SCIENTIFIC REPORT

Surgical and visual outcomes following exchange of opacified Hydroview® intraocular lenses

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Aim: To report the clinical and surgical outcomes following exchange of opacified Hydroview® intraocular lenses (IOLs), and to relate the final visual and anatomic results to clinical and surgical variables.

Methods: This is a prospective study of seventy-three eyes that underwent exchange of opacified Hydroview® IOLs in Waterford Regional Hospital, Ireland. Preoperative, intraoperative and postoperative details were recorded.

Results: This study comprised 73 eyes of 71 consecutive patients undergoing IOL exchange, performed at mean ($\pm$ SD) intervals of 36.64 ($\pm$ 9.9) months following the primary cataract surgery. The mean ($\pm$ SE) follow-up following the exchange procedure was 13 ($\pm$ 1) months (range: 1–45 months). The secondary IOL was placed in the capsular bag, in the sulcus, and in the anterior chamber in 22 (30.1%), 24 (32.9%) and 27 (37%) cases, respectively. The IOL exchange procedure was uneventful in 36 eyes (49.3%), whereas intraoperative events such as posterior capsule rupture, vitreous loss and zonular dehiscence were seen in the remainder (50.7%). Following the IOL exchange procedure, a significant improvement in best corrected visual acuity (BCVA) was noted at one and at three months, and at the final visit (Wilcoxon signed ranks test: $p < 0.001$, $p = 0.006$, and $p < 0.001$, respectively). Following exclusion of eyes with visually consequential ocular comorbidity, a better final BCVA was noted among those eyes where the secondary IOL was placed in the capsular bag or in the sulcus when compared with placement of the secondary IOL in the anterior chamber (IOL in the bag or sulcus: 26 eyes (35.6%), median (IQR) final BCVA: 0.2 (0.10–0.40); IOL in the anterior chamber: 19 eyes (26.02%), median (IQR) final BCVA: 0.5 (0.20–0.60); Mann Whitney U Test: $p = 0.004$).

Conclusion: IOL exchange is a technically challenging, but visually rewarding procedure. However, placement of the secondary IOL in the anterior chamber is associated with a poorer visual outcome when compared with placement of the secondary IOL in the sulcus or in the capsular bag.

Cataract surgery is the most commonly performed surgical procedure worldwide, and the use of foldable lenses in such surgery is now well established.¹ The Hydroview lens (Bausch & Lomb Surgical, Rochester, New York, USA) is a foldable hydrogel intraocular lens (IOL), designed for implantation in the capsular bag. Opacification of the Hydroview® IOL following implantation has been well described.^{2–5}

Opacification of the Hydroview® IOL results in visual impairment, reflected in a deterioration in visual acuity and contrast sensitivity.⁸ Where indicated, IOL exchange has been shown to be of visual benefit in these patients.^{2 7 9 10}

In Waterford Regional Hospital, Ireland, there has been an epidemic of opacified Hydroview intraocular lenses.⁸ In this

study, we report the clinical and surgical outcomes of IOL exchange in 71 patients (73 eyes) with opacified Hydroview® IOLs.

MATERIAL AND METHODS

The Hydroview® IOL was first used in the Department of Ophthalmology at Waterford Regional Hospital in 1999, and the first case of its opacification was noted in 2001. At the time of writing, seventy-three eyes (71 patients) with opacified Hydroview® IOLs with consequential visual impairment had undergone IOL exchange in this unit. Of note, a proportion of the IOL exchange procedures presented in this article have been reported previously, albeit with shorter postoperative follow-up and less in-depth analysis.⁸

Following pharmacological dilatation of the pupils, a clinical diagnosis of IOL opacification was made at the slit-lamp in the presence of characteristic granular deposits on the surface of the IOL. (fig 1) All IOL exchange procedures were performed between June 2001 and January 2005, and patients provided written and informed consent before undergoing the surgery.

Details germane to the primary cataract surgery and Hydroview® IOL implantation were recorded, and include BCVA (before, and 3 months after, cataract surgery); type of anaesthesia; viscoelastic substance used; surgical complications.

