Posterior capsular opacification (PCO) is the most frequent complication of cataract surgery. Advances in surgical techniques, intraocular lens (IOL) materials, and designs have reduced the PCO rate; however, it remains a significant problem resulting in suboptimal outcome of cataract surgery. The present article reviews the published literature that gives insight into the current concepts related to this topic.

**Terminology**

Goulden (Proc R Soc Med 1948;41(5):271-80) described the various types of opaque capsule membrane after cataract and described the different methods of its treatment and the complications associated with it.

Apple et al. (Surg Ophthalmol 1992;37:73-116) described two clinically distinguishable morphological forms of this complication: fibrosis-type PCO and Elschnig-pearl type PCO.

**Quantification and grading of PCO**

Lasa et al. (Ophthalmic Surg 1995;26(2):110-3) described a method to objectively document post-cataract surgery PCO using Zeiss Scheimpflug photography and computerized image analysis. They examined 42 eyes with clear capsules (group A) and 27 with PCO (group B). The eyes in group A had significantly better visual acuity [VA] \( P < .05 \), lower mean capsular densitometry readings \( 0.03 \pm 0.03 \) optical density units versus \( 0.15 \pm 0.11 \) optical density units, \( P < .0001 \), and thinner capsules \( 0.03 \pm 0.4 \text{ mm} \) versus \( 0.10 \pm 0.05 \text{ mm} \).

Tetz et al. (J Cataract Refract Surg 1997;23(10):1515-20) developed a morphological scoring system of PCO not based on VA testing, in which standardized photographs of the pseudophakic anterior segments were obtained using a photo slit lamp and scoring was done by evaluating retro-illumination photographs. The individual PCO score was calculated by multiplying the density of the opacification (graded from 0 to 4) by the fraction of capsule area involved behind the IOL optic.

Camparini et al. (Invest Ophthalmol Vis Sci 2000;41(10):3074-9) investigated the relative merit of retroillumination and reflected light slit lamp-derived photographs in the assessment of PCO in 23 consecutive eyes with PCO in uncomplicated pseudophakia. They concluded that, with respect to retroillumination images, reflected-light photography has an increased ability to adequately capture the presence and severity of PCO and that the use of only retroillumination images may lead to its underestimation.

Findl et al. (J Cataract Refract Surg 2003;29(1):106-11) compared four methods for quantifying PCO—a fully automated analysis system (Automated Quantification of After-Cataract [AQUA]), subjective grading by four experienced and four inexperienced examiners, subjective Evaluation of Posterior Capsular Opacification (EPCO) system, and posterior capsule opacification software (POCO). The objective AQUA score correlated well with subjective methods, including the EPCO system. The POCO system, which assesses PCO area, did not adequately describe PCO intensity and includes a subjective step in the analysis process.

Pande et al. (J Cataract Refract Surg 1997;23(10):1521-7) developed a system for high-resolution imaging of the posterior lens capsule using coaxial illumination and imaging based on Zeiss components with a digital camera directly linked to a computer for objective assessment of PCO. The system produced high-resolution digital images with even background illumination of sufficient quality to demonstrate progressive LEC changes that are amenable to computer image analysis. They concluded that this type of system can produce excellent images for objective documentation and quantitative measurement of PCO.

Friedman et al. (Invest Ophthalmol Vis Sci 1999;40(8):1715-26) developed a digital imaging and analysis technique by taking retroillumination images of the posterior capsule for assessing the extent of PCO. The images were analyzed using an available image analysis software program. Automated analysis of images correlated well with clinical grading both at slit lamp examination and when looking at the images themselves (Spearman's correlation coefficient \( > 0.7 \)). Analysis of images taken at different times showed high reproducibility (intraclass correlation \( > 0.9 \)), and the system was able to identify progression of capsular opacity over a 2 year period with a mean increase of 15.8% in progressors versus an increase of 0.6% in nonprogressors \( P < 0.05 \). They concluded that their technique was reliable, easy to use, and could detect small changes in PCO over time.

