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Case report

Intraocular lens dystrophic calcification after trans-scleral diode laser treatment for a cyclodialysis cleft

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ABSTRACT

Purpose: To describe a case of intraocular lens (IOL) dystrophic calcification as a complication of trans-scleral diode laser successfully used to treat a post-trabeculectomy cyclodialysis cleft.

Observations: A 76-year-old male with primary open angle glaucoma and pseudophakia (+19.0D Akreos M160L, Bausch & Lomb) was evaluated for vision impairment 4 months post-trabeculectomy complicated by a cyclodialysis cleft of his right eye. The patient was successfully treated with trans-scleral diode laser. After this treatment IOL opacification developed. Slit lamp examination and color photography of the anterior segment was performed prior to exchange of the opacified IOL. The explanted IOL underwent star testing, macroscopic imaging, phase contrast and scanning electron microscopy in addition to energy dispersive x-ray spectroscopy.

Confluent IOL deposits developed 4 months after trans-scleral diode laser treatment requiring IOL exchange. Star optical testing of the explanted IOL showed disruption of the diffraction image. An asymmetric pattern of deposition was congruent with the laser treatment quadrant. The subsurface location and discrete nature of the deposits were seen on phase contrast and electron microscopy. Energy dispersive x-ray spectroscopy demonstrated a predominance of calcium/phosphate in the deposits. We are unaware of previous reports in the literature of IOL dystrophic calcification occurring as a complication of trans-scleral diode laser treatment for a post-trabeculectomy cyclodialysis cleft.

Conclusion and importance: Delayed postoperative IOL dystrophic calcification in our case may have been from a combination of IOL biomaterial susceptibility to diode laser energy; damaged IOL material providing a nidus for calcific nucleation; and blood ocular barrier breakdown altering aqueous composition. We suggest that pseudophakia should influence the consideration of diode laser as treatment of a cyclodialysis cleft.

1. Introduction

A number of pathological processes may lead to opacification or discoloration of the optical component of the intraocular lens (IOL). These include: the formation of deposits/precipitates on the IOL surface or within the IOL substance, IOL opacification by excess influx of water in hydrophobic materials, direct discoloration of the IOL by capsular dyes or medications, IOL coating by substances such as ophthalmic ointment and silicone oil and slowly progressive degradation of the lens biomaterial.[1]

Hydrophilic acrylic lenses are the most frequently explanted type of IOL (28%), and in most cases (98%), explantation is required because of optic opacification secondary to dystrophic calcification.[2] Awareness of this complication can prevent unnecessary interventions such as Nd:YAG laser posterior capsulotomy or vitrectomy with their recognized associated risks.[3]

We describe a case of progressive IOL dystrophic calcification requiring IOL exchange, which occurred as a complication of trans-scleral diode laser for a post-trabeculectomy cyclodialysis cleft in a patient with primary open angle glaucoma (POAG). We are unaware of previous reports in the literature of IOL dystrophic calcification occurring as a complication of trans-scleral diode laser treatment in this setting.

2. Case report

A 76-year-old Caucasian male with POAG was referred for evaluation of vision impairment 4 months after diode laser treatment for a post-trabeculectomy cyclodialysis cleft of his right eye. Past medical history included type II diabetes with good systemic control. Past ophthalmic history included minimal diabetic retinopathy,

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phacoemulsification cataract extraction with implantation of a +19.0D Akreos hydrophilic M160L (Bausch & Lomb) 6 years previously and retinal detachment repair 17 years prior to the current presentation.

Four months prior to presentation with IOL opacification, he underwent a trabeculectomy with Mitomycin-C 0.2mg/dL complicated in the immediate postoperative period by hypotony for 6-weeks. This lead to multiple interventions, which included revision of the trabeculectomy and re-suturing of the scleral flap with a scleral patch graft repair; autologous blood patch; and finally, once a cyclodialysis cleft was identified, trans-scleral diode laser at 1.5 W × 1.5 s × 7 applications, 10-weeks post-trabeculectomy.

On examination at the current assessment, visual acuity was 6/12, IOP was 10 mmHg, slit lamp examination showed a deep anterior chamber and a superior thin walled bleb with limbal overhang. The IOL optic demonstrated punctate white deposits with a superior temporal predilection, characterized by a circumscribed shape, most confluent superior temporally within the area of involvement and less dense towards the periphery. Neither involvement of the IOL margins nor any of the four haptics was observed.

At 10 months follow-up, visual acuity had deteriorated to 6/24 with progression of the density of the IOL deposits. In addition, the view to the posterior segment was compromised, necessitating surgical intervention (Fig. 1). IOL exchange was performed through a temporal limbal approach. Due to the minimal anterior capsular optic overlap only visco-dissection was necessary to free the anterior and posterior capsular bag adhesions. This was followed by excision of the temporal haptics using Microsurgical technology (MST) intraocular scissors. The nasal haptics were prolapsed from the capsular bag using an intraocular cannula. Once the IOL was prolapsed in the anterior chamber, the limbal wound was extended and the IOL explanted using MST intraocular forceps. Anterior vitrectomy for an intraoperative posterior capsular tear was performed and a +18.5D model MA60AC intraocular lens (Alcon laboratories) was implanted in the sulcus (Fig. 2). The postoperative period was uneventful. At final follow-up after 6 months visual acuity stabilized at 6/18, limited by focal, non-geographic macular atrophy.

