techniques

Phacoemulsification in the presence of pseudoexfoliation: Challenges and options

I. Howard Fine, MD, Richard S. Hoffman, MD

ABSTRACT

Phacoemulsification in the presence of pseudoexfoliation of the lens presents surgeons with particular challenges. The frequency of intraoperative and postoperative complications such as zonular dialysis, capsular tears, vitreous loss, and intraocular lens (IOL) decentration may be reduced with careful attention to detail and careful surgical technique. Improvements in phacoemulsification technology, IOLs, and new capsular supporting rings allow surgeons to perform safer surgery in these eyes. We present the challenges of and options for managing cataract extraction in the presence of pseudoexfoliation. *J Cataract Refract Surg 1997; 23:160–165*

Cataract surgery in the presence of pseudoexfoliation of the lens presents unusual challenges. In addition to a higher incidence of glaucoma, these patients have loss of zonular integrity, occasionally associated with lens subluxation, and pupils that dilate poorly. Although the use of phacoemulsification in experienced hands has resulted in a low incidence of intraoperative and postoperative complications such as zonular dialysis, capsular tears, vitreous loss, and intraocular lens (IOL) decentration,[1] special care should still be exercised when performing cataract surgery in these patients. Improvements in phacoemulsification technology, technique, and new capsular supporting rings will ultimately enable cataract surgery in these eyes with even fewer complications.

Surgical Technique

Glaucoma

Poorly controlled glaucoma with concomitant cataract and pseudoexfoliation is best managed by a glaucoma triple procedure. We prefer to use a limbal conjunctival incision without vertical releasing incisions and a self-sealing scleral tunnel incision (without vertical releasing incisions), located superiorly, through which phacoemulsification is performed. A Crozafon-De Laage punch (Moria #18069) is used to disrupt the posterior corneal lip, creating a fistula that usually results in a diffuse, shallow bleb that filters posteriorly. The conjunctival incision is sutured to the limbus at the conclusion of the procedure. Although this is our preferred method, any combined technique can be used with or without antimetabolites.

For patients with glaucoma who do not need filtration surgery at the time of cataract surgery, we prefer our usual clear corneal incision from the temporal periphery. This allows the entire procedure to take place through avascular tissue and does not prejudice future filtration surgery in a superior location.

Small Pupils

The small pupil can be managed in a variety of ways including sector iridectomy, iris hooks, iris rings, and pupillary stretching with or without the use of multiple half-width sphincterotomies.[2] At present, we find the Beehler pupil dilator (Moria #19009) to be uniformly

From Oregon Eye Associates, Eugene.

Reprint requests to I. Howard Fine, MD, Oregon Eye Associates, 1550 Oak Street, #5, Eugene, Oregon 97401, USA.

applicable in the presence of small pupils. It usually stretches the pupil to 6.0 to 7.0 mm while creating tiny microsphincterotomies circumferentially around the pupil (Figure 1). The pupil can then be mechanically reduced at the end of the procedure with a Lester hook supplemented with an intraocular miotic. Pupils enlarged in this manner maintain a good cosmetic appearance and an ability to react to light but may require miotic drops for some time after cataract surgery to avoid synechias to the capsulorhexis margin.

Capsulorhexis

Weak zonules lead to particularly challenging situations during phacoemulsification. Of utmost importance is to not challenge the integrity of the zonules by overpressurizing the eye. This can occur after peribulbar or retrobulbar injection with digital or Honan pressure, when the anterior chamber is overexpanded with viscoelastic before capsulotomy, or as a result of an excessively high bottle height during phacoemulsification.

Because of the lack of zonular integrity, it is frequently difficult to perforate the capsule to begin a capsulorhexis. We use a pinch-type forceps such as the Kershner capsulorhexis cystotome forceps (Rhein Medical 05-2320) or the capsulorhexis cystotome forceps (Rhein Medical 05-2326), which allow the capsule to be grasped to start the tear rather than beginning the capsulotomy with a perforation by downward pressure on the lens. This is especially important in fibrosed capsules that cannot be perforated by a needle. When one purchases the capsule with a pinch and tears it, the tear will commence at the edge of the fibrosis, usually at the pupillary margin.