Camparini et al. (Invest Ophthalmol Vis Sci 2000;41(10):3074-9) investigated the relative merit of retroillumination and reflected light slit lamp-derived photographs in the assessment of PCO in 23 consecutive eyes with PCO in uncomplicated pseudophakia. They concluded that, with respect to retroillumination images, reflected-light photography has an increased ability to adequately capture the presence and severity of PCO and that the use of only retroillumination images may lead to its underestimation, which may be relevant to clinical studies aiming to evaluate incidence and progression of PCO.

Barman et al. (Invest Ophthalmol Vis Sci 2000;41(12):3882-92) described a software program that can provide an objective assessment of the amount of PCO in high-resolution digital images of the posterior capsule after cataract surgery. Images were analyzed by a set protocol of defining the area of the posterior capsule, removing the Purkinje light reflexes by intensity segmentation, contrast enhancement, filtering to enhance low-density PCO, and variance analysis using a co-occurrence matrix to assess texture. The image analysis-derived measure of PCO showed good agreement with clinically derived measures of PCO on a computer screen image and also under slit lamp examination (Pearson's correlation coefficient for both methods \( > 0.92 \)).
Aslam et al. (Br J Ophthalmol 2002;86(10):1181-6) analyzed the various systems of PCO grading published in literature and concluded that no single system is gold standard and it is difficult to comment on the advantages of one system over another.

Bender et al. (J Cataract Refract Surg 2004;30(10):2058-63) described a new interactive software program, POCOman, for the semi-objective assessment of PCO. Digital images of the posterior capsule, acquired by any technique, were analyzed by the observer to determine the percentage area of PCO and assign a severity score. The system was validated by comparing it to clinical slit lamp evaluation of PCO and automated POCO system analysis using a library of 100 images taken from archives. They found that an image could be analyzed in approximately 2 minutes and the results of the POCOman system correlated well with the results of the automated POCO system and clinical evaluation.

Moreno-Montanes et al. (Invest Ophthalmol Vis Sci 2005;46(11):3999-4006) evaluated PCO in humans after cataract surgery with IOL implantation by using optical coherence tomography (OCT-1). A total of 66 eyes with PCO and 20 eyes with a normal posterior capsule were analyzed using a 3-mm-long horizontal scan of the posterior capsule. Peak intensity (PI) and posterior capsule thickening (PCT), with PCT indicating the distance between two reflectivity spikes, with an approximate axial resolution of 10 µm were obtained and compared with VA and PCO type. PCT was found in PCO eyes (median: 86.13 µm; range: 46.33–115.33), whereas no second spike appeared in control eyes (P = 0.001). The area under the receiver operating characteristic curve of the average PCT for differentiating pearl-type from fibrosis-type PCO was 0.87 (P = 0.001). For a cutoff point of 55.3 µm, the sensitivity was 97.5% and the specificity was 69%. Worse VA correlated significantly with larger PCT. They concluded that OCT-1 is useful to quantitate and discriminate between different types of PCO and that PCT may be a previously unrecognized factor in VA degradation.

Kaluzny et al. (J Cataract Refract Surg 2006;32(11):1892-5) evaluated in vivo imaging of PCO using Spectral OCT (SPECT) in a case 3 years after uneventful extracapsular cataract extraction (ECCE) with implantation of a poly methyl methacrylate (PMMA) IOL. The quality of the SPECT images was adequate for detailed cross-sectional evaluation of the IOL, PCO, and morphological changes after laser capsulotomy.

Grewal et al. (Invest Ophthalmol Vis Sci 2008;49(5):2004-8) developed a method to quantify PCO in eyes after cataract surgery and IOL implantation using Scheimpflug Pentacam tomograms and compared its validity with slit lamp retroillumination image analysis. In a study of 124 pseudophakic eyes of 124 patients, they found good correlation between the two methods and Pentacam tomograms were easier to obtain, free of flash reflections, and they allowed more objective analysis in comparison with the retroillumination method.

Elgohary et al. (Eye 2008;22(5):613-9) compared the effect of PCO on visual function in patients with multifocal and multifocal IOLs. A total of 33 consecutive patients with clinically significant PCO, 24 with multifocal, and nine with multifocal IOLs were recruited. There was no significant difference between the proportions of patient with different PCO grade in the two groups. At presentation, high- and low-contrast distance VA were significantly greater in the multifocal group (0.40 versus 0.20; P = 0.04 and 0.34 versus 0.48; P = 0.006), whereas near VA and contrast sensitivity (CS) were similar. The effect of PCO on visual function in the two groups is comparable, although patients in multifocal group present with earlier loss of visual function.

