

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings the intraocular implant of the invention is identified at 21. It comprises a solid non-inflatable, non-expandable, transparent optic member 23 having a central axis 25 and an outer periphery 27. Coupled to and circumferentially surrounding the outer periphery 27 of the optic member 23 is a haptic member 31. The haptic member 31 comprises thin flexible wall structure 33 joined to and circumferentially surrounding the outer periphery 27 defining an enclosed annular chamber 35 for receiving a fluid such as a gas or a liquid or other fluid-like material for inflating the haptic member 31. As shown in FIG. 6, one or more small openings 37 may be formed through the wall 33 of the haptic means 31 to which are coupled tubes 37 with one-way valves 41 to allow the fluid to be injected into the chamber 35 for inflation purposes. The one-way valves 41 allow fluid to flow only into the chamber 35 and prevents the fluid from flowing out of the chamber 35.

The inflatable haptic member 31 is constructed to surround and attach to the outer periphery of the central optic 23. The haptic member 31 is formed of a thin flexible material which may also be an elastic or resilient material. It may be formed in its annular shape and then bonded to the outer periphery of the optic 31. In its uninflated condition (FIG. 2), it is essentially flat and can be folded over the optic 23 (FIG. 3) minimizing the volume of the implant 21 thereby permitting implantation through an incision size (formed through the corner 51 of the eye 53) determined primarily by the dimensions and volume of the optic. Once inside the eye, the implant is intended to be positioned entirely within the capsular bag 55 (behind the iris 57), where the haptics are then inflated for fixation and centration of the optic (FIG. 5). Therefore, it can be seen that the entire implant, comprised of the central uninflatable optic and surrounding inflatable haptic member (in its uninflated condition), will be implantable through a very small incision. Further, as mentioned, the problems with optic quality are totally avoided. Therefore, a lens of high and unvarying optical quality with small incision implantation capability is provided.

The haptic member 31 is inflated by injecting a suitably biocompatible fluid, which preferably is a liquid or other flowable liquid-like material but which may be a gas, into the chamber 35 which is ultimately defined and limited by the distensibility of the material comprising the haptic cavity wall 33. The injected fluid-like material or liquid may or may not develop a certain fixed shape or "harden". It can be seen that requirements of such a fluid-like material are considerably less stringent than requirements for materials which are injected into an optic space. That is to say, the biological properties of a fluid-like material which is injected into a haptic space are not as demanding as the biological properties of a material injected into an optic space and therefore are not as difficult to develop.

The fluid-like material may be injected into the inflatable haptic space 35 through the small conduit 39 with the aid of a small tubular needle with the one-way valve 41 allowing fluid flow in only one direction (toward the haptic chamber only) (FIG. 6). The material is injected until the haptic chamber is seen to be completely distended and the optic appropriately centered. In one embodiment, the one-way valve 41 may be of the type

disclosed in U.S. Pat. No. 4,585,457, although other types of one-way valves may be used. Another mechanism for preventing material leakage is to employ only the conduit 39 and to seal its opening by heat, glue or other means after injection is completed. The wall of the inflatable haptic member is constructed of a thin, "foldable" or pliable material which may be an elastic or resilient material which defines the outer dimensions and configuration of the inflatable haptic member upon injection of a suitable biocompatible material. The wall material of the haptic member is nonpermeable to the injection material to prevent leakage of the injection material through the wall and into the eye.

In the preferred embodiment, the configuration of the haptic member 31 is annular such that the central uninflatable optic 23 is surrounded 360° peripherally and circumferentially by the haptic member 31 which when inflated is in the shape somewhat like that of an inflated inner tube. This will then give a complete circumferential type of contact between the haptic and the outer tissue (the lens capsule when placed within the capsular bag) which is recognized to be probably the most secure and desirable type of intraocular lens fixation attainable. The cross-sectional area of the inflated space 35 may be generally circular (FIG. 4), although it may vary considerably from this general configuration, particularly in decreasing the anterior/posterior dimension, while maintaining the radial dimension. Approximate dimensions for a preferred embodiment of the implant 21 comprises an optic measuring approximately 6 to 7 mm. in diameter, with the haptic cavity inflatable to give an overall diameter of the insert 21 of approximately 10-13 mm.

In one embodiment, the optic 23 may be formed of polymethylmethacrylate or other suitable materials such as a foldable silicone-like material. The haptic member 31 may be formed of a suitable silicone or silicone-like elastomers. The optic 23 and the haptic member 31 may be formed initially separately and the haptic member 31 located around the outer periphery 27 of the optic 23 and bonded or attached to the outer periphery. The fluid employed to inflate the haptic member 31 may be solutions of physiologic salts (index 1.33 to 1.44) and Dertran (index 1.39 to 1.4) or a polymeric material such as a Silastic as disclosed in U.S. Pat. No. 4,585,457. Other fluid type materials that may be employed to inflate the haptic member 31 are disclosed in U.S. Pat. No. 4,693,717.

In summary, a unique intraocular lens design incorporating a central uninflatable optic attached to and peripherally (circumferentially) surrounded by an inflatable haptic member which fixates and centers the optic within the eye (within the capsular bag) is provided. The implant is inserted into the eye in its uninflated configuration to minimize insertion wound size requirements, and then the haptic member is inflated by injection of a suitable biocompatible material into the haptic member once the implant is positioned loosely but completely within the capsular bag. This new design avoids the problems of optical quality inherent in any design in which the optic is inflated or expanded, yet still possesses the desirable features of a small incision lens with excellent fixation characteristics. This design solution to small incision implants provides a safer and more practical solution than those inflatable or expandable designs which involve the optic.

I claim: