·Clinical Research·

Comparative incidence of posterior capsular opacification in AcrySof and PMMA intraocular lenses

Mahtab Alam Khanzada, Siddiqa Gul, Syed Asher Dabir, Shafi Muhammad Jatoi, Ashok Kumar Narsani

Department of Ophthalmology, Liaquat University Eye Hospital, Hyderabad, Pakistan

Correspondence to: Mahtab Alam Khanzada. Advani Lane Chotki Ghitti, Hyderabad, Pakistan. syedasherdabir@yahoo.com

Received:2009-02-16 Accepted:2009-05-02

Abstract

• AIM: To evaluate the extent of significant posterior capsular opacification (PCO) after implanting polyme-thylmethacrylate (PMMA) and soft acrylic intraocular lenses.

• METHODS: A total of one hundred patients (110 eyes) undergoing intraocular lens(IOL) implant surgery were randomly divided into two groups based on the type of IOL implanted: Group I: AcrySof (SA60AT) and Group II: PMMA (LX10BD). The density of posterior capsular opacification (PCO) was assessed 3, 6, 12 and 18 months after surgery by taking best corrected visual acuity (BCVA) and the digital photographs.

• RESULTS: At the end of 3 months postoperatively, the PCO density in the Group I (PMMA) increased significantly (3.6%) while no increase was found in the Group II (Acrylic). By the end of 18 months follow-up, the incidence of significant PCO was found to be less in the acrylic group (14.5%) as compared to the PMMA group (34.5%).On the basis of density, the PCO was more extensive with the PMMA lens than the AcrySof lens, which led to more severe visual loss.

• CONCLUSION: The intraocular implantation of the AcrySof IOL helps to reduce the incidence of PCO to a greater degree as compared to the PMMA IOL.

•KEYWORDS: posterior capsular opacification; lens epithelial cells;intraocular lens

Khanzada MA, Gul S, Dabir SA, Jatoi SM, Narsani AK. Comparative incidence of posterior capsular opacification in AcrySof and PMMA intraocular lenses. *Int J Ophthalmol* 2009;2(2):150-153

INTRODUCTION

Posterior capsular opacification (PCO) is the main and common complication after extracapsular cataract extraction (ECCE) surgery [1-5] and the PCO incidence is about 18% to 50% by two years postoperatively [1,6].

As the role of lens epithelial cells (LECs)in PCO was recognized, varieties of surgical techniques have been advised to prevent the development of PCO, like phacoemulsification in which the continuous curvilinear capsulorrhexis (CCC) and hydro-dissection separates the lens material from the lens capsule [6].

Nowadays, more attention is being focused on the type of IOL. Acrylic material lenses have been reported as having very low rates of PCO as compared to polymethyl methacrylate (PMMA) and silicone material lenses [7]. This reduced incidence of PCO is due to lower migration of lens epithelial cells (LECs) on the posterior capsule and their subsequent regression[8].

Recent advances strongly suggest that the lens design rather than the lens material may be a more important factor in the prevention of PCO development. The contribution of lens design has been reported in the past by the varying rates of PCO between silicone lens of a plate or loop haptic design [9] and between plano convex or biconvex lenses [10].

The concept of "no space no cells" [11] suggests that the lack of a mechanical support of the lens which holds the posterior capsule away from the lens optic facilitates the proliferation of LECs and their central migration to develop the PCO [12]. It has been studied that the lens proliferation and their migration from the equator of lens capsule to the sharp edge optic lens was very low as compared to round optic lens [12,13]. On the basis of contact inhibition, recently, the consensus has been made that the relationship between the IOL optic and the anterior capsule plays an integral role in PCO development [14].

MATERIALS AND METHODS

One hundred patients (110 eyes) attending the cataract clinic of Department of Ophthalmology, Liaquat University of Medical & Health Science Jamshoro/Hyderabad were enrolled in the study.

The patients older than 45 years old, having senile cataract of grade I & II and patients with normal papillary reactions and pupil size more than 7mm after dilatation were included in the study. The patients younger than 45 years old, having

pseudoexfoliation or mature, traumatic and complicated cataract; and patient with poor papillary reactions or pupil size less than 7mm after dilatation were excluded from study.

Also patients having history of laser treatment, glaucoma, diabetes mellitus, any posterior segment disease or previously treated with topical or systemic Non Steroidal Anti- Inflammatory Drugs (NSAIDs) and steroids were not included in the study.

Before performing the surgery, patients biodata including age, sex, race, laterality, date of surgery, best corrected visual acuity (BCVA), intraocular pressure (IOP) and grade of cataract were recorded on a profoma.

After maximum dilatation of the pupil with 10g/L tropicamide, all surgeries were performed by same surgeon using the phacoemulsification technique under retrobulbar anaesthesia (20g/L xylocain inj).

Initially a temporal corneal incision of 3.0 mm was made with the phaco knife. After inserting viscoelastic hydroxypropyl methyl cellulose to inflate the anterior chamber, a CCC of about 4.5 to 5mm was performed. Then hydrodisection, hydrodelemination and rotation of nucleous were followed by phacoemulsification with Legacy Everest (Alcon Laboratories) in the capsular bag. After this, thorough and complete removal of cortex was performed with automated irrigation and aspiration. Thereafter, viscoelastic was inserted into the capsular bag to implant the posterior chamber intraocular lens (PC-IOL). Whole viscoelastic was then aspirated before sealing the corneal incision.

The patients were divided randomly into two groups. Group I (55 eyes of 45 patients) received multi- piece foldable AcrySof IOL (SA60AT) of 6.00mm optic size through same corneal incision, whereas Group II (55 eyes of 55 patients) received PMMA (LX10BD) of 5.25mm optic size after increasing the corneal incision upto 5.5mm with phaco knife. Postoperatively each patient was advised a combination of topical steroid and antibiotic eyedrops four times daily for a week and then gradually tapered and finally stopped after forty-five days.

The patients were advised to attend the cataract clinic for follow-up after one week, one month, three months and thereafter every six months for eighteen months. During follow-up BCVA and significant PCO was documented with photo slit lamp by using retro illumination techniques.

RESULTS

Fifty-five eyes for group I and 55 eyes for group II were randomized to implant AcrySof (SA60AT) and PMMA (LX10BD) IOLs respectively. Of the hundred patients, 56 were males and 44 were females. The mean age of Group I was 60 years (range from 45 to 75 years) and of Group II was 60.5 years (range from 45 to 76 years). The density of PCO was assessed by recording the visual acuity and taking the photographs with photo slit lamp by retro illumination techniques. By the end of three months postoperatively, the PCO density in the PMMA group increased significantly (3.6%) while no increase was found in the acrylic group.The incidence of significant PCO was 1.8%, 5.4% and 7.3% with AcrySof Lens and 5.4%, 12.7% and 12.7% with the PMMA group, at the end of 6, 12 and 18 months postoperatively. Based on the density, the PCO was more extensive (19/55,34.5%) with PMMA less than the AcrySof lens (8/55,14.5%) , which led to more severe deterioration in the postoperative visual outcome (P<0.05,Table 1).

Table 1 Visual acuity after implanting intraocular lens (n=55)

Visual acuity	Acrysof lens[a]	PMMA
6/18	3	11
6/12	5	8
6/9	10	24
6/6	37	12

[a]P<0.05, *vs* PMMA

In conclusion, the density of PCO after implantation of PMMA IOL progresses significantly with time as compared to AcrySof IOL and results in marked impairment of the final visual outcome. Hence it is recommended that the AcrySof IOL helps to reduce the PCO incidence which may in turn reduce the requirement of Nd: YAG laser capsulotomy.

DISCUSSION

PCO is the last obstacle to BCVA after an un-eventful ECCE surgery and the treatment of PCO is also a financial burden on patients of poor countries after cataract surgery.