Incidence

Wainsztein et al. (J Cataract Refract Surg 1992;18(6):586-8) observed in their study that senile complete cataracts (mature cataracts) had a significantly lower tendency to produce PCO than other cataract types (nuclear, cortical, and posterior subcapsular).

Viljalmsson et al. (Klin Monbl Augenheilkd 1992;200(3):167-70) evaluated the incidence of secondary cataract in sulcus versus capsular bag fixation of posterior chamber lenses. They found that the incidence of capsular opacification was 20% in eyes with sulcus fixation as opposed to 14% for those with capsular bag fixation.

Buckley et al. (Am J Ophthalmol 1993;115:722-8) reported that the rate of PCO is high in young children, reflecting greater tissue reactivity of LECs. The rate of PCO is up to 100% when the posterior capsule remains intact.

Ignjatovic (Srp Arh Celok Lek 1998;126(7-8):239-41) demonstrated that there is a higher incidence of PCO in myopic population than in normal population, it varies from 40% to 60%, and its treatment is associated with a higher rate of complications (cystoid macular oedema, rupture of anterior hyaloid, retinal detachment) in myopic populations.

Spalton (Eye 1999;13:489-92) in their review article demonstrated that PCO is the commonest complication of cataract surgery occurring in up to 50% of patients after 2-3 years of surgery.

Trivedi et al. (JAAPOS 2004;8(2):156-64) reported the incidence and risk factors for secondary surgical intervention to treat visual axis opacification (VAO) after cataract surgery and acrylic IOL implantation during the first year of life. They observed that a secondary surgical procedure was required in 37.9% of eyes to maintain a clear visual axis. Most secondary surgery for VAO occurred within the first 6 months after surgery. Postoperative opacification was most common in eyes with associated ocular anomalies.

Ebihara et al. (J Cataract Refract Surg 2006;32(7):1184-7) compared the degree of PCO after cataract surgery in patients with and without diabetes mellitus (DM) (42 eyes in each group). The PCO value was determined using the POCO system 3, 6, and 12 months after surgery. Although similar at 3 months, the PCO values of the DM group were significantly higher than those of the control group at 6 and 12 months (P = .002 and P = .03, respectively).

Vasavada et al. (J Cataract Refract Surg 2009;35(9):1532-9) conducted a study to determine whether axial myopia affects PCO in eyes with high myopia (axial length [AL] ≥ 26.00 mm). The PCO area behind the IOL optic was scored (scale 0–100%) using the POCO software system. The median PCO in the myopia group and control group, respectively, was 3.7% and 3.6% at 36 months (P = .78), and 10.0% and 2.3% at 48 months (P = .61). By 4 years, PCO had encroached onto the central
3.0 mm of the optic in 38% of the myopia group and 20% of the control group (P = .04). They concluded that axial myopia did not significantly increase the area or incidence of PCO at 4 years.

**Mechanism of PCO development**

Tetz et al. ([Surf Ophthalmol 1992;37:73-116](#)) described that PCO is a complication of ECCE with or without posterior chamber IOL implantation and that the condition is usually secondary to a proliferation and migration of residual LECs.

Marcantonio et al. ([Eye 1999;13:484-8](#)) observed that PCO results from growth and transdifferentiation of LECs left on the anterior capsule at the time of cataract surgery. These cells proliferate to form monolayers on the capsular surfaces and such monolayers continue to line the anterior capsule leaflet many years after surgery. However, some cells differentiate or undergo a transition to another cell type, and these processes greatly contribute to PCO. Equatorial differentiation of cells to fibre-like structures leads to Soemmerring’s ring formation and peripheral thickening of the capsular bag. Closer to the rhexis, cell swelling can result in globular Elschnig’s pearls, which may occlude the visual axis. Cells at the rhexis edge and those in the space around the optic appear to undergo epithelial-mesenchymal transition. The resulting cells are fibroblastic in morphology, express the smooth muscle isoform of actin, and secrete extracellular matrix containing proteins not normally present in the lens.

