

# Analyzing Explanted IOLs

A review of the pathological processes that affect pseudophakic patients' postoperative vision.

BY LILIANA WERNER, MD, PhD

Every week, the John A. Moran Eye Center at the University of Utah in Salt Lake City receives discolored or opacified IOLs explanted from cataract patients. As of 2006, my colleagues and I at the Berlin Eye Research Institute in Germany have also received explanted ocular devices from institutions all over the world, especially from Europe. Our sample from both sites contains a wide range of designs and materials, including some not currently available in the US (Figure 1).

First-line treatments for decreased vision after cataract surgery may include Nd:YAG laser capsulotomy or vitrectomy, depending on the underlying cause. These interventions are not effective, however, if the problem is caused by an opacified or discolored IOL. The only way to improve vision in these situations may be to replace the opacified device.

This article summarizes our analyses of explanted IOLs and discusses the pathologic processes underlying the opacification of these lenses.

## TRACKING CAUSE AND EFFECT

To better understand the pathologic processes that affect the clarity of IOLs, my colleagues and I examined opacified lenses with gross and light microscopy, scanning electron microscopy, energy dispersive x-ray spectroscopy, gas chromatography-mass spectroscopy, and other methods.<sup>1</sup> Our analyses revealed several factors that can compromise an IOL's optical clarity, some of which may be prevented (see *Strategies for Preventing Some Causes of IOL Opacification*).

Depending on the underlying process, IOLs can become opacified or discolored at any time during or after surgery. We described two cases in which single-piece hydrophobic acrylic SA60AT IOLs (Alcon Laboratories, Inc., Fort Worth, TX) were explanted because fragments of the ophthalmic viscosurgical device (OVD)

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used to load the lenses into the injectors crystallized intraoperatively on their surfaces.<sup>2</sup>

An analysis of three-piece silicone IOLs explanted from six patients who developed cloudy vision a few hours after cataract surgery showed that the environment in which lenses are stored preoperatively could affect their behavior in the eye. Investigators determined that the chemicals used to clean a storage facility caused the IOLs' normally hydrophobic surfaces to become more hydrophilic. After the silicone lenses were implanted, they absorbed excessive water and became opaque.<sup>3,4</sup>

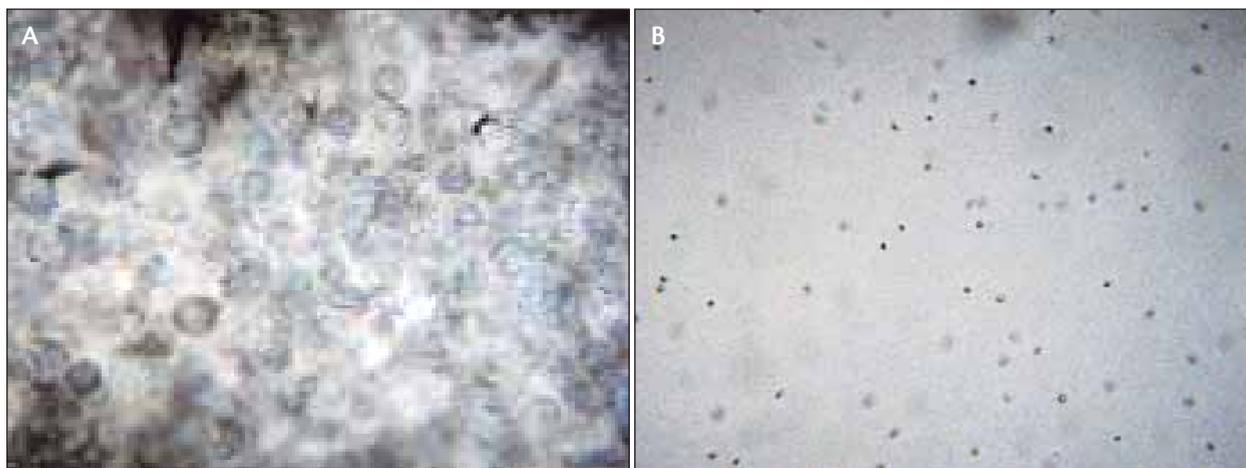
The high-water content (73%) of an explanted Acqua hydrophilic acrylic IOL (Mediphacos, Belo Horizonte, Brazil, [not available in the US]) appeared to contribute to the lens's uptake of trypan blue during cataract surgery.<sup>5</sup> Compared with other hydrophilic acrylic IOLs, which contain less water and are stored in balanced salt solution or distilled water prior to their insertion, the Acqua IOL is implanted in a dry state. Consequently, the lens reaches its full size only after it absorbs additional fluid from the capsular bag. The use of capsular dyes is contraindicated with the Acqua IOL because it will absorb any dye left in the eye following surgery.

