SPARE PARTS FOR USE IN OPHTHALMIC SURGICAL PROCEDURES

This invention relates to the art of ophthalmic surgical procedures, and in particular to a class of novel "spare parts" which are adapted for use by ophthalmic surgeons in the course of those surgical procedures which involve the removal of a cataract from a human eye.

BACKGROUND OF THE INVENTION

Generally speaking, the portion and components of a human eye with which the present invention is most closely concerned, though well known to those skilled in the art, are illustrated and labeled for lexicographic purposes in FIG. 1 of the hereto appended drawings. The eyeball (which is suspended in the orbit by various types of tissues and muscles and is protected in front by the upper and lower eyelids, all not shown) is enclosed in three layers or coats of which only the outer one, the sclera, is explicitly represented (the other layers being the retina and the choroid coat). At the front of the eye, the place of the sclera, which is white and opaque, is taken by the cornea, which is transparent and adjoins the sclera at the limbus under the conjunctiva. The posterior part of the eyeball is enclosed by Tenon's capsule which is connective tissue that extends anteriorly to the conjunctival fornix and is continuous with the muscular fascia of the eye. Interiorly of the eyeball and located behind the cornea are the iris and the lens, with the lens being suspended in place by the ciliary zonule or zonular fibers which are connected at one end to the lens and at the other end to the ciliary body. The iris, which normally rests against the front of the lens (although for the sake of clarity it is shown in FIG. 1 as being spaced somewhat therefrom) is actually a continuation of the choroid coat starting from a location just anteriorly of the ciliary body and is provided in the middle with a circular opening, the pupil, through which light entering the eye through the cornea is able to reach the lens. The space between the cornea and the iris constitutes the anterior chamber of the eye, with the peripheral channel or groove where the cornea and the iris meet in the limbal region of the eye constituting the angle of the anterior chamber. The space between the iris and the lens constitutes the posterior chamber. These two chambers, which communicate through the pupil, are filled with a watery fluid, the aqueous humor. The space in the eyeball behind the lens is filled with a transparent jelly-like substance, the vitreous humor. The lens itself includes a viscous nucleus of inert material enclosed by layers of fibers which in turn are surrounded by an elastic membrane or capsular bag. That part of the capsular bag which is located at the side of the lens facing toward the iris and the cornea is designated the anterior capsule, and that part of the capsular bag which is located at the side of the lens facing toward the retina and engaging the hyaloid face of the vitreous humor is designated the posterior capsule. The hyaloid face is a skin-like somewhat denser region of the vitreous humor which constitutes the boundary of the latter at its interface with the posterior capsule and the ciliary zonule. The cornea, the aqueous humor, the lens and the vitreous humor constitute the refractive media through which light entering the eye passes prior to reaching the retina, with the cornea constituting the main light-refracting structure while the lens, a relatively minor part of the overall optical system, constitutes principally the means of varying the focus.

As is well known, human beings, especially elderly persons, tend to develop a degree of opacity or clouding of the lens fibers surrounding the inert nucleus. The condition

where this opacity spreads into the center of the lens in the region behind the pupil so as to impair vision, is designated cataract. When the opacity has progressed sufficiently to cause the loss of useful functional vision, the cataract is said to be mature, and the only currently available treatment for that condition is the removal of the cataract by extraction of the lens from the eye. Such a cataract removal, which is a very delicate operation but probably one of the most common and widely performed ophthalmic surgical procedures these days, may involve either an intracapsular or an extracapsular extraction of the lens.

In an intracapsular cataract extraction (ICCE), the entire lens, including the nucleus, the cortex (the fibers) and the enveloping capsular bag, is taken out as a unit, with the zonular fibers which connect the bag to the ciliary body being first dissolved and the cataract then being removed with the aid of a low temperature probe. In such a case, it was initially the practice, in the early stages of the development of artificial lenses, to follow up the removal procedure by the implantation of an intraocular lens (IOL) into the anterior chamber of the eye, with the lateral position fixation elements or haptics (resilient loops, arms, or the like) of the IOL being received in the angle of the anterior chamber. However, as the structural and functional characteristics of intraocular lenses were modified and improved over the years and as the surgical techniques and skills for the successful implantation of such lenses have become more refined and sophisticated, it became acceptable, as a follow-up to an ICCE, to implant the IOL in the posterior chamber, with the haptics or position fixation elements being received in the ciliary sulcus (which is the juncture region between the iris and the ciliary body and is generally shallow or flat but, merely for the sake of clarity, has been illustrated in FIG. 1 in a somewhat exaggerated fashion as having the form of a relatively deep channel or groove), subject to the provision that steps are taken to ensure that the IOL does not fall into the vitreous humor.

In an extracapsular cataract extraction (ECCE), by way of contrast, first a major portion of the anterior capsule is cut away, leaving in place only that part of the natural or endogenous capsular bag which consists of the posterior capsule and the remaining, generally annular, anterior capsular flap. Then the lens nucleus is extracted from the capsular bag by any well-known type of expression or by phacoemulsification, and finally the cortex is removed by irrigation and aspiration. In such a case, the current practice is to follow up the removal procedure by the implantation of an IOL into the posterior chamber of the eye, with the haptics or position fixation elements being received either in the ciliary sulcus, where the residual portion of the endogenous capsular bag constitutes the means for preventing the IOL from falling into the vitreous humor, or in the residual capsular bag itself at the equatorial region thereof, i.e., where the anterior capsular flap adjoins the posterior capsule.

Irrespective of whether the procedure performed is an ICCE or an ECCE, sooner or later the surgeon may be faced with the post-operative necessity of having to implant any of a number of optical or mechanical devices into the patient's eye. The desired implant may, as stated above, be an optical device such as an IOL (which may be a multi-focal lens, or a lens specifically designed for monocular vision, toric vision, low vision, etc., or even a single-lens or multiple-lens system designed to provide an appropriate degree of correction for astigmatism or macular degeneration), or a mechanical device such as a semipermeable membrane to keep the vitreous humor or other fluids from migrating from