

At an earlier point in the history of lens implants, the entire natural lens was removed from the eye (the intracapsular technique) and an intraocular lens, for example, of the type shown in U.S. Pat. No. 4,588,406, was inserted with the haptic elements positioned at opposed points along the groove formed between the iris and the ciliary sulcus. Current practice is significantly advanced over that procedure. Today, the preferred procedure is to form an opening in the anterior capsule of the lens and remove the entire nucleus, leaving only the capsule (or bag) itself. The opening in the anterior capsule may be made by removing a disk-shaped portion of the anterior capsule of approximately 8 mm in diameter. Alternatively, a thin slit is made in the anterior capsule through which the nucleus of the lens is removed. The intraocular lens implant is then placed through the opening in the anterior capsule and positioned within the capsule, again by means of the haptic elements in the traditional lenses of the type referred to above. In those situations in which only a slit is formed in the anterior capsule, a full disk-like opening must be created before the intraocular lenses in current use can be implanted. It is in this environment that the intraocular lens of the present invention is intended to be utilized.

The intraocular lens 30 in accordance with the present invention is shown in plan view in FIG. 4 and in sectional views in FIGS. 5A, 5B and 5C. It should be understood that FIGS. 5A, 5B and 5C are vastly out of scale relative to the thickness of the lens. The lens is very thin, on the order of magnitude of tenths of millimeters and, therefore, cannot be illustrated in these drawings in anything even approaching the proper scale. Typically, the thickness of the outer region may be as small as approximately 0.25 mm, but the central portion will be thicker.

The lens 30 consists of a central ocular portion 32 which is the primary corrective portion of the lens. The central portion is typically biconvex and is about 4.5 mm in diameter (it may vary in diameter in a range from about 3 mm to about 7 mm). Surrounding the central ocular portion 32 is a generally dish-shaped supporting portion 34 and which is typically about 9.5 mm in outside diameter (and which also may have corrective optical characteristics). While the overall diameter of the outer supporting portion 34 is typically about 9.5 mm, it may vary in dimension, depending upon the size of the posterior capsule, and would generally be in the range of about 9 mm to about 14 mm. The entire lens 30 may be formed of a homogeneous material or, as in the presently preferred embodiment, the central optical portion 32 may be formed of PMMA and the outer supporting structure may be formed of silicone, a hydrogel or other materials as are widely known and used in soft contact lenses. These materials are well established as not being harmful to the eye and not subject to degradation within the eye.

The central optical portion 32 is formed with the proper optical properties for the particular patient in a manner known in the art and is relatively rigid. The outer soft supporting portion 34 is relatively thin compared to the optical portion 32 and is therefore flexible and soft as compared to the central portion. It provides gentle contact with the interior of the posterior capsule of the natural lens to thereby provide gentle support for the lens 30 in the eye. The overall shape of the lens should conform to the natural shape of the patient's lens capsule (see FIGS. 2, 3, 5A, 5B and 5C). The periphery 36 of the lens 30 has a rounded shape adapted to con-

form to the natural shape of the outer portion of the eye capsule.

Future research may show that it will be possible to place the lens 30 at other locations in the eye. For example, in patients whose lens capsule cannot be used, it may be shown that the lens 30 can be positioned in the anterior chamber, between the iris and the cornea.

FIG. 5A shows a form of the lens in which the optical portion 32 is formed continuously with the outer portion 34. In FIG. 5B the optical portion 32 is shown on the inner surface of the lens 30, either formed on or mounted on the thin support portion 34; the optical portion could also be formed or mounted on the posterior face of the supporting portion 34. FIG. 5C shows a further variation in which the supporting portion 34 is secured to the optical portion 32 at or adjacent the outer edge of the optical portion. Each of these variations may be formed of homogeneous material, or two different materials, and may be formed, by molding or otherwise, at one time or by assembly.

When in position within the eye, the intraocular lens of the present invention is substantially as shown in FIGS. 2 and 3. The posterior capsule 20 and a portion of the anterior capsule 18 of the natural lens remain in the eye and the curve of the intraocular lens 30 is positioned against the concave curve of the posterior capsule 20. It is placed through the iris 14 by rolling the opposite sides of the thin, dish-shaped supporting portion 34 of the lens 30 over each other, thereby reducing the dimension of the lens and permitting it to be easily passed through a small slit (e.g., about 5 mm) in the anterior capsule. Once within the capsule, the rolled portions 34 of the intraocular lens 30 are allowed to unfold and the lens is positioned against the posterior capsule. The overall diameter of the lens 30 is approximately the same as the overall diameter of the natural lens capsule such that the lens 30 is properly positioned in correct axial alignment within the eye. Since the dish-shaped supporting portion 34 of the lens 30 is soft, due to the material of which it is made and/or because it is quite thin, the lens is supported in the eye in an extremely gentle manner. In contrast with the small supporting surfaces in intraocular lenses which use conventional haptic devices, the lens of the present invention is supported around its entire posterior surface and completely around its very soft, flexible perimeter. This perimeter edge is approximately 30 mm for a device of 9.5 mm outside diameter. This characteristic of the lens 30 substantially reduces, if not completely eliminates, the relatively high pressure associated with prior intraocular lenses.

The foregoing describes presently preferred illustrative embodiment of the present invention. It is contemplated that variations from the details described above can and will be made without departing from the spirit and scope of the invention. Accordingly, the following claims should be interpreted broadly consistent with the scope and breadth of this invention.

What I claim is:

1. An intraocular lens for implant into the posterior lens capsule of a human eye after the nucleus thereof has been removed comprising a central optical portion of biconvex configuration formed of PMMA and a relatively soft and relatively thin annular supporting portion formed of a different material surround said optical portion, said supporting portion being connected to said optical portion around its periphery and extending outwardly in a dish-shaped configuration compatible with, conforming to and shaped to lie against the posterior of