INTRAOCULAR LENSES WITH FIXATED HAPTICS

RELATED APPLICATIONS

This application is a division of my co-pending application Ser. No. 08/947,113, filed Oct. 8, 1997, now U.S. Pat. No. 6,051,024 which is a continuation-in-part of my application Ser. No. 08/540,040, filed Oct. 6, 1995, now abandoned.

BACKGROUND OF THE INVENTION

In cataract surgery, the practice is to remove the cataractous natural lens and replace it with a man-made lens. The replacement lens is placed inside the natural capsular bag of the natural human lens. Such replacement of the natural lens by artificial intraocular lens is discussed in my U.S. Pat. Nos. 5,476,514 and 5,047,051.

The present invention represents improvements over my above-mentioned patents relative to the fixation or anchoring of the lens haptics in the bag, thereby overcoming certain potential disadvantages of plate haptic lenses. My U.S. Pat. No. 5,047,051 discloses a method of fixing a haptic plate in the capsular bag by means of mini-loops at the ends of haptic anchor plates. This enables the bag to fibrose about the loops to fix the lens in the bag.

In such procedures, plate haptic lenses without loops or fixation means can only be implanted in an intact capsular bag with a continuous circular capsulotomy. Such plate haptic lenses, if placed into a capsular bag having a tear in the anterior capsular rim or posterior capsule, can dislocate with resultant serious complication of the surgery.

During the healing and fibrosis process, the anterior capsule rim becomes fused to the posterior capsule by fibrosis, and a plate haptic with an appendage thereof is retained in position by a pocket or tunnel defined by the fibrosis about the haptic or appendage portions between the anterior capsular rim and the posterior capsule.

SUMMARY OF THE INVENTION

As discussed in the foregoing background, a haptic is retained in place by a pocket or tunnel defined in fibrosis about haptic and appendage portions between the anterior capsular rim and the posterior capsule.

The fibrosis fuses together the anterior and posterior capsules, and surrounds portions of a plate haptic.

Plate haptic lenses are sometimes desirable because they provide certain advantages over long loop lenses, including stabilization of the vitreous with substantially less probability of the most serious complications of cataract surgery, these being retinal detachment and cystoid macular edema. Another advantage is the consistent posterior location of the optic, which not only stabilizes the vitreous, but provides more predictable post-operative, uncorrected visual acuity. A further advantage is that the posterior location of the lens results in tight contact of the lens with the posterior capsule, thereby resulting in reduced rate of opacification of the posterior capsule with resultant reduced posterior capsulotomy rate.

Improved accommodating intraocular lenses according to the invention include a central optic having normally anterior and posterior sides and extended portions spaced circumferentially about and extending generally radially out from the edge of the optic. These extended portions have inner ends joined to the optic and opposite outer ends movable anteriorly and posteriorly relative to the optic.

The lens is surgically implanted in the evacuated capsular bag of the lens of an eye through the anterior capsule opening in the bag in a position wherein the lens optic is aligned with the opening defined by the anterior capsular remnant, and the outer ends of the lens distal portions are disposed within the outer perimeter or cul-de-sac of the bag. The lens has a radial dimension from the outer end of each distal or extended portion to the axis of the lens optic so that with the lens implanted within the capsular bag, the outer ends of the extended portions engage the inner perimetrical wall of the bag with no or minimal stretching of the bag.

After implantation of the accommodating intraocular lens in the capsular bag, active ectodermal cells on the posterior surface of the anterior capsule rim of the bag cause fusion of the rim to the elastic posterior capsule of the bag by fibrosis about the lens extended portions in such a way that these portions are effectively "shrink-wrapped" by the fibrous tissue so as to form radial pockets or tunnels in the fibrous tissue which contain the haptic portions with their distal ends positioned within the cul-de-sac of the capsular bag. The lens is thereby fixated within the capsular bag with the lens optic aligned with the opening in the anterior capsular bag. The anterior capsule rim shrinks during fibrosis, and this, combined with fibrosis about the extended portions, causes some radial compression of the lens so as to tend to move the optic relative to the outer ends of the extended portions in one direction or the other along the optic axis. The fibrosed, leather-like anterior capsule rim prevents anterior movement of the optic and urges it rearwardly during fibrosis. Accordingly, fibrosis induced movement of the optic occurs posteriorly to a distant vision position wherein either or both the optic and the inner ends of the extended portions press rearwardly against and stretch the elastic posterior capsule rearwardly.

During surgery, the ciliary muscle of the eye is paralyzed with a ciliary muscle relaxant, i.e., a cycloplegic, such as atropine, to place the muscle in its relaxed state. Following surgery, a ciliary muscle relaxant is periodically introduced throughout a post-operative fibrosis and healing period (such as two to three weeks) to maintain the ciliary muscle in its relaxed state until fibrosis is complete. This drug-induced relaxation of the ciliary muscle prevents contraction thereof and immobilizes the capsular bag. By this means, the lens optic is fixed during fibrosis in its distant vision position within the eye relative to the retina and the lens presses rearwardly against and thereby posteriorly stretches the elastic posterior capsule of the capsular bag. If the ciliary muscle was not thus maintained in its relaxed state until the completion of fibrosis, the ciliary muscle would undergo essentially normal brain-induced vision accommodation contraction and relaxation during fibrosis, and the intraocular lens would not necessarily fix in the distant position but in some other location along the axis of the eye.

The present invention provides haptic lens features which serve to fixate the distal haptic portions of the lens, thus preventing dislocation and slipping from the proper positions in pockets or tunnels formed over the haptic lens features by fibrosis. Enlarged and/or distal haptic portions or protuberances are prevented by their larger dimension from moving or sliding along pockets or tunnels formed by fibrosis about proximally inward haptic portions. The enlarged distal structural features prevent the haptic from sliding inwardly relative to such fibrosis pockets to fixate and prevent dislocation of the intraocular lens. The enlarged distal structural features may take such forms as: protuberances extending from one or both sides of distal portions of plate haptics; flexible extensions extending from distal cor-