Intracameral Illuminator-Guided Advanced Lens Capsule Polishing During Cataract Surgery in Eyes with Diabetic Retinopathy

Improvements in surgical techniques, materials and designs of intraocular lens, and therapeutic agents have lowered the rate of posterior capsule opacification (PCO), but capsular changes such as PCO and anterior capsule contraction are still significant problems.[1,2]

Especially in eyes with vitreoretinal disease such as diabetic retinopathy (DR) or uveitis, PCO and anterior capsule contraction are known to be more severe than in nonpathologic eyes.[3–5] Furthermore, cataract surgery is more challenging in eyes with DR because of the poorly dilated pupil, posterior synechiae, corneal edema, and poor fundus reflex.[6,7] Because the opacification of the lens capsule interferes with the visualization of the fundus, laser photocoagulation of the retina, and vitreoretinal surgery, it is necessary to keep the entire lens capsule transparent in eyes with DR.

Here, we introduce an advanced technique involving intracameral illuminator-assisted lens capsule polishing during phacoemulsification cataract surgery in eyes with DR.

Surgical Technique

A clear corneal wound for cataract surgery was created at the 10-o'clock position. Capsulorhexis of the anterior capsule was done with its margin covering the edge of a 6.0-mm optic intraocular lens. After hydrodissection, bimanual phacoemulsification was safely accomplished in all cases. With external microscope light illumination, after cortex aspiration, the lens capsule appeared optically clear during lens capsule polishing, but the lens fibers and lens epithelial cells (LECs) of the lens capsule were not evident (Figure 1A). Then, the surgeon used his or her left hand to hold and insert a 25-gauge illuminator through the previous paracentesis site, which was made for the chopper, into the anterior chamber for a more advanced intraocular illumination during anterior and posterior capsule polishing (Figure 1, B and C). With intracameral endoillumination, it was possible to follow and guide the lens capsule area in which the polishing was being conducted. In many of the eyes, lens fibers adhering to the posterior capsule and LECs adhering to the anterior capsule were evident with oblique intracameral illumination but were optically insignificant when viewed under a microscope light (Figure 1, D–F). With excellent visibility of the lens capsule, peeling off the lens fibers and the LECs from the capsule can be almost completely achieved without complications in most eyes, although in certain cases, it is impossible to remove those in the subincisional area. Even in eyes with a poor fundus reflex as a result of small pupil, corneal opacity, or vitreous opacity, both visualization and polishing of the lens capsule were greatly improved. Particularly, in eyes with poorly dilated pupils or surgically induced miosis, the oblique-angle intracameral illumination enabled us to more safely and effectively approach the subiris area and remove the lens materials than with coaxial microscope illumination (Figure 1, G–H). However, it proved almost impossible to remove all LECs in the capsular fornix. After lens capsule polishing, a hydrophobic acrylic lens was implanted through the 3.0-mm clear corneal wound (see **Video, Supplemental Digital Content 1**, http://links.lww.com/IAE/A75).

Results

Twenty eyes of 20 patients with significant cataract and DR underwent the surgical procedure from June 2010 to February 2011. The baseline characteristics of the patients are shown in Table 1. All procedures were performed by a single physician (D.H.N.). The lens nucleus and cortex could be

