FIXATION MEMBER FOR AN INTRAOCULAR LENS

FIELD OF THE INVENTION

This invention relates to an intraocular lens and, more particularly, to an intraocular lens having a deformable optic which is supported by a resilient, deformable fixation member configured to minimize an undesirable tipping of the optic.

BACKGROUND OF THE INVENTION

Whenever cataracts or other conditions require, the natural lens of the human eye can be removed and replaced with an intraocular lens. An intraocular lens comprises an optic or lens and one or more fixation members for fixing the lens in the proper position within the eye so that the optic can direct light toward the retina.

In one common form of intraocular lens, the optic is constructed of a hard, non-deformable material, such as polymethylmethacrylate (PMMA). In a second type of intraocular lens, the optic is constructed of a deformable material, such as silicone or hydrogel. A deformable optic can be rolled or folded for insertion through an incision into the eye. An important advantage of an intraocular lens having a deformable optic is that, when it is rolled or folded, it can be inserted through a relatively small incision into the eye. This reduces the trauma to the patient and provides other advantages.

One problem with an intraocular lens having a deformable optic is in supporting it in an acceptable manner within the eye. One prior art approach is to employ fixation members which are integral with the optic. However, because of the soft, deformable nature of the optic material, it is necessary to make the integral fixation members relatively thick in order that they will have sufficient thickness to adequately retain and position the optic within the eye. Without this necessary thickness, the fixation members may buckle under the generally radial compressive load imposed by the posterior capsule as the posterior capsule shrinks following removal of the natural lens. This causes the optic to tip unacceptably, causing the image being transmitted through the optic to be deflected away from the retina, resulting in blurred and unreliable vision. The problem is that thickening of the integral fixation members gives the rolled or folded intraocular lens a larger cross-sectional area than would exist without such thickening, and this, in turn, requires a larger incision.

Another approach is to utilize separate fixation members and attach them to the optic. These separate fixation members, which are commonly constructed of PMMA or polypropylene, are typically fine hair-like strands. It is somewhat difficult to attach these fine hair-like strands to a deformable optic in a way that will assure that the strands will not pull out from the deformable optic.

What is needed is a support system for a deformable intraocular lens wherein a fixation member is easily attached to the optic and has the characteristics necessary to ensure that the optic does not tend to tilt undesirably in the manner described above.

SUMMARY OF THE INVENTION

This invention solves the problem outlined above for an intraocular lens having a resiliently deformable optic for implantation into an eye. An annular fixation member or support of resilient deformable material for supporting the optic in the eye is coupled to, and circumscribes, the optic and has within it a plurality of elongated openings. These elongated openings, while not unacceptably weakening the fixation member, render the fixation member less bulky and more capable of being rolled or folded more tightly, in order to allow the intraocular lens to be inserted through a small incision when being placed into the eye. Preferably, the annular fixation member is integrally molded to the optic, in order to eliminate the problem of having to attach the two elements.

A particularly novel feature of the invention is that the annular fixation member is configured to deform in a generally circumferential direction rather than in an axial direction when it is placed under a compressive load of the type applied by the capsular bag of the eye in which the optic is implanted. These compressive forces are directed from the radial outward end of the fixation member toward the optic. By configuring the fixation member to resiliently flex or deform in a generally circumferential direction, tipping of the optic in response to these forces is virtually eliminated, and normal vision may be maintained.

Specifically, the annular fixation member comprises an annulus and at least one resiliently deformable strut which has a proximal end portion attached to the optic and a distal end portion attached to an annulus. The strut is predisposed to bow circumferentially rather than axially when placed under the compressive load. This predisposition is accomplished by curving or bowing the strut a predetermined amount in a circumferential direction when it is in an unloaded condition, thereby giving the strut the predisposition to bow circumferentially when under load. In a preferred embodiment, a plurality of struts are employed, with the struts being arranged in spoke-like fashion around the periphery of the optic. Each of the struts is preferably bowed a predetermined amount when in an unloaded condition.

The fixation member struts can be in several different configurations. For example, in one preferred configuration, the struts are paired, with the proximal ends and the distal ends of the two struts in each pair being closely spaced at their attachment locations on the optic and on the annulus, respectively. The two struts in each pairing are bowed in opposite circumferential directions with respect to one another. In this configuration, the elongated openings are formed between the two struts in each pairing. In another configuration, the struts are all bowed in the same circumferential direction. The elongated openings lie between adjacent struts.

In another aspect of the invention, the intraocular lens comprises a deformable optic for implantation into an eye and a resiliently deformable support for supporting the optic in the eye. The support includes an annulus which circumscribes the optic and a plurality of struts which integrally join the optic and the annulus. Each of the struts bows circumferentially in response to a compressive load applied generally along the struts from the annulus toward the optic.

The invention, together with additional features and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying illustrative drawing.