

## INTRAOCULAR ARTIFICIAL LENS AND METHOD FOR FABRICATING SAME

This is a continuation application under 37 C.F.R. §1.53 of U.S. Pat. application Ser. No. 08/150,078, filed as PCT/DE92/00418 May 22, 1992 now abandoned.

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

The invention relates to an intraocular artificial lens for replacement of the lens of the eye (posterior chamber lens), as used for example in cataract operations.

#### 2. Description of the Prior Art

The hitherto customary methods of implanting an artificial lens precisely in the location of the natural lens of the eye, i.e. in the so-called posterior chamber, are all extremely difficult to perform. This is so because it is important to fix the artificial lens securely in this location without damaging structures of the eye, and at the same time to minimize both the time and the surgical work required for the operation.

Various methods of implantation are known using various types of artificial lens, such as described for example in Fechner "Intraokularlinsen, Grundlagen und Operationslehre", second edition, Ferd. Enke Verlag, Stuttgart 1984, in particular page 128 ff.

Thus, for example for so-called "extracapsular cataract extraction", i.e. when the posterior lens capsule is preserved, an artificial lens is implanted whose haptic fasteners lie either in the capsule sac or in the posterior chamber angle (sulcus ciliaris).

When the lens capsule is not preserved (frequently it tears when the damaged lens is removed), an additional means of support must be used. For example, the artificial lens can be fixed by sewing the haptic fasteners to structures of the eye, e.g. the ciliary body. However, this damages the structures of the eye and bleeding can occur inside the eye. In addition, the sewing is difficult and complicated and takes a lot of time.

It is also possible to effect the fixture by creating an artificial membrane (drawing in threads) which prevents the lens from slipping rearwards in the direction of the vitreous humor. This method has essentially the same disadvantages as described previously.

Therefore, it was proposed as an alternative for every operation that an artificial lens be implanted as far as possible in the original location of the natural lens lying either on the iris, in the form of a so-called iris clip, or even in front of it, in the form of a so-called anterior chamber lens (EP-A1-03 46 245). These anterior chamber lenses present a continual hazard for structures of the anterior portion of the eye such as the cornea, chamber angle and iris. In addition, the function of the iris, in particular the pupil, is considerably impaired by the iris clip. Serious irritating conditions are often caused by permanent rubbing between the surface of the lens and the surface of the iris.

It is also known for the artificial lens to be supported by haptic fasteners both in the anterior chamber and in the posterior chamber. Thus, U.S. Pat. No. 4,366,582 and U.S. Pat. No. 4,316,291 each show a lens supported by means of two haptic fasteners in the anterior chamber (passed through the pupil and resting on the outer periphery of the iris) and by means of two further haptic fasteners in the posterior chamber. In addition, U.S. Pat. No. 4,316,291 proposes a spine penetrating through the iris from the front to the rear.

A lens is known from German reference 31 40 465 with a supporting element for the posterior chamber of the eye

and a fastener which is passed through an incision in the iris into the anterior chamber and there surrounds the iris concentrically in a ring and presses against the supporting element in the posterior chamber resiliently in the manner of a clip.

U.S. Pat. No. 4,242,760 describes a lens which is also supported in the posterior chamber. One of the haptic fasteners extends through the iris aperture/pupil, runs a short distance radially in front of the same and then passes through a peripheral incision back into the posterior chamber again where the curved end piece then rests on the sulcus.

Moreover, U.S. Pat. No. 4,504,981, in particular FIGS. 9 and 12, discloses an artificial lens which exhibits two mirror-symmetrical haptic fasteners running in opposite directions with two recognizably different portions, namely a posterior chamber portion curved in a slightly concave manner from the edge of the lens body, and an anterior chamber portion running in the opposite direction parallel with the anterior chamber angle. Through an end area of the posterior chamber portion these haptic fasteners pass through a relatively peripheral iridectomy out of the posterior chamber into the anterior chamber where the anterior chamber portion is supported lying on the iris. Thus, this known lens is attached by means of the anterior chamber portions of the haptic fasteners in the iris and at the same time supported on the iris. Displacement or unscrewing from this suspension of the lens or its haptic fasteners is prevented in that the fasteners are embodied so that they run in opposite directions. These haptic fasteners need not have a special elasticity since they are not supported in any of the eye chamber angles but are only attached in the iris and secured by their running in opposite directions through the passages through the iris. However, the fact that these haptic fasteners are embodied so that they run in opposite directions makes their introduction and fixture very complex and the clamping effect in the iris can also prevent their movement or lead to irritation. The lenses are only fixed in position radially through the arrangement of the iridectomies and attachment of the haptic fasteners by means of these. Elastic radial support, e.g. in the sulcus ciliaris, ensuring precisely central arrangement of the lens regardless of the production of the iridectomies during the operation, is not guaranteed.

Lastly, U.S. Pat. No. 4,404,694 discloses a lens which has a first haptic fastening element mounted in the lens capsule and a second haptic fastening element mounted by its end portion in the anterior chamber angle and passing through the iris in the peripheral area.

### SUMMARY OF THE INVENTION

The object of the present invention is to provide an intraocular artificial lens which allows easy relatively rapid implantation with the lens body (optic) disposed in the posterior chamber in the location of the natural lens, universal application, secure fixture and the minimum possible danger to structures of the eye. In addition, another object of the invention is to provide an economical method for manufacturing the inventive artificial lens.

According to the invention, this object is achieved through an intraocular artificial lens having at least one haptic fastener that is fixed to the lens body disposed in the posterior chamber of the eye so that the lens body is supported both in the posterior chamber angle (sulcus ciliaris) and in the anterior chamber. Starting from the lens body, in succession, the haptic fastener includes a posterior chamber portion with a posterior chamber supporting