In the last decade of 20th century, many researches have been conducted to determine the definite method for preventing PCO formation. But it was difficult to decide which method accounts for difference in PCO rate. Recently the suggestions have been given that the improvement in surgical technique[14-18] and IOL related factors like material [19-22] and design of IOL [23-25] influence the PCO development. Currently, the consensus has been made that the relationship between IOL optic and anterior capsule also plays an integral role in the PCO formation[26,27].

Peg *et al* [28] found that the most important technique to reduce the incidence of PCO is meticulous cortical clean-up. In this study all surgeries were done by single surgeon and

same techniques of phacoemulsification, CCC, complete cortical wash and in bag placement of IOL except 2mm difference in incision size for rigid PMMA IOL were used for each patient of same demographic data and a combination of topical antibiotic and steroiod drugs was prescribed to prevent the inflammatory effect on PCO formation.

Our study shows a significant difference in the percentage of PCO at 18 months follow-up between the two lens groups. The patients with AcrySof IOLs were associated with less PCO incidence as compared to the patients with PMMA IOLs. During this study, we found three reasons for less PCO incidence with AcrySof IOLs. First, the biomaterial composition of the lenses; Linnola *et al*[29] found that acrylic binds best with fibronectin relative to other biomaterial. Adhesive nature of AcrySof IOLs squeezes out the cells, thus causing atrophy of the LECs already in the capsule [8]. One study reported the retraction of capsulorhexis edges off the PMMA and silicon IOLs and stability of the anterior capsule on the anterior surface of the AcrySof IOLs[6]. Apple *et al* [30] found low rate of PCO(14.1%) with foldable IOLs than rigid PMMA IOLs(31.1%) which is consistent with previous report and our study. Second, the shape of IOLs; the shape of IOL is also an important factor in LECs proliferation. Experimental studies with different IOL material have suggested that the sharp, truncated optic edge along with total covering by anterior capsule is crucial to block the migration of LECs [31-33]. It has been reported that the IOLs with square edge optic create a sharp bend in the posterior capsule that mechanically inhibits the cell migration to the posterior capsule [34] where as IOLs with round edge optics are unable to create such bend, thus, loosing their effectiveness to prevent the PCO formation [32-35]. One study conducted on 372 eyes showed a significantly reduced incidence in the sharp edged lenses, irrespective of optic convexity [12]. In our study, we found that the incidence of PCO in patients with round edge PMMA IOLs was 34.5% while patients having sharp edge AcrySof IOLs had 14.54% PCO incidence rate. Third, the size of the IOLs; there is a conflict regarding the IOL size to determine the incidence of PCO. One study reported a low incidence of PCO in large Acrylic IOLs but Davison [36] reported no significant difference between the rate of PCO in 5.5mm and 6.0mm size IOL. An other prospective study between a 6.0mm and 5.5mm optic size concluded that large IOL optic was associated with less PCO[25].

We also found a low incidence of PCO in patients with large size optic of foldable (AcrySof) IOL than small size optic of rigid (PMMA) IOL. This may be due to the fact that large optic applies greater peripheral pressure against posterior capsule and creates a barrier for LECs migration as compared to small optic[34].

Although different practical approaches to prevent the PCO formation have been provided, but the exact method is not yet established. At present, the IOL optic design and lens material are the important factors in reducing the incidence of PCO.

REFERENCES

1 Apple DJ, Solomon KD, Tetz MR, Assia EI, Holland EY, Legler UF, Tsai JC, Castaneda VE, Hoggatt JP, Kostick AM. Posterior capsule opacification. *Surv Ophthalmol*1992;37(2):73-116

2 Paulsson LE,Sjostrand J.Contrast sensitivity in the presence of a glare light. Theoretical concepts and preliminary clinical studies. *Invest Ophthalmol Vis Sci*1980; 19(4):401-406

3 Sundelin K, Sjostrand J.Posterior capsule opacificatin 5 years after extracapsular cataract extraction. *J Catarat Refract Surg*1999;25(2):246-250

