A study of the haptic bearing angles in eyes with the Optiflex anterior chamber implant

A T N EKDAWY

From Kent County Ophthalmic and Aural Hospital, Maidstone, Kent

SUMMARY Gonioscopy and goniophotography were performed on 137 eyes with the Optiflex angle supported implant. At the time of gonioscopy the lenses had been in situ for a median of 20 months, with a range of 3–38 months. In 75.9% of cases one or both haptics were positioned posterior to the scleral spur with some degree of iris push. Iris tuck was seen in 29.2% of cases. Three different types of fibrous tissue formations were seen in the angles. The first two types (sleeving and iris haptic adhesions) occurred in the majority of cases and were haptic related. The third type was in the form of true peripheral anterior synechiae and occurred in 17.5% of cases. In cases with haptic related adhesions only, the angle remained open. Secondary glaucoma developed in 12 cases (8.7%). Ten cases had open angles. In the remaining two cases peripheral anterior synechiae were present in more than two-thirds of the angle, which was considered to be closed. Total burial of one of the haptics occurred in 25.5% of cases. A prominent iris vessel was observed near one of the haptics in nine cases. The thin looped haptics appear to stimulate fibrous tissue formation in the majority of cases. The haptic related adhesions add to the stability of the implant. It would make dislocation of the lens unlikely, even under severe trauma to the eye. However, once formed it would make removing the implant virtually impossible without severing the haptics. With time and with burial, the haptics seem to move away from the direction of the cornea. Total insulation of the haptic from the peripheral cornea is achieved with the occurrence of total burial.

Anterior chamber implants have been widely used as a primary procedure for the apparent ease of insertion. They are also used for secondary implantation in aphakic eyes. Gonioscopic studies have been performed on eyes with the Choyce mark VIII and Tennant lenses.^{1,2}

The design changes of anterior chamber implants have been towards more flexibility and lighter weight. The flexibility in anterior chamber implants has been introduced to obviate the problems associated with sizing, postoperative tenderness, and astigmatism.³ A number of different angle supported lenses have been developed with varying degrees of flexibility. Questions have arisen concerning the effect of such implants on the ocular structures, particularly so on the angle structures where the implant gains its support. If a lens implant has to be compressed to be inserted into the eye, the lens haptics store energy. Such energy must be released over a period of time.⁴

There has been a report on the early postoperative gonioscopic appearance of the anterior chamber (AC) implants with thin closed loop haptics.⁵ This gonioscopic study reports the structural changes in angles that have been bearing such haptics for as long as three years.

Materials and methods

Over a period of four years the Optiflex AC implants were inserted into 515 eyes. The implant was inserted following intracapsular cataract extraction, either as a primary or as a secondary procedure. The Optiflex implant is a one piece lathe cut polymethylmethacrylate lens (Fig. 1). The lens has a 6 mm diameter optic and two closed looped haptics. The loops are thin and measure 0.24 mm in diameter.⁶ An Optiflex implant (12 mm in length and of 19.5 dioptres) weighs 18 g in air. A weight of 20 g is required to produce a longitudinal flexion of the implant.³

Gonioscopy and goniophotography were performed postoperatively on 137 eyes of 130 patients.

Correspondence to A T N Ekdawy, FRCS, Kent County Ophthalmic and Aural Hospital, Church Street, Maidstone, Kent ME14 1DT.

Length (mm) 11.5 12.0 12.5 13.0 13.5

Fig. 1 Dimensions of the Optiflex implant.

Of the implants 134 were inserted as a primary procedure and three as a secondary procedure. Four eyes had unplanned extracapsular cataract extraction. Three eyes had operative hyphaema which was considered too minor to abort implantation. One hundred and thirty eyes had an uncomplicated intracapsular cataract extraction. Implants were inserted following the partial closure of the surgical wound and reformation of the AC. Air was used to reform the AC. Neither Sheet glides nor viscoelastic materials were used during the course of implantation. The size of the implant was estimated by measuring the corneal diameter and adding 0.5–1 mm. The implants used varied in diameter between 11.5 mm to 13.5 mm in 0.5 mm increments. The number of iridectomies varied from one to three according to the surgeon's preference.

