Prevention of posterior capsule opacification using capsular tension ring for zonular defects in cataract surgery

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PURPOSE. *To evaluate the incidence of secondary cataract in phacoemulsification and intraocular lens implantation using a capsular tension ring in case of zonular dehiscence.*

METHODS. *Phacoemulsification using a double capsular tension ring and intraocular lens implantation was done in 65 eyes with cataract and severe zonular weakness. One year after surgery capsular opacities and fibrosis were detected in a double-blind examination. The results were compared with a control group of 36 eyes that did not have a capsular tension ring but had similar surgery.*

RESULTS. *In the group with the capsular tension ring and implantation 7.7% of patients had moderate or severe posterior capsule opacification, compared with 36.1% in the control group.*

CONCLUSIONS. *Capsular tension rings may influence the formation of capsule opacification. (Eur J Ophthalmol 2003; 13: 151-4)*

KEY WORDS. *Zonular defect, Capsular tension ring, Posterior capsule opacification, Zonular weakness, Posterior capsule opacification formation*

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INTRODUCTION

In recent years numerous methods have been described to retard or prevent posterior capsule opacification (PCO) in cataract surgery (1, 2). However, the goal of reducing PCO has still not been achieved and the results of these studies do not yet permit final eradication of secondary cataract.

Several aspects of surgical technique appear to help reduce the incidence of PCO, such as quality and thoroughness of hydrodissection-enhanced cortical clean-up, in-the-bag fixation, and the size of the capsulorhexis, with a slightly smaller diameter than the intraocular lens (IOL) optic (3-5). The IOL type and design have been examined too: silicone and acrylic IOL are more biocompatible than other types, and a sharp, square or truncated edge design seems to be important in reducing PCO (6, 7). Other features that contribute usefully to preventing cell growth behind the IOL optic are maximal IOL-posterior capsule contact and the absence of IOL optic-anterior capsule adhesion (8).

All these factors are extremely important in delaying PCO formation, but unfortunately there are some cases in which they cannot be applied. Copious hydrodissection and careful cortical clean-up are important for truly eradicating PCO, but in case of zonular dehiscence, defect or weakness these surgical procedures unfortunately become very dangerous and are less effective in achieving complete removal of cells from the capsular bag and reducing regrowth and ingrowth of the cells with consequent PCO formation (1). In such cases, the capsular tension ring (CTR) maintains the capsule contour and stretches the posterior capsule; this special device therefore

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makes cataract surgery easier (9).

We report here the results of an *in vivo* analysis of PCO formation after phacoemulsification using a double CTR and IOL implantation in complicated cataract surgery.

METHODS

From January 1999 through June 2001 we performed a total of 118 cataract extractions in 118 eyes with subluxation of the lens caused by blunt ocular trauma or severe and profound zonular weakness caused by pseudoexfoliation syndrome. In 80 eyes (group 1) an implant of CTR before phacoemulsification was scheduled and in a control group of 38 eyes (group 2) with moderate zonular weakness the CTR was not implanted. During the follow-up we excluded 15 eyes of group 1 and two eyes of group 2 because of decreased visual acuity not due to PCO formation, follow-up less than one year or IOL over 1 mm from the center.

Group 1 included 65 eyes of 62 patients with CTR implant, 38 females and 24 males with a mean age of 65.2 years ± 6.5 (SD) (range 49 to 87 years). Group 2 included 36 eyes of 35 patients without CTR implant, 20 females and 15 males with a mean age of 60.3 years ± 5.2 (SD) (range 49 to 78 years).

All the surgical procedures were performed by the same surgeon with the following standardized technique. Using a standard 3.2 mm tunnel through the temporal clear cornea, a central 5.0 mm continuous curvilinear capsulorhexis and thorough but cautious hydrodissection using a 27-gauge non-beveled cannule were done. Detaching the lens from the anterior capsular bag using viscoelastic material along the whole circumference of the capsulorhexis enabled us to create a space in which - with due care to avoid inadvertent capsular entanglement - a standard 12.3/10 mm diameter CTR (Morcher type 14) was inserted with gentle rotation, only in the eyes of group 1. Softly spinning the lens free from residual capsule attachments, a phacoemulsification was started using an OMS Diplomate unit and Nagahara phaco-chop technique with blunting Pezzola chopper (Janach J2180.8A type). Delicate irrigation/aspiration (I/A) was done to gently but thoroughly remove all the visible fibers stuck to the capsular bag, and a 5.0 mm diameter single-piece poly(methyl methacrylate) (PMMA) IOL (Corneal CM50M type) was inserted and centered in the capsular bag.Complete aspiration of residual viscoelastic fluid to ensure perfect contact between the posterior capsule and the IOL optic was the final surgical step.

All the eyes were examined one year after surgery. Capsule trasparency was evaluated using slit-lamp biomicroscopy and photography and examination with a three-mirror Goldmann lens. Central PCO was graded from 0 (transparency of posterior capsule) to 5 (total PCO and capsular fibrosis), in accordance with the Oxford system for evaluation of focal posterior opacities (slit 2 mm high, 0.7 mm thick and 45-degree angle) (10). The photographs were examined by two observers using a double-blind method.

Visual acuity one month and one year after surgery for each eye using a Snellen test to check for any loss. The eyes with best-corrected visual acuity (BCVA) at least three lines less than the one-month score were treated by neodymium YAG (Nd:YAG) laser posterior capsulotomy.

