METHODS FOR IMPLANTATION OF DEFORMABLE INTRAOCULAR LENSES

BACKGROUND OF THE INVENTION

Intraocular lenses have gained wide acceptance in replacement of human crystalline lens after a variety of cataract removal procedures. The human crystalline lens is generally recognized to be a transparent structure having a thickness of about 5 millimeters and diameter of about 9 millimeters. The lens is suspended behind the iris by zonular fibers which connect the lens to the ciliary body. A lens capsule surrounds the lens, the front portion of the capsule being commonly known as the anterior capsule and the back portion commonly known as the posterior capsule.

Numerous procedures for the removal of cataracts have been developed in which the lens is removed from the eye and replaced by an artificial lens implant. The extraction procedure may be generally categorized as intracapsular (in which the lens is removed together with the lens capsule) or extracapsular (in which the anterior capsule is removed with the lens, and the posterior capsule is left intact).

Since Ridley implanted the first artificial lens in about 1949, the problems associated with cataract extraction and lens implantation have received a great deal of attention from ophthalmic surgeons.

Various types of artificial lenses have been proposed, and appropriate surgical procedures have been developed which strive to reduce patient discomfort and reduce post-operative complications. Reference is made in this connection to Pseudophakos by N. Jaffe, et al; "History of Intraocular Implants" by D. P. Choyce (Annals of Ophthalmology, Oct. 1973); U.S. Pat. No. 3,991,426 issued to Flom on Nov. 16, 1976; and U.S. Pat. No. 4,092,743 issued to Kelman on Nov. 8, 1977 which disclosures are hereby incorporated by this reference.

Of particular interest in the context of the present invention is the development of surgical techniques requiring relatively small incisions in the ocular tissue for the removal of cataracts as disclosed in U.S. Pat. Nos. 4,002,169 and 3,996,935. A number of skilled artisans have disclosed intraocular lens structures comprising an optical zone portion generally made of rigid materials such as glass or plastics suitable for optical use.

However, one of the principle disadvantages of the conventional rigid intraocular lens is that implantation of the lens requires a relatively large incision in the ocular tissue. This type of surgical procedure leads to a relatively high complication rate, among other disadvantages. For instance, the serious dangers associated with implantation of a rigid lens structure include increased risks of infection, retinal detachment, and laceration of the ocular tissues, particularly with respect to the pupil.

Accordingly, those skilled in the art have recognized a significant need for an intraocular lens implant which affords the clinical advantages of using relatively small incision techniques, yet possesses an optical zone portion having a fixed focal length and which will retain a prescribed configuration once, implanted in the central optical area, thereby providing a safer and more convenient surgical procedure and comfortable fit for the eye. The present invention fulfills these needs.

SUMMARY OF THE INVENTION

This invention relates to improved intraocular lens structures, methods and instrumentation for implantation of the lens through a relatively small incision made in the ocular tissue. In more detail, the inventive lens structures comprise a deformable optical zone portion having prescribed memory characteristics which enable the lens to be deformed by compressing, rolling, folding, stretching, or by a combination thereof, to a diameter of 80% or less of the crosssectional diameter of the optic, and yet return to its original configuration, full size and fixed focal length after insertion in the eye. The unique optical zone portion can be fabricated from selected biologically inert materials possessing superior elasticity and compression characteristics and optionally, may include a wide variety of support appendages.

The embodied methods for implantation of the artificial intraocular lens can be utilized for replacement of, or for refractive correction of, a human crystalline lens. These inventive methods include:

providing an intraocular lens having a deformable optical zone portion with prescribed memory characteristics; deforming the optical zone portion of the lens to a diameter of about 80% or less of the cross-sectional diameter of the optic in an unstressed state; inserting the intraocular lens through a relatively small incision made in the ocular tissue; allowing the lens implant to return to its original configuration, full size and fixed focal length after insertion in the eye; whereby a safer, more convenient surgical procedure and more comfortable fit for the eye is achieved.

Further, the present invention provides unique instrumentation for deforming and inserting the lens through a small incision during implantation. In one embodied form, the instrumentation comprises a single micro-hook type device adapted to fit the lens to enable the lens to be appropriately deformed and pulled through the incision made in the ocular tissue. In a second embodied form, a double micro-hook type device is provided which enables the lens to be stretched in a direction perpendicular to the incision in an amount sufficient to allow insertion of the lens through a relatively small incision made in the ocular tissue. In yet a third embodied form, the instrumentation comprises an injection type device especially adapted to compress the inventive lens through a cannula and insert the lens into the eye. In a fourth embodiment, the instrumentation comprises a forceps type device having a compressor member to partially or fully encase and deform the intraocular lens to facilitate insertion within the eye.

Thus, the present invention offers a unique implantation system for correction of or replacement of a human crystalline lens after, for instance, cataract removal by way of small incision technique.

The above and other objects and advantages will become apparent from the following more detailed description of the invention, taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a stylized frontal view of a human eye illustrating a relatively small surgical incision made in the ocular tissue relative to major eye components for purposes of referencing the description of deformable intraocular lens implants in accordance with the present invention;