

## LENS IMPLANTS FOR INSERTION IN THE HUMAN EYE

This invention relates to lens implants for insertion in the human eye from which the natural lens has been removed with an extra-capsular extraction.

Such lens implants consist of a lens made of polymethyl methacrylate (PMMA) having holding portions projecting from its periphery to hold the lens in position in the eye between the posterior capsule and the iris after the implant has been inserted through an incision at the junction of the cornea and the sclera. The holding portions are usually in the form of closed loops or curved arms, which have one end free and are usually also known as loops, lying in the plane of the lens. The loops are flexible and resilient and in existing lens implants are of various shapes.

In most existing lens implants, the closed loops or curved arms are made of Prolene, which is a polypropylene and are fixed to the periphery of the lens. It has been found however that over a long period of time the Prolene is subject to some bio-degradation and if degradation takes place, there is a risk that the lens may become displaced in the eye unless sufficient fibrous growth has occurred around it to hold it in place.

To overcome this problem attempts have been made to make the lens with integral holding portions of PMMA which is not subject to degradation. These integrally formed holding portions have been in the form of tabs which lie in the plane of the lens and project radially from its periphery. As these tabs are not able to bend in the plane of the lens in the same way as is possible with the loops or curved arms, they cannot spring outwards into contact with the internal surface of the eye after they have been inserted and for this reason they are not so successful as the loops or arms in holding the lens accurately in position in the eye. Further, also owing to the lack of flexibility in a radial direction in the plane of the lens, they tend to cause greater difficulties in the insertion of the implant through the incision in the eye than occur with implants having holding portions in the form of flexible loops or arms.

The aim of the present invention is to provide a lens implant for insertion in the posterior chamber of a human eye after an extra-capsular extraction, the implant comprising a lens with holding portions of PMMA so that the problem, of degradation is overcome, and in which the holding portions are so formed that insertion into the eye is facilitated while the maintenance of the positioning of the implant in the eye is improved.

To this end, according to this invention, such a lens implant, which comprises a lens of PMMA with two similar holding loops or arms projecting from the periphery of the lens, each loop or arm lying substantially in the plane of the lens and being open-ended with one end fixed to the lens and the other end free, is characterised in that the loops or arms are of PMMA and each has one end formed integrally with the lens, the loops or arms being substantially diametrically opposite each other around the periphery of the lens, and each loop or arm, starting from the end which is integral with the lens, has a first portion extending substantially radially outwards from the lens, then extending around a sharp bend into a second portion of a curvature such that it follows, but is spaced radially outwards from, the pe-

riphery of the lens, a third portion which extends from, and is of less curvature than, the second portion, and a fourth portion which extends from the third portion and is of a greater curvature, substantially similar to that of the second portion, the end of the fourth portion being free and lying radially outwards of the second portion of the other loop or arm, so that the two loops or arms together surround the lens, and the first portion of each loop or arm being relatively stiff and the other portions being more flexible and resilient so that, in use, when the implant is to be inserted through an incision into the eye, the fourth portion of each loop or arm can be pressed inwards into contact with the second portion of the other loop or arm, and the two loops or arms bend in such a way that together they form a substantially circular ring surrounding the lens, and, after insertion, the loops or arms spring open again but the configuration of an encircling ring is maintained and the ring tends to adhere to the underlying posterior lens capsule although a part of it may encroach on to the ciliary sulcus. The encircling ring may act as a barrier protection against the ingrowth of secondary lens fibres from the fornix of the human lens. This will tend to prevent secondary clouding of the posterior capsule which normally occurs some months after the cataract extraction.

It has been found that by forming the lens with integral loops having the configuration, which is commonly known as a D-shape even though the straight part of the D is not present and the ends of the curved part of the D are not connected to each other, and also the relative stiffnesses of the different parts of the loops described above, the implant as a whole can be inserted through the incision in the eye and through the dilated iris into the posterior chamber more easily than can be done with existing forms of lens implant intended for insertion into the posterior chamber. After insertion, the shapes and flexibility of the loops or arms are such that the lens is held very securely in position regardless of whether the radially outer parts of the loops contact the anterior capsular flaps, which remain after removal of the anterior capsule, or the ciliary sulcus in between the posterior capsule and the iris.

The two loops or arms preferably lie in a flat plane which is the plane containing the periphery of the lens, but they may alternatively lie in planes which are inclined to this plane by a small angle of up to 10° and it is this that is meant by saying that the loops or arms lie substantially in the plane of the lens.

Preferably each loop is of rectangular cross-section and of constant thickness perpendicular to the plane of the lens. The first portion is then of greater width in this plane than the other portions to provide its greater stiffness. The width of the first portion tapers from the periphery of the lens to the beginning of the second portion and preferably the width of the second portion tapers from the first portion to the third portion. The third portion and the major part of the fourth portion are then preferably of constant width.

The width of the fourth portion of each loop is preferably increased at its free end and both the wider free end part and the first portion are preferably provided with positioning holes extending through them perpendicular to the plane of the lens.

These positioning holes assist in moving the lens into the exact required position after it has been inserted and, after insertion, material of the eye tends to grow and penetrate through the holes to anchor the lens implant more firmly in position.