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Wave-like calcification on the posterior surface of an acrylic hydrophilic bag-in-the-lens (BIL) implant

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ABSTRACT

Purpose: To report secondary opacification of a hydrophilic bag-in-the-lens (BIL) which is a rare manifestation that can happen years after initial surgery.
Observations: We describe a case of a prominent wave-like, rippled opacification on the posterior surface of the BIL. The opacification was composed of calcium deposits and seems to start in the periphery as a ring and progresses to the centre of the posterior surface. Due to the specific design of the BIL, there is direct contact between the BIL and the posterior chamber, both with the space of Berger, and the anterior hyaloid, particularly in this very hyperopic eye. Conclusions and importance: Abnormal fluid flow and stagnation in an unusual retrolenticular space is a possible explanation for this unusual pattern of posterior surface opacification.

1. Introduction

Intraocular lens (IOL) opacification is an uncommon, albeit significant, complication that can occur after cataract surgery and has been reported across a wide range of acrylic hydrophilic and silicone lenses.[1] The majority of lens opacifications occur due to the accumulation of calcium and phosphate salts in the lens material, and are often associated with surgeries that utilise air or gas.[2,3] Neuhann et al. previously described a classification system for lens calcifications that comprised three categories: primary calcification, secondary calcification, and pseudocalcification.[4] Primary calcifications are those seen within 2 years of implantation and are associated with the lens manufacturing and packaging issues. Secondary calcifications, conversely, occur many years after implantation and are thought to be caused by interactions between the lens and the ocular microenvironment.[4] Silicone lenses in particular are known to interact with the vitreous in cases of asteroid hyalosis after capsulotomy.[5–7]

The Bag-in-Lens (BIL) implant (Morcher GmBH, Germany) is an alternative approach to posterior IOL placement, in which the IOL is fully supported by both an anterior and posterior capsulorhexis and which has been specifically designed to prevent PCO.[8] Like most other hydrophilic acrylic IOLs, it is rarely associated with opacification that manifests many years after implantation, which is consistent with secondary calcification.[9] IOL exchange is typically necessary in most cases to improve vision, although this can occur many years after the primary surgery in cases of secondary calcification, thereby adding to the surgical complexity. In this report, we describe an unusual, wave-like pattern of secondary calcification, the surgical approach to exchange such a lens, and the postoperative clinical outcome.

2. Case report

A 77-year-old woman presented complaining of a slowly progressing blurred vision and a glare in her right eye over a number of months; this consultation took place 14 years after an uneventful cataract surgery using a high powered BIL (+31D). Her referring ophthalmologist had diagnosed PCO and had tried to perform a laser capsulotomy, albeit unsuccessfully. Other than a history of hyperopia and bilateral pseudophakia, she had no other ophthalmic issues and she took no regular ocular or systemic medications.

On clinical examination, her best-corrected visual acuity (BCVA) was 1.0 (Decimal Snellen) in both eyes and her spectacle correction

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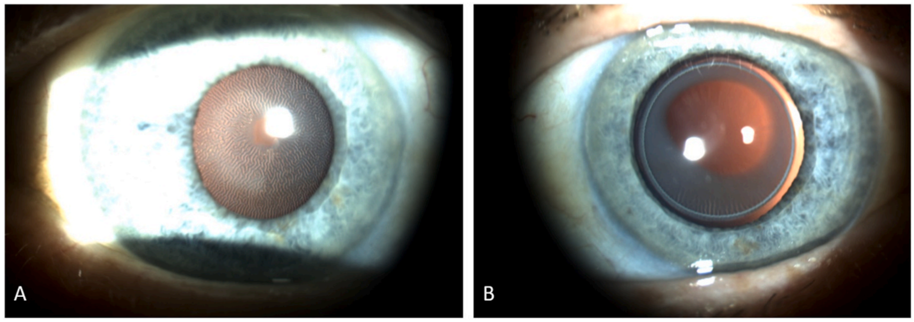

Fig. 1. A: Slit-lamp picture of the wave-like opacification on the posterior surface of the BIL in the right eye. B: Slit-lamp picture of the opacification of the BIL in the left eye.

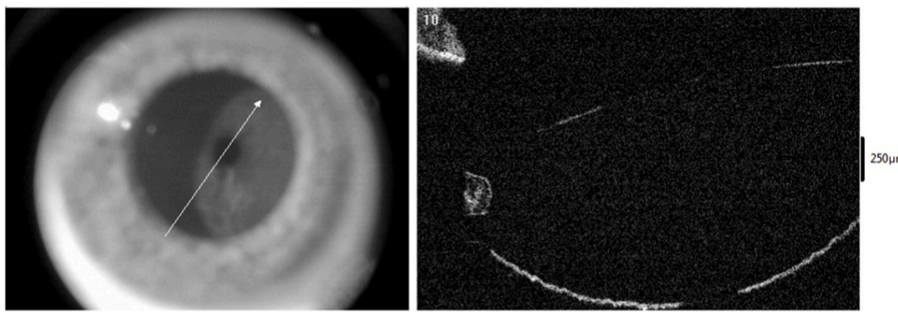

Fig. 2. Anterior segment OCT of the BIL.

