Laboratory analyses of two explanted hydrophobic acrylic intraocular lenses

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Two three-piece hydrophobic acrylic intraocular lenses (IOLs) were explanted from two patients at 7 and 9 years, respectively, after implantation, because of poor fundus visualisation and/or a clinically significant decrease in visual acuity related to their opacified IOLs. In addition to light microscopy, scanning electron microscopy and energy dispersive X-ray spectroscopy, confocal laser scanning microscopy was used for the first time to observe the explanted IOLs. The clinical aspect seemed to correspond to the phenomenon of surface light scattering, while laboratory analyses showed dense glistenings in the central layer of the IOL optic, which had no change next to the surface. Further studies on these phenomena are needed.

Key words: Glistenings, hydrophobic acrylic, intraocular lens

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Current soft foldable intraocular lenses (IOLs) are usually made of silicone, hydrophilic acrylic, or hydrophobic acrylic. However, silicone IOLs may react with the silicone oil used in vitreoretinal surgery. Opacification and calcium deposits have been observed in different hydrophilic IOL models.[1,2] Hydrophobic acrylic IOLs present the phenomena of glistenings and/or surface light scattering.[3] Controversy remains on whether the severity of glistenings or surface light scattering could impact the visual function over time, with very few reports of IOL explantation. Herein, we report two cases of hydrophobic acrylic IOL explantation and related laboratory analyses.

Case Reports

Case 1

A 65-year-old man underwent phacoemulsification with IOL implantation (Alcon MA60MA + 1.0 diopters, serial number 635084.092) in his right eye for cataract complicated with high myopia on April 17, 2002. Nine years later, the postoperative best-corrected visual acuity (BCVA) decreased from 20/40 (0.3 logMAR) to 20/200 (1.0 logMAR), and fundus visualization was obscured by the opacified IOL [Fig. 1a]. IOL explantation/replacement was thus performed, resulting in postoperative BCVA of 20/70 (0.5 logMAR) and improved fundus visualization with the new lens.

Case 2

A 47-year-old man, who was diagnosed with cataract and Fuch's corneal dystrophy in both eyes, underwent penetrating keratoplasty combined with IOL implantation (Alcon MA60MA + 5.0 diopters, serial number 774087.091) in his left eye, with postoperative BCVA of 20/40 (0.3 logMAR). Seven years later, he developed secondary glaucoma and

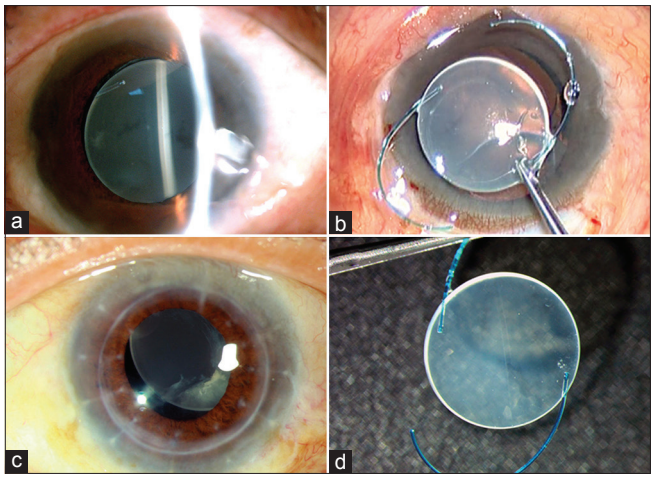

Figure 1: Slit-lamp photographs (original magnifications ×16) (Case 1: (a), Case 2: (c) and gross photographs of the explanted intraocular lenses (IOLs) during the surgery (Case 1: (b), Case 2: (d). The IOLs appear as white opacity

