·Clinical Research·

Anterior segment complications after phacoemu - lsification combined vitrectomy and foldable intraocular lens implantation

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Foundation item: Supported by Key Grants of Wenzhou Medical College,China (QTJ05025)

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Received:2010-07-21 Accepted:2010-08-29

Abstract

• AIM: To evaluate the anterior segment complications of phacovitrectomy and foldable intraocular lens (IOL) implantation in eyes with significant cataract and co-existing vitreoretinal diseases.

• METHODS: This retrospective study was consisted of 285 eyes of 238 patients with various vitreoretinal abnormalities and visually significant cataracts. Vitreoretinal surgery was combined with phacoemulsification and foldable IOL implantation. Main outcome measures were visual acuity, the preoperative data, and the anterior segment complications at postoperative 6 to 72 months.

• RESULTS: The most common indications for surgery were non-diabetic vitreous hemorrhage, proliferative diabetic retinopathy. Preoperative vision ranged from 20/30 to light perception and postoperative vision ranged from 20/20 to no light perception. Postoperatively, in 245 eyes (85.9%), visual acuity improved by 3 lines or more on the Snellen chart. In 24 eyes (8.4%), vision remained within 3 lines of preoperative levels and in 16 eyes (5.6%), vision had decreased at the last follow-up. The most common anterior segment pathological change was PCO in 50 eyes (17.5%), the second was corneal edema in 32 eyes (11.2%) and the third was elevated IOP in 31 eyes (10.8%).

• CONCLUSION: The combined vitreoretinal surgery and phacoemulsification with foldable IOL implantation is safe and effective.

• KEYWORDS: anterior segment; complications; cataract; phacoemulsification; vitrectomy
DOI:10.3980/j.issn.2222-3959.2010.03.16

Zheng QX, Wu RH, Zhang YP, Xu M, Li WS. Anterior segment complications after phacoemulsification combined vitrectomy and foldable intraocular lens implantation. *Int J Ophthalmol* 2010;3 (3): 249-254

INTRODUCTION

Pars plana vitrectomy is now commonly used in the management of various posterior segment disorders ranging from retinal detachment and proliferative diabetic retinopathy to macular hole and epiretinal membrane. In the phakic eye, pars plana vitrectomy often results in cataract formation. Cataract surgery in the vitrectomized eye has been reported to present special challenges, which include the loss of vitreous support, unstable posterior capsules, weakened zonules, and posterior capsular plaques [1-3]. In the present study, we evaluated deeply anterior segment pathological changes during and after combined clear corneal phacoemulsification with foldable IOL implantation and vitreoretinal surgery in patients with cataract and miscellaneous retinal abnormalities.

MATERIALS AND METHODS

Materials A total of 285 eyes of 238 patients who underwent combined vitreoretinal surgery and phacoemulsification with foldable IOL implantation were retrospectively analyzed. All patients had clinically significant lens opacities at the time of vitreoretinal surgery. The indications for vitreoretinal surgery were non-diabetic vitreous hemorrhage in 58 eyes (20.3%) (branch retinal vein occlusion in 34 eyes, central retinal vein occlusion in 11 eyes, Eales disease in 8 eyes and other pathologic changes in 5 eyes which had undergone vitrectomy previously), proliferative diabetic retinopathy (PDR) in 52 eyes (18.3%) (12 eyes had undergone vitrectomy previously), retinal

detachment with or without proliferative vitreoretinopathy (PVR) in 42 eyes (14.7%), and macular pathology in 73 eyes, including macular hole (41 eyes, 14.4%), macular membrane (32 eyes, 11.2%), posterior uveitis (22 eyes, 7.7%), vitreomacular traction syndrome (21 eyes, 7.4%), subfoveal choroidal neovascular membrane from age-related macular degeneration (9 eyes, 3.2%), and the remaining eyes had other vitreoretinal abnormalities as indications for vitreoretinal surgery, including 8 eyes (2.8%) with acute retinal necrosis. The preoperative clinical data obtained for each patient included age, gender, systemic diseases, preoperative visual acuity, intraocular pressure (IOP) measurement, slit-lamp biomicroscopy, fundus contact lens/indirect biomicroscopy, B-scan ultrasonography, optical coherence tomography (OCT), type and extent of cataract, vitreoretinal disease, and previous laser or intraocular surgeries. We identified 285 eyes of 238 patients who fit for the study criteria. The mean age was 64.2 years (range: 18 to 89 years). There were 132 male patients and 106 female patients. The ratio of right eyes to left eyes was 138 to 147. Among them 78% of patients had diabetes mellitus, 63% having hypertension, 42% having cardiovascular diseases, and 14% having other systemic diseases. The follow-up ranged from 6 to 72 months (mean: 12.2 months). All eyes in the study had cataracts.

