ELECTRONIC CLINICAL CASE

Calcification of a hydrophilic acrylic intraocular lens: Case report with laboratory analysis

Calcification d’un implant intraoculaire acrylique hydrophile : cas clinique avec analyses physicochimiques

Z.M. Bodnar\textsuperscript{a}, P. Rozot\textsuperscript{b}, L. Leishman\textsuperscript{a}, A. Ollerton\textsuperscript{a}, J. Michelson\textsuperscript{a}, S. Plasse-Fauque\textsuperscript{b}, L. Werner\textsuperscript{a,\ast}

\textsuperscript{a} John A.-Moran Eye Center, University of Utah, 65, Mario-Capecci Drive, Salt Lake City, 84132 Utah, USA
\textsuperscript{b} Clinique Monticelli, 88, rue du Commandant-Rolland, 13008 Marseille, France

Received 26 September 2012; accepted 7 November 2012
Available online 18 May 2013

Summary We analyzed a single-piece plate-type hydrophilic acrylic posterior chamber intraocular lens (IOL) that was explanted due to a progressive loss of vision, which occurred 6 years after uncomplicated phacoemulsification. Gross and light microscopy, as well as anterior segment optical coherence tomography (OCT) revealed granular deposits below the IOL surface. Light scattering, as measured with Scheimpflug photography and densitometry analyses was found to be increased; spectrophotometry demonstrated a decrease in the light transmittance of the explanted lens. The granular deposits within the IOL material were found to be composed of calcium by histochemical methods (alizarin red and Von Kossa stains). To our knowledge this is the only report of calcification of this IOL design.

© 2013 Elsevier Masson SAS. All rights reserved.

Résumé Nous avons analysé un implant intraoculaire acrylique hydrophile, monobloc à trois haptiques, qui a dû être explanté à cause d’une diminution progressive de la vision, six années après phacoémulsification. Des analyses macroscopique et microscopique, ainsi qu’une tomographie à cohérence optique du segment antérieur ont révélé des dépôts granulaires sous la surface de l’implant. Les photographies Scheimpflug avec densitométrie ont mis en évidence une augmentation de la dispersion lumineuse ; la spectrophotométrie a montré une diminution

DOI of original article: http://dx.doi.org/10.1016/j.jfo.2012.09.014.
* The text of this article is also completely published in the continuing medical education site of the French Journal of Ophthalmology http://www.e-jfo.fr, in the section “Clinique” (free consultation for subscribers).
* Corresponding author.
E-mail addresses: liliana.werner@hsc.utah.edu, werner.liliana@gmail.com (L. Werner).

081-5512/S – see front matter © 2013 Elsevier Masson SAS. All rights reserved.
http://dx.doi.org/10.1016/j.jfo.2012.11.012
Introduction

Calcification of the intraocular lens (IOL) optic material leading to lens opacity and reduced visual function is a complication that has been observed in some hydrophilic acrylic posterior chamber IOL designs \([1–3]\). This phenomenon has also been observed in silicone lenses in association with asteroid hyalosis \([4–6]\). Studies of explanted opacified hydrophilic acrylic IOLs by histochemical methods such as alizarin red stain or Von Kossa stain, as well as surface analyses confirmed the calcific nature of the opacification process. These studies, and others using anterior segment optical coherence tomography (OCT) demonstrated deposition of granular calcium deposits within the hydrophilic acrylic material, in a band at some distance from the IOL surface, or on the material surface \([2,7]\). Scheimpflug photography with densitometry analyses and spectrophotometry has shown that the calcium deposits can increase light scattering and decrease light transmittance by the affected lenses \([8]\).

The Genium Prepak is a hydrophilic acrylic posterior chamber IOL that is pre-packaged in a specially-designed sterile injector for delivering the implant into the capsular bag. This lens is manufactured by LCA Pharmaceutical (Chartres, France). The IOL consists of a single biconvex optic surrounded by one leading haptic and two trailing haptics arranged in a plate-type, triangular configuration. The length of the lens, from the tip of the leading haptic to the tips of the trailing haptics is 11.0 mm. Two optic sizes are available: 5.5 mm and 6.0 mm.