During the capsulotomy, special care and attention are required because traction on the capsule can unzip weakened zonules. If there are areas of missing zonules, centripetal traction on the capsular flap may result in further damage to the adjacent weakened zonules. Techniques of two-handed capsulotomy using tangential forces as described by Neuhann[3] are excellent adjunctive techniques in eyes with loose zonules. After the capsulotomy has been started, the capsular flap is stabilized with the forces through the main incision while a second instrument, such as a bifurcated spatula, is introduced through the side-port incision. Slight backward traction is placed on the flap with the forceps while the

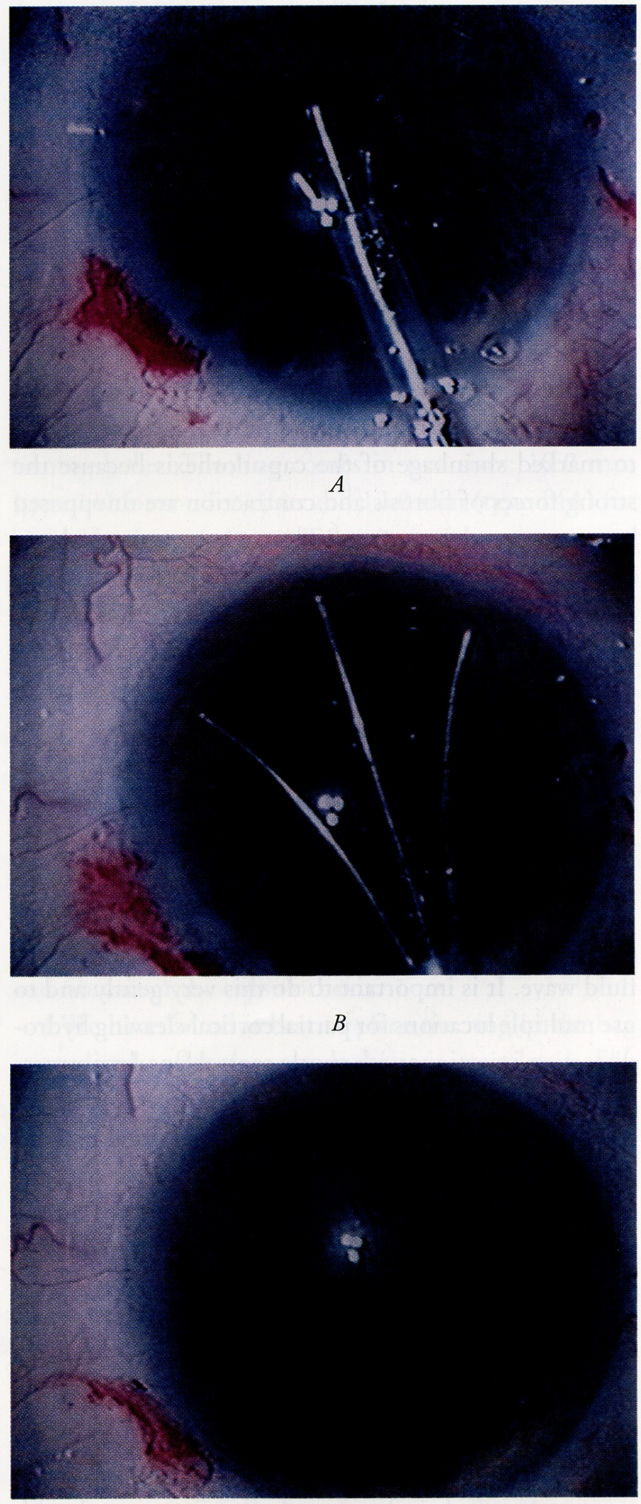

Figure 1. (Fine) *A:* A small pupil with a Beehler pupil dilator inserted through a temporal clear corneal incision. *B:* The temporal iris is engaged with a mounted hook on the undersurface of the instrument and retracted, while the dilator is opened to stretch the pupil at four points on 360 degrees. *C:* Appearance of pupil after mechanical dilation.

second instrument directly advances the torn edge in a tangential manner.

