

SURGICAL METHOD AND APPARATUS FOR IMPLANTS FOR THE EYE

The present invention relates generally to improvements in surgical procedures relating to the eye, and more particularly, to a method for removing the lens of the eye of a human and replacing the same by a substitute implant and to novel implants.

Several types of surgical procedures are used today for removing lenses from the eye which suffer from various types of defects, such as cataracts. The lens is removed, for example, by an ultrasonic procedure, in which it is emulsified, or by a mechanical cutting procedure which is described, for example, in my U.S. Pat. No. 3,996,935. That patent also describes a procedure for filling the eye capsule with fluid (liquid or gas) after the lens has been removed to serve as a substitute for the removed lens.

In another type of surgical procedure, once the lens has been removed, it is replaced by an implant which has an optical lens thereon, which can be made of either glass or a hard or a soft plastic. In this procedure the lens implant is not controlled by any of the eye muscles or tissue.

The present invention relates to a method and a device for overcoming the aforesaid disadvantages. More particularly, in accordance with the surgical method, the eye lens is removed together with the anterior portion of the lens capsule. In some cases, the posterior capsule is also removed together with the zonules which hold the lens capsule in the eye. After removal of the eye lens, it is replaced by an implant which, in accordance with a preferred embodiment of the invention, is formed of a suitable inert deformable or elastic material. The implant is attached to the eye by attaching it to the ciliary body. The implant can then deform in accordance with the muscle reflexes of the ciliary body and better perform a true, variable lens function.

It is therefore an object of the present invention to provide a surgical method and devices for use with the surgical method in which the lens of an eye is removed and replaced by an implant which is attached to the ciliary body of the eye.

A further object is to provide a method for operating in the eye and a device for use in the method comprising an implant made of a deformable plastic material which is attached to the ciliary body of the eye.

An additional object is to provide novel implants and implant capsules to replace a removed eye lens in which the implants are adapted to be attached to a portion of the eye.

Other objects and advantages of the present invention will become more apparent upon reference to the following specification and annexed drawings in which:

FIG. 1 is an elevational view in section showing a portion of the eye which is to be operated upon;

FIG. 2 is a plan view showing a capsule implant in accordance with one embodiment of the invention;

FIG. 3 is a cross-sectional view of the capsule of implant of FIG. 2 along lines 3—3 of FIG. 2;

FIG. 4 shows the implantation of the lens of FIGS. 2-3 into the eye;

FIG. 5 is a cross-sectional view of a further embodiment of implant capsule;

FIGS. 6 and 7 are cross sectional and plan views of a further embodiment of implant; and

FIG. 8 is a plan view of another type of implant.

FIG. 1 is a cross-sectional view of the eye showing its various parts. The parts of interest here have been labeled and include a retina 12, surrounded by the choroid 20, which in turn is covered by the sclera 22. The vitreous material 16 is contained within the retina 12 and is separated from the lens capsule by the vitreous membrane 23. The lens capsule has an anterior portion 24 and a posterior portion 25 which hold a lens. The lens capsule is connected to the ciliary body 27 by zonules 28. The zonules are hairlike members which convey the muscle reactions of the ciliary body to the lens capsule causing it to change its shape to accommodate varying conditions.

Also shown in FIG. 1 is an instrument 29 which is passed through an opening, usually at the limbus. The instrument 29 is intended to represent an ultrasonic or a mechanical instrument such as described in the aforesaid patent. The purpose of showing the instrument is to designate that during a part of the surgical procedure, all of the lens 26 is fragmented and removed by ultrasonic, mechanical or other type of action or by any other type of surgical procedure. Also, in the removal of the lens 26, it is usually necessary to remove the anterior capsule. In some cases, although not absolutely necessary, the posterior capsule is also removed.

Depending upon the surgical procedure used and the condition of the eye at the time of the operation, the zonules may or may not be removed. Removal is accomplished by ultrasonic or mechanical action or by surgical cutting. The zonules also can be weakened by a chemical action, that is by adding a chemical to the eye rather than removal. The zonules may or may not be left, as desired.

FIGS. 2 and 3 show one embodiment of the capsule 30. The capsule implant is formed by a suitable plastic material which has deformable and/or elastic properties. One class of materials which is suitable, are the so-called "soft" lens materials used for contact lenses. These are, for example, plastics of the hydrophilic acrylic polymer, e.g. HYDRON, type. The implant capsule 30, which is shown in greatly enlarged form has upper and lower pieces 31 and 32 which are sealed around the edges thereof leaving a lip, or flap, 33 on one or both of the pieces. The sealing is accomplished by heat or ultrasonic sealing or by a waterproof adhesive. The internal part of the capsule 30 is filled with a suitable liquid or semi-viscous material 34, such as, for example a sterile solution or gelatin. Other materials which can be used are plain, or Ringer's saline solution. Each of these materials has a known index of refraction which is combined with that of the plastic material to achieve a desired lens action similar to the eye lens that was removed.

The overall size and shape of the implant capsule 30 approximates or is smaller, than that of the lens capsule which is to be replaced and the overall shape of capsule 30 is that of a double convex lens.

As seen in FIG. 2, the lip 33 is outside of the sealing and active area of the capsule 30. The lip 33 is provided so that there can be attached thereto a plurality of sutures 35. These are attached to the lip 33 by any suitable conventional suturing process either manual or mechanical which takes place either prior to the time that capsule 30 is inserted into the eye or after it is inserted. The sutures also can be attached to lip 33 by an adhesive or by heat or ultrasonic sealing depending upon the type of suture. As many of the sutures 35 can be used as is necessary.