Pseudoaccommodating intraocular lens implantation in patients with irregular nonreactive pupils

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We report 3 patients implanted with the AcrySof ReSTOR pseudoaccommodating intraocular lens (IOL) who had irregular nonreactive pupils as a consequence of pupil stretching during phacoemulsification. Despite the pupils, the visual acuity at distance and near was not compromised. The outcome in these cases suggests that an irregular nonreactive pupil is not an exclusion criterion for pseudoaccommodating IOL implantation.

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Cataract surgery patients occasionally have small pupils, often due to the effects of aging, pseudoexfoliation, uveitis, or previous surgery. Several methods to mechanically stretch small pupils have been described.[1,2] These include using flexible iris hooks and mechanical dilating devices and performing multiple partial iris sphincterotomies. The pupil stretching techniques may alter the regular shape of the iris.

The role of the pupil after pseudoaccommodating intraocular lens (IOL) implantation has recently been reported.[3] The study concludes that regular pupil size influences distance and near visual acuity and contrast sensitivity. We present several patients with a pseudoaccommodating IOL with an irregular nonreactive pupil as a consequence of pupil stretching during phacoemulsification.

CASE REPORTS

Case 1

A 73-year-old man with an advanced nuclear cataract in the left eye had cataract surgery; pupil stretching was performed during phacoemulsification. An AcrySof ReSTOR IOL (SA60D3, Alcon) was implanted in the capsular bag. The pupil was nonreactive, with a 5.5 mm diameter (Figure 1). Five months postoperatively, the best corrected distance visual acuity was 20/20 with +1.00 −1.50 × 95 and the best distance corrected near visual acuity was 20/30. There was no glare or halos.

Case 2

A 73-year-old man with noninsulin-dependent diabetes and a posterior subcapsular cataract in the left eye had cataract surgery with pupil stretching during phacoemulsification. An AcrySof ReSTOR IOL was implanted in the capsular bag. The pupil was nonreactive, with a fixed 2.0 mm diameter (Figure 2). One year postoperatively, the uncorrected visual acuity (UCVA) and the uncorrected near visual acuity (UCNVA) were 20/20. There was no glare or halos.

Case 3

An 83-year-old man with a nuclear cataract in the left eye had cataract surgery with pupil stretching during phacoemulsification. The AcrySof ReSTOR IOL was implanted in the capsular bag. The pupil was nonreactive, with a 3.0 mm diameter (Figure 3). One month postoperatively, the UCVA and the UCNVA were 20/20. There was no glare or halos.

DISCUSSION

To our knowledge, these are the first reported cases of irregular nonreactive pupils in patients implanted with the AcrySof ReSTOR pseudoaccommodating IOL. The AcrySof ReSTOR IOL has a diffractive–refractive design to provide improved control of energy distribution.[4] The base lens provides the distance power using its refractive shape; 12 diffractive steps are incorporated into the anterior surface to provide the diffractive add power. The diffractive steps cover the central 3.6 mm diameter of the IOL, while the optic

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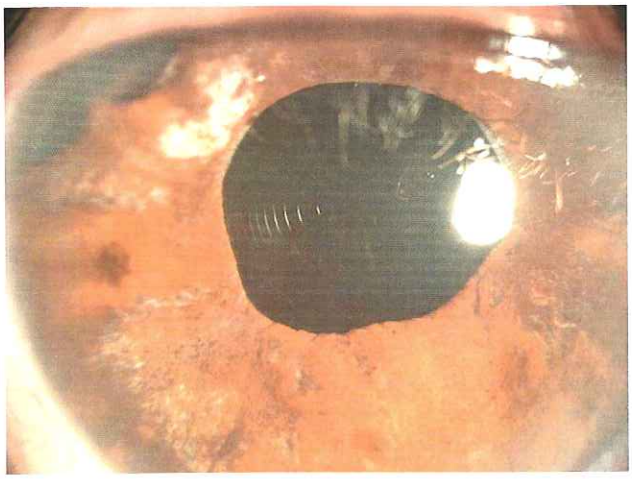

Figure 1. Case 1: Slitlamp photograph showing the irregular nonreactive pupil and the AcrySof ReSTOR IOL. The diffractive steps of the IOL can be seen in the left part of the image.