Methods Intraoperative data included surgical incision site, vitreoretinal procedure performed, type of IOL, internal tamponade, and intraoperative complications. The postoperative data obtained included visual acuity with postoperative refraction, length of follow-up, postoperative complications, fundus, and subsequent surgical procedures. All patients were operated on by the same experienced surgeons (Dr. Li and Zhang) between June 2002 and January 2005 at the Department of Ophthalmology, the Second Affiliated Hospital of Kunming Medical College, and from March 2005 to June 2008 at the Eye Hospital, Wenzhou Medical College, China. Patients with less than 6 months of follow-up were excluded. Phacoemulsification preceded vitreoretinal surgery in all cases. A 3mm wide and 1.5-2.0mm long clear corneal tunnel incision was created at the temporal limbus. After filling the anterior chamber with a viscoelastic substance, a 5-6mm continuous curvilinear capsulorhexis was created, followed by phacoemulsification and cortex removal. In order to prevent posterior capsule opacification (PCO), especially because of oil or gas tamponade, polishing of the anterior and posterior capsules was performed thoroughly by using an irrigation/aspiration device in all eyes. The IOL was not implanted until the completion of posterior segment surgery. A standard 3-port pars plana vitrectomy was performed using a contact lens viewing system for visualization. Vitreoretinal procedures performed included vitrectomy, peeling of the posterior hyaloid membrane, epiretinal and subretinal membrane peeling, photocoagulation, cryotherapy, diathermy, fluid-gas and oil-gas exchange, and gas or silicone oil injection. The acrylic foldable IOL (one-piece acrylic SA60AT for 153 eyes, MA60BM for 118, Acrysof, Alcon) was implanted in all eyes through a 3.5-4.0mm wide corneal incision after internal tamponade was performed.

To avoid postoperative gas-related complications, we also recommended constricting the pupil with a miotic at the conclusion of the procedure. Postoperatively, we suggested dilating gas-filled eyes once daily with short-acting agents, such as 10g/L tropicamide, rather than with long-acting agents, such as atropine. This, combined with topical corticosteroids, may help prevent formation of synechiae and minimize the chance of pupillary capture by the IOL. After the combined surgery, corneal epithelial defects were encountered in 15 eyes, which improved with a therapeutic lens and frequent artificial tears application. Eighteen eyes with anterior chamber fibrin resolved with topical steroids and non-steroidal anti-imflammatory drugs and there were no organized fibrin membranes or anterior proliferative vitreoretinopathy (PVR) complications postoperatively.

Table 1 Preoperative and postoperative BCVA of 285 eyes

n(%)

Visual acuity	Preoperative	Postperative
NLP		4 (1.4)
LP-FC	89 (31.2)	21 (7.4)
20/400	78 (27.4)	38 (13.3)
20/200	67 (23.5)	82 (28.7)
20/100-20/50	34 (11.9)	98 (34.4)
20/40-20/20	17 (5.9)	42 (14.7)

RESULTS

Visual Acuity Preoperative visual acuity ranged from light perception to 20/40. Postoperative vision ranged from 20/20 to no light perception (mean: 20/50). Postoperatively, in 245 eyes (85.9%), visual acuity improved by 3 lines or more on the Snellen chart. In 24 eyes (8.4%), vision remained within 3 lines of preoperative levels and in 16 eyes (5.6%), vision had decreased at the last follow-up (Table 1).