Capsulorhexis size is extremely important in patients with pseudoexfoliation. Ideal capsulorhexis size is thought to be 5.5 to 6.0 mm or larger in routine cases.[4] We believe it should be at least 6.0 mm in pseudoexfoliation cases because a larger capsulorhexis leaves a smaller amount of lens epithelial cells (LECs) postoperatively than a smaller capsulorhexis. Residual LECs participate in metaplasia and extracellular matrix deposition, ultimately resulting in capsular fibrosis.[5] Patients with pseudoexfoliation are particularly susceptible to marked shrinkage of the capsulorhexis because the strong forces of fibrosis and contraction are unopposed by strong zonular traction.[6] Thus, a larger capsulorhexis should decrease the incidence of symptomatic capsule contraction by decreasing the number of LECs able to participate in the fibrosis process and by allowing a larger final capsulorhexis diameter once capsule contraction has ceased to progress.

Hydrodissection and Hydrodelineation

Cortical cleaving hydrodissection[7] requires extremely careful maneuvers, especially when one decompresses the bag after having performed the posterior fluid wave. It is important to do this very gently and to use multiple locations for partial cortical cleaving hydrodissection injections with gentle central lens decompression. This should alleviate the chances of depressing the lens with excessive forces that would tear zonules.

Hydrodelineation is a useful technique in pseudoexfoliation because it produces an epinuclear shell as an added safeguard. During both hydrodissection and hydrodelineation, it is wise to keep the cannula in a position that slightly depresses the posterior lip of the incision. This will ensure easy egress out of the eye for viscoelastic or fluid should the spaces be overinflated with balanced salt solution.

Phacoemulsification

Extreme caution must be used during lens manipulation so as to not tear zonules. Two-handed rotations of the lens nucleus are recommended because the forces can be truly tangential and divided by using opposite sides of the same meridian. Grooving also requires special care as there is a tendency to put posterior pressure on the nucleus. High cavitation tips (e.g., the Kelman tip on the Alcon System 20,000 Legacy) are a great advantage because they can obliterate nuclear material in advance of the tip without exerting forces on the lens or the lens zonules. The configuration of the Kelman tip allows for a variation of the phaco sweep procedure,[8] in which the initial groove can be formed and then, without rotating the lens, a lateral and rotational motion of the phaco probe grooves in a lateral direction (Figure 2).

The surgeon can also help stabilize the nucleus during grooving. We find it best not to perform downslope sculpting because nudging the nucleus in the direction in which one is sculpting can put unnecessary traction on the zonules in the subincisional area. If the nucleus is to be stabilized, it can be done through the side port with a second instrument. In addition to stabilization, one can push the nucleus toward the phaco tip to maximize the efficiency of the tip while elevating the lens slightly.

For lens cracking, we recommend nonrotational cracking as described by Fine and coauthors.[9] This appears to be the least traumatic method of cracking the nucleus and dismantling it into quadrants that are easy to mobilize. Chopping techniques are also useful for dismantling the nucleus while placing minimal stress on the zonular apparatus. In both techniques, the epinuclear shell helps stabilize the nucleus and is useful during the mobilization of the four quadrants because all phaco and mechanical forces can be confined within the

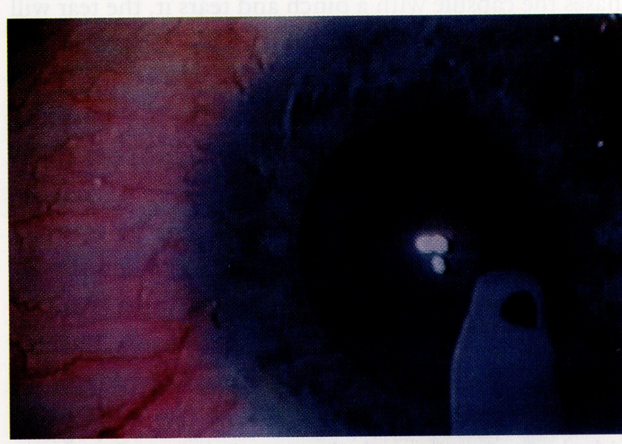

Figure 2. (Fine) Following formation of a vertical groove in the meridian of the incision, a groove perpendicular to the first is formed without rotating the lens by moving the phaco probe laterally and with a rotational movement.

epinuclear space, reducing stress on the zonules as well as the capsule.

Cortical aspiration is the biggest threat to the zonules during phacoemulsification of cataracts in pseudoexfoliation patients because the greatest amount of traction can be placed on the zonules during this step. Prior use of cortical cleaving hydrodissection is important in reducing traction on zonules and facilitating removal of most if not all of the cortex during flipping and evacuation of the epinuclear shell. Viscodissection to separate cortex from the capsule can also be used to assist in cortex removal or used to isolate segments of nucleus.