Gonioscopy was performed from three months up to 38 months postoperatively. The Goldmann gonioscope together with the slit-lamp microscope were used to visualise the angle structures. A magnification of 25.6× was achieved with the objective power of 1.6× and (16×) oculars of the slit-lamp microscope. The Pentax ME super camera was mounted on the slit-lamp and used for goniophotography. A special adaptor incorporating one of the slit-lamp oculars was used. A 1000 ASA film was used for photography, and slit-lamp illumination provided the required lighting.

The position of each of the two haptics was noted in

relation to the angle structures. The two haptics were classified as proximal and distal in relation to the incisional site. Each of the two haptics was judged to be in one of four positions:

(1) First position or position S. The haptic was situated against the scleral spur or between the scleral spur and the iris root without a significant iris push.

(2) Second position or position P. The haptic was situated posteriorly on the iris root with some degree of iris push but not tucked into an iris fold. The normally slit-like filtration angle has expanded in an anteroposterior configuration by the posterior bowing of the iris.

(3) Third position or position F. The haptic was tucked either partially or wholly into an iris fold.

(4) The fourth position, or position A. The haptic was situated anterior to the scleral spur.

Table 1 The length of time implants have been in situ at the time of gonioscopy

	Postoperative duration (months)	Number of eyes
Group 1	3–6	21
Group 2	7–12	39
Group 3	13–18	41
Group 4	19–24	15
Group 5	25–30	13
Group 6	31 and over	8
Total		137

Table 2 *Distribution of the lens length used among the 137 implants*

Implant length (in mm)	Number of implants	Percentage
11.50	11	8.0%
12.00	45	32.8%
12.50	57	41.6%
13.00	21	15.3%
13.50	3	2.2%

Changes in the peripheral iris were recorded. The presence of different types of fibrous tissue formations in the angle were described. Changes in the shape of the pupil were noted. Intraocular pressure was recorded in all cases prior to gonioscopy.

Results

At the time of gonioscopy the lenses had been in situ for a median of approximately 20 months with a range of three months to 38 months. Table 1 shows the length of time the implants had been in situ at the time of gonioscopy. The most commonly used size was 12.5 mm in length implant (41.6% of cases.)

Table 2 shows the distribution of the lens length used among the 137 implants.

In 30 eyes (21.9%) both haptics were in the position S. In 47 eyes (34.3%) one of the haptics was in position S and the other haptic was in position P. In all of the 47 eyes the haptic in the position P was the distal haptic. In 17 eyes (12.4%) the two haptics were in position P. In 40 eyes (29.2%) the distal haptic was tucked into an iris fold, position F. (Fig. 2). In this group the proximal haptic was in the S position in 16 eyes. In the remaining 24 eyes the proximal haptic was in position P. In three eyes the proximal haptic was found to be anterior to the scleral spur, position A. In this group the distal haptics were in position S. Table 3 shows the incidence of the different haptic positions in relation to the length of the implant used. Fig. 3 further illustrates the incidence of the posteriorly placed haptics in the different lens length

Fig. 2 *A gonioscopic photograph showing one of the haptics tucked into an iris fold. (Gonio-view position).*

groups. It would appear that in a total of 104 eyes (75.9%) at least one of the haptics was placed posteriorly. In all cases the posteriorly placed haptic either produced a change in the angle configuration or was tucked in an iris fold.

Delicate fibrous tissue coating one or both haptics was observed in 109 cases (79.6%). The fibrous tissue coating (or sleeving) was variable in extent. In most cases the sleeving was observed on the horizontal bar of the haptics (Figs. 4, 5). In a few cases it was also observed on the longitudinal limb of the haptic (Fig. 6). The incidence of sleeving did not change significantly with the length of time the implant was in situ (Table 4).

Coarse iris-haptic adhesions occurred in 83 cases (60.6%). Iris-haptic adhesions were pigmented and occurred predominantly at the corners of the haptics (Fig. 7). In most cases a combination of the sleeving and coarse adhesions was present.