Case report and laboratory analysis

A 79-year-old woman was referred to one of us (PR) for IOL exchange in December 2011 because of late onset IOL opacification in her right eye. Her current medications were clonidine and bisoprolol hemifumarate/hydrocholothiazide for high blood pressure, bezafibrate for hyperlipidemia, and chondroitin sodium sulphate for arthritis. She had undergone phacoemulsification with IOL implantation in the right eye (OD) on January 19, 2005 under topical anesthesia with no surgical complications. The IOL inserted was a Genium Prepak AF15.5, with a dioptic power of +22.5 D. The same surgery was performed on the left eye (OS) a few weeks later under the same conditions and a Genium Prepak AF15.5 IOL, with a dioptic power of +21.5 D was implanted. The postoperative course was uneventful. Postoperative visual acuity in both eyes was LogMAR 0.00 J1 with a slightly myopic correction. An Nd:YAG laser posterior capsulotomy OD was performed in 2008. The patient complained of progressive blurry vision in January 2011. At that time the best-corrected visual acuity (BCVA) was LogMAR 0.18 J2 OD, and remained at LogMAR 0.00 J1 OS. At the time of referral in December 2011, the BCVA OD was LogMAR 0.40 J3. Biomicroscopic examination revealed well-centered IOLs, fixated in the capsular bag in both eyes. The right IOL exhibited a diffuse milky opacification (Fig. 1). The left IOL remained completely transparent. The endothelial cell count was 1600 cells/mm² OD and 1960 cells/mm² OS. Macular OCT imaging was normal bilaterally. The patient underwent an IOL exchange in the right eye in January 2012 with anterior vitrectomy and insertion of a 3-piece Acrysof IOL (Alcon Laboratories, Fort Worth, TX, USA) in the sulcus under general anesthesia. The postoperative course was uneventful with complete visual recovery to a BCVA OD of 0.00 LogMAR.

The explanted IOL was sent to the laboratory at the John A. Moran Eye Center intact in the dry state. There was a cut extending from the periphery of the optic to its center between the two trailing haptics that had been made during explantation. The optic and haptics were moderately opacified and there was a mild amount of dried material on the IOL surface. Gross photographs of the lens were taken (Fig. 2).

The IOL was examined with light microscopy, where dried ophthalmic viscosurgical device (OVD) and balanced salt solution (BSS) crystals were noted on the optic surface. Multiple, small granular deposits were noted within the optic material and also within the haptics. There were also a few cellular deposits on the lens surface.

The IOL was hydrated in distilled water and placed in a model eye for imaging with anterior segment OCT (Visante, Zeiss, Jena, Germany), and Scheimpflug...
photography with light scattering measurements (EAS-1000, Nidek, Tokyo, Japan). Anterior segment OCT showed subsurface densities within the IOL optic (Fig. 3A). Scheimpflug photography showed a high level of light scattering occurring close to the optic surfaces (Fig. 3B). The highest value measured was 223 computer compatible tapes (CCT), in a scale from 0 (black) to 255 (white). Light transmittance was then measured through the optic of the explanted IOL using a Perkin-Elmer Lambda (Waltham, MA, USA) 35 UV–vis spectrophotometer (single-beam configuration with a Lab Sphere RSA-PE-20 integrating sphere). For this, the IOL was placed inside a cuvette filled with BSS. Fig. 4 plots the percent light transmittance through the explanted IOL and a control hydrophilic acrylic IOL over the wavelength interval from 350 nm to 850 nm. The average light transmittance in the visible light spectrum was 92.5% for the explanted lens, and 97.3% for the control lens.

Following imaging, the IOL was stained with alizarin red (Fig. 5C). This confirmed that the granular deposits were, at least in part, composed of calcium. An optic cylinder was cut from the center of the optic and stained with the Von Kossa method, which confirmed the presence of calcified granules within a subsurface band inside the IOL optic material, and also demonstrated the present of calcified granules in the center of the optic (Fig. 5D).