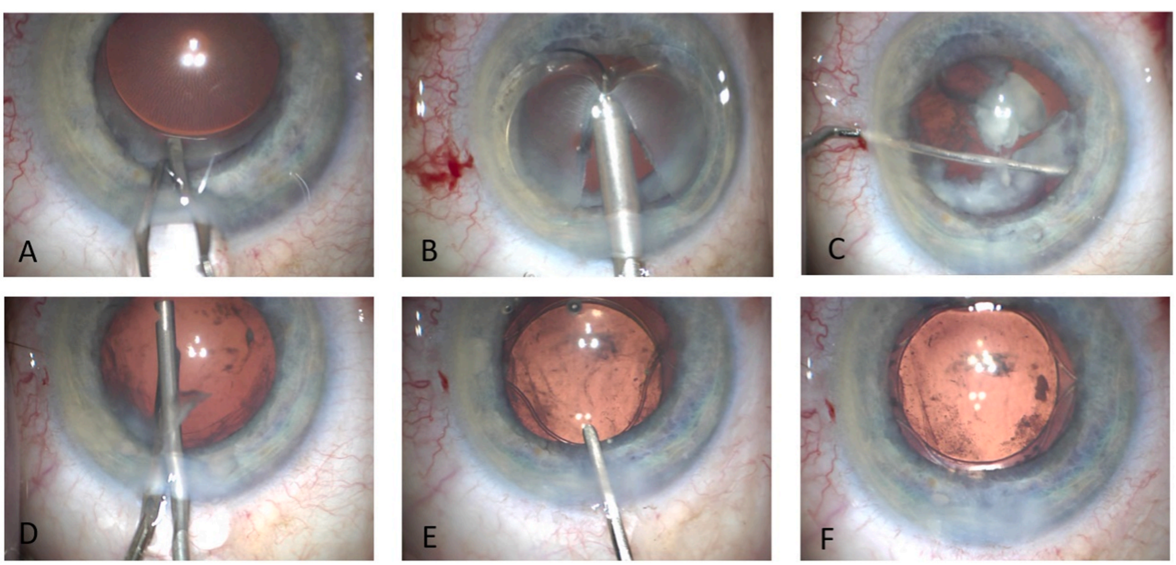

Fig. 3. A: Manipulation of the BIL out of the capsulorhexis. B: Cutting the BIL into 2 pieces. C: Removal of capsular proliferative material from inside the bag. D: Anterior vitrectomy for the proliferative material. E: Stabilisation of the BIL-capsule complex by 2 bean shaped segments. F: Postoperative image.

(+0.50DS/0DC Right, +1.25DS/0DC Left) had remained comparable to her previous consultation, 8 years previously. Slit lamp examination showed a light speckled haze on the anterior surface and a dense, rippled wave-like opacification on the posterior of the lens, with a small central aperture (Fig. 1A). The left eye displayed similar opacification, but it was less extensive, with a larger zone sparing the visual axis (Fig. 1B). Intraocular pressure was within normal range bilaterally (17 mmHg right, 14 mmHg left). The fundus appeared normal bilaterally, but the density of the haze in the right eye prevented a detailed inspection of the peripheral retina. Anterior segment optical coherence tomography proved that the opacification was formed at the posterior surface of the IOL (Fig. 2), thereby making it easier to mistake for PCO, though this cannot occur with the BIL as no posterior capsule is present behind the optic.

3. Surgery

An IOL exchange of the right eye was performed under topical anaesthesia (video 1). A 3-step 2.8mm, clear corneal incision was made temporally with a single 1mm paracentesis. After intracameral injection 0.5mls of local anesthetic (Mydrane, Théa, France containing 0.2mg/ml tropicamide, 3.1mg/ml phenylephrine hydrochloride and 2mg/ml