Anterior Segment Pathological Changes The most common anterior segment pathological change was PCO in 50 eyes (17.5%), the second was corneal edema in 32 eyes (11.2%) and the third was elevated IOP in 31 eyes (10.8%)

Table 2 Anterior segment pathological changes

Anterior segment pathological changes	Vitreoretinal disease									Tamponade	
	ARN	MH	MM	NVH	PDR	PVR	SCNV	PU	VT	Air/gas	Silicone oil
ACH				2	4	1				2	4
Corneal edema	1	3		3	16	8	1			14	12
CED	1			1	9	4				8	7
EIOP		2	1	5	12	8	1		1	12	14
Fibrinous reaction	1			3	8	5		1		6	9
IOL dislocation				1	1	1				1	1
Keratopathy					3	1				1	3
NVG				1	3	2				1	3
PCB				2	2	2				1	2
PCO	2	3	3	11	15	12	1	2	1	12	31
Posterior synechiae	1	1		2	5	4		1		4	8
Rubeosis iridis				2	4	2		1		2	6
Total	6	9	4	33	82	50	3	5	2	64	100

ACH: anterior chamber hyphema; CED: corneal epithelial defects; EIOP: elevated intraocular pressure; NVG:Neovascular glaucoma; PCB:Posterior capsule break; PCO:Posterior capsule opacification.
ARN: acute retinal necrosis; MH: macular hole; MM: macular membrane; NVH: non-diabetic vitreous hemorrhage; PDR: proliferative diabetic retinopathy; PVR: etinal detachment with or without proliferative vitreoretinopathy; SCNV: subfoveal choroidal neovascularization; PU: posterior uveitis; VTS: vitreomacular traction syndrome.

(Table 2). The anterior segment pathological changes after combined surgery were presented in Table 3.

Table 3 Anterior segment pathological changes after combined surgery (n=285)

Anterior segment pathological changes	n	Total (%)
Anterior chamber hyphema	7	2.5
Corneal edema	32	11.2
Corneal epithelial defects	15	5.2
Elevated intraocular pressure	31	10.8
Fibrinous reaction	18	6.3
IOL dislocation	3	1.1
Keratopathy	4	1.4
Neovascular glaucoma	6	2.1
Posterior capsule break	6	2.1
Posterior capsule opacification	50	17.5
Posterior synechiae	14	4.9
Rubeosis iridis	9	3.2

DISCUSSION

To our knowledge, the present study is one of a few studies to investigate the effects of during and after the combined phacoemulsification and vitreoretinal surgery on the anterior segment. In cases in which cataracts co-exist with vitreoretinal disease, surgeons have struggled to optimize retinal visualization during vitreous surgery and improve postoperative visual rehabilitation for their patients while minimizing complications. This study reported the influence to the anterior segment during and after combined phacoemulsification and vitreoretinal surgery performed during one session. The indication for combined surgery in this study was the co-existence of vitreoretinal disease and a significant cataract that obscured visualization.

We found a relatively high rate of PCO in our series, specifically, in 50 of 285 eyes (17.5%) that did not undergo primary capsulectomy at the time of surgery. It was the most common anterior segment complication in our study. Opacification of the posterior capsule has been mentioned as a frequent postoperative anterior segment complication in eyes treated with combined surgery [4]. Previous studies indicated that PCO was the most frequent pathological changes combined surgery, with an incidence ranging from 2.2 to 28.4%[1,5,6]. PCO is more common in children and in patients with diabetes or uveitis [7]. In combined anterior and posterior segment surgery, the occurrence of PCO may be greater due to the longer duration of surgery, increased manipulation, and greater inflammation that occurs in these eyes. Our technique attempts to decrease the occurrence of this complication by polishing the anterior capsule to remove residual epithelial cells and by using a hydrophobic acrylic IOL, which has been reported to have a PCO rate as low as 2.2% [8-10].The IOL material may play an important role in PCO. Hollick compared the effect of PMMA, silicone, and acrylic IOL on PCO. The YAC capsulotomy rate was 0% for polyacrylic, 14% for silicone, and 20% for PMMA IOLs. Intraocular lenses made of polyacrylic were associated with a significantly lower YAC capsulotomy rate. The truncated edge of the acrylic IOL is felt to be

responsible for the lower incidence of PCO. The barrier effect of the square optic edge, in addition to the material itself, may affect lens epithelial cell migration over the visual axis [11]. The future will show if new IOLs with square-edge optics made from material other than acryl will also result in less PCO and lower YAC rates.