Stanford et al. ([Br J Ophthalmol 2000;84:323-6](#)) described in their *in vitro* studies and animal models that several cytokines and growth factors play a major role in the pathogenesis of PCO, of which transforming growth factor β (TGF-β) and fibroblast growth factor 2 (FGF-2) are most significant in the genesis of PCO in humans. These cytokines act as stimulators of myofibroblastic differentiation and attachment of LECs to the underlying posterior capsule.

Joo et al. ([Invest Ophthalmol Vis Sci 2004;45(8):2696-704](#)) studied the effect of hepatocyte growth factor (HGF) in LECs and the signaling pathways that contribute to HGF-induced proliferation. They concluded that HGF is a potent growth factor for LECs and may contribute to the development of PCO.

Khaw ([Br J Ophthalmol 2004;88(7):868-72](#)) evaluated the role of matrix metalloproteinases (MMPs), a group of proteolytic enzymes, in cell migration and cell-mediated contraction following wound healing. The authors inferred that inhibiting MMP activity can reduce LEC migration and, as a result, lead to reduction in cell-mediated capsule contraction.

Clark et al. ([Invest Ophthalmol Vis Sci 2007;48(10):4679-86](#)) reported that during PCO formation the TGF-β activated pathway is influenced by SPARC (secreted protein, acidic, and rich in cysteine) matricellular protein that is a potent cell-cycle inhibitor that arrests cells in mid-G1 phase.

Eldered et al. ([Invest Ophthalmol Vis Sci 2012;53(7):4085-98](#)) conducted a study aimed to elucidate the role of the ECM modulators MMPs in TGFβ-mediated PCO formation. They concluded that MMP2 plays a critical role in TGFβ2-mediated matrix contraction, which appears to be independent of MT1-MMP. They recommended that MMP2 inhibition may provide a novel strategy for the treatment of PCO.

Chandler et al. ([Invest Ophthalmol Vis Sci 2012;53(4):1835-45](#)) evaluated the role of hyaluronic acid (HA) and found that exogenous HA can induce lenticular migration and CD44 expression; hence, the use of surgical viscoelastics that contained HA resulted in increased rates of *ex vivo* PCO, suggesting judicious selection and use of viscoelastic material during cataract surgery.

**Prevention of PCO**

**Surgical techniques**

Nishi et al. ([J Cataract Refract Surg 1991;17:218-20](#)) reported that PCO occurred in 3.7% of patients who had LEC removal done using ultrasound and aspiration; this was significantly less than the 10.8% found in the control group (P < .01).

Hikida et al. ([Ophthalmic Surg 1991;22(8):444-50](#)) conducted a preliminary trial of a method of LEC removal in cataract surgery that combined mechanical and pharmaceutical treatments. The cells were first loosened from their junctional complexes with Dispare, a preparation of a neutral protease used for separating cells in tissue culture. To avoid intraocular tissue damage, the enzyme preparation was dissolved in sodium hyaluronate and injected into the capsular bag, which was carefully preserved during endocapsular cataract surgery. The cells were removed by irrigation and aspiration. There was negligible damage to the zonules or corneal endothelium.

Khalifa et al. ([J Cataract Refract Surg 1992;18:170-3](#)) reported that polishing the posterior capsule after lens cortex cleaning had no significant role in delaying or preventing capsular opacification. For patients <80-years-old (390 patients), the cumulative capsulotomy rate was 9.2% in the polished capsule group and 12.0% in the unpolished capsule group.

Ravalico et al. ([J Cataract Refract Surg 1996;22(1):98-103](#)) studied the relationship of capsulorhexis size with the occurrence of PCO and concluded that capsulorhexis with a slightly smaller diameter than the IOL optic appears to be better than a large-size capsulorhexis in reducing the incidence of PCO.

Gimbel et al. ([J Cataract Refract Surg 1997;23:652-56](#)) reported that posterior continuous curvilinear capsulorhexis with optic capture of the heparin-coated IOL was successful in preventing secondary opacification of the visual axis in pediatric cataract cases.

