MULTI FOCAL INTRA-OCULAR LENS

This is a divisional of copending application(s) Ser. No. 07/366,638 filed on Jun. 14, 1989 now U.S. Pat. No. 5,139,519 which was a continuation-in-part of Ser. No. 07/224,540 filed Jul. 26, 1988, abandoned.

FIELD OF THE INVENTION

This invention relates to intra-ocular lenses (IOL) and, more particularly, to an improved multi-focal intra-ocular lens.

BACKGROUND OF THE INVENTION

Over the past several decades, it has become a common place surgical procedure to replace an opacified lens in the human eye with an artificial single power IOL. Such replacements have seen wide success. Until recently, the employment of multi-focal IOL's had not been considered seriously. However, with advances in the state of the art in multi-focal contact lenses, physicians are proceeding with the implantation of multi-focal IOL's.

Some of the more successful contact lenses of the multi-focal type are called "simultaneous image lenses". Those lenses are characterized by an aspheric anterior and/or posterior surface and by a continuously changing power from the para-central area to the mid-periphery. Lenses of this type are described in U.S. Pat. No. 3,031,927 to Wesley; U.S. Pat. No. 3,037,425 to DeCarle and U.s. Pat. No. 4,636,049 to Blaker. The Wesley lens includes a small center zone for near vision surrounded by a concentric distance correction zone. The DeCarle lens includes an opposite construct wherein the distance zone is in the center and is surrounded by the near correction zone. Blaker, describes a lens similar to the Wesley lens, however, he indicates that the near zone center section should be approximately equal to half the pupil area of the eye under average light reading conditions. The latter consideration indicates one of the problems with these lenses—i.e. that they are affected by the pupil size in that the pupil must be large enough to let enough light through the higher add zone of the lens to provide true bifocal action. Lenses of the Wesley/-Blaker type are called reverse centrad bifocals.

One significant problem with the reverse centrad bifocals is that during outdoor activities in bright light, or in the presence of a bright illumination at night (e.g. such as driving a car in the presence of oncoming traffic), pupillary constriction reduces the proportion and percentage of rays of light that pass through the distance outer zone thus reducing the quality of distance vision. In fact, if there is sufficient pupillary constriction during the day or as a result of the headlights from oncoming vehicles at night, substantially all distance vision may be lost. This is obviously unacceptable—especially when it is considered that such a loss, when driving a car or as a pedestrian, is life threatening.

Recently, Nielsen at the Center for Eye Surgery in Clearwater, Fla. has implanted bifocal IOL's employing the designs suggested by Wesley and Blaker. Those lenses were implanted in a number of patients and were reported as providing "successful results". (see Ophthalmology Times volume 11, number 9, May 1, 1986, pages 1, 77 and 78).

Nielsen's implanted lenses experience the same defects as the reverse centrad bifocal lenses, i.e. during activities outdoors in bright light or at night when driv-

ing a car in oncoming traffic conditions, pupillary constriction reduces the proportion and percentage of rays of light that can be perceived from the distance (outer) zone and thus reduces the quality of distance vision.

German Published Patent Application DE 3332313 A1 (U.S. Pat. No. 4,813,955) describes a multifocal intra-ocular lens wherein the near and far regions of the lens have approximately equal surface proportions and are symmetrically disposed as increasing concentric circles. The patent teaches that the approximate 50/50 ratio of surface areas of near and far correction regions is to be kept constant. This constraint creates problems in low light situations, i.e. at night. As the pupil enlarges, half the light is focused for near vision and half for far vision. This reduces the light utilizable for either far or near vision to one half the available light and significantly reduces the ability to see at night.

If a design is chosen which utilizes a far vision center zone, the lens is restricted to 50% or greater far vision. This design does not offer a combination of dimensions which would allow a more than 50% near vision under preferred reading conditions.

Accordingly it is an object of this invention to provide an improved bifocal IOL which preserves distance vision under all circumstances.

It is a further object of this invention to provide an improved bifocal IOL which preserves distance vision while also enhancing near vision under moderate light conditions.

It is another object of this invention to provide an improved bifocal IOL which is particularly adapted to insertion into the posterior lens capsule.

SUMMARY OF THE INVENTION

The invention comprises an IOL with at least a center zone and two concentrically located ring zones arranged thereabout, the center zone having a distance power correction. The first concentric ring zone has a near power correction and the second concentric zone a distance power correction. In one embodiment the lens body is provided with haptics which act to center the lens body when it is surgically implanted within the posterior lens capsule. In another embodiment, the greater proportion of the lens' correction zones are devoted to distance power corrections.

In a second embodiment, the lens diameter is increased to mate with the internal dimensions of the posterior lens capsule.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of an IOL embodying the invention.

FIG. 2 is a sectional view of the invention taken along line 2—2.

FIG. 3 is a section view of an eye with the lens of this invention implanted in the posterior lens capsule.

FIG. 4 is a plan view of an IOL embodying the invention with a circular haptic.

FIG. 5 is a plan view of an IOL embodying the invention with enhanced bright and low light distance power corrections.

FIG. 6 is a side view of the lens of FIG. 5 and shows representative dimensions for the lens' correction zones.

FIG. 7 is a plot which shows the dominant affect of the distance correction zones of a lens incorporating the invention.