SOFT INTRAOCULAR LENS

FIELD OF THE INVENTION

The present invention relates to soft intraocular lenses, and more particularly, to means for joining one or more haptics, or filamentary support members, to the optic of an intraocular lens.

BACKGROUND OF THE INVENTION

In the human eye, light enters through the cornea (front surface of the eye) passes through the natural lens of the eye (behind the iris) to the retina. The natural lens of the eye is a clear, gelatinous substance enclosed in a transparent capsular bag, whose periphery is connected to the muscles within the eye by suspensory ligaments called zonules. As one ages, one's lens sometimes becomes cataract, a pathological condition in which the lens progressively clouds, hardens and ultimately opacifies to slowly reduce the amount of light passing through the lens to the retina. Intraocular lenses are implants used to replace the cataract natural lens to restore sight.

There are various well-known intraocular lens designs. An implanted lens may be placed between the cornea and the iris in the anterior chamber or behind the iris in the posterior chamber of the eye. Intraocular lenses generally have two parts. The first part is the optic which is centrally placed within the eye between the cornea and the retina in either the anterior or posterior chamber. The second part of the lens is called a haptic which extends from the optic and supports the optic in its proper position within the eye. With many present lenses, the optics are made of a hard, biocompatible acrylic material like polymethylmethacrylate (PMMA) which has good refractive optical characteristics. The optics are generally circular in cross section and have diameters which vary between 5 mm and 7 mm. The haptics are usually made of a flexible, filamentary material which extend from the periphery of the optic to the surrounding anatomy of the eye to hold the optic in place.

In the past, some haptic supports have been made of metal wire like platinum. They have been attached to PMMA optics by heating the end of the platinum haptic to a temperature higher than the melting temperature of the optic and then inserting the heated end into the plastic of the optic. The plastic melts to permit the metal wire to be inserted and then solidifies around the metal haptic to hold it in place.

Other lenses have used polypropylene haptics which can be attached to PMMA optics by drilling holes in the optic, inserting the end of the polypropylene haptic into the hole and holding it in position by, for example, bonding the polypropylene to the PMMA or crimping the PMMA around the periphery of the polypropylene to mechanically lock it in place.

When one inserts rigid optics into the eye, one must make an incision slightly larger than the diameter of the optic. It is desirable to use the smallest incision possible. In the past, the diameter of the rigid optic has been the limiting factor on the size of the incision in the eye.

In order to reduce the size of the incision one may use an optic made of a soft, flexible material like silicone elastomer, polyurethane elastomer, hydrogel plastics, collagen, organic or synthetic gels or combinations of these materials. Since these materials are soft and flexible the conventional methods of mounting haptics to optics generally do not work as well. For example, one cannot drill holes in soft silicone optics into which the end of the haptics can be fastened by heat staking.

One method of attaching haptics to flexible optics is shown in U.S. Pat. No. 4,615,702 where an annular ring from which integral haptics extend is embedded in the soft material of the optic when the optic is molded.

In U.S. Pat. No. 4,790,846 haptics are separately molded into the soft optic and have various geometric configurations at the point where they are embedded in the optic like bulbous enlargements, loops, barbs, and the like to try to secure the haptic into the optic.

In U.S. Pat. No. 4,834,751 an arcuate anchor is attached to one end of a haptic and molded into a soft optic.

Since the haptics for soft lenses are usually insert-molded into the lens, the material of which the haptic is made must be selected so that it will not be affected or degraded during the molding process. Polypropylene haptics can be insert-molded into silicone optics, but care must be taken not to damage the very small diameter haptic filaments or alter the haptic geometry during the thermal cycles that are required to cure a silicone material. In some instances, it is desirable to make the haptic supports of PMMA. However, PMMA haptics may melt at temperature above the molding temperature of silicone and thus cannot be directly insert-molded into silicone optics.

It would be desirable to have an improved means for mounting conventional haptics made of well-known and accepted haptic materials into the materials from which soft intraocular lens optics are made, without concern for haptic degradation.

SUMMARY OF THE INVENTION

The present invention provides an insert means for attaching a haptic to a flexible, molded optic of a soft intraocular lens. The optic can be molded about the insert means, and the insert means can be made of a variety of materials which will not be damaged during the process of molding the optic. The insert means which allows for attachment of the haptic to the flexible optic includes an optic attachment member having an aperture through it. The optic is molded about the optic attachment member and within the aperture so as to securely fasten the optic attachment member to the flexible optic. The insert means also has a haptic attachment member integral with the optic attachment member. The haptic attachment member has a bore therein for receiving the haptic. This permits any suitable material to be used for the haptic and one need not worry about damaging the delicate haptic filaments during the process of manufacturing the optic.

Typically, two haptics are attached to the optic at diametrically opposed positions. One may use one insert means for each haptic and the insert means are preferably connected to each other only by the material of the optic. It would also be possible to replace separate optical attachment members for each insert means with a single annular optical attachment member which would be embedded inside the periphery of the optic. Separate haptic attachment members for each haptic can be integrally connected to such an annular optic attachment member.

In the preferred embodiment, the optic could be made of silicone and the haptics could be made of polypropylene or PMMA. Other materials could be used for