Peng et al. ([J Cataract Refract Surg 2000;26(2):188-97](#)) analyzed the role and efficacy of hydrodissection in achieving maximal cortical cleanup and concluded that hydrodissection is an effective mean to help remove LECs and thus alleviate the incidence of PCO.

Lam et al. ([Clin Experiment Ophthalmol 2005;33(5):495-8](#)) in their study reported that posterior capsulotomy using the 25-gauge transconjunctival sutureless vitrectomy (TSV) system is safe and effective in management of PCO in pseudophakic children.

Lee et al. ([J Cataract Refract Surg 2004;30(8):1626-8](#)) also reported good success of TSV system in removing dense PCO and anterior hyaloid opacity.

Ram et al. ([J Cataract Refract Surg 2001;27(7):1039-46](#)) compared the incidence of PCO after ECCE and phacoemulsification and found that visually significant PCO occurred in 42.45% of eyes.
having ECCE and 19.18% of eyes having phacoemulsification (P <.001, Chi-square test) after a mean follow-up of 2.4 ± 0.7 years. In both groups, visually significant PCO was significantly less in eyes with in-the-bag IOL fixation than in those with one haptic in bag and one in sulcus or in both haptics in sulcus (P <.001) and it was significantly lower in eyes with a hydrophobic acrylic IOL (2.22%; P <.05, Chi-square test).

Pandey et al. (J Cataract Refract Surg 2003;29:1566-8) described a technique of sealed capsule irrigation (SCI) to reduce PCO. This device consisted of a foldable suction ring with two separate lines, one for vacuum application and the other for irrigation. The device allowed the temporary seal of the capsulorrhexis after cataract removal and selective irrigation of the capsular bag with a pharmacological agent without damaging surrounding tissues.

Menapace (J Cataract Refract Surg 2006;32(6):929-43) studied the efficacy of posterior optic buttonholing (POBH) through a primary posterior capsulorrhexis (PPCC) to preserve full capsular transparency, and its potential as a routine alternative to standard in-the-bag implantation of sharp-edged optic IOLs. POBH precluded LECs from accessing the retrolental space. The sandwiched posterior capsule blocked optic contact, thereby resulting in fibrosis of the anterior capsule. POBH avoided after-cataract independent of the optic edge design.

Hara et al. (Arch Ophthalmol 2007;125(4):483-6) reported the advantages of a closed endocapsular ring to prevent PCO. They used a solid, flexible silicone ring with 9.0-mm outer diameter, 1.0-mm width, and 1.0-mm thickness with a square edge. This approach was shown to be promising in PCO prevention in the eyes of adults and children.

Huang et al. (Br J Ophthalmol 2010;94(8):1024-7) evaluated the safety and efficacy of dry pars plana posterior capsulotomy and anterior vitrectomy in pediatric cataract surgery using 25-gauge instruments in a series of 57 pediatric patients (80 eyes). No reopacification of the visual axis, IOL capture, vitreous prolapse, choroidal detachment, or retinal detachment was found during the follow-up period of 13.7 ± 8.3 months.

Liu et al. (J Cataract Refract Surg 2010;36(2):208-14) in their study concluded that anterior capsular polishing, although removed many LECs, did not decrease residual cell growth and, conversely, enhanced cell proliferation in capsular bag cultures. This might explain why polishing does not reduce PCO in clinical studies.

Yazici et al. (Middle East Afr J Ophthalmol 2012;19(1):115-9) evaluated two-year outcome of phacoemulsification combined with primary posterior curvilinear capsulorrhexis (PPCC) in 93 eyes of 91 adult patients. PCO occurred in only two (2.2%) patients. No serious complications such as retinal detachment and endophthalmitis were observed during the follow-up. They concluded that cataract surgery combined with PPCC is a safe procedure in adults.

IOL materials and designs
Milauskas (J Cataract Refract Surg 1987;13(6):644-8) evaluated the incidence and time of onset of PCO in a consecutive series of 147 silicone lens implants and in 585 (PMMA) lens implants. Silicone lenses had an opacification rate of 27.9%, while PMMA had a rate of 7.0%. Over a period of 4 months, 65.9% in the silicone lens series and 28.6% in the PMMA group required YAG laser posterior capsulotomy.