Corneal edema in 32 eyes (11.2%), in which the edematous epithelium was scraped and resulted in corneal epithelial defects in 15 eyes (5.2%) due to the influence of surgical procedures, except in 2 eyes. Previous authors have advocated avoiding corneal tunnels in diabetic patients owing to concerns of increased risks of delayed healing and epithelial complications[12,13]. However, we found no instance of wound leaks, delayed healing, or persistent epithelial defects in our diabetic patients and others. There were no postoperative problems related to corneal edema. Thirty-two patients (11.2%) experienced an immediate postoperative mild or significant transient corneal edema on the day after surgery, 26 of 32 eyes related to elevated IOP, as long as if only the elevated IOP was controlled, the transient corneal edema was relieved within 1 week after surgery. In 3 other cases, the corneal edema could not be treated because of elevation of the IOP. Nevertheless, Our results support findings of other similar studies, in which it has been reported that the incidence of corneal edema ranges from 4.4 to 44.4%[1,14,15].

Elevated IOP was the more frequent anterior segment complications of combined surgery, with an incidence ranging from 4.4 to 23.8% [1,5,6,15]. This was similar to the results in our study, in which we reported that the incidence of elevated IOP after combined surgery was 10.8%(range: 24-45mmHg), it was the more common early postoperative complication was elevated IOP on the first postoperative day, but returned to normal values following administration of anti-glaucomatic drugs within 1 week after surgery in 22 eyes. In an additional nine patients, the IOP was normal during the first postoperative week, but rose later and declined with subsequent anti-glaucomatic treatment. In 31 eyes, the IOP (≥24mmHg) increased postoperatively, resulting presumably from internal tamponade (12 eyes with air or gas tamponade, 14 eyes with silicone oil tamponade, and 4 eyes with papillary block). Only one eyes without internal tamponade developed increased IOP postoperatively.

Treumer analysis revealed fibrinous exudation in the anterior chamber to be significantly more frequent after combined surgery, particularly in cases of PDR [16]. Eighteen patients (6.3%) in our series had small, fibrinous reaction in the anterior chamber, by topical steroids appear to be effective in bringing it under good control soon after the surgery. Although there is an increase in inflammation following combined surgery. Factors predisposing to fibrin reaction include multiple surgical procedures, such as retinokryopexy, excessive endolaser photocoagulation, large retinotomy, diabetes, and internal tamponade (especially silicone oil). The incidence of anterior chamber fibrin in our study was comparable to that in other studies in which vitrectomy was combined with phacoemulsification; based on our anecdotal experience, it is more common in children and in patients with diabetes or uveitis. Of 113 patients in the Jun's series, 16.8% (19 eyes) developed anterior chamber fibrin during follow-up [15]. In Pollack's series, mild fibrinous reactions progressed in 11.2% of 42 eyes [6]; however, Demetriades reported an incidence of only 4.0% of fibrin anterior chamber inflammation after combined surgery on 122 eyes [1]. In our study, significant early postoperative inflammation developed in 14 eyes (4.9%), causing posterior synechiae to the anterior capsulorrhexis despite the use of topical steroids over 1 month, but fibrin was absorbed following the topical use of steroids. Posterior synechiae has been described as a complication of the combined procedure; similar results were obtained by three groups of investigators who described the rate of posterior synechiae as 4.4, 9.0, and 9.5% after combined surgery[6,15,17].

Anterior chamber hyphema occurred in 7 eyes (2.5%) and absorbed spontaneously within 2 weeks of surgery. A posterior capsule break occurred in 6 eyes(2.1%) during the procedures, 2 eyes with non-diabetic vitreous hemorrhage and PDR and PVR, respectively. Posterior capsule breaks has been reported in other studies in which the rate of posterior capsule breaks during the combined surgery ranged from 1.8 to 5.5% [14,15]. Additionally, except for the above-mentioned anterior segment postoperative complications, one of the seldom anterior segment complications was dislocation of the posterior chamber IOL in 3 eyes (1.1%). The all was dislocated inferiorly; one IOL had a posterior capsule break and another IOL with lens zonule mutilation resulted in monocular diplopia. Two patients accepted surgery to reposition the lens. NVG has been described as a serious complication of the combined procedure [4,18]. We encountered NVG in 6 eyes (2.1%) in our series. All patients were given additional PRP with the indirect laser at the end of vitrectomy to treat the anterior retina and to fill in areas previously untreated. Similar results were obtained in a large study of 113 and 223 cases [2,15]. We believe this is the result of careful preoperative examination of the iris for