4 Hewitt A, Verma N, Gruen R. Visual outcomes for remote Australian Aboriginal people after cataract surgery. *Clin Experiment Ophthalmol*2001;29(2):68-74

5 Reinhard T, Engelhardt S, Sundmacher R. Black diaphragm aniridia intraocular lens for congenital aniridia: long-term follow-up. *J Cataract Refract Surg*2000;26 (3):375-381

6 Zemaitience R, Jasinskas V, Barzdziukas V, Auffarth G U. Prevention of posterior capsule opacification using different intraocular lens (results of one-year clinical study). *Medicina (Kaunas)*2004;40(8):721-730

7 Ursell PG, Spalton DJ, Pande MV, Hollick EJ, Barman S, Boyce J, Tilling K. Relationship between intraocular lens biomaterials and posterior capsule opacification. *J Cataract Refract Surg*1998;24(3):352-360

8 Hollick EJ, Spalton DJ, Ursell PG, Pande MV. Lens epithelial cell regression on the posterior capsule with different intraocular lens materials. *Br J Ophthalmol* 1998;82(10):1182-1188

9 Cumming JS. Postoperative complications and uncorrected acuities after implantation of plate haptic silicone and three-piece silicone intraocular lenses. *J Cataract Refract Surg*1993;19(2):263-274

10 Yamada K,Nagamoto T,Yozawa H,Kato K,Kurosaka D,Miyajima HB,Kimura C. Effect of intraocular lens design on posterior capsule opacification after continuous curvilinear capsulorhexis. *J Cataract Refract Surg*1995;21(6):697-700

11 Born CP, Ryan Dk. Effect of intraocular lens optic design on posterior capsular opacification. *J Cataract Refract Surg*1990;16(2):188-192

12 Nagata T, Watanabe I. Optic sharp edge or convexity: comparison of effects on posterior capsule opacification. *JPM J Ophthalmol*1996; 40(3):397-403

13 Nishi O, Nishi K, Mano C, Ichihara M, Honda T. The inhibition of lens epithelial cell migration by a discontinuous capsular bend created by a band-shaped circular loop or a capsule-bending ring. *Ophthalmic Surg Lasers* 1998;29 (2): 119-125

14 Ravalico G, Tognetto D, Palomba M, Busatto P, Baccara F. Capsulorhexis size and posterior capsule opacification. *J Cataract Refract Surg*1996;22(1):98-103

15 Hollick EJ, Spalton DJ, Meacock WR. The effect of capsulorhexis size on posterior capsular opacification: one-year results of a randomized prospective trial. *Am J Ophthalmol*1999;128(3):271-279

16 Apple DJ, Peng Q, Visessook N, Werner L, Pandey SK, Escobar-Gomez M, Ram J, Whiteside SB, Schoderbeck R, Ready EL, Guindi A. Surgical prevention of posterior capsule opacification. Part I: Progress in eliminating this complication of cataract surgery. *J Cataract Refract Surg*2000;26:180-187

17 Schmidbauer JM, Vargas LG, Apple DJ, Escobar-Gomez M, Izak A, Arthur SN, Golescu A, Peng Q. Evaluation of neodymium:yttrium-aluminum-garnet capsulotomies in eyes implanted with AcrySof intraocular lenses. *Ophthalmology* 2002;109 (8):1421-1426

18 Ram J, Pandey SK, Apple DJ, Werner L, Brar GS, Singh R, Chaudhary KP, Gupta A. Effect of in-the-bag intraocular lens fixation on the prevention of posterior capsule opacification. *J Cataract Refract Surg* 2001;27(7):1039-1046

19 Oshika T, Nagata T, Ishii Y. Adhesion of lens capsule to intraocular lenses of polymethylmethacrylate, silicone and acrylic foldable materials: an experimental study. *Br J Ophthalmol* 1998;82(5):549-553

20 Nagata T, Minakata A, Watanabe I. Adhesiveness of AcrySof to a collagen film. *J Cataract Refract Surg* 1998;24(3):367-370