Sellman et al. (J Cataract Refract Surg 1988;14(1):68-72) evaluated the effect of a plano-convex posterior chamber lens on capsular opacification from Elschnig pearl formation in a randomized prospective clinical study. They demonstrated a statistically significant reduction in PCO by Elschnig pearls at 1 year in the reverse optic lenses (18.2% versus 7.6%; P = .03).

Peng et al. (J Cataract Refract Surg 2000;26(2):198-213) microscopically analyzed 150 consecutive eyes obtained postmortem and concluded that a square, truncated optic edge seemed to provide the maximum impediment to cell growth behind the IOL optic.

Nishi et al. (J Cataract Refract Surg 2000;26(10):1543-9) compared the preventive effect on PCO of an acrylic IOL and a silicone IOL, both with sharp rectangular optic edges. They noted that acrylic IOL had a better capsular bend effect in the histological sections, but there was no apparent difference in PCO development between the two IOLs.

Wickstrom et al. (J Cataract Refract Surg 2000;26(10):1543-9) demonstrated that the sharp-edged optic IOL and the formation of a capsular bend are highly effective in reducing PCO. Adhesion of the lens capsule material with the lens capsule also plays a role in PCO prevention by creating a sharp capsular bend, which inhibits LEC migration onto the posterior capsule.

Nishi et al. (J Cataract Refract Surg 2001;27(4):608-13) evaluated the effect of round-edged acrylic IOL on preventing PCO in rabbit eyes. The effect of the AcrySof lens (Alcon Laboratories, TX, USA) in preventing PCO is mainly a result of its rectangular, sharp-edged optic design. The acrylic material may play a complementary role by helping create a sharp capsular bend. Capsular bend formation is the key to PCO preventive effect of an IOL.

Grierson et al. (Clin Experiment Ophthalmol 2006;34(6):568-74) reported that IOL surface modification by gas plasma and polyethylene glycol affects LEC behavior and prevents PCO.

Auffarth et al. (Br J Ophthalmol 2007;91(5):644-8) reported that there was no difference in PCO development between three-piece and one-piece acrylic hydrophobic IOLs over 2 years.

Biber et al. (J Cataract Refract Surg 2009;35(7):1234-8) determined and compared the incidence of PCO and Nd:YAG laser capsulotomy after implantation of three IOL types: ReSTOR SN60D3 (multifocal spherical group), Natural Sn60AT (monofocal spherical group), or IQ SN60WF (monofocal aspheric group). The PCO rate was 42.7% in the multifocal spherical group, 28.0% in the monofocal spherical group, and 14.7% in the monofocal aspheric group. The difference in the Nd:YAG rate was statistically significantly higher in the multifocal and monofocal spherical groups than in the monofocal aspheric group (P <.001 and P <.008, respectively) but was not significantly different between the two spherical IOL groups (P = .232).

Nixon et al. (J Cataract Refract Surg 2010;36(6):929-34) compared PCO in eyes who had implantation of a Tecnis AAB00 IOL with a continuous optic edge in one eye and an
AcrySof SA60AT or SN60AT IOL with an interrupted optic edge in the other eye. Posterior capsule opacification was assessed using the Evaluation of Posterior Capsular Opacification (EPCO) system on a scale of 0 (none) to 4. They concluded that eyes with an IOL with a continuous 360-degree square edge had significantly less PCO.

Shah et al. (J Refract Surg 2010;26(8):565-8) compared the frequency of posterior capsulotomies in patients receiving a multifocal (RESTOR SN60D3) or monofocal (AcrySof SN60WF) IOL of a similar design following cataract extraction. After an average 22-month postoperative follow-up, 15.49% eyes in the multifocal group underwent posterior capsulotomies compared with 5.82% eyes in the monofocal group ($P = .0014$). The main indication for Nd:YAG laser capsulotomy in the multifocal group was complaint of poor quality of vision rather than of decreased CDVA.