In general, we recommend that cortical cleanup not be performed in these cases until after IOL implantation. Aspiration of residual cortex is safer after the lens has been implanted because the IOL stabilizes the capsular bag. In the presence of pseudoexfoliation, we usually implant a foldable lens with poly(methyl methacrylate) (PMMA) haptics sized for bag placement. The optic size is 6.0 mm to allow an extra margin of safety should mild lens decentration develop. The overall lens diameter is 12.0 to 12.5 mm utilizing PMMA haptics to increase haptic resistance and attempt to prevent capsule contraction and lens decentration.

We also recommend tangential traction on the cortex with the irrigation/aspiration (I/A) tip rather than stripping centrally to maximize forces on a few cortical/capsular connections at a time (Figure 3). If there are areas of zonular dehiscence, it is important to strip tangentially toward the dehiscence because stripping away from it localizes forces on weakened zonules, which might lead to unzipping of the zonular dehiscence.

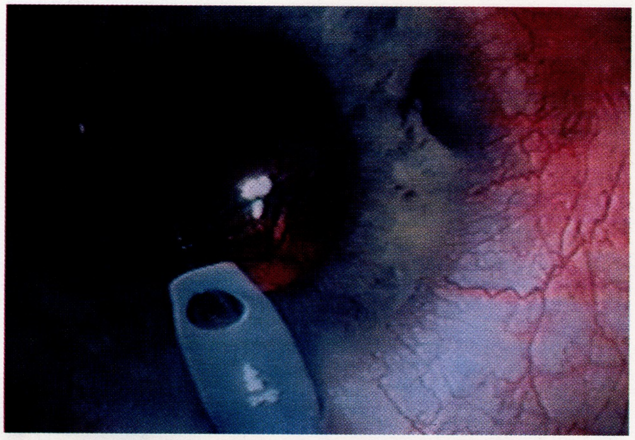

Figure 3. (Fine) Tangential rather than centripetal stripping of cortical material maximizes forces on a few cortical/capsular connections at a time.

Capsular Ring

The newest adjunctive therapy in addressing cataracts with pseudoexfoliation is use of a capsular ring (Morcher) as described by Witschel and Legler ("New Approaches to Zonular Cases: The Capsular Ring," Audiovisual Journal of Cataract & Implant Surgery 1993; 9:4) and Cionni and Osher.[10] This PMMA ring, which is not currently approved by the U.S. Food and Drug Administration, has expanded ends that contain positioning holes. The ring comes in two sizes: 10.0 mm (type 14) for routine cases and 12.0 mm (type 14A) for high myopia.

When placed in the capsular bag, which is approximately 10.0 mm in diameter, the ring keeps the bag stretched and provides several advantages. It prevents concentration of forces on individual zonules by distributing all forces applied to any point on the capsulorhexis to the entire zonular apparatus. It also keeps the bag stretched throughout the procedure, allowing for greater safety during all intraocular manipulations. Finally, the continuous pressure of the ring against the capsular fornices bolsters residual zonular traction on the capsule and counters the force of constriction after metaplasia and fibrosis of the capsulorhexis.

We have found it best to place the ring in the bag immediately after the capsulorhexis is completed. The ring is slipped into the incision and fed under the capsulorhexis with a forceps while the second hand glides it with a Lester hook through the side-port incision (Figure 4). Once the ring is in place, cortical cleaving hydrodissection is performed followed by hydrodelineation. The remainder of the procedure can be done using many of the guidelines listed above. Although cortical cleaving hydrodissection may have been performed, the endocapsular ring holds much of the cortex pressed up against the capsular fornices, requiring additional force to remove the cortex with the I/A handpiece. Despite this, there is a great deal more safety during the procedure because of the equal distribution of forces by the ring and stabilization of the capsular bag.