In some cases, lenticular opacification affects only visual acuity, whereas in others the underlying cause has potentially serious consequences. In the July 2006 issue of *Cataract & Refractive Surgery Today*, I described eight cases of Toxic Anterior Segment Syndrome that were



Figure 1. Examples of IOLs explanted in different countries and analyzed at the John A. Moran Eye Center at the University of Utah in Salt Lake City or the Berlin Eye Research Institute in Germany. The lenses were manufactured from different biomaterials and exhibit opacification of their optics due to conditions such as interlenticular opacification (A), calcification (B to D), contamination by exogenous molecules (E), or incipient snowflake degeneration (F). All these conditions were discussed in: Werner L. Causes of intraocular lens opacification or discoloration. *J Cataract Refract Surg.* 2007;33:713-726.





**Figure 2.** Light microscopic photographs showing the aspect of the dry lesions in the snowflake degeneration of a PMMA IOL (A) and of the fluid-filled vacuoles, known as glistenings, within a hydrophobic acrylic lens (B).

materials (Hydroview; Bausch & Lomb, Rochester, NY; Aqua-Sense; Ophthalmic Innovations International, Ontario, CA).<sup>11,12</sup> We also observed calcification of another hydrophilic acrylic IOL (SC60B-OUV IOL; Medical Developmental Research, Inc., Clearwater, FL),<sup>13</sup> which some researchers<sup>14</sup> have attributed to premature aging of its UV-blocking agent.

Although interlenticular opacification, a process in which residual cortex adheres to the opposing surfaces of piggybacked IOLs, does not cause the lenses themselves to become cloudy, it can be associated with the

explanation of pairs of hydrophobic acrylic IOLs.<sup>15</sup>

All the cases of interlenticular opacification that my colleagues and I have analyzed to date occurred when two posterior chamber hydrophobic acrylic IOLs were implanted in the capsular bag through a small capsulorhexis. In every instance, the capsulorhexis' margins overlapped the anterior IOL's optic edge for 360°.

Because the pathogenesis of interlenticular opacification is similar to pearl-like posterior capsular opacification, surgeons should always perform careful cortical cleanup before implanting piggybacked IOLs. They can

#### STRATEGIES FOR PREVENTING SOME CAUSES OF IOL OPACIFICATION

- Follow the manufacturer's recommendations for loading IOLs into injectors and storing OVD. Surgeons should take special care to minimize the period of contact between the OVD and the lens before its injection into the eye.
- Store IOLs in a clean, dry environment, and avoid exposing them to chemicals that could alter their surface properties.
- Avoid using capsular dyes with IOLs that have a very high water content.
- Construct clear corneal incisions properly, ensure the wound's integrity at the end of the procedure, and avoid patching eyes tightly after instilling ophthalmic ointment.
- Do not implant silicone IOLs in patients who are likely to need retinal surgery in the future, because silicone IOLs interact with silicone oil.
- Remove all residual cortex from the capsular bag before implanting piggybacked IOLs. Either insert both lenses into the capsular bag through a capsulorhexis with a relatively large diameter or implant the anterior IOL in the sulcus and the posterior IOL in the bag through a small capsulorhexis.

also reduce the risk of this complication by implanting both IOLs in the capsular bag through a relatively large capsulorhexis or by placing the anterior IOL in the sulcus and the posterior IOL into the capsule through a small capsulorhexis.

“Snowflake lesions can increase in intensity and number over time and eventually affect visual acuity.”

PMMA lenses may be associated with a form of opacification known as *snowflake degeneration*.<sup>16,17</sup> This pathological process first appears as scattered white-brown spots within the IOL's substance that can increase in intensity and number over time and eventually affect visual acuity. Snowflake lesions tend to form in the central anterior area of PMMA IOLs' optics, which suggests an association with long-term exposure to UV radiation. Manufacturing variations in some PMMA IOLs fabricated in the 1980s to early 1990s may be responsible for the lens' progressive degeneration. Snowflake lesions are dry and thus differ from glistenings because the latter are fluid-filled vacuoles that can be observed with any IOL material. Glistenings are largely described in association with hydrophobic acrylic lenses, however, and are generally stated to be clinically insignificant<sup>18</sup> (Figure 2).

## CONCLUSION

My colleagues and I hope that our research will help surgeons identify the cause of an IOL's opacification, decide if and when explantation is necessary, and reduce the risk that patients will undergo unnecessary capsulotomy or vitrectomy. ■

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