Prinz et al. (J Cataract Refract Surg 2011;37(2):251-7) compared the rotational stability and PCO rate in eyes with a one-piece or three-piece acrylic IOL. Patients with age-related cataract received a plate-haptic acrylic IOL (Acri.Smart 46S) in one eye and a three-piece loop-haptic acrylic IOL (Acri.Lyc 53N) in the other eye. Both IOLs had comparable and good rotational stability. The mean AQUA PCO score (scale 0–10) was 0.4 in both IOL groups ($P = .7$). Both IOL models had comparable rotational stability and low PCO intensity 1 year after operation.

**Therapeutic agents**

Wang et al. (Zhonghua Yan Ke Za Zhi 1994;30(6):405-7) conducted a clinical study to evaluate the effect of heparin on inhibition of secondary cataract. ECCE with posterior chamber lens implantation was performed on 47 eyes with senile cataract, of which 22 eyes were irrigated with heparin solution (25 U/ml) and 25 eyes were kept in the control group. Postoperatively, PCO was significantly less in the heparin group.

Ismail et al. (Ophthalmic Res 1996;28(1):64-9) performed an experimental study to note the prevention of secondary cataract by antimitotic drugs mitomycin C (MC, 0.2 mg/ml) and 5-fluorouracil (5-FU; 50 mg/ml). A statistically significant difference ($P < .005, \text{Student's t-test}$) was obtained between the two groups treated with antimitotics when compared with the control group, and 5-FU showed a more potent inhibitory effect than MMC ($P < .005, \text{Student's t-test}$).

Shin et al. (Ophthalmology 1998;105(7):1222-6) investigated the incidence of PCO requiring YAG capsulotomy after primary trabeculectomy with MMC combined with phacoemulsification and implantation of all polymethylmethacrylate IOL and concluded that intraoperative subconjunctival MMC application during combined glaucoma and cataract surgery has a beneficial effect of inhibiting PCO after combined surgery in patients with POAG. The probability of PCO requiring YAG capsulotomy was significantly lower in the MMC group than in the control group ($P = .004$).

Flach et al. (Trans Am Ophthalmol Soc 2000;98:101-5) conducted a randomized prospective clinical investigation to determine the incidence of PCO following treatment with either diclofenac 0.1% and ketorolac 0.5% ophthalmic solutions four times daily for 30 days. PCO was present more often with diclofenac treatment than with ketorolac treatment, but the difference was not significant statistically ($P = .142$).

Nishi et al. (J Cataract Refract Surg 2001;27(9):1359-65) evaluated the preventive effect of a capsular bending ring (PMMA) on anterior and PCO in a 2-year clinical study in 60 patients with senile cataract. Anterior capsule opacification (ACO) and shrinkage were significantly less in eyes with the ring. The mean PCO score was 0.235 ± 0.215, 0.287 ± 0.200, and 0.398 ± 0.248 with the ring and 0.530 ± 0.190, 0.670 ± 0.225, and 1.111 ± 0.298 without the ring at 6 months, 1 year, and 2 years, respectively ($P < .01$ at each follow-up), indicating a significant reduction of ACO and PCO with the capsular bending ring.

Pandey et al. (J Cataract Refract Surg 2003;29(8):1566-8) developed the Perfect Capsule device (Milvella Ltd, Sydney, Australia), which permits cytotoxic agents to be delivered selectively to the capsular bag, thus selectively targeting residual LECs. This device also allows cytotoxic agents to be removed after treatment during the cataract surgery procedure.

Malecaze et al. (Gene Ther 2006;13:1422-9) provided a gene therapy approach to target LECs in the capsular bag by inducing therapeutic apoptosis by overexpression of proapoptotic genes. Using adenovirus-mediated gene transfer, they reported that it was feasible to prevent PCO by overexpressing pro-apoptotic molecules such as pro-caspase 3 or Bax in the residual LECs following cataract surgery.

Duncan et al. (Invest Ophthalmol Vis Sci 2007;48(6):2701-7) demonstrated that the applications of the Perfect Capsule device in conjunction with the cytotoxic drug thapsigargin is effective in the prevention of PCO.

Rabsilber et al. (Br J Ophthalmol 2007;91(7):912-5) investigated long-term safety and efficacy of SCI during cataract surgery to prevent PCO and concluded that SCI is a safe procedure that enables the specific pharmacological targeting of LECs inside the capsular bag.