The safety of a plate-haptic IOL in the presence of an endocapsular ring is in question because of the outward force of the ring. The ring may cause decentration of the plate-haptic IOL because it continues to keep the

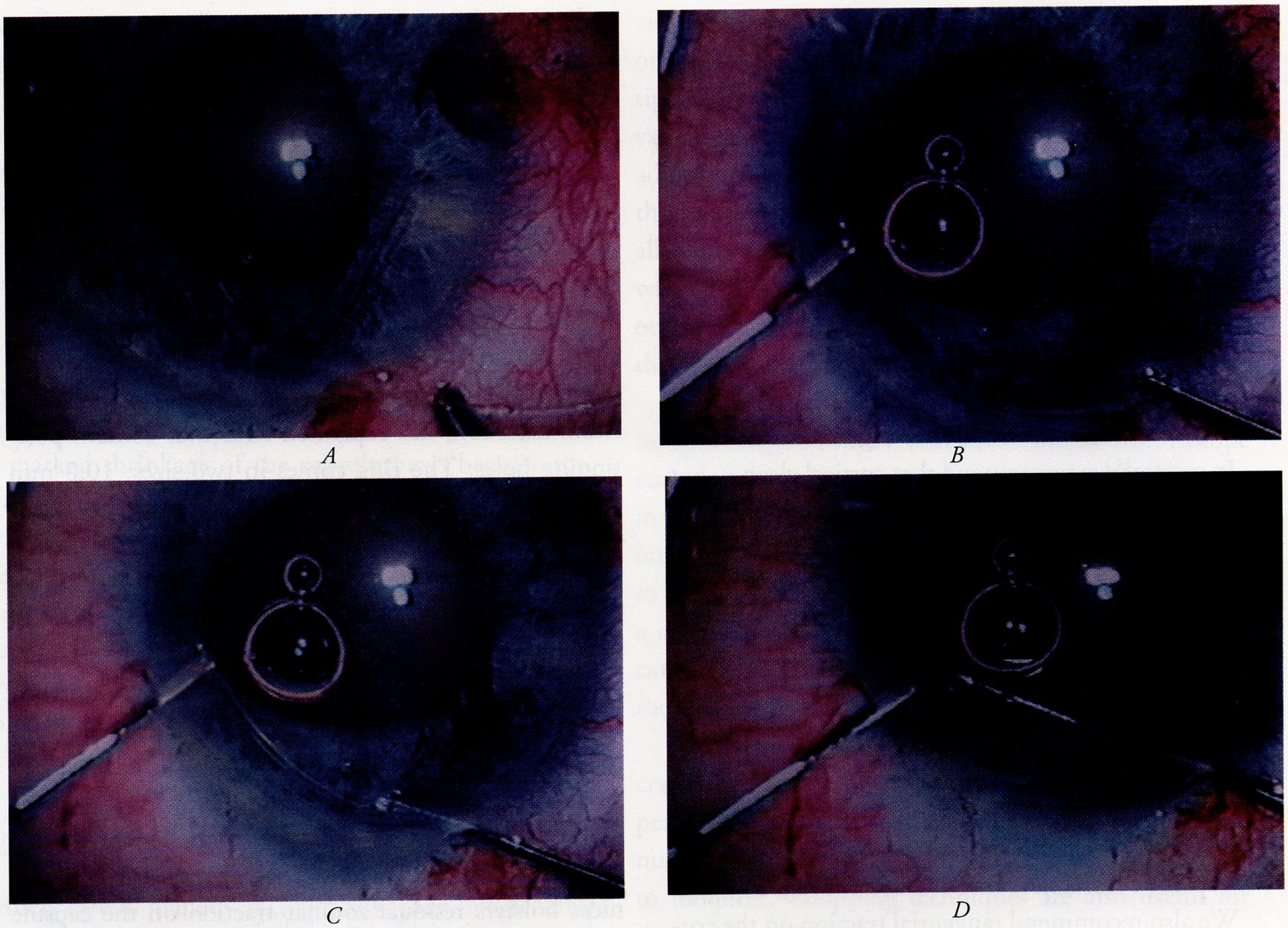

Figure 4. (Fine) Capsular ring insertion. *A:* After capsulorhexis and before cortical cleaving hydrodissection, the capsular ring is inserted through the clear corneal incision with a forceps. The leading eyelet is placed under the capsulorhexis into the capsular fornix. *B:* Once the ring is inserted until the trailing eyelet has reached the incision, a Lester hook is placed in the trailing eyelet while a second Lester hook is placed through the paracentesis. *C:* The right-handed Lester hook then inserts the ring farther as it enters the anterior chamber, while the second instrument helps guide the capsular ring. *D:* As the trailing eyelet reaches the edge of the capsulorhexis, the right-handed Lester hook is rotated clockwise 90 degrees to disengage the eyelet from the hook. The inherent tension of the ring will place the trailing end in the capsular fornix.

