D. Binkhorst, and is known as the "iris clip lens" or the Binkhorst four-loop lens. This lens includes a pair of anterior loops projecting from the top and bottom of the lens which seat against the front of the iris. A second pair of loops extend from the rear of the lens, and are formed in an L-shape when viewed from the side. These