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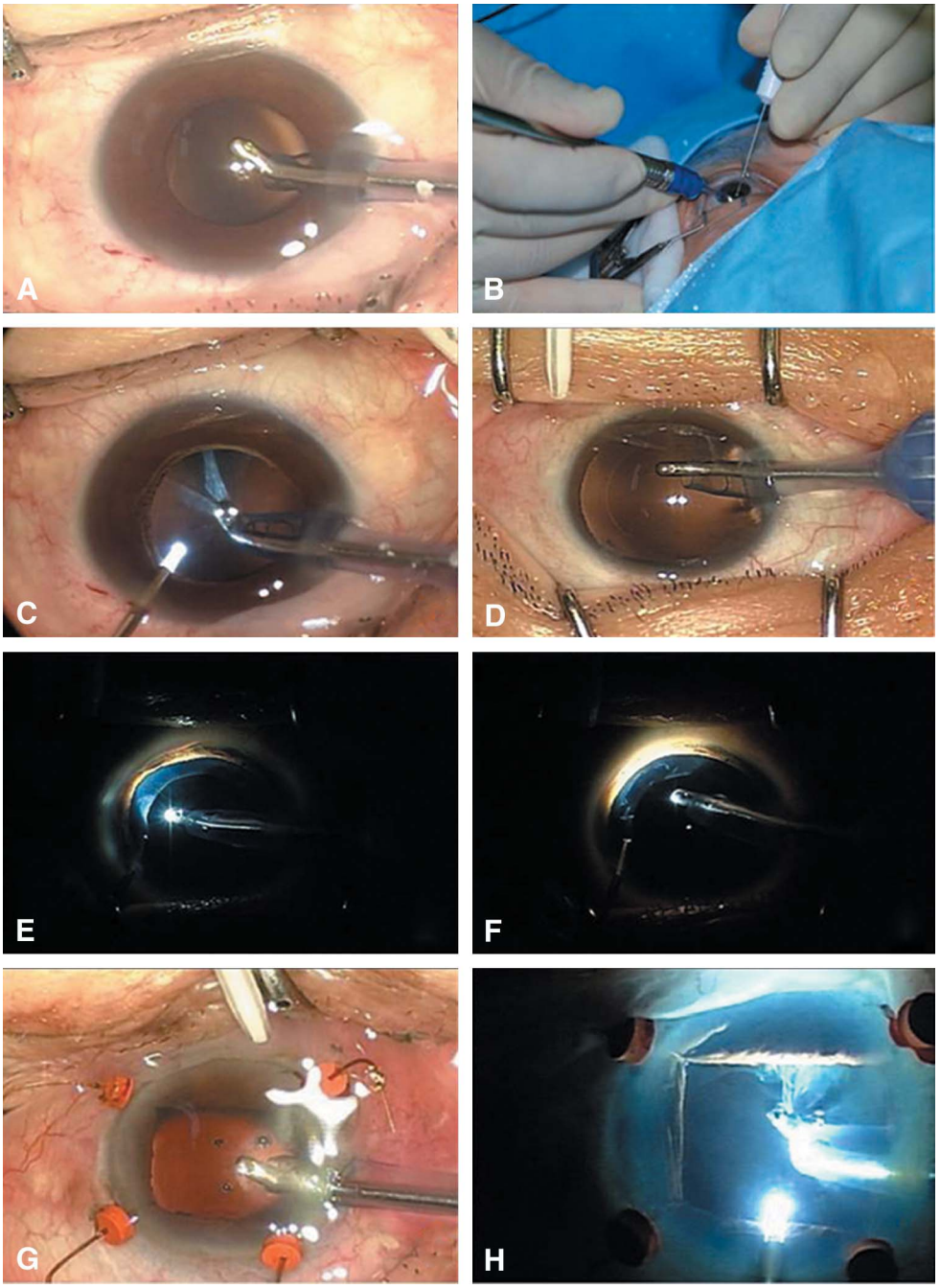

Fig. 1. Photographs of three cases of intracameral illuminator-guided lens capsule polishing. **A**. First case. With an external microscope light illumination, after cortex aspiration, the lens capsule appeared optically clear during lens capsule polishing in an eye with nonproliferative DR, but the lens fibers and LECs of the lens capsule were not apparent. **B**. A surgeon-controlled intracameral illuminator was inserted for advanced lens capsule polishing. **C**. Lens fibers remaining adherent to the posterior capsule were evident with oblique intracameral illumination but were not visible under microscope light. **D**. Second case. Anterior lens capsule seemed optically clear under an external microscope light illumination. **E** and **F**. Remaining LECs adherent to the anterior capsule were evident with oblique intracameral illumination and that could be removed. **G** and **H**. Third case. In a patient with diabetes with poorly dilated pupil and corneal opacity, the iris retractors were implanted, and the lens capsule appeared optically clear with a microscope light. However, with an intracameral illuminator, the lens materials remaining in the subiris area were apparent and were removed.

clearly observed during phacoemulsification and cortex aspiration under external microscope illumination; the visualization of the anterior and posterior capsules was then markedly improved with the aid of intracameral endoillumination. In all 20 eyes, the polishing of anterior and posterior capsules was completely done without any intraoperative complications. Postoperatively, the rates of PCO and anterior capsule opacification were 10.0% (2 of 20 eyes) and 15% (3 of 20 eyes), respectively (Table 1).

