

"SPARE PARTS" FOR USE IN OPHTHALMIC SURGICAL PROCEDURES

Matter enclosed in heavy brackets [] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This invention relates to the art of ophthalmic surgical procedures, and in particular to a class of novel "spare parts" adapted for use by ophthalmic surgeons in the course of such procedures.

As will become apparent from the following description, the applicability of the principles of the present invention is fairly wide and general. For the sake of an orderly presentation, therefore, and to facilitate comprehension of those principles, the description will be focused in the first instance on those surgical procedures which involve the removal of a cataract from a human eye, with other applications being set forth subsequently.

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. 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 region where the cornea and the iris meet constituting the angle of the anterior chamber, and the space between the iris and the lens constitutes the posterior chamber, with these two chambers, which communicate through the pupil, being 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, with that part of the bag which is located at the side of the lens facing the iris and cornea being designated the anterior capsule, and with that part of the bag which is located at the side of the lens engaging the hyaloid face of the vitreous humor being designated the posterior capsule. The hyaloid face is a skin-like somewhat denser region of the vitreous humor which consti-

tutes 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.

It is readily apparent, therefore, that corrective ophthalmic surgery is an aspect of the field of medicine in which eye surgeons are required to perform extremely delicate operations on a highly sensitive body organ which per se is relatively small and in addition is located in a relatively small and not easily accessible space. Moreover, of such operations, which may range from reinforcement to repair to removal and replacement of individual eye components, some necessitate the insertion of one or more surgical tools into the interior of the eye through a very small corneal incision and entail the performance of extensive manipulations of such tools, thereby creating a substantial risk, no matter how talented and careful the surgeon may be, that occasionally some unintended serious and potentially dangerous damage may be done to tissues and components of the eye.

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 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 extraction, 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, the removal procedure is usually followed by the implantation of an intraocular lens (IOL) into the anterior chamber of the eye, with the lateral position fixation elements (resilient loops, arms, or the like) being received in the angle of the anterior chamber defined between the outer periphery or rim of the iris and the back of the cornea in the limbal region thereof, although it has also been proposed to implant the IOL in the posterior chamber, with the position fixation elements being received in the ciliary sulcus, subject to the provision that steps are taken to ensure that the IOL does not fall into the vitreous humor.

In an extracapsular extraction, by way of contrast, first a major portion of the anterior capsule is cut away, leaving in place only that part of the capsular bag which consists of the posterior capsule and the remaining 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 removal procedure is usually fol-