INTRAOCULAR MULTIFOCAL LENS

PRIOR APPLICATION

This application is a continuation application of pending prior application Ser. No. 088,227 filed on Aug. 24, 1987 for a Intraocular Multifocal lens, now U.S. Pat. No. 4,769,033.

FIELD OF THE INVENTION

The invention relates to aphakic lenses and more particularly to aphakic intraocular lenses.

BACKGROUND OF THE INVENTION

Intraocular lenses have been increasingly used in the last decade, in particular in aphakic patients after a cataract operation. Intraocular lenses provide many advantages over both spectacle and contact lenses. They permit a better elimination of perceptual problems and reduce image size disparity. Since the intraocular lens is intended to remain in situ, it eradicates the difficulties in inserting and removing contact lenses encountered by elderly patients. The use of an intraocular lens may also be advantageous for those working in unusual environments and for those whose visual requirements for occupation must be fulfilled. Presently, opthamologists and eye surgeons recommend that intraocular implant lens surgery be performed when the patient is not likely to manage a contact lens.

According to Norman S. Jaffe et al, "Psudophakos", published by The C.V. Mosby Company, 1978, the majority of patients who undergo lens implant surgery in the United States receive implants whose power is estimated from the basic refraction of the eye. Experience has shown however that there are many pitfalls in estimating the basic refraction in this way, in view of the high incidence of residual anisometropia and aniseikonia cases in patients thus corrected. More recently ophthalmologists surgeons have endeavoured to design bifocal intraocular lenses (IOL hereinafter) to focus both the near and far images on the retina. The "Ocular Surgery News", June 1, 1987, Volume 5, Number 11, reports the latest findings concerning bifocal IOL's. These IOL's, however, provide near and distance vision but do not provide a continuum in the dioptric range. To the best of the inventor's knowledge, there is not known any multifocal intraocular lens.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to provide a new multifocal intraocular lens with a full dioptric range.

It is also another object of the present invention to produce an intraocular lens which can be easily and safely implanted in a patient's eye and which can provide optimal post-operative vision.

Another object is to provide an intraocular lens which can be easily manufactured and can be produced at low cost.

Another object of the present invention is also to furnish an intraocular lens which is more particularly designed for the surgical correction of aphakia following extracapsular cataract exraction.

In accordance with the present invention, an intraocular lens has the general shape of a biconvex disk. The proximal side, to be placed against the vitreous humor is substantially spherical, whereas the distal side is composed of three sectors. The upper sector is essentially spherical and extends to the midsection of the disk. The center sector, adjacent the upper sector, extends therefrom to the lower quarter of the disk and is formed of an aspherical sector of decreasing radius of curvature. The lower sector is also essentially spherical. Such a configuration allows light rays impinging on the intraocular lens to be refracted at different angles. The focal plane thus varies continuously between a near focal plane for near objects and a far focal plane for distant objects, thereby permitting both near and far vision. The proximal side of the IOL can also be a plane or a concave surface in other embodiments of the present invention.

BRIEF DESCRIPTION OF THE DRAWING

Other objects and advantages of this invention will become more apparent from the following specification taken in conjunction with the drawing wherein:

FIG. **1** is a front perspective view from the distal side of an intraocular lens common to the first, second and third preferred embodiments of the invention;

FIG. **2** is a side view of a first preferred embodiment of the present invention;

FIG. **3** is a side view of a second preferred embodiment of the present invention;

FIG. **4** is a cross-sectional view of a third preferred embodiment of the present invention taken along line **4—4** of FIG. **1**;

FIG. **5** is an optical diagram illustrative of the variable multifocal effect achieved by the first preferred embodiment of the present invention.

FIG. **6** is a side view of the fourth embodiment wherein the aspherical sector extends over the entire central part of the lens;

FIG. **7** is a perspective view of the fifth embodiment which includes an upper spherical angular sector;

FIG. **8** is a cross-sectional view thereof taken along line **8—8** of FIG. **7**;

FIG. **9** is a side view of the sixth embodiment wherein the asphericity of the aspherical sector is achieved in discrete steps;

FIG. **10** is a perspective view of the seventh embodiment using concentric spherical and aspherical sectors;

FIG. **11** is a median cross-sectional view thereof; and

FIG. **12** is an optical diagram illustrative of the various multifocal effects obtained with the seventh embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

Referring now to FIG. **1**, there is represented a front perspective view from the distal side (or external side) of the intraocular lens of the present invention. The IOL of the present invention is particularly designed for the surgical correction of aphakia following extracapsular cataract extraction. This lenticulus is to be implanted in the posterior chamber of the patient's eye and is designed to be placed in the ciliary sulcus.

As illustrated in FIG. **1**, the IOL of the present invention has the general shape of a biconvex disk. The distal side **1**, represented in FIG. **1**, has a generally spherical form with the exception of a sector **3** extending approximately from the mid-section of the distal side **1** to the lower quarter **4**. The aspherical sector **3** is configured such that the radius of curvature decreases monotonously from the value R_0 of the radius of the upper spherical sector **2**, to a lower value R_1. The lower spherical sector **4** has the same radius as the upper