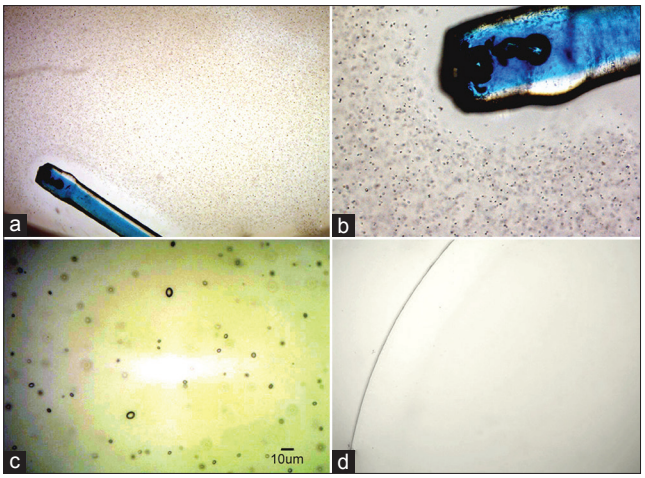

Figure 2: Light photomicrographs of the explanted intraocular lenses (IOLs) (a-c) and the control IOL (d) (original magnifications of A through D ×40, ×200, ×400, and ×40, respectively). Many microvacuoles are present throughout the optic within the explanted IOL

the BCVA was 20/100 (0.7 logMAR). It was difficult to visualize the fundus, because the IOL was slightly dislocated and opacified [Fig. 1c]. IOL explantation/replacement and trabeculectomy were performed. On postoperative day 3, we could see the optic disc cupping clearly with the new IOL. However, the BCVA was still 20/100 (0.7 logMAR) for the serious optic nerve damage.

Laboratory analyses

The IOL removed from the eye was placed in a sterile balanced salt solution (Alcon) for 5 s, before transferred to a dry plastic vial and immediately sent to the laboratory for analyses on the day of surgery. Gross and light microscopic examinations of the IOL were made within 30 min after explantation. Then, confocal laser scanning microscopy was performed to observe the IOL. Last, the IOL was detected by energy dispersive X-ray and scanning electron microscopy. A new IOL of the same design was used as the control lens throughout the laboratory analyses.

Results

Light microscopy findings

Both preoperative slit-lamp photographs and intraoperative gross photographs show that the IOL was white and opaque [Fig. 1a-d]. Many microvacuoles, up to 10 μm in size, were observed throughout the optic of the explanted IOL by light microscopy [Fig. 2a-d].

Confocal laser scanning microscopy findings

Through a process of optical sectioning, different layers of the IOL were present. Dense glistenings mainly occurred in the central layer of the optic [Fig. 3: sections 4 through 8, about 300 μm thick], whereas almost no glistenings were found next to the surface [Fig. 3: sections 1 through 3 and 9 through 10].

Scanning electron and energy dispersive X-ray analysis

The surface of the explanted IOL was quite smooth. There were only carbon and oxygen in the IOL deposits but no elements like calcium and phosphorus [Fig. 3].

Discussion

Glistenings are refractile microvacuoles that can form within the IOL optic when the IOL is in an aqueous environment. They have been observed in IOLs with different materials, especially the hydrophobic acrylic IOLs,[3] which may be related to IOL manufacturing techniques, temperature change, and IOL packaging. Some intraoperative factors, which may lead to breakdown of the blood-aqueous barrier[3] (with higher levels of serum components in aqueous humor) or increase the degree of postoperative inflammation,[4] are supposedly implicated in increasing glistenings. Whether glistenings would influence the visual function over time is still uncertain. It was reported that the density/severity of glistenings in the hydrophobic acrylic AcrySof IOLs increased over time.[4,5] A three-piece hydrophobic acrylic IOL (Alcon MA60AC) was explanted from the left eye of a 68-year-old patient because of the unusual pattern of glistenings that impaired fundus visualization.[6] However, some investigators argued that there was no statistical association between the frequency and density of glistenings and time,[7] or between glistenings and visual function.[3]

Moreover, surface light scattering (also called "whitening" or "nanoglistenings") has been reported less often than glistenings, and little is known about its development. Nishihara *et al*.,[8] found light scattering on the surface of 6 of 10 explanted IOLs, with no effect on visual function, in an experimental study. Matsushima *et al*.,[9] observed that the explanted IOLs with whitening had an approximately 4% decrease compared with the control IOLs in light transmission. In this study, the clinical aspect seemed to correspond to the phenomenon of surface light scattering, while laboratory analyses showed that glistenings also appeared in the optic. No matter what it is, glistening or/and surface light scattering, the visual function of patients was impaired. Further studies on these phenomena are needed.