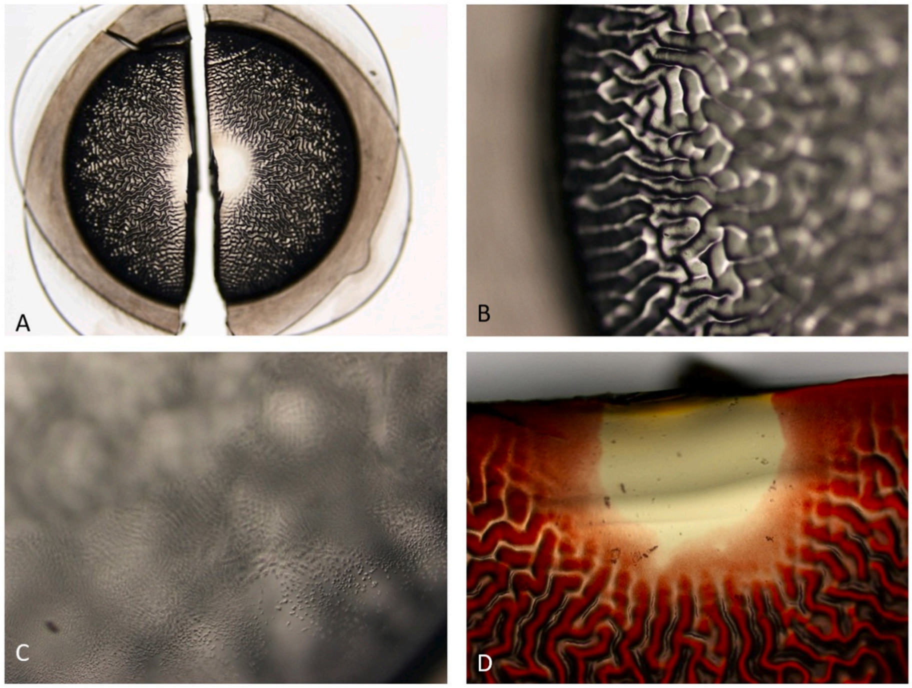

Fig. 4. A: Wave-like calcification of the posterior surface of BIL. B: detailed picture of the wave-like opacification. C: Fine granular calcification on the anterior surface. D: Alizarin red staining. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

lidocaine hydrochloride), the anterior chamber was filled with ophthalmic viscosurgical device (OVD, Healon GV, Johnson & Johnson Vision, USA). The lens was gently disengaged from the capsular ring and a less viscous OVD (Healon, Johnson & Johnson Vision, USA) was injected behind the BIL and into the space of Berger (Fig. 3A). This allowed the BIL to be prolapsed into the anterior chamber. The implant was then fed into the loop of a soft IOL cutter (Moria Surgical SA, France) and was cut into 2 pieces (Fig. 3B). These pieces were then removed using a coaxial-forceps. The residual capsule contained a large amount of proliferative lens epithelial material, and this was debulked by manual aspiration and anterior vitrectomy (Fig. 3C+D). The replacement BIL (Type 89A, +30.5D) was then injected into the anterior chamber and sited in the central capsular bag openings, as had been done previously. The capsular support was noted to be less stable than preoperatively, likely due to the both the explantation and the removal of the proliferative material, so additional capsular reinforcement was deemed necessary. Two bean-shaped ring segments (Type 80C, Morcher, Germany) were then positioned into the sulcus in order to create a 5mm central aperture which, in addition to the anterior and posterior capsulorhexes, held the lens optic firmly in place (Fig. 3E). A solution of intracameral carbachol/carbamylcholine was then injected intracamerally, to prevent postoperative iris capture and any residual OVD was both irrigated and aspirated. The incisions were closed by stromal hydration and were examined for water-tightness before the case was completed with an intracameral injection of 0.1ml cefuroxime (Aprokam containing cefuroxime 10mg/ml when reconstituted, Thea Pharmaceuticals, France).

Supplementary video related to this article can be found at https://doi.org/10.1016/j.ajoc.2022.101693.

Five weeks after surgery, the BCVA of the right eye was 1.0, with a minor refractive correction (+0.5DS/-0.5DCx135°). Her subjective haze and glare symptoms had resolved. The implant itself was immediately sent to an expert IOL explant research laboratory (John A Moran Eye Centre, USA) for further analysis. Upon examination using light microscopy, the opacifications were confined to the optic of the lens and the elliptical haptics remained clear (Fig. 4A). The posterior lens surface showed a dense wave-like, rippled pattern of opacification, diminishing as it approached the centre (Fig. 4B). The anterior surface showed milder opacifications, and these appeared to be more subtle, granular opacifications (Fig. 4C). Alizarin red staining confirmed the presence of calcium in the deposits (Fig. 4D).