Total burial of the horizontal bar of one of the haptics was observed in 35 cases (25.5%). In 33 cases the buried haptic was the distal haptic. Cases with a totally buried haptic included implants with haptics disappearing into an iris fold (Fig. 2). It also included cases where the horizontal bar of the haptic seemingly disappeared into a tunnel of fibrous tissue (Fig.

Table 3 *The different haptics positions in relation to the lens length*

Lens length in mm	11.50	12.00	12.50	13.00	13.50
Number of eyes	11	45	57	21	3
Number of cases in which one or both haptics were posteriorly placed (excluding cases with iris tuck)	5 (45.4%)	19 (42.2%)	29 (50.8%)	9 (42.8%)	2 (66.7%)
Number of cases in which one haptic was tucked into an iris fold	2 (18.2%)	12 (26.7%)	18 (31.6%)	7 (33.3%)	1 (33.3%)
Number of cases in which the two haptics were in the position S	4 (36.4%)	11 (24.4%)	10 (17.5%)	5 (23.8%)	—
Number of cases in which one of the haptics was placed anterior to the scleral spur	—	3 (6.7%)	—	—	—

Fig. 3 The incidence of posteriorly placed haptics in the different implant length groups.

8). In the latter group the haptics in question were not necessarily posteriorly placed. The incidence of total burial increased significantly with the length of time the implant was inside the eye (Fig. 9). It had a peak incidence in the group which were examined by gonioscopy 25–30 months postoperatively. The incidence of total burial also increased with the length of the implant (Fig. 10). For implants longer than 12.5 mm the incidence was significantly high.

Sleeving and iris-haptic adhesions were confined to the implant loops. These two types of fibrous tissue formation did not appear to extend anterior to the

Fig. 5 Goniophotograph showing sleeving along the horizontal bar (arrows). Note the slightly anterior position of the haptic. (Anatomical position).

scleral spur. They did not conceal the trabeculum in any of the cases.

Peripheral anterior synechiae (PAS) were seen in 24 cases (17.5%). The height of the synechiae varied, but in all cases it extended from the iris and concealed the concavity of the angle recess. In 14 cases (10.2%) the PAS were limited to the superior part of the angle in relation to the surgical wound. In 10 cases (7.3%) the synechiae were observed in the four different quadrants of the angle. In all cases the distribution of the synechiae was not specifically related to the site of the haptics within the angle.

A prominent iris vessel was observed near the corners of the looped haptics in 9 cases (6.5%) (Fig. 8).

Among the 137 cases 12 had a persistent rise in intraocular pressure (8.7%). One patient had a trabeculectomy to control the intraocular pressure. Two patients had laser trabeculoplasties. They were controlled on medical treatment following the laser

Fig. 4 Goniophotograph showing sleeving at both ends of the horizontal bar (arrows). (Anatomical position).

Fig. 6 Goniophotograph showing sleeving of both the horizontal and vertical limbs of the haptic. Arrow marks the junction of the sleeved and non-sleeved parts of the vertical limb. (Gonio-view position).

Table 4 Incidence of fibrous tissue formation in the angle in relation to the postoperative duration

Postoperative duration (months)	3-6	7-12	13-18	19-24	25-30	31+
Number of eyes	21	39	41	15	13	8
Number of eyes in which fine fibrous tissue coating of the haptics was evident	18 (85.7%)	32 (82.0%)	30 (73.2%)	13 (86.7%)	10 (76.9%)	6 (75%)
Number of eyes in which coarse iris-haptic adhesions were present	9 (42.8%)	24 (72.0%)	25 (60.9%)	10 (66.7%)	8 (61.5%)	7 (87.5%)
Number of eyes in which the horizontal bar of one of the haptics was totally buried	3 (14.3%)	6 (15.4%)	13 (31.7%)	5 (33.3%)	5 (38.5%)	3 (37.5%)

trabeculoplasties. In nine patients the intraocular pressure was controlled on medical treatment. In two cases more than two-thirds of the angle was found to be closed by peripheral anterior synechiae. In 10 cases the angle was considered to be open. Five cases had peripheral anterior synechiae extending for less than one-third of the angle. In the remaining five cases the angle was open all around.