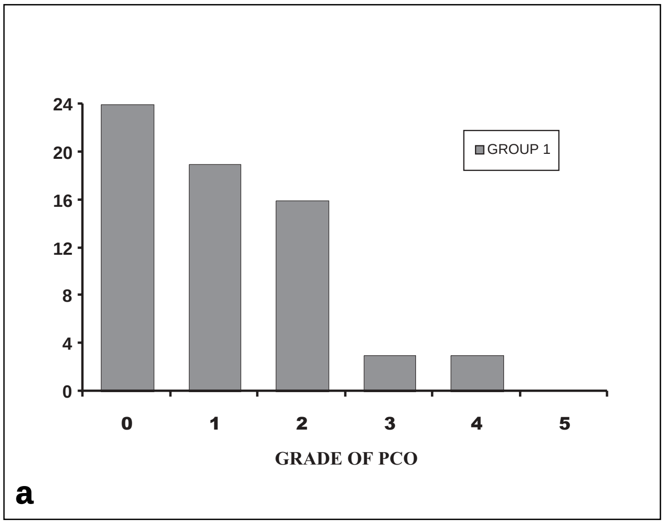
RESULTS

The scores for central PCO in both groups after one year are shown in Figures 1a and 1b. In group 1, 43 eyes (66.1%) had transparency or minimal opacities in the central area (grade 0 to 1) and 3 eyes (4.6%) needed Nd:YAG capsulotomy (grade 4 to 5). In group 2 there were 16 eyes (44.4%) with slight PCO (grade 0 to 1) and 4 cases (11.1%) that needed laser treatment. Nd:YAG capsulotomy was done only in the eyes with grades 4 and 5 PCO.

PCO was moderate or severe (range from 3 to 5) in 7.7% in group 1 and 36.1% in group 2. The difference between groups was significant ($p < 0.001$).

DISCUSSION

Removal of the lens epithelial cells (LEC) in order to preserve the transparency of the posterior capsule is very difficult in eyes with zonular atrophy or failing zonular fibers, as in the pseudoexfoliation syndrome, with or without glaucoma. In addition, high myopia, hypermature cataract or ocular blunt trauma and consequent loss of zonular fibers often causes difficulty



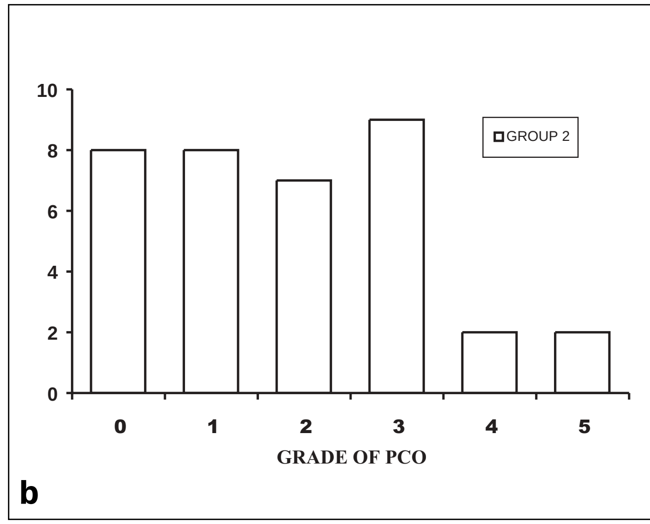


Fig. 1 - *Number of patients and scores for posterior capsule opacification one year after surgery.* **a)** *Group 1 with double CTR and IOL implantation.* **b)** *Group 2 without CTR implantation.*

in cataract surgery.

Incomplete removal of residual LECs is frequent in case of zonular weakness. Capsule polishing and aspiration require additional surgical time, which may result in increased surgical trauma, particularly with failing capsules. However, proliferation and migration of LECs may cause PCO, fibrosis and shrinkage of the anterior capsule.

Nishi et al reported that an IOL optic with a sharp edge inhibits LEC migration (7). Hara et al implanted an endocapsular tension ring in the capsular bag of rabbit eyes to maintain capsular integrity and observed a significant reduction in PCO (8). A double CTR and 5.0 mm IOL implant in monkey eyes minimized PCO in histopathologic and clinical examination (11). Although in this study we implanted a 5.0 mm diameter single-piece PMMA IOL that seems to cause a higher rate of PCO than larger IOL optics and silicone or acrylic IOL, the low rate of PCO in group 1 may be explained by the presence of CTR in the capsular bag (6, 12).

In 1998 Schaumberg et al, in a meta-analysis on PCO, found the post-operative incidence was 11.8% at one year and 20.7% at two (13). Considering the difficulty of clean-up in cataract surgery with zonular dehiscence, the results of this study appear encouraging but a longer follow-up is obviously essential.

Menapace et al reported that CTR may delay PCO in three ways: 1) by causing posterior capsule stretching that reduces the IOL-capsule distance; 2) by inhibiting migration of LECs with a discontinuous capsular bending effect along the optic edge that really becomes uniform; 3) by keeping the anterior capsule leaf away from the anterior optic surface and the posterior capsule (14).

In accordance with other published opinions, we suggest that the low percentage of PCO in double CTR and IOL implantation may depend on the ability of the CTR to stretch the posterior capsule, thus making thorough removal of cortical fibers during surgery possible (9, 13, 14). As a consequence of the insertion of the CTR, complete capsulocortical cleavage makes cortical clean-up easier because the CTR can trap residual lens fibers around the equator.

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