4. Discussion

Like most hydrophilic acrylic lens implants, the BIL rarely develops secondary calcifications (at a rate of 0.07%), though exchanging these lenses requires a different technique.[10] There are no lens haptics to disengage from the capsular bag and the lens can be prolapsed into the anterior chamber.[9] The lens, in this case, was of a high power (+31D) and, thus, was thicker than average. Despite this, it was possible to bisect using a soft IOL loop cutter. This enabled the removal of the IOL through a 2.8mm incision, without a need to enlarge it. When the capsular support is deemed to be insufficient, it can be augmented by the sulcus-supported bean-shaped ring segments, without the need for suture fixation.[11,12]

While secondary lens calcifications are relatively rare, the appearance of the opacity in this case was particularly unusual, and was quite different to the cases we have reported upon previously.[9] Experimental evidence suggests that most calcifications are caused by nucleation and the crystal growth of calcium phosphate on the IOL surface.[13,14] What is unusual in this case is that the nucleation of the crystal formation appears to begin as a 360° ring in the periphery of the lens optic, and seems to progress centrally. The appearance of similar crystallization in the left eye, with a larger clear central zone, suggests that this may be an earlier stage of the process. The formation of the wave-like ripples, instead of haze, is another interesting aspect. In 1952, the mathematician Alan Turing described a model of how patterns in nature can occur naturally, proposing that a system in a homogeneous state can form patterns triggered by “random disturbances”.[15] The lens pattern in this case can certainly be described as “Turingesque”.

Agresta et al. have suggested that lens calcifications are influenced by aqueous convection currents, but the calcifications were present on the anterior lens surface in their case.[16] In our case, the calcifications were posterior and this may be because the entire BIL has direct contact

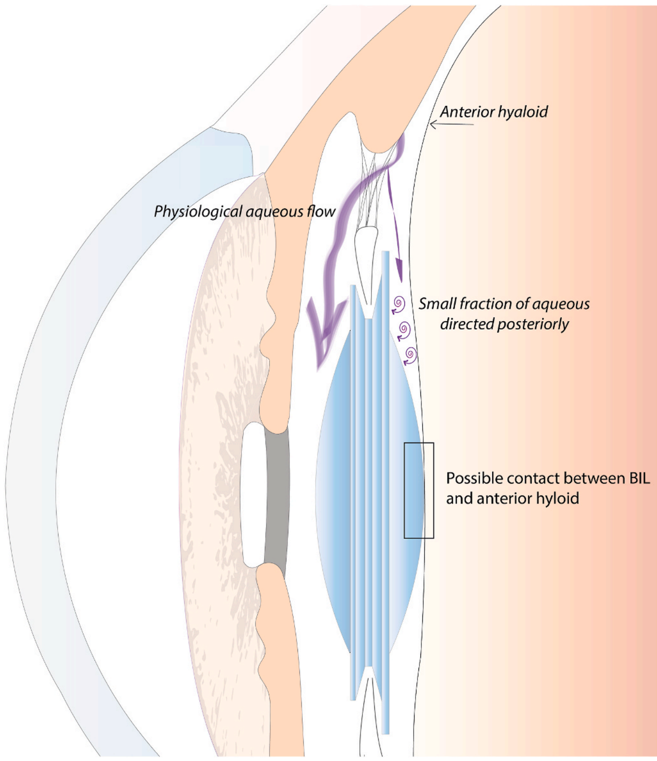

Fig. 5. Diagram of how retrolenticular aqueous flow could cause calcification.

with both the space of Berger and the anterior hyaloid. While the majority of the aqueous produced is directed anteriorly, towards the iris, it is possible that a fraction is directed posteriorly after cataract surgery to the space behind the lens (Fig. 5). Retrolenticular aqueous flow could perhaps also be facilitated if both the ligament of Wieger and the anterior vitreous detach after cataract surgery, thereby creating a larger space. This patient also had an abnormal ocular anatomy, a small eye (20.67mm), and a very convex lens, which could also influence the aqueous currents. Subtle tremors or vibrations of the lens implant caused during saccades or REM sleep could also generate retrolenticular turbulence and cause these "random disturbances".[17] While we cannot say for certain, we will observe both of her IOLs over time in order to determine whether or not a further evolution or recurrence in the new lens has taken place.

5. What was known

- Secondary opacification, many years after primary implantation had been described in many different types of hydrophilic IOL.
- Opacification of a BIL is rare, but it has been described.

6. What this papers adds

- This is the first report of a late prominent "wave-like" opacification of the posterior surface in a BIL.
- The unusual, rippled appearance may be due to abnormal vitreolenticular interface and possible retrolenticular aqueous flow.

Patient consent

Written consent to publish this case has not been obtained. This report does not contain any personal identifying information.

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Authorship

All authors attest that they meet current ICMJE criteria for authorship.

Financial disclosure

Marie-José Tassignon has a financial interest in the Bag-in-the-Lens IOL design licensed to Morcher GmbH. No other author has a financial or proprietary interest in any material or method mentioned.

Declaration of competing interest

MJT has a financial interest in the BIL implant. The following authors have no financial disclosures: SND, CJ, DCD, LVO, JR, LW, DVD.

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