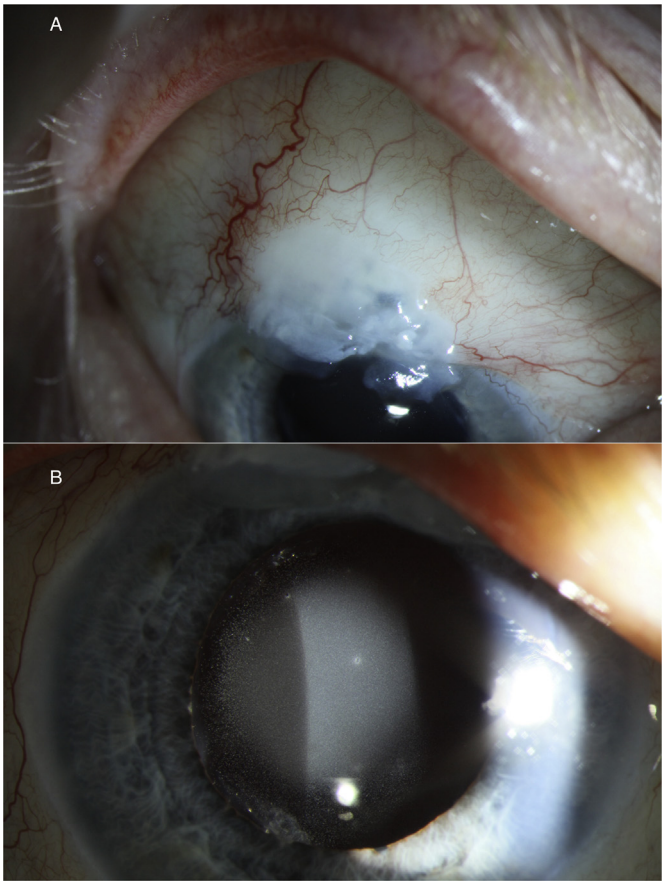

Fig. 1. Slit lamp images of right eye 10 months post trabeculectomy showing A) a thin walled, ischemic trabeculectomy bleb with limbal overhang. B) Dense intraocular lens (IOL) deposits involving the IOL optic. The deposits are confluent centrally with superior temporal predilection compromising the view to the posterior segment.

The explanted intraocular lens was evaluated functionally by the Star optical test[4] and structurally by macroscopic imaging, phase-contrast, scanning electron microscopy and energy dispersion x-ray spectroscopy; the results are summarized in Figs. 3 and 4 respectively.

3. Discussion

Hydrogels especially those consisting of polyhydroxyethyl methacrylate (PHEMA) are a class of polymer widely used in medical implants. The main underlying pathophysiologic mechanism of dystrophic calcification involves the ionicity of the polymer matrix allowing the acrylate polymer surface to form complexes with calcium ions, thereby providing nucleation sites for calcium/phosphate aggregation. PHEMA has a greater tendency toward calcification compared to other acrylates, possibly due to the presence of hydroxyl groups, which can ionize or complex with phosphate to initiate surface nucleation.[5]

The water content in hydrophilic IOL models varies widely and can be as high as 38%.[6] Enhanced hydration leads to more ionized groups on the surface, thereby promoting calcification.[7]

Since most intraocular hydrogels are porous, the uptake of proteins and lipids is also an important factor in material calcification, differences in porosity may also lead to differences in penetration, and more porous materials generally show greater calcification due to the increased infiltration of calcification precursors.[7,8]

A study by Lou et al. examining the effects of topography and porosity of hydrogels on their tendency to calcify in vitro demonstrated that calcification begins across the entire polymer surface with a density directly proportional to the density of the surface defects, which serve as nucleation sites for crystallization. Subsurface deposits were directly proportional to the material porosity.[9]

The blood ocular barrier is composed of the blood-aqueous barrier and the blood-retinal barrier. If compromised by hypotony, surgical trauma, intraocular inflammation or diabetes an aqueous with disturbed constituents may result.[10] These include inflammatory cells and blood plasma components such as proteins, cytokines and growth factors.[11] Abnormal aqueous constituents may play a role in dystrophic calcification by local supersaturation of ions or proteins, which in turn act as sites of nucleation.[2] The calcium content of the normal aqueous humor is about half that of the serum. The effects of ion super-saturation has been induced experimentally and demonstrated in observational studies. The concentration of these compounds was reported to be high in the aqueous humor collected from eyes of diabetic patients with calcified IOLs, where chronic breakdown of the blood-aqueous barrier influences aqueous composition.[12–14]

In a clinicopathological analysis of 106 hydrophilic acrylic (hydrogel) IOL explants, Neuhan et al. proposed proteins absorbed on the surface of the IOL undergo conformational alterations, which affect their ability to be recognized by cell surface receptors. These changes lead to the formation of tightly bound complexes of protein, fatty acid, and calcium, which in turn can be promoted by long-chain fatty acids. In the presence of micro-defects of the polymer surfaces, the absorption of such macromolecules can stimulate the formation of a calcification nucleus in a subsurface location.[15]

The described risk factors were present in our case and likely contributed to an altered aqueous composition and calcium/phosphate deposition.

Silicone oil has been reported as an exogenous nucleation source of dystrophic calcification in hydrophilic lenses, either as a complication

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