The pupil was observed to be oval in 26 cases (18.9%). In all the 26 cases one of the haptics was grossly malpositioned and tucked into a large iris fold. Ovalling of the pupil was not observed in cases with minimal iris tuck. Table 5 shows the incidence of ovalling of the pupil in relation to the postoperative duration. From the table it is apparent that the incidence of ovalling of the pupil was not related to the length of time the implant had been in situ.

Discussion

Rigid angle supported implants were associated with sizing problems. Postoperative astigmatism, tenderness, iris tuck, and ovalling of the pupil are a few examples. Uveitis—glaucoma—hyphaema, or the so-called Ellingson syndrome, was described with the early angle supported AC lens implants.⁷ The syndrome represented the result of interaction between the implant and the ocular structures in the angle.

Fig. 7 Goniophotograph showing two bands of coarse iris haptic adhesions at both corners of the haptic (arrows). (Gonio-view position).

A generation of highly flexible and semiflexible implants were introduced to minimise the complications seen with the early rigid AC lenses. The basic changes in the design of the implant were towards a lighter weight and higher flexibility. The changes were also aimed at minimising the contact between the implant and uveal tissues by improving the lens vault.⁸

Within the angle it would appear that the ideal site for the implant haptics to fixate is against the relatively inert scleral spur. In this study only 21.9% of the implants had both haptics at the level of the scleral spur. In the majority of cases (75.9%) the position of one or two of the haptics was found to be posterior to the spur. Histopathological studies of eyes with semiflexible and closed loop implants have shown most of the haptics to be posterior to the scleral spur, with a variable degree of uveal tissue penetration.^{9,10} The incidence of posteriorly placed haptics did not vary significantly with the length of the implant used. Iris tuck was present in 29.2% of cases. With the exception of the size 11.50 mm the incidence of iris tuck has not increased significantly with the length of the implant. The incidence in the 11.50 mm group was lower at 18.2%. It would appear that iris tuck is an inherent complication of insertion of this type of lens.

Fig. 8 Goniophotograph showing total burial of the horizontal bar of the haptic into a tunnel of fibrous tissue. Note the presence of a prominent iris vessel (arrow) near one of the corners of the haptic. (Anatomical position).

Fig. 9 The incidence of total burial of one haptic in relation to postoperative duration.

It is of interest to know that Kraff *et al.*¹ reported an incidence of 28% of iris tuck with the rigid Choyce's and Tennant's implants. The Optiflex implant is not as flexible as other lens implants in the semiflexible range. A weight of 20 g is required to flex the Optiflex implant as compared with a 7 g for the semiflexible Leiske's lens. On the other hand the implant is not as rigid as the Choyce mark IX, for instance, where a weight of 208 g is required to produce flexion.³ Perhaps the Optiflex implant would be best described as a semirigid lens.

Three distinctly different types of fibrous tissue formations were seen in the angles supporting the Optiflex implant. A combination of two or more of these were seen in the same angle. The first type was in the form of delicate fibrous tissue coating the thin loops and best described as sleeving. It occurred in 79.6% of cases. The extent of sleeving varied, and in the majority of cases it involved the horizontal bar mainly. The second type was in the form of coarse iris haptic adhesions. It occurred predominantly at the junctions between the horizontal bar and the vertical limbs of the loops. This type of adhesion was more pigmented than the first type, and it was seen in 60.6% of cases. The aetiology of sleeving and iris haptic adhesions remains speculative. Mechanical activation of the iris stromal fibroblasts by lens haptics has been postulated as a possible mechanism.

Fig. 10 The incidence of total burial of one haptic in the different implant length groups.

This was histologically proved with some of the polymethylmethacrylate (PMMA) implants.¹¹ Inflammatory changes in the angle are another possible mechanism.⁵

The site of the coarse iris haptic adhesions at the point of maximum iris contact (the corners of the haptics) suggests mechanical stimulation as a possible mechanism. The fact that sleeving has been seen on haptics which were not in direct contact with the iris suggests inflammation as a possible mechanism. However, a combination of mechanical stimulation and inflammation probably exists in all cases.