**Discussion**

There are a variety of causes of postoperative opacification or discoloration of IOLs, which are dependent on the material composition of the IOL in addition to other aspects of the manufacturing process, as well as surgical factors, patient factors, packaging and other variables. The causes of IOL opacification/discoloration include chemical exposure, systemic medications, silicone oil deposition, calcification and material degeneration [1].

Granular deposition of calcium within the IOL material has been observed in a number of hydrophilic acrylic designs [3]. Surface calcification has been reported to occur on silicone lenses that have been implanted in eyes with asteroid hyalosis and in some hydrophilic acrylic lens designs [2,4–6]. Calcification has not been reported to occur in hydrophobic acrylic or poly(methyl methacrylate) (PMMA) lenses. Catanese et al. published a case of an IOL with intraoptic opacification, which they described as glistenings [9]. They presented an OCT image which is similar to Fig. 3A. We have analyzed cases of IOLs explanted because of a pattern of optic opacification very similar to that of Catanese et al. They were represented by explanted

---

**Figure 2.** Gross photograph of the explanted lens showing dried ophthalmic viscosurgical device and balanced salt solution on the lens surface. The optic and haptics appear opacified. A radial cut in the optic that was made during explantation can be seen between the distal haptics.

**Figure 3.** A. Anterior segment optical coherence tomography of the explanted lens in a model eye revealing a band of granular material beneath the optic surface. The distribution of the granules is denser close to one of the optic surfaces. B. Anterior segment Scheimpflug photograph of the explanted lens in a model eye demonstrating significant light scattering in the areas of granular material (76 and 223 computer compatible tapes). The area with higher scattering (bottom surface in the Scheimpflug photograph) corresponds to the region with denser granular material (upper surface on the optical coherence tomography).

**Figure 4.** Graph showing the % light transmittance from 350 to 850 nm of the explanted intraocular lens and a control hydrophilic acrylic intraocular lens.
single-piece hydrophilic acrylic IOLs with intraoptic calcified granules; the calcific nature of the granules was confirmed by different methods for calcium [10,11]. We believe the case of Catanese et al. actually corresponds to optic calcification of a hydrophilic acrylic lens and not glistenings. When present, glistenings are usually homogeneously distributed throughout the optic of the lens [7,12]. Optic opacification due to calcification usually results in significant decrease in visual function, requiring explantation. In some cases, the visual acuity may remain unchanged, and the complaints are dominated by disability glare. This may be because calcification significantly increases light scattering in the affected IOL [8,13], although it may only reduce light transmittance in the visible spectrum by about 5%, as was the case with the Genium Prepak explant that we analyzed [8]. Clinically, it can sometimes be difficult to distinguish surface calcification, intraoptic calcification, posterior capsular opacification (PCO) and other causes of postoperative opacification and vision loss. Anterior segment OCT and/or Scheimpflug photography may be useful in telling these entities apart [7,8]. PCO can be managed with Nd:YAG laser posterior capsulotomy whereas other causes of opacification may require a lens exchange. It is therefore important to identify the etiology of the optic opacification and vision loss accurately prior to treatment.

**Conclusion**

We analyzed an explanted Genium Prepak hydrophilic acrylic posterior chamber IOL that was explanted due to opacification and vision loss. A dense band of calcified granular deposits was identified beneath the surface of the IOL material. To the best of our knowledge, this is the only report on late postoperative calcification of this lens design, and we are not aware of other cases. Awareness of this potential complication and imaging/analyses methods that may assist in the diagnosis are warranted.

**Disclosure of interest**

The authors declare that they have no conflict of interest concerning this article.
Acknowledgements

Mary Mayfield assisted in the sectioning and staining of this specimen. Supported in part by an unrestricted grant from Research to Prevent Blindness, Inc, New York, NY, USA to the Department of Ophthalmology and Visual Sciences, University of Utah, and by a Seed Grant of the University of Utah to Liliana Werner, MD, PhD.

References