bag in a highly expanded state. In addition, neodymium: YAG laser capsulotomy, which may be followed by tears of the posterior capsule out to the equator, could allow a plate-haptic lens to drop into the vitreous cavity because older models are not fixated by the capsule.[11] It is possible that newer plate-haptic lens designs with fenestrations or half haptics will be safer in the presence of an endocapsular ring because they fixate to the capsular bag (D.J. Apple, MD, "Enhancement of Silicone Plate IOL Fixation by the Use of Positioning Holes in the Lens Haptic;" N. Mamalis, MD, "Comparison of Silicone Plate Haptic IOL Models AA-4203 and AA-4203F in a Rabbit Model," presented at the Symposium on Cataract, IOL and Refractive Surgery, Seattle, Washington, USA, June 1996).

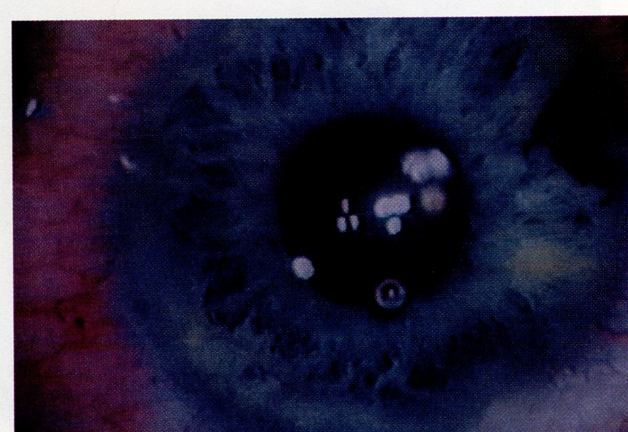

Figure 5. (Fine) Appearance of eye after phacoemulsification, IOL insertion, and mechanical and pharmacologic pupil constriction.

Conclusion

Phacoemulsification in the presence of pseudoexfoliation presents the possibility of many complications that are less likely to occur in the absence of pseudoexfoliation. Specialized techniques should allow surgeons to avoid and cope with the various intraoperative difficulties that may occur during cataract surgery in these patients (Figure 5). One of the newest devices to assist in managing these cases is the endocapsular ring. It offers the potential benefits of fewer intraoperative and postoperative complications by means of capsular stabilization. Future studies will determine the benefits and indications of the endocapsular ring.

References

1. Osher RH, Cionni RJ, Gimbel HV, Crandall AS. Cataract surgery in patients with pseudoexfoliation syndrome. Eur J Implant Refract Surg 1993; 5:46–50
2. Fine IH. Phacoemulsification in the presence of a small pupil. In: Steinert RF, ed, Cataract Surgery: Technique, Complications, & Management. Philadelphia, WB Saunders Co, 1995; 199–208
3. Neuhann TF, Capsulorhexis. In: Steinert RF, ed, Cataract Surgery: Technique, Complications, & Management. Philadelphia, WB Saunders Co, 1995; 134–142
4. Joo C-K, Shin J-A, Kim J-H. Capsular opening contraction after continuous curvilinear capsulorhexis and intraocular lens implantation. J Cataract Refract Surg 1996; 22:585–590
5. Ishibashi T, Araki H, Sugai S, Tawara A, et al. Anterior capsule opacification in monkey eyes with posterior chamber intraocular lenses. Arch Ophthalmol 1993; 111:1685–1690
6. Davison JA. Capsule contraction syndrome. J Cataract Refract Surg 1993; 19:582–589
7. Fine IH. Cortical cleaving hydrodissection. J Cataract Refract Surg 1992; 18:508–512
8. Gimbel HV, Chin PK. Phaco sweep. J Cataract Refract Surg 1995; 21:493–503
9. Fine IH, Maloney WF, Dillman DM. Crack and flip phacoemulsification technique. J Cataract Refract Surg 1993; 19:797–802
10. Cionni RJ, Osher RH. Endocapsular ring approach to the subluxed cataractous lens. J Cataract Refract Surg 1995; 21:245–249
11. Levy JH, Pisacano AM, Anello RD. Displacement of bag-placed hydrogel lenses into the vitreous following neodymium:YAG laser capsulotomy. J Cataract Refract Surg 1990; 16:563–566