



Effect of Anterior and Posterior Capsular Polishing on the Rate of Posterior Capsule Opacification

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Authors' contributions

This work was carried out in collaboration between all authors. Author AK designed the study, wrote the protocol, and wrote the first draft of the manuscript. Authors AK, CC and AG managed the literature searches, analyses of the study performed the spectroscopy analysis and author KT managed the experimental process and author SNM identified the species of plant. All authors read and approved the final manuscript.

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ABSTRACT

Aim: To analyze whether anterior and posterior capsule polishing after lens cortex cleaning done by phacoemulsification has any effect on the rate of posterior capsule opacification (PCO).

Study Design: Randomized controlled trial.

Materials and Methods: A total of 587 with cataract who underwent uncomplicated phacoemulsification surgery were analyzed. The patients were divided into two groups. The anterior capsule and posterior capsule polishing procedure after lens cortex cleaning was carried out in 271 patients (Group 1) and not carried out in 316 patients (Group 2). The posterior capsule

was evaluated by using the retroillumination technique on the biomicroscope by one ophthalmologist.

Results: The mean age was 65.33 ± 13.90 (18-93) years in group 1 and 67.32 ± 11.72 (22-95) years in group 2. PCO developed in 9 of 271 patients (3.3%) in group 1 and 39 of 316 patients (12.3%) in group 2. The difference was statistically significant ($p < 0.001$). Comparison of the two groups for PCO development at the 6th and 12th months revealed a statistically significant difference ($p < 0.001$) with less PCO in group 1 at both time points. The mean follow-up duration was 29.72 ± 2.7 (24-37) months.

Conclusion: Our study shows that the PCO rates showed a statistically significant decrease in patients who underwent anterior and posterior capsule polishing during cataract surgery. The combination of anterior capsule and posterior capsule polishing may significantly reduce the rate of PCO development.

Keywords: Anterior capsule polishing; cataract; phacoemulsification; posterior capsule opacification; posterior capsule polishing.

1. INTRODUCTION

The most common threat to postoperative vision and contrast sensitivity faced by cataract surgeons is opacification and fibrosis of the anterior and posterior lens capsule due to the proliferation of residual equatorial lens epithelial cells (RELEC) [1,2]. RELEC reside in the capsular bag equator. They have significant potential to migrate to the center of the posterior capsule unless preventive measures are taken. They can decrease vision and contrast sensitivity due to pearl formation or whitening and shrinkage of the capsule [3,4]. The effective cleaning and polishing of RELEC using an irrigation/aspiration capsule-polishing cannula during cataract surgery can prevent the transit of RELEC to the anterior and posterior capsule [3]. This procedure can also ensure the removal of all lenticular epithelial cells that cannot be seen with the operating microscope. The rate of posterior capsule opacification (PCO) development can therefore be reduced by polishing the anterior and posterior lens capsules. We are not aware of any study on the effect of combined anterior and posterior capsule polishing on PCO development in large patient series previously. We therefore aimed to determine the effect of combined anterior and posterior capsule polishing during cataract surgery on PCO development.

2. MATERIALS AND METHODS

Five hundred eighty seven cataract patients were prospectively included in the study from January 2010 to January 2011. Written informed consent forms were obtained from all patients and the study was performed in accordance with the ethical standards laid down in the 1964

Declaration of Helsinki. Patients underwent uncomplicated phacoemulsification surgery at the Maya Eye Hospital, Kayseri. Patients were divided into two groups with computer randomization. The anterior capsule and posterior capsule polishing procedure after lens cortex cleaning was carried out in 271 patients (Group 1) and not carried out in 316 patients (Group 2). The patients included in the study were aged 18-95 years and had no systemic disorder other than hypertension. Exclusion criteria were traumatic cataract, pseudoexfoliation, subluxated or dislocated lens, anterior and posterior segment disorders (such as corneal disorders, glaucoma and uveal pathologies), diabetes mellitus, systemic steroid use, retinitis pigmentosa, and any intraoperative complications such as posterior capsule rupture.

The cataract was classified by anatomical location within the lens according to Brown and Hill [5] and the Lens Opacities Classification System III [6] using the slit-lamp. According to these classification systems, clouding and increase in light scattering of the lens can occur only in the nucleus in which case the term "nuclear sclerosis" is used. If cuneiform or wedge-shaped opacities occur in the lens cortex only, the cataract is named a "cortical cataract." If the loss of clarity and accumulation of granular and fibrillary material of the lens is primarily in the posterior capsule, the term "posterior subcapsular cataract" is used. If the lens is totally opaque, it is named a "mature cataract".

