ACCOMMODATIVE LENS IMPLANTATION

This application is a continuation of U.S. application Ser. No. 08/954,656, filed on Oct. 20, 1997, now U.S. Pat. No. 5,843,188.

BACKGROUND OF THE INVENTION

This invention relates generally to implantation of artificial lenses in the eyes of humans, and/or animals, and more particularly concerns implantation of such lenses in the posterior chambers of the eyes, i.e., between the iris and the natural lens zone. That zone may contain a natural lens, or an artificial lens, such as a pseudophakic lens.

It is known to insert artificial lenses into posterior chambers of eyes; however, prior implantations have suffered from difficulties. These have included presumed need for attaching or anchoring the artificial lens directly onto a surface of the pseudophakic lens, as by bonding, or by clipping mechanism. These expedients can or do interfere with vision and lens movement. There is need for method and apparatus that avoids such problems and difficulties. There is also need for implantation of lenses capable of movement toward or away from the natural lens zone as will be referred to herein.

SUMMARY OF THE INVENTION

It is a major object of the invention to provide implantation of a vision correcting artificial lens into the eye posterior chamber, and in such manner as to avoid problems and difficulties, as referred to. Basically, the method of the invention includes the steps:

a) providing the artificial lens to be compliant and to have anterior and posterior surfaces, and haptics extending away from the periphery of the artificial lens,

b) and inserting the artificial lens to extend into position between the iris and the natural lens zone, and to cause the haptics to extend into adjacency to the ciliary muscles, and

c) allowing the haptics to adhere or attach to the ciliary muscles, to move in response to ciliary muscle movement.

Such adherence may be achieved by adherence of haptic outer surfaces to zonular ligaments and/or onto fascia of the ciliary muscles, thereby positioning the artificial lens close to the surface of the pseudophakic lens; and so that clarity of vision is not interrupted by bonding zones, or clip devices to hold the lens in place, such bonding and clips not being needed.

It is another object to position the inserted lens in the manner referred to whereby subsequent movement of the ciliary muscles causes movement of the haptics, transmitted to effect bodily movement of the lens in posterior and anterior directions, to change the angularity of refraction of light passing through the lens toward the eye retina, i.e., adapting to near and far vision.

The invention achieves one or more of the following advantages:

a) enables haptics to be placed in the uncluttered territory of the anterior aspect of the posterior ciliary sulcus;

b) allows placement of an elongated, asymmetric lens implant across the eye chamber to position the haptics for fixation onto zonular ligaments and/or into the fascia of the ciliary muscle;

c) affords conforming of a lens implant posterior surface over the pseudophakic lens, with haptics that extend laterally to anchor onto the available plateau at the ciliary sulcus, the fascia of the ciliary muscle, and/or onto the inert zonular ligaments;

d) allows haptics to achieve a distinctive leverage over and control of the lens optic segment, even with a mildly weak ciliary muscle;

e) affords the opportunity of using the advantages of the clear, temporal corneal wound for lens insertion without previous scarring;

f) provides an axis of astigmatism, and prisms, or other means, for correcting diplopia with particular haptic edge designs;

g) provides separability of the implanted lens from the pseudophakic lens, to:

1) enable recoverability of the lens with ease, if necessary;

2) maintain eye aqueous humor lateral flow behind the implanted lens without need for a central apical puncture or hole, which can detract from the clear vision;

3) separated independent functioning of the implanted lens, without impairment from the encased pseudophakic lens entrapped in the lens capsule;

4) allows laser titrateable (effected) alterations in the supportive elastimed band of an elongated, rectangular (i.e., asymmetric) lens implant, such as adjustments to accommodate to:

a) the need for sufficient separability of the lens implant;

b) the need for lens re-positioning, post-operatively;

c) the stiffness of the haptics in control of the optic segment, as desired;

h) provides for more natural passage of aqueous humor between the pseudophakic and implanted lenses; accommodation of the lens implant is enhanced by conformance to the natural lens configuration that exists, particularly in the realm of the autonomic nerve system, and pertaining to accommodative reflex;

i) components for the errancy of the pseudophakic lens needs, such as light-blocking function of the lens implant for glare and U-V exposure, in addition to refractive corrections for astigmatism, diplopia, anisometropia, and for severe and mild degrees of myopia and hyperopia, and loss of accommodation;

j) use of the implant lens can become preferred, in view of the case of a five minute, very accurate, operative implant procedure, which is readily reversible, if ever necessary, and having the added advantage of quick relief of pain and restoration of clear vision in hours, and full rehabilitation by the next morning;

k) the range of useful indications for this lens implant are startling and may require or enable a combination of seven to eight different lens implants in one lens implant procedure, to achieve a desired vision result;

l) the ciliary muscle having a leveraged effect on the optic segment through the angle of approach of the lateral and posterior design and stiffening of the haptic, as well as adhesive, restraint on the optic segment to prevent excessive forward advancement of the optic segment by the addition of adhesive haptic edges, which also thickens the A-P diameter of the lens to assist in accommodation.

A further object includes detecting and modifying a physical characteristic of the lens inserted into the eye. Miniature electronic circuitry implants on the lens unit, as via a wafer or wafers, may be employed in such determination, and/or modification.