neovascularization, and most importantly, the use of an endolaser and indirect laser photocoagulation. Rubeosis iridis were present late postoperatively in 9 eyes (3.2%) in our study. Combined phacoemulsification, IOL implantation, and vitrectomy have been reported to yield a satisfactory visual outcome and lower incidence of postoperative rubeosis [6,19]. However, there are concerns about a possible increased risk for rubeosis and NVG in patients with PDR when cataract surgery is combined with a vitrectomy. Nine eyes in our study developed this complication, and six developed NVG. Furthermore, rubeosis iridis regressed after another surgery in 80% of our patients.

The visual results in this study were very much what we expected from a series of vitreoretinal procedures of this nature. In 245 eyes, visual acuity improved by 3 lines or more on the Snellen chart in 85.9% of the eyes, but varied within the different groups of patients. Similar results (84.6%) in postoperative visual improvement were reported by Chung *et al* [20]; in 24 eyes, vision remained within 3 lines of the preoperative levels, and in 16 eyes, vision had decreased at the last follow-up. Honjo *et al* [3] reported improvement in the postoperative visual acuity by 2 lines or more in 78% of operated eyes, while Demetriades *et al*[1] reported postoperative visual improvement in 105 of 122 (86.1%) patients. The latter two series most likely included eyes with less severe initial maculopathy. In the cases in which vision decreased, the decrease was judged to be on the basis of progressive retinal deterioration from the underlying disease process or capsular opacification. In the current study, the major cause of decreased visual acuity was maculopathy, particularly incases of recurrent complicated retinal detachment and/or severe diabetic retinopathy or capsular opacification. Toda found significantly more extensive PCO after combined surgery than after cataract surgery alone [21]. After combined cataract surgery, eyes can also develop severe postoperative inflammation. This inflammation probably leads to more extensive PCO. To prevent PCO, we polished the anterior and posterior capsule after phacoemulsification thoroughly by using an irrigation/aspiration device in all eyes. Recently, further work subjected to meta-analysis demonstrated that the rates of PCO and Nd:YAG laser capsulotomy may be influenced by different IOL biomaterials and optic edge designs. The lenses made by acrylic and silicone and those with sharp optic edges are superior in lowering the rates of PCO and laser capsulotomy[22].

Visual acuity improvement is mainly dependent on macular pathology. In our study, the majority of patients who had had surgery for non-diabetic vitreous hemorrhage, macular diseases, macular-on retinal detachment, and epiretinal membranes experienced improvement in visual acuity after combined surgery. In contrast, visual improvement was less commonly seen in patients previously treated for macula-off retinal detachment, serious PVR, and PDR. These patients are more likely to have impaired macular function, and should therefore be given a guarded prognosis for cataract surgery. Our series has the following limitations. It was uncontrolled, non-comparative, and represents only one surgeon's initial experiences. An additional drawback was the retrospective nature of the series. In particular, cases were preselected to be favorable for combined procedures.

In summary, our results show that postoperative anterior segment pathological changes did not increase significantly in the combined phacoemulsification and vitreoretinal surgery. The visual outcome and complications depended primarily on underlying posterior segment pathology and were not related to the combined procedure technique. Combined surgery by phacoemulsification with posterior chamber IOL and vitrectomy can be considered in treating patients with cataract and posterior segment pathology.