All surgeries were performed by the same surgeon. The phacoemulsification device (INFINITI®, Alcon Laboratories, Inc., Fort Worth, TX, USA) was used for all cataract surgeries. The pupil was dilated with topical mydriatic in all patients. Phacoemulsification was performed

under topical anesthesia with proparacaine hydrochloride 0.5% (Alcain®, Alcon Laboratories, Inc., Fort Worth, TX, USA). A three-step temporal clear corneal incision of 2.8 mm was made and an anterior continuous curvilinear capsulorhexis of approximately 5.5 mm created using dispersive viscoelastic material (sodium hyaluronate 3%-chondroitin sulfate 4%, Viscoat®, Alcon Laboratories, Inc., Fort Worth, TX, USA). Two side port incisions were opened. After cortical hydrodissection, the nucleus was rotated. The cataract was aspirated using the usual phacoemulsification surgical technique in all surgeries (phaco-chop). The remaining soft cortex residue was cleaned with bimanual irrigation aspiration. We then chose the polishing mode on the device to apply polishing. Residual lens material on the anterior and posterior capsule was gently removed with extensive 360-degree polishing (including the equatorial zone) using a bimanual irrigation/aspiration cannula in the polishing mode of the phaco device. The polishing maneuver typically required approximately 40 to 60 seconds. The vacuum power was 20 mmHg, aspiration rate was 10 cc/min and bottle height was 78 cm on polishing mode. After the absence of visible lens matter (lens cortex and remnant surface debris) on the undersurface of the anterior capsule and on the posterior capsular bag was confirmed with observation through the operating microscope, the anterior chamber was filled with a cohesive viscoelastic material (1% Sodium hyaluronate, Provisc®, Alcon Laboratories, Inc., Fort Worth, TX, USA). The same type of foldable one-piece hydrophilic acrylic intraocular lens (IOL) with square edges and an equi-biconvex optic design (IOL, Acryfold®, Appasamy Associates, Chennai, India) was injected into the bag with an injector in all patients. The IOL had a 6 mm optic diameter. The viscoelastic material was then aspirated from under the IOL, capsular bag, and anterior chamber using a bimanual irrigation/aspiration cannula. Both the main incision and the paracentesis incision were then hydrated. Balanced salt solution (BSS; Alcon Laboratories, Inc., Fort Worth, TX, USA) was used as the irrigation solution. The same type of IOL and viscoelastic material was used for all surgery. The patients were asked to return for postoperative follow-up visits 1, 3 and 6 months and 1 and 2 years later. Routine follow-up assessment included visual testing, slit lamp examination and intraocular pressure measurement. At these visits, the pupil was maximally dilated and PCO was evaluated using a biomicroscope and the retro-illumination

method. The examiner was grading PCO blinded to the technique (polished vs not polished). All patients were evaluated by the same investigator who was masked to the intervention, and the same biomicroscope.

PCO within the central 3 mm area of the posterior capsule reduces visual acuity and affects high contrast sensitivity, low contrast acuity [7]. We took opacities in the central 3 mm area into account for PCO assessment. The dimension of the opaque zone was measured with the biomicroscope. The decision to perform Nd:YAG laser posterior capsulotomy was based on subjective patient complaints or a measurable decrease in postoperative corrected visual acuity caused by a blurry posterior capsule.

Data was managed and analyzed using SPSS version 17.0 statistical software. The difference between the two groups in terms of age was evaluated by Student's t test. Statistical differences between Group 1 and Group 2 patients in term of PCO development (eyes needing Nd:YAG capsulotomy), gender distribution and PCO development time were evaluated by chi-square test. A p value less than 0.05 were considered significant.

3. RESULTS

The anterior capsule and posterior capsule polishing procedure was carried out in 271 patients (46.2%) (Group 1), and not carried out in 316 patients (53.8%) (Group 2). Table 1 shows the patients' age, gender information and axial length. There was no statistical difference between the two groups for mean age, gender and axial length.

The types of cataract were, in order of frequency, nuclear sclerosis in 273 patients (46.5%), posterior subcapsular in 197 patients (33.6%), cortical in 68 patients (11.6%) and mature in 49 patients (8.4%). PCO presence by cataract type is specified in Table 2.

PCO developed at a statistically significantly higher rate following surgery for mature and posterior subcapsular cataract compared to nuclear and cortical cataract ($p=0.008$).

PCO developed in 9 of 271 patients (3.3%) in group 1 and in 39 of 316 patients (12.3%) in Group 2. The difference was statistically significant ($p<0.001$). There was a significant difference between the two groups for PCO development at the 6th and 12th months

($p < 0.001$) with lower PCO rates in group 1 for both timepoints. The development time of PCO for both groups is specified in Table 3.

4. DISCUSSION

We found in this study that polishing the anterior and posterior capsule with an irrigation/aspiration cannula decreased the PCO rate significantly. There was also a significantly decreased rate in group 1 regarding the PCO development rate at the 6th and 12th months ($p < 0.001$). Most of our PCO cases developed after surgery for mature and posterior subcapsular cataracts.

