# FLEXIBLE INTRAOCULAR LENS HOLDER

This is a continuation, of application Ser. No. 648,079, filed Sept. 7, 1984, now abandoned.

## FIELD OF THE INVENTION

The present invention is directed to flexible holders which allow one or more synthetic lenses to be securely positioned within the intraocular chambers of the human eye, and which can be inserted into the eye through corneal incisions of minimal size.

## BACKGROUND OF THE INVENTION

Many different types of synthetic intraocular lens structures have been developed to replace the natural lens of the human eye after lens removal during cataract surgery. During such operations, an opening or incision is made in the cornea and in the anterior surface of the capsular bag, commonly in the area adjacent to the pupilary aperture. The damage lens tissue is then removed by means of a vacuum tool resulting in a total loss of vision to the affected patient. In order to restore normal or correctable vision to the patient, a variety of lens structures have been developed which are designed to be affixed in the intraocular space of the eye. Such structures commonly comprise two portions: a centrally positioned lens and two or more appendages attached to the body of the lens which function to position and secure the lens in front of or just behind the pupil.

The artificial lens is formed from an optically clear substance and shaped so as to focus the impinging light onto the retina of the eye. Such lenses are commonly optically formed so as to be plano-convex, convex-plano or bi-convex. The appendages attached to the lens typically comprise flexible legs or resilient plastic or metal fibers which are designed to make point contact with the appropriate structures in the interior of the eye. One commonly employed type of intraocular lens structure is designed to position the lens in the anterior chamber of the eye just in front of the pupil. Such devices are designed to operate by wedging the flexible lens fibers or loops into the anterior chamber angle. Intraocular lens structures of this type are disclosed, for example, by K. J. Hoffer (U.S. Pat. No. 4,244,060), J. L. Tennant (U.S. Pat. No. 4,254,510), E. A. Rainin (U.S. Pat. No. 4,242,760), and C. D. Kelman (U.S. Pat. No. 4,343,050). Such structures may be inserted via loaded plastic sleeves which are then withdrawn from the eye leaving the lens structure to be positioned by conventional techniques as disclosed by A. Y. Anis in U.S. Pat. No. 4,251,887.

Although such intraocular lens structures have successfully addressed many of the problems associated with the restoration of vision following lens removal operations, their insertion and positioning within the eye presents many difficulties. In the first place, the use of discreet attachment appendages, such as flexible legs and loops, tends to localize contact of the structure with the supporting tissues. Such localized pressure can lead to distortion of the pupil and eye irritation. Furthermore, the support appendages which are attached to the lens body effectively increase the size of the lens and the dimensions of the incision which must be made in the eye in order to insert the structure. Especially in the case of elderly patients, such large incisions lead to increased recovery times and healing problems. Although resilient attachment means, such as those formed of plastic fibers, may be compressed prior to the insertion of the lens structure into the eye via the incision, their decompression, once the structure is within the eye may lead to a whipping action which can tear the iris and cause bleeding and other complications.

Furthermore, the need to minimize the size of the incision in the eye has heretofore resulted in the development of intraocular lens structures which comprise only one lens body. Such structures do not fully address the vision problems of patients who normally require bi- or trifocal-type lenses to correct near-far vision discrepencies.

Thus, a need exists for intraocular lens structures which can be inserted into the eye through minimally sized incisions and can be securely positioned within the eye without placing undue or localized pressure upon the structures of the eye. Furthermore, a need exists for intraocular lens structures which will introduce a plurality of lens bodies into the interior space of the eye while causing minimal trauma thereto.

## BRIEF DESCRIPTION OF THE INVENTION

The present invention is directed to an intraocular lens structure which comprises a flexible lens holder incorporating one or more lens bodies. The holder will comprise means adapted to individually secure the artificial lenses to the holder in a coplanar fashion. Preferred means include one or more optically-transparent lens pockets which are formed within or attached to the body of the holder. The pockets permit the lenses to be removably positioned therein either after or, preferably before the lens holder is introduced into the eye. For example, the lens holder may be in the form of a disk with lens pockets shaped so as to secure the lenses in a coplanar relationship with the longitudinal axis of the disk. In a preferred embodiment of the invention, such a holder is used to secure a multiaperture array of lenses adjacent to the irial opening. However, as used herein the securing means are also intended to include a flexible holder which integrally incorporates a plurality of lens bodies. For example, both the holder and the lenses may be formed from a single body of polymeric material, as by milling, injection molding or a like process.

When all of the lenses introduced into the lens pockets have the same focal length, they will function together in the manner of a superimposition eye. Each individual lens will form an image of its own. The lenses can be arranged, and the holder positioned, so that all the images are superimposed on the retina to form a common image for a given field of view.

The advantage of the use of a multiaperture lens array in the present intraocular lens structure is that the individual lenses employed can be considerably smaller than the artificial lens bodies heretofore employed to replace the natural lens in intraocular implant operations. Therefore, according to the practice of the present invention, a plurality of lens bodies can be secured in a flexible lens holder to form a flexible intraocular multiaperture structure which may be rolled, folded or otherwise compressed and inserted into the interior of the eye through an incision of smaller size than heretofore required to introduce a single aperture lens. Once within the interior of the eye, the holder is decompressed and secured to the appropriate interior structure of the eye so as to securely position the lenses adjacent to, and in a substantially coplanar fashion with the plane of the irial opening.