21 Hollic EJ, Spalton DJ, Ursell PG, Pande MV, Barman SA, Boyce JF, Tilling K. The effect of polymethylmethacrylate, silicone, and polyacrylic intraocular lenses on posterior capsular opacification 3 years after cataract surgery. *Ophthalmology* 1999;106(1):49-55

22 Vasavada AR, Shastri LR, Raj SM, Ashutosh S. Cell response to Acry Sof intraocular lenses in an Indian population. *J Cataract Refract Surg* 2002;28 (7): 1173-1181

23 Nishi O, Nishi K, Wickström K. Preventing lens epithelial cell migration using intraocular lenses with sharp rectangular edges. *J Cataract Refract Surg* 2000;26 (10):1543-1549

24 Nishi O, Nishi K, Akura J. Speed of capsular bend formation at the optic edge of acrylic, silicone, and poly (methyl methacrylate) lenses. *J Cataract Refract Surg* 2002;28(3):431-437

25 Meacock WR, Spalton DJ, Boyce JF, Jose RM. Effect of optic size on posterior capsule opacification: 5.5mm versus 6.0mm Acry Sof intraocular lenses. *J Cataract Refract Surg* 2001;27(8):1194-1198

26 Birinci H, Kuruoglu S, Oge I, Oge F, Acar E. Effect of intraocular lens and anterior capsule opening type on posterior capsule opacification. *J Cataract Refract Surg* 1999;25(8):1140-1144

27 Vasavada AR, Raj SM. Anterior capsule relationship of the AcrySof intraocular lens optic and posterior capsule opacification: a prospective randomized clinical trial. *Ophthalmology* 2004;111(5):886-894

28 Peng Q, Visessook N, Apple DJ, Pandey SK, Werner L, Escobar-Gomez M, Schoderbek R, Solomon KD, Guindi A. Surgical prevention of posterior capsule opacification. Part 3: intraocular lens optic barrier effect as a second line of defense. *J Cataract Refract Surg* 2000;26(2):198-213

29 Linnola RJ, Sund M, Yl nen R, Pihlajaniemi T. Adhesion of soluble fibronecting, laminin, and collagen type-IV to intraocular lens materials. *J Cataract Refract Surg* 1999;25(11):1486-1491

30 Apple DJ, Peng Q, Visessok N, Werner L, Pandey SK, Escobar-Gomez M, Ram J, Auffarth GU. Eradication of posterior capsule opacification: documentation of a marked decrease in Nd:YAG laser posterior capsulotomy rates noted in an analysis of 5416 pseudophakic human eyes obtained postmortem. *Ophthalmology* 2001;108 (3):505-518

31 Nishi O, Nishi K. Preventing posterior capsule opacification by creating a discontinous sharp bend in the capsule. *J Cataract Refract Srug* 1999;25(4):521-526

32 Nishi O, Nishi K, Akura J, Nagata T. Effect of round-edged acrylic intraocular lenses on preventing posterior capsule opacification. *J Cataract Refract Surg* 2001; 27(4):608-613

33 Schmidbauer JM, Esobar-Gomes M, Apple DJ, Peng Q, Arthur SN, Vargas LG. Effect of haptic angulation on posterior capsule opacification in modern foldable lenses with a square, truncated optic edge. *J Cataract Refract Srug* 2002;28 (7): 1251-1255

34 Boyce JF, Bhermi GS, Spalton DJ, El-Osta AR. Mathematical modeling of the forces between an intraocular lens and the capsule. *J Cataract Refract Surg* 2002; 28(10):1853-1859

35 Findl O, Menapace R, Sacu S, Buehl W, Rainer G.. Effect of optic material on posterior capsule opacification in intraocular lenses with sharp-edge optics. *Ophthalmology* 2005;112(1):67-72

36 Davison JA. Clinical performance of Alcon SA30AL and SA60AT single-piece acrylic intraocular lenses. *J Cataract Refract Surg* 2002;28(7):1112-1123