Confocal laser scanning microscopy, a technique for obtaining high-resolution optical images with depth selectivity, is mainly used in biology and immunology. In this study, it was used for the first time to examine the IOLs. During

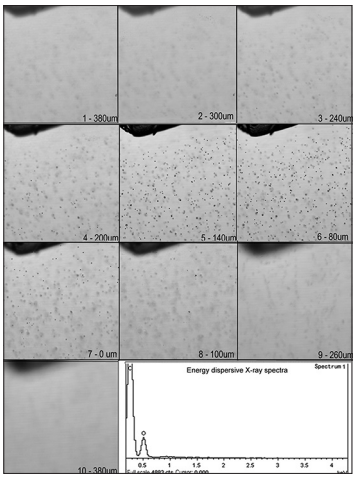

Figure 3: Confocal laser scanning photomicrographs (1×10, original magnifications ×40) and energy dispersive X-ray spectra of the explanted intraocular lenses. Selected optical sections from the front surface to the back at different depths from the center (section 7) are shown

the process of optical sectioning, a precise analysis of the inner structure changes of the IOL could be made, including the location, the thickness, and so on. However, environmental changes (e.g., temperature or hydration) when the IOL was explanted from the eye may lead to a slight deviation in our results, for both glistenings[3] and surface light scattering,[10] are related to the hydration state of the IOLs. Although the lenses were just placed in the dry container for less than 30 min before confocal microscopy examination, the regions close to the surfaces would start to dry. It seems to be better to perform the examination within 1 or 2 min after explantation.

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References

1. Huang Y, Xie L. Delayed postoperative opacification of foldable hydrophilic acrylic intraocular lenses. J Biomed Mater Res B Appl Biomater 2011;96:386-91.
2. Neuhannn IM, Werner L, Izak AM, Pandey SK, Kleinmann G, Mamalis N, *et al*. Late postoperative opacification of a hydrophilic acrylic (hydrogel) intraocular lens: A clinicopathological analysis of 106 explants. Ophthalmology 2004;111:2094-101.
3. Werner L. Glistenings and surface light scattering in intraocular lenses. J Cataract Refract Surg 2010;36:1398-420.
4. Moreno-Montañés J, Alvarez A, Rodríguez-Conde R, Fernández-Hortelano A. Clinical factors related to the frequency and intensity of glistenings in AcrySof intraocular lenses. J Cataract Refract Surg 2003;29:1980-4.
5. Waite A, Faulkner N, Olson RJ. Glistenings in the single-piece, hydrophobic, acrylic intraocular lenses. Am J Ophthalmol 2007;144:143-4.
6. Werner L, Storsberg J, Mauger O, Brasse K, Gerl R, Müller M, *et al.* Unusual pattern of glistening formation on a 3-piece hydrophobic acrylic intraocular lens. J Cataract Refract Surg 2008;34:1604-9.
7. Christiansen G, Durcan FJ, Olson RJ, Christiansen K. Glistenings in the AcrySof intraocular lens: Pilot study. J Cataract Refract Surg 2001;27:728-33.
8. Nishihara H, Yaguchi S, Onishi T, Chida M, Ayaki M. Surface scattering in implanted hydrophobic intraocular lenses. J Cataract Refract Surg 2003;29:1385-8.
9. Matsushima H, Mukai K, Nagata M, Gotoh N, Matsui E, Senoo T. Analysis of surface whitening of extracted hydrophobic acrylic intraocular lenses. J Cataract Refract Surg 2009;35:1927-34.
10. Ong MD, Callaghan TA, Pei R, Karakelle M. Etiology of surface light scattering on hydrophobic acrylic intraocular lenses. J Cataract Refract Surg 2012;38:1833-44.

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