REFERENCES

1 Demetriades AM, Gottsch JD, Thomsen R, Azab A, Stark WJ, Campochiaro PA, de Juan E Jr, Haller JA. Combined phacoemulsification, intraocular lens implantation, and vitrectomy for eyes with coexisting cataract and vitreoretinal pathology. *Am J Ophthalmol* 2003;135(3):291-296

2 Lahey JM, Francis RR, Kearney JJ. Combining phacoemulsification with pars plana vitrectomy in patients with proliferative diabetic retinopathy. A series of 223 cases. *Ophthalmology* 2003;110(7):1335-1339

3 Honjo M, Ogura Y. Surgical results of pars plana vitrectomy combined with phacoemulsification and intraocular lens implantation for complications of proliferative diabetic retinopathy. *Ophthalmic Surg Lasers* 1998;29(2):99-105

4 Scharwey K, Pavlovic S, Jacobi KW. Combined clear corneal phacoemulsification, vitreoretinal surgery, and intraocular lens implantation. *J Cataract Refract Surg* 1999;25(5):693-698

5 Ahfat FG, Yuen CHW, Groenewald CP. Phacoemulsification and intraocular lens implantation following pars plana vitrectomy: a prospective study. *Eye* 2003;17(1): 16-20

6 Pollack A, Landa G, Kleinman G, Katz H, Hauzer D, Bukelman A. Results of combined surgery by phacoemulsification and vitrectomy. *Isr Med Assoc J* 2004;6 (3):143-146

7 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(1):73-116

8 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

9 Meucci G, Esente S, Esente I. Anterior capsule cleaning with an ultrasound irrigating scratcher. *J Cataract Refract Surg* 1991;17(1):75-79

10 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 1: Progress in eliminating this complication of

cataract surgery. *J Cataract Refract Surg* 2000;26(2):180-187

11 Hollick EJ, Spalton DJ, Lirsel PC. The effect of polymethyl-methacrylate, silicone and polyacrylic intraocular lenses on posterior capsular opacification 3 years after cataract surgery. *Ophthalmology* 1999;106(1):49-59

12 McDermott ML, Puklin JE, Abrams GW, Eliott D. Phacoemulsification for cataract following pars plana vitrectomy. *Ophthalmic Surg Lasers* 1997;28 (7): 558-564

13 Grusha YO, Masket S, Miller KM. Phacoemulsification and lens implantation after pars plana vitrectomy. *Ophthalmology* 1998;105(7):287-294

14 Androudi S, Ahmed M, Fiore T, Brazitikos P, Foster CS. Combined pars plana vitrectomy and phacoemulsification to restore visual acuity in patients with chronic uveitis. *J Cataract Refract Surg* 2005;31(3):472-478

15 Jun Z, Pavlovic S, Jacobi KW. Results of combined vitreoretinal surgery and phacoemulsification with intraocular lens implantation. *Clin Experiment Ophthalmol* 2001;29(5):307-311

16 Treumer F, Bunse A, Rudolf M, Roider J. Pars plana vitrectomy, phacoemulsification and intraocular lens implantation. Comparison of clinical complications in a combined versus two-step surgical approach. *Graefes Arch Clin Exp Ophthalmol* 2006;244(7):808-815

17 Lahey MJ, Francis RR, Fong DS, Kearney JJ, Tanaka S. Combing phacoemulsification with vitrectomy for treatment of macular holes. *Br J Ophthalmol* 2002;86(8):876-878

18 Mamalis N, Teske MP, Kreisler KR, Zimmerman PL, Crandall AS, Olson RJ. Phacoemulsification combined with pars plana vitrectomy. *Ophthalmic Surg* 1991; 22(4):194-198

19 Kadonosono K, Matsumoto S, Uchio E, Sugita M, Akura J, Ohno S. Iris neovascularization after vitrectomy combined with phacoemulsification and intraocular lens implantation for proliferative diabetic retinopathy. *Ophthalmic Surg Lasers* 2001;32(1):19-24

20 Chung TY, Chung H, Lee JH. Combined surgery and sequential surgery comprising phacoemulsification, pars piana vitrectomy, and intraocular lens implantation: comparison of clinical outcomes. *J Cataract Refract Surg* 2002;28 (11):2001-2005

21 Toda J, Kato S, Oshika T, Sugita G. Posterior capsule opacification after combined cataract surgery and vitrectomy. *J Cataract Refract Surg* 2007;33(1): 104-107

22 Cheng JW, Wei RL, Cai JP, Xi GL, Zhu H, Li Y, Ma XY. Efficacy of different intraocular lens materials and optic edge designs in preventing posterior capsular opacification: a meta-analysis. *Am J Ophthalmol* 2007;143(3):428-436