Data collected for each subject with respect to the IOL exchange procedure was classed as demographic, preoperative, peroperative and postoperative. Preoperative details included: medical history, systemic and topical medications; allergies; interval since primary cataract surgery (ie, Hydroview® IOL implantation); subjective visual complaints. Peroperative details comprised: surgeon; surgical technique; complications; intraoperative medications. Postoperative details included: BCVA; intraocular pressure (IOP); anterior and posterior segment findings; status of posterior capsule, in terms of transparency; other post operative events.

BCVA was measured using the Snellen notation at 6 metres, and converted to Logarithm of Minimal Angle of Resolution (LogMAR) units for statistical analysis, as follows: BCVA of 6/7.5 on Snellen chart is equivalent to 0.1 on LogMAR; counting fingers, hand movement, perception of light and no perception of light were given arbitrary values of 1.5, 1.6, 1.8 and 2, respectively.

Surgical techniques

The surgical technique(s) of IOL exchange has been described in detail elsewhere.^{8 11} Briefly, and following separation of the opaque IOL from the posterior capsule using viscoelastic, a haptic was dialled into the anterior chamber, and this was followed by manipulation of the whole IOL into the anterior

Abbreviations: ARM, age related maculopathy; BCVA, best corrected visual acuity; ERM, epiretinal membrane; IOL, intraocular lens; IOP, intraocular pressure; IQR, interquartile range; LogMAR, Logarithm of Minimal Angle of Resolution; POAG, primary open angle glaucoma

Figure 1 An opacified Hydroview® IOL. Note the areas of relative transparency left by the lens-introducing forceps.

chamber. A 6.0 mm clear corneal incision was then created, through which the IOL was removed, having been grasped with a McPherson forceps (Technique 1). The corneal wound was then sutured with interrupted 10/0 Nylon sutures. However, and in an attempt to restrict the size of the corneal wound, some surgeons elected to bisect the optic of the opacified IOL in the AC prior to its extraction through a smaller incision (Technique 2).

Next, the zonules and capsular bag were checked for anatomic integrity. The secondary IOL was inserted in the capsular bag (if possible). If the posterior capsule was ruptured and capsular support was deemed inadequate, the secondary IOL was placed in the sulcus or in the anterior chamber. In those cases where vitreous prolapsed into the anterior chamber during IOL explantation, an anterior vitrectomy was performed.

In the postoperative period, the eye that underwent IOL exchange was treated with topical Maxitrol (Dexamethasone 0.1%, Neomycin 0.35%, polymyxin B sulphate 6000 units/g) for a period of approximately one month. BCVA was assessed at one, three, and six months following surgery, and at the last visit prior to discharge.

All explanted Hydroview® IOLs underwent chemical analysis by the manufacturer (Bausch & Lomb).⁸

Statistical analysis

In order to test for differences between anatomic locations of the secondary IOL with respect to final BCVA, the Kruskal-Wallis test was employed. Post hoc comparisons were performed using Mann Whitney U tests employing the Bonferroni correction to ensure that overall Type I error probability of 0.05 was not exceeded. In order to make statistical comparison between BCVA before and after primary cataract surgery, and to make the same comparison before and after IOL exchange, the Wilcoxon-signed ranks test was used. Spearman's rank correlation was used to test for associations between numerical variables. For summarisation, median and interquartile range (IQR), or mean and standard of error (SE), were used where appropriate. A *p* value <0.05 was deemed significant.

RESULTS

Seventy-three opaque Hydroview® IOLs were explanted from 71 patients during the time considered in this study, and the mean ($\pm$ SD) age was 76 (8.8) years (range: 41 to 89 years). The male:female ratio was 46:25 (64.8%:35.2%), and the right:left eye ratio was 31:42 (42.5%:57.5%).

