INTRAOCULAR LENS WITH ASTIGMATISM CORRECTION

RELATED APPLICATION

This application is a continuation-in-part of my copending application, Ser. No. 113,967, filed Jan. 21, 1980.

BACKGROUND OF THE INVENTION

The invention relates to intraocular lenses, whether designed for anterior-chamber implantation or for posterior-chamber implantation in the human eye, and whether or not iris-supported.

As far as I am aware, with the exception of my constructions, prior intraocular lenses have been of plastic construction, and they are tissue-reactive in the sense that tissue growth after implantation is not retarded and can become a clouding factor to degrade optical performance of the implant. With such plastic lenses, sterilization must be accomplished using a caustic solution or ethylene oxide gas.* Such lenses are injection-molded products and therefore cannot be classed with the quality of an optically finished lens. But glass lenses as implants have been generally shunned, primarily because of the high specific gravity of glass, as compared to that of plastic; see Binkhorst, et al., "A Weightless Iseikonic Intraocular Lens", American Journal of Ophthalmology, Vol. 58, No. 1, July 1964, pp. 73 to 78. And, in particular, it is noted that although Choyce, et al., U.S. Pat. No. 4,087,866 mentions glass as a possible lens material, the disclosure is silent on any suggestion of optically finished glass for the purpose.

* A glass lens would allow for autoclaving. To my best knowledge and belief, the difficulties and expense of making molds for plastic intraocular lenses have meant that the implanted lens must be simple and basic, reliance being placed upon later prescription of corrective spectacles if astigmatism is to be corrected in an individual case.

BRIEF SUMMARY OF THE INVENTION

It is an object of the invention to provide an improved intraocular lens (with associated haptic structure) and a method of making the same.

It is a specific object to make such a lens using a single optically finished glass lens element, thus assuring high optical quality.

Another specific object is to make such a lens which incorporates a predetermined degree of astigmatism correction and which incorporates a unique angular orientation feature whereby the ophthalmological surgeon can recognize orientation and thus is enabled to correctly orient the astigmatism correction in the course of an implantation operation.

A general object is to meet the above objects with structure which is autoclavable, and which can be reliably manufactured in production quantities, at relatively low cost for the inherent high optical quality involved.

The foregoing and other objects and features of the invention are achieved in configurations wherein a circular optically finished glass lens element is so retained by haptic structure having a uniquely recognizable transverse axis that an astigmatism correction ground into the optical finish of the lens element may be at predetermined (prescription) angular relation to the uniquely recognizable orientation axis of the haptic structure, thus enabling the surgeon to make an optically correct implant which has built-in correction for an astigmatic defect.

DETAILED DESCRIPTION

The indicated feature is illustratively described for haptics of single and multiple-element varieties, in conjunction with the accompanying drawings, in which:

FIG. **1** is a plan view of an anterior-chamber lens and haptic of the invention;

FIGS. **2** and **3** are longitudinal sectional views to show alternative forms of the lens and haptic of FIG. **1**;

FIG. **4** is a plan view, to an enlarged scale, to show application of the invention to a two-piece haptic construction;

FIG. **5** is a view similar to FIG. **4**, to show application of the invention to a three-piece haptic construction;

FIG. **6** is a side-elevation view of the construction of FIG. **5**; and

FIG. **7** is a plan view of one of the haptic pieces of the construction of FIG. **5**.

In the configuration of FIG. **1**, an intraocular-lens assembly comprises a circular optically finished lens **10** of diameter D_1 secured centrally to an elongate haptic base **11** of thin flat glass sheet. The lens **10** may be plano-convex in which case one surface of the haptic base **11** may be in bonded intimate continuous adjacency to the plane side of lens **10**. Alternatively, the base **11** may be centrally apertured to the peripheral contour of lens **10**, with lens **10** peripherally bonded therein, as shown in FIGS. **2** and **3**. The sheet **11** is of width essentially determined by the lens diameter and extends longitudinally beyond diametrically opposite regions of the lens, but its maximum longitudinal extent is short of the mounting diameter D_2 dictated by inner confines of the anterior chamber of an eye, at the so-called "angle", namely the groove or space between the scleral ridge and the iris. The diametral span D_2 varies and is generally 12 to 14 mm, depending on the size of the eye, and it is important for avoidance of trauma that the span D_2 of the haptic be selected correctly, within the indicated range. Means whereby the span D_2 of the haptic may be adjustably selected are disclosed in said copending application but are not important to the present invention and are therefore not here described.

The indicated securing of lens **10** to haptic **11** is preferably achieved by fusing the two elements using a suitable frit. Alternatively, one may employ an optical cement, inert to body fluids, such cement being selected from commercially available varieties, including sodium silicate, balsam compounds, benign epoxies, and UV-cured optical cements. Preferably, the longitudinal ends of haptic **11** are of smoothly undulated contour (as shown in FIG. **1**) and are also offset axially in one direction away from the plane of support of lens element **10**, thereby enabling an implanted lens element **10** to be clear of contact with the iris of the eye. In the event of fusing lens **10** to haptic **11**, such offsets may be produced by slumping at the time of fusing, it being shown in FIG. **2** that for a haptic **11** that is flat at its central region of lens support, the slumping produces axially offset foot elements, suggested by phantom outlines **12**; alternatively, in FIG. **3**, the haptic **11** is arcuately bowed to produce the desired offset, with outer foot formations **13** extending in a single plane at the offset location. Still further, it will be understood that in the FIG. **2** or in the FIG. **3** situation, the haptic may be slumped to desired offsetting profile prior to or after the fused assembly of lens element **10** thereto.