Total burial of the horizontal bar of one of the haptics occurred in 25.5% of cases. Total burial is probably the result of direct pressure on the iris and ciliary body together with mechanical stimulation of these tissues. It is also possible that inflammation has a minor role. The involvement of the distal loop in nearly all cases of burial is significant. The induction of haptic burial, mostly inferiorly, was reported by

Table 5 Incidence of ovalling of the pupil in relation to the postoperative duration

Postoperative duration (months)	3-6	7-12	13-18	19-24	25-30	31+
Number of eyes	21	39	41	15	13	8
Number of eyes with oval pupil	4 (19.0%)	8 (20.5%)	6 (14.6%)	4 (26.6%)	2 (15.4%)	2 (20.0%)

Poleski and Willis⁵ with two different semiflexible implants. The weight of the implant is insignificant. This is because the specific gravity of the PMMA (1.19) is similar to the specific gravity of the aqueous (1.01).³ The predominant burial of the distal loops could be more readily explained by their position. They are more likely to be placed posteriorly on the iris.

The first two types of fibrous tissue formations were confined to the implant loops. In almost all cases they have not extended anterior to the scleral spur. They have not concealed the trabecular meshwork, and the angle remained open. The first two types do not constitute true peripheral anterior synechiae. They represent the interaction between the haptics and ocular structures. The third type was in the form of peripheral anterior synechiae which concealed the concavity of the angle recess. The incidence of PAS in the superior part of the angle (10.2%) is lower than the reported incidence of 35% following uncomplicated cataract extraction.¹² The distribution of PAS within the angle makes it highly unlikely that the loops played any part in its formation. Transient pupil block and angle closure is a possible mechanism in the formation of PAS in the different parts of the angle. Rowsey^{12,13} and Gayler *et al.* have suggested that the presence of an intraocular lens at the site of PAS would lead to gradual tilting of the implant. The postulated direction for the tilt of the implant was forward and superiorly. This is perhaps true when an implant haptic is placed in contact with a previously formed PAS. In this series, with the formation of the haptic related fibrous tissues the direction of shift (if any) seems to be away from the cornea.

The significance of the presence of a prominent iris vessel near one of the haptics is not clear. It appeared in 6.5% of cases, none of which had any neovascular changes in the rest of the angle. The constant site of the vessel, near the point of maximum pressure of the haptics (the corners), suggests localised iris stromal atrophy as a possible mechanism. The vessels are probably normal iris vessels which became apparent as a result of the stromal atrophy. The incidence of 6.5% is significantly lower than the 30% figure reported with the more rigid angle supported implants.¹ This is not surprising, as we know that the Optiflex implant has a linear compressibility of 20 g compared with 208 g for the more rigid implants.³

Secondary glaucoma developed in 12 cases (8.7%). In two cases the mechanism of glaucoma was clearly that of a closed angle. In 10 eyes the angles were open and functional damage to the trabecular meshwork must exist. Trauma, inflammation, and inflammatory products would all be contributory factors. The general incidence of pseudophakic secondary glaucoma was estimated by Layden to be 8%.¹⁴

Ovalling of the pupil, representing gross iris tuck, was present in 18.9% of cases. Pearce's study of the more rigid Choyce lenses showed that 25% of cases had peaked pupils.¹⁵

CONCLUSION

The Optiflex implant still retains some of the characteristics of the rigid angle supported implants. There is a tendency for the implant haptics to be placed posterior to the scleral spur. Sizing of the implant is important, though not as critical as in the more rigid lenses. The thin looped haptics stimulate fibrous tissue formation. In the majority of cases, with haptic related adhesions only, the angle remained open. Fibrous tissue formation around the haptic adds to the stability of the implant. It would make dislocation of the lens unlikely even under severe trauma to the eyes. However, once formed it would make removing the implant virtually impossible without severing the haptics. With time and with burial the haptics seem to move away from the direction of the cornea. Total insulation from the cornea is achieved with the occurrence of total burial.

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