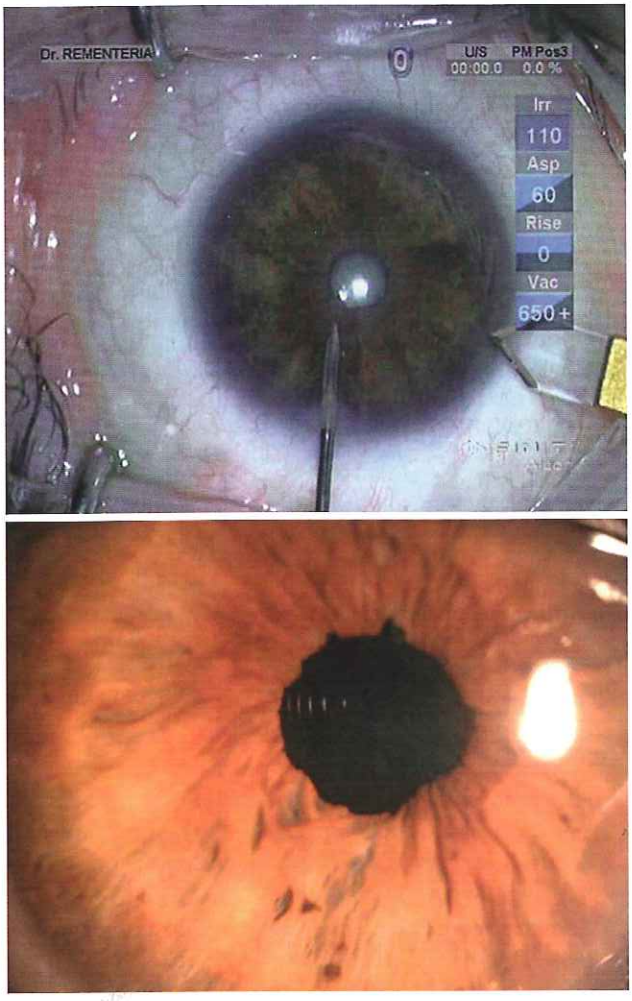

Figure 2. Case 2: Slitlamp photographs of the eye showing the small pupil diameter preoperatively (*top*) and the nonreactive 2.0 mm pupil postoperatively (*bottom*).

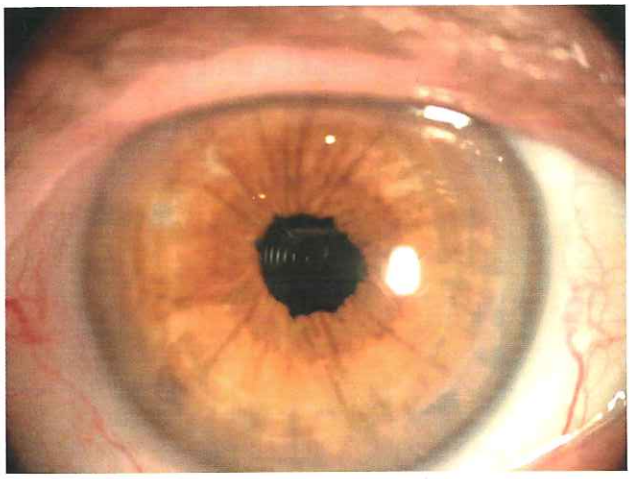

Figure 3. Case 3: Slitlamp photograph showing the irregular pupil.

peripheral to the 3.6 mm diameter to the 6.0 mm edge is a refractive surface dedicated to distance vision.

For distance and near visual tasks, we generally use bright light, which makes our pupils smaller. Considering the light distribution energy of the IOL,[4] enough light energy for distance and near vision is distributed.[3] When we perform any distance activity under mesopic conditions, a large pupil diameter helps distance vision due to the peripheral refractive region of the IOL. The limited diffractive region limits the size and energy of defocused light under large pupil conditions. In contrast, if any near visual task is performed under mesopic conditions, near visual acuity may be compromised. Alfonso et al.[3] recently reported that a larger pupil correlates significantly with better distance visual acuity and worse near visual acuity.

The visual acuity outcomes in our cases suggest that the irregular pupil does not affect the light distribution between foci and, consequently, the visual performance of the IOL for distance and near vision. Visual acuities in nonreactive pupils (fixed diameter) depend on the pupil diameter and correlate with light distribution between foci. In Cases 2 and 3, with pupil diameters of 2.0 mm and 3.0 mm, respectively, the visual acuity was 20/20 for distance and near vision. The corresponding light distributions for distance and near foci are about 45% and 40%, respectively, and 60% and 30%, respectively, for both cases (see the figure of light distribution for distance and near foci versus pupil diameter in Davison and Simpson[4]). For a large pupil diameter, as in Case 1 (5.5 mm), light distribution changes to 90% and 10% for distance and near foci, respectively. This maintains distance (20/20) and reduces near (20/30) visual acuities. Elderly patients with small pupils (smaller than 3.5 mm) and

minimal reactivity show acceptable visual performance at near vision after ReSTOR IOL implantation. Case 3 is an atypical case of a large nonreactive pupil with low light energy percentage at near focus with acceptable near visual acuity. It should be noted that more patients with this characteristic are needed to evaluate and confirm the good performance of this IOL at near in eyes with large nonreactive pupils.

From these data, we conclude that the optimal percentage of light energy for near focus to provide good near visual acuity is 30% to 40%. The relative energy between the distance and near powers makes the equal distribution between the 2 foci at approximately 2.00 mm.[4] However, the visual results reported by Alfonso et al.[3] move the balance (in terms of visual acuity) to approximately 3.75 mm. Our results agree with the clinical outcomes reported by Alfonso et al.[3]

The 3 cases in this report add to the current literature because they demonstrate that irregular nonreactive pupils should not be contraindications to implantation of pseudoaccommodating IOLs. The first case shows that a large pupil diameter maintains distance and reduces near visual acuity. Considering the outcomes in Cases 2 and 3, patients with irregular and nonreactive pupils with small diameters will show better distance and near visual acuities because of the light distribution balance between distance and near foci.

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