Table 1 Intraoperative details germane to the primary cataract surgery in which the Hydroview® IOL was implanted

Variables	No of cases (%)
Type of anaesthesia	
Local	68 (93.2)
General	5 (6.8)
Viscoelastic materials	
VISCOAT	72 (98.6)
Non recordable	1 (1.4)
Pre-operative complications	
Vitreous loss	1 (1.4)
Suprachoroidal haemorrhage	1 (1.4)
Iris bleeding	1 (1.4)
No complication	70 (95.9)

IOL exchanges were undertaken at mean ($\pm$ SD) intervals of 36.64 ($\pm$ 9.9) months (range: 16 to 57 months) after the primary cataract surgery. The mean ($\pm$ SE) follow up following the IOL exchange procedures was 13($\pm$ 1) months (range of 1–45 months). Details germane to the IOL exchange procedures are given in table 2.

The primary cataract surgery, during which the Hydroview® IOLs were implanted, was uneventful in 70 cases (95.9%). (table 1).

At the time of listing for the IOL exchange procedure, 45 (61.6%) eyes were free of ocular comorbidity. Coexisting ocular pathology evident at the time of IOL exchange included: primary open angle glaucoma (POAG) (18; 24.6%); age related maculopathy (7; 9.5%); branch retinal vein occlusion (1; 1.4%); previous retinal detachment (1; 1.4%); retinitis pigmentosa (1; 1.4%).

A significant improvement in BCVA was noted at one and at three months following the exchange procedure, and at final follow-up (Wilcoxon signed ranks test: *p*<0.001, *p* = 0.006, and *p*<0.001 respectively). Forty (54.8%) eyes achieved a final BCVA of 6/12 or better.

Anatomic location of the secondary IOL was associated with differences in final BCVA in a statistically meaningful way (Kruskal-Wallis Test: *p* = 0.007). Final BCVA did not differ between eyes where the secondary IOL was placed in the sulcus versus those cases where the secondary IOL was placed in the capsular bag, after excluding eyes with coexisting ocular pathology that affected vision (IOL in capsular bag: 10 eyes (13.7%), median (IQR) BCVA: 0.25 (0.10–0.40); IOL in the sulcus: 16 eyes (21.9%), median (IQR) BCVA: 0.15 (0.03–0.40); Mann Whitney Test: *p* = 1.00). A significantly better final BCVA

Table 2 Intraoperative details germane to the IOL exchange procedures

Variables	No of cases (%)
Type of anaesthesia	
Regional (retrobulbar/peribulbar/sub-Tenon's)	68 (93.2)
Topical	1 (1.4)
General anaesthesia	4 (5.5)
Surgical Techniques	
Technique 1	28 (38.4)
Technique 2	23 (31.5)
Per-operative complications	
No complications	36 (49.3)
Rupture of PC, with or without vitreous loss	5 (6.8)
ZD	32 (43.8)
Vitreous loss	23 (31.5)
Position of the secondary IOL	
Bag	22 (30.1)
Sulcus	24 (32.9)
AC	27 (37)

ZD, zonular dehiscence; AC, anterior chamber.
See the material and methods section

was noted in those eyes where the secondary IOL was placed in either the sulcus or in the capsular bag versus those cases where the secondary IOL was placed in the anterior chamber (IOL in the sulcus or capsular bag: 26 (35.6%) eyes, median (IQR) final BCVA: 0.20 (0.10–0.40); IOL in the AC: 19 (26.02%) eyes, median (IQR) BCVA: 0.50 (0.20–0.60); Mann Whitney Test: $p = 0.004$).

Vitreous loss occurred in 23 eyes (31.5%) that underwent IOL exchange. After excluding eyes with ocular comorbidity that impacted on visual acuity, a significantly worse final BCVA was associated with this complication (vitreous loss: $n = 15$, mean ($\pm$ SD) final BCVA = 0.55 ($\pm$ 0.5); no vitreous loss: $n = 30$, mean ($\pm$ SD) final BCVA = 0.30 ($\pm$ 0.3); χ^2 test: $p = 0.005$). However, it worth noting that all cases of vitreous loss occurred in those cases where the secondary IOL was placed in either the sulcus or in the anterior chamber, and that, in the presence of this complication, placement of the secondary IOL in the sulcus was associated with a significantly better final BCVA than those cases where the secondary IOL was placed in the anterior chamber (Mann Whitney U Test: $p = 0.033$).