PCO is the most common complication after cataract extraction with IOL implantation [2]. Nd:YAG laser capsulotomy is a definitive, easy and rapid treatment of PCO; however, there are rare but significant complications of capsulotomy, including cystoid macular edema, retinal detachment, damage to and subluxation of the IOL, and increased intraocular pressure. In addition, Nd:YAG capsulotomy to treat PCO results in increased requirement for patient follow-up and has a substantial socioeconomic impact [2-4]. The PCO percentage has been

reported to be 20-40% after cataract surgery [3]. A variety of methods have been mentioned to prevent PCO during cataract surgery. These include using extended irrigation/aspiration systems [8-12], dispersion and aspiration of RELEC using pharmacological agents [13-15], the use of different shaped and coated IOLs, the opening of the optical center of the posterior capsule and the polishing of anterior capsule and/or posterior capsule [12,16,17]. Nowadays, cataract surgery is also considered as a refractive surgery. With the continued development of IOLs to treat astigmatism and presbyopia with toric or multifocal IOLs, the development of PCO and fibrosis with contraction becomes an even more disruptive complication. Furthermore, these IOLs may require higher degrees of capsule clarity and subsequent earlier Nd:YAG laser capsulotomies to prevent capsule opacification imperative [18].

PCO results from the proliferation, growth, migration and transdifferentiation of RELEC left on the anterior capsule at the time of cataract surgery. RELEC may remain adherent to the anterior and posterior capsule during surgery. They migrate to the surface and multiply in the

Table 1. Age, gender and total axial length in group 1 and group 2

	Total	Group 1	Group 2	p values
Age				
mean±SD	66.40±12.8	65.33±13.90	67.32±11.72	0.060
(min-max)	(18-95)	(18-93)	(22-95)	
Gender (m/f)%	54.5/45.5	57.2/42.8	52.2/47.8	0.227
Axial				
length(mm)	23.65±1.7	23.75±1.86	23.57±1.68	0.180
mean±SD	(19.85-34.83)	(23.75-34.83)	(23.57-34.80)	
(min-max)				

m, male; f, female.

Table 2. PCO presence in various cataract types

	Nuclear sclerosis n (%)	Posterior subcapsular n (%)	Cortical n (%)	Mature n (%)
PCO (+)	20 (7.3)	19 (9.6)	4 (5.9)	5 (10.2)
PCO (-)	253 (92.7)	178 (90.4)	64 (94.1)	44 (89.8)

PCO, posterior capsule opacification; n, number.

Table 3. The time of PCO development

	1 month	6 months	12 months	24 months	Total
Group 1 n(%)	1(0.4)	6(2.2)	2(0.7)	0	9(3.3)
Group 2 n(%)	0	30(9.5)	9(2.8)	0	39(12.3)

PCO, posterior capsule opacification; n, the number of patients with posterior capsular opacification.

The follow-up time was 29.72±2.7 (24-37) months.

posterior capsule, then undergo metaplasia and get transformed into fibroblasts, causing PCO development [19,20]. The benefits of capsule polishing have therefore been investigated in several studies. There are various opinions on whether the PCO rate is reduced or not afterwards. Several studies have shown a reduction in the PCO rate after posterior capsule polishing [21-23] and various results have been reported [24-28]. Menapace et al. [24] showed that anterior capsule polishing is not effective on the regenerative type of PCO but reduces fibrotic PCO. Bolz et al. [25] reported that anterior capsule polishing is effective in preventing opacification of the anterior capsule, but not effective in preventing the development of PCO. We observed that the combination of anterior and posterior capsule polishing reduced the rate of PCO. In Khalifa's study of 412 patients with bilateral cataract, extracapsular cataract extraction was performed and the right eye was posterior capsular polished while the left eye was not. The incidence of PCO was 9.2% in the polished eyes and 12.0% in the unpolished eyes. These data are similar to our findings [16]. Liu et al. [26] found that anterior capsule polishing did not reduce the growth of residual cells although it removed much of the RELEC, and conversely resulted in enhanced cell proliferation in capsular bag cultures. Baile et al. [27] found no significant difference in PCO formation with anterior capsule polishing during cataract surgery. However, the rate of anterior capsule opacification and capsular phimosis showed a significant reduction when anterior capsular polishing was done. Sacu et al. [28] showed that eyes with extensive anterior capsule polishing had less anterior capsule opacification and fibrotic PCO after 3 years of follow-up. The previous studies on anterior capsular polishing did not reveal a reduction of the PCO rate, in contrast to our study. The cause of the reduced PCO in the present study could be combined anterior and posterior capsule polishing.

PCO developed more commonly after surgery for mature and posterior subcapsular cataract than for nuclear and cortical cataracts in this study ($p < 0.05$). The rate of PCO in these cataract types was statistically higher because these cataract types are closer to the posterior capsule. In addition, polishing is difficult in these cataract types due to the epithelial cells adherent to the posterior capsule.

One of the limitations of the study is the lack of digital retro-illumination cameras and the

corresponding field lens to use as an objective method in the measurement and evaluation of PCO. The PCO diagnosis was based on slit lamp examination. The decision to whether perform a Nd:YAG capsulotomy or not is subjective and largely based on patient complaints. A patient with PCO may not be symptomatic if other problems decreasing the visual acuity coexist and this may have prevented patients with PCO from being included in the Nd:YAG capsulotomy group. Generally, PCO rates have been assessed by either comparing the presence or absence of PCO within the central visual axis or the Nd: YAG capsulotomy rates in previous clinical studies [27,29-31]. Another limitation is that no classification of PCO (regenerative-fibrotic) was conducted.

5. CONCLUSION

The combination of anterior capsule and posterior capsule polishing may reduce the rate of PCO development.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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