**Treatment of PCO**

Wasserman et al. (J Am Intraocul Implant Soc 1985;11(3):245-8) presented results of a study of 367 Nd:YAG laser posterior capsulotomies and associated changes in intraocular pressure (IOP), corneal endothelial cell integrity, and visual acuities. The average maximum induced IOP rise was 1.4 mmHg and this occurred within 1 hour of the capsulotomy. The average maximum induced IOP rise was 1.4 mmHg and this occurred within 1 hour of the capsulotomy. The average corneal endothelial cell loss was of 7%. VA improved to better than 20/30 in 87.5% of patients.

Mitra et al. (Ophthalmic Surg Lasers Imaging 2003;34(4):327-31) performed pars plana capsulotomectomy in cases with PCO in which the Nd:YAG laser was ineffective in clearing the visual axis, and they found success in penetrating the thick pupillary membranes.

Lee et al. (J Cataract Refract Surg 2004;30(8):1626-8) reported a case of dense PCO and anterior hyaloid opacity after congenital cataract extraction that was successfully and easily removed using the TSV system with maintenance of clear visual axes.

Lam et al. (Clin Experiment Ophthalmol 2005;33(5):495-8) evaluated the safety and efficacy of pars plana membranectomy using 25-gauge TSV system in the surgical management of PCO in 10 pseudophakic eyes of 6 (mean age: 35.1 ± 37.8 months; age range: 6–93 months) children. All eyes showed improvement.
of VA from a mean of 6/67 before to 6/29 after surgery \((P = 0.001)\). One eye in a patient with uveitis developed recurrent PCO and a second capsulotomy was performed using the 25-gauge TSV system.

Lam et al. (Clin Experiment Ophthalmol 2005;33(5):495-8) evaluated the safety and efficacy of the 25-gauge TSV system in the surgical management of PCO in pseudophakic children and found it to be a safe and effective approach. The advantages included easier manipulation with smaller instruments in these small eyes.

Xie et al. (Zhonghua Yan Ke Za Zhi 2005;41(6):511-4) evaluated the outcome of pars plana capsulotomy and vitrectomy with infusion through the limbus to remove PCO in 51 children (57 pseudophakic eyes) in which it was not possible to remove it through Nd:YAG capsulotomy. The central opaque posterior capsule and anterior vitreous were successfully removed in all patients without complication. A round hole with 3–4 mm diameter was obtained at the central part of the posterior capsule with VA ≥0.3 in 51.9% eyes at 3 months and a clear visual axis maintained over a follow-up period of 30 months.

Stager et al. (JAAPOS 2006;10(2):159-63) evaluated the effectiveness of Nd:YAG laser capsulotomy for the treatment of PCO in children with acrylic IOLs. A total of 51 eyes (70%) maintained a clear visual axis after a single Nd:YAG procedure, ten eyes (84% cumulative) after two procedures, and another three eyes (88% cumulative) after three procedures (follow-up period range: 3–92 months; median: 25 months). They concluded that Nd:YAG laser capsulotomy is an acceptable option for the management of PCO after acrylic IOL implantation in children.

Xie et al. (J Pediatr Ophthalmol Strabismus 2008;45(6):362-5) in a similar study reported that pars plana capsulotomy and vitrectomy is a safe and effective approach for thick PCO in pseudophakic children with good visual recovery, normal postoperative IOP, and a mean overall endothelial cell loss of 3.4%.

**Conclusion**

In recent years, our understanding of mechanisms of PCO development has increased significantly; therefore, several advances have been made to improve cataract surgery techniques, IOL materials and designs, and the use of therapeutic agents. Because of these improvements, PCO occurrence has decreased or at least PCO onset has been delayed. Nevertheless, PCO remains the most common complication of cataract surgery, especially in young adults and children. Therefore, research aimed at improving surgical techniques to eliminate almost all LECs from the capsular bag at the time of surgery, optimizing IOL biocompatibility, minimizing postoperative inflammatory reaction, and targeting residual LECs by therapeutic agents that have minimal or no effect on other ocular tissues is highly desirable.

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