Following exclusion of eyes with ocular comorbidity, 11 eyes underwent the IOL exchange procedure using Technique 1 and 14 eyes underwent the procedure using Technique 2, and these techniques did not differ in terms of final BCVA in a statistically meaningful way (Technique 1: 11 eyes (15.06%), median (IQR) BCVA: 0.30 (0.10–0.40); Technique 2: 14 eyes (19.2%), median (IQR) BCVA: 0.20 (0.08–0.40); Mann Whitney U Test: $p = 0.609$).

Postoperative adverse events following the IOL exchange procedure are given in table 3.

DISCUSSION

Opacification of IOLs is an uncommon event, with postoperative opacification of the Hydroview® IOL first being described by Chang and co-authors in 1999, and since by many other investigators.^{4–5, 8–12} In this paper, we report the visual and surgical outcomes in a series of patients following exchange of opacified Hydroview IOLs, and relate the results to clinical and surgical variables. To our knowledge, this is the largest series of IOL exchange procedures ever reported.

Although opacification of implanted IOLs remains relatively a rare indication for IOL exchange, a cluster of such opacification, as reported here, represents a significant challenge and burden to local ophthalmic services.

In this study, a significant improvement in BCVA was reported following explantation of the opaque IOL and placement of the secondary IOL, reflected in a postoperative visual acuity of 6/12 or better in 54% of eyes undergoing this procedure. However, seven (9.6%) eyes exhibited no significant

change in BCVA (within 2 Snellen lines of preoperative BCVA), and six (8.2%) eyes exhibited a deterioration in BCVA following the exchange procedure. However, and paradoxically, it is worth noting that a deterioration in BCVA following exchange of opacified Hydroview® IOLs is often accompanied by a large degree of patient satisfaction, presumably because of enhanced contrast sensitivity. This is because opacification of the Hydroview® IOL adversely affects contrast sensitivity and visual acuity, but contrast sensitivity to greater extent.⁸

In this study, it was found that placement of the secondary IOL in the anterior chamber was associated with a significantly worse final BCVA when compared with those cases where the secondary IOL was placed in either the sulcus or in the capsular bag. Of note, this finding contrasts with previous reports by us and by other investigators. Certainly, one explanation for the discrepancy between our current findings and our previous report probably relates to the fact that, in this article, we have excluded eyes with visually consequential ocular comorbidity for this analysis. However, it is also worth noting that the series reported here is associated with longer follow-up (mean ($\pm$ SD): 10 ($\pm$ 2.3) months) than previous reports by us and by other investigators. Longer follow up may explain, at least in part, our finding that placement of the secondary IOL in the anterior chamber is associated with poorer final BCVA, since progression of age related maculopathy (ARM) and the development of epiretinal membrane (ERM) were noted in five (18.5%) of the eyes where an anterior chamber IOL was inserted. Of note, ERM formation and ARM progression have been putatively linked with intraocular inflammation, and placement of the secondary IOL in the anterior chamber is necessary in those cases where the barrier between the anterior and posterior segments is disrupted, thus, presumably, promoting inflammatory processes throughout the eye.^{19, 20}

In conclusion, exchange of opacified Hydroview IOLs is a visually rewarding, if technically challenging, procedure. Final BCVA is independent of the time between the primary cataract surgery and the IOL exchange procedure, but is compromised in those cases where the secondary IOL is placed in the anterior chamber.

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Table 3 Late postoperative events following IOL exchange procedures

Events	Position of the secondary IOL	
	AC N (%)	Capsular bag or sulcus N (%)
Progression of ARM	2 (2.7)	
ERM	3 (4.1)	
Corneal decompensation	1 (1.4)	
Endophthalmitis	1 (1.4)	
Raised IOP		1 (1.4)
MH	1 (1.4)	
PCO		21 (28.76)

AC, Anterior chamber; IOL, intraocular lens; ARM, age related maculopathy; ERM, epiretinal membrane; IOP, intraocular pressure; MH, macular hole; PCO, Posterior capsule opacification.

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