Discussion

The anterior capsule LECs induce capsule fibrosis and shrinkage, and the equatorial capsule LECs form Elschnig pearls in the space between the intraocular lens optic and the posterior capsule, which are responsible for most cases of PCO-related visual loss and require a neodymium:YAG laser capsulotomy if they encroach on the visual axis. Near-complete removal of residual LECs may prove necessary to prevent anterior capsule

Table 1. Baseline Characteristics and Outcomes of Patients

Patient	Age (Years)	Vitreoretinal Diagnosis	CDVA		F/u (Months)	PCO	Onset of PCO (Months)	ACO	Onset of ACO (Months)
			Initial	Final					
1	69	PDR	0.5	0.6	12	–	–	–	–
2	84	NPDR	0.1	0.7	12	–	–	–	–
3	54	PDR	0.3	0.9	12	–	–	–	–
4	64	PDR	0.3	0.6	11	+	5	–	–
5	73	NPDR	0.5	0.8	10	–	–	–	–
6	62	PDR	0.7	0.7	10	–	–	–	–
7	54	NPDR	0.4	0.5	10	+	4	–	–
8	71	NPDR	0.5	0.9	9	–	–	–	–
9	73	NPDR	0.3	0.8	9	–	–	–	–
10	61	NPDR	0.6	0.8	9	–	–	+	1
11	63	NPDR, AMD	0.6	0.9	8	–	–	–	–
12	54	PDR	0.5	0.8	8	–	–	–	–
13	75	NPDR, BRAO	0.2	0.5	7	–	–	+	1
14	75	NPDR	0.5	1	7	–	–	–	–
15	74	PDR	0.4	0.7	6	–	–	+	3
16	69	NPDR, AMD	0.15	0.4	6	–	–	–	–
17	69	NPDR, AMD	0.8	0.9	6	–	–	–	–
18	83	NPDR	0.6	0.9	6	–	–	–	–
19	44	PDR	0.6	1	6	–	–	–	–
20	50	NPDR	0.7	0.8	6	–	–	–	–

CDVA, corrected distance visual acuity; F/u, follow-up period; ACO, anterior capsule opacification; PDR, proliferative diabetic retinopathy; NPDR, nonproliferative diabetic retinopathy; AMD, age-related macular degeneration; BRAO, branched retinal artery occlusion.

contraction and PCO.[8,9] Therefore, researches aiming at improving surgical techniques to remove LECs extensively are still needed.

Good visualization of the lens cortex and anterior and posterior lens capsules is essential for the safe and effective removal of LEC and lens fibers in cataract surgery. Endoillumination-assisted cataract surgery has been introduced in eyes with a compromised red reflex because of severe vitreous opacities or hemorrhages.[10–12] As compared with external microscope illumination, intraocular (intravitreal or intracameral) illumination has been shown to improve both contrast and resolution.[13] We began to perform lens capsule polishing using an intracameral illuminator-assisted system, which offered us the ability to see more brilliance, contrast, and depth perception than with the surgical microscope illumination.[10] Although this measure could not peel off the equatorial germinative LECs behind iris, more advanced polishing of unrevealed lens fibers and LECs was successfully accomplished under this system.

We continued to have concerns about possible adverse effects after intracameral illuminator-assisted cataract surgery. First, the use of endoillumination is associated with an increased risk of retinal phototoxicity in eyes undergoing cataract surgery.[14,15] The distance between the light source and the posterior pole is much longer than the 3.0 mm to 7.0 mm during conventional vitrectomy, and there is a capsular barrier between the intracameral illuminator and the macula. Additionally, macular phototoxicity caused by intracameral oblique illumination might be less than microscope coaxial illumination. Therefore, the risk of phototoxicity may be almost completely absent. Second, the insertion and movement of an endoilluminator into the anterior chamber could increase the chance of a tear in the Descemet membrane at the entry site or zonular dehiscence. Nonetheless, because the pipe length introduced into the eye is quite short and is controlled by experienced cataract surgeons, any complication, such as damage to the Descemet membrane or zonules, was not observed after this polishing procedure using an intracameral illuminator. Third, the technique should reduce the surgical time required. The mean polishing time was <2 minutes.

In summary, during the lens capsule polishing in eyes with DR, the intracameral illumination delivered excellent visibility of the lens capsule, which facilitated the exhaustive removal of LECs from the capsular bag. These advancements should prove advantageous for complicated cases, such as those with small pupil, poor fundus reflex, or weakened zonule.

Key words: anterior capsule opacification, cataract surgery, illuminator, lens capsule polishing, phacoemulsification, posterior capsule opacity.

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