Prognostic factors that determine visual outcome following cataract surgery complicated by vitreous loss

ARISTIDES KONSTANTOPOULOS[1], GHASEM YADEGARFAR[2], KHRISHNAPA MADHUSUDHANA[1], CHRIS R. CANNING[1], ANDREW J. LUFF[1], DAVID F. ANDERSON[1], PARWEZ N. HOSSAIN[1,3]

[1]Southampton Eye Unit, Southampton General Hospital
[2]Public Health Sciences and Medical Statistics Division, School of Medicine, Southampton General Hospital, University of Southampton
[3]University of Southampton - UK

PURPOSE. *To identify prognostic factors that determine visual outcome following phacoemulsification cataract surgery complicated by vitreous loss.*
METHODS. *A retrospective cohort study. All cases of vitreous loss during phacoemulsification surgery at a university hospital, between June 2000 and December 2005, were identified from the hospital computer database. By reviewing the medical notes, preoperative, intraoperative, and postoperative data were collected. Outcome of interest was presence of poor visual outcome (best-corrected visual acuity [BCVA] <6/12). Chi-square and Mann-Whitney U tests were used to compare groups of poor and good visual outcome.*
RESULTS. *A total of 230 consecutive cases (eyes) were identified; medical notes were available for 228. Mean patient age was 78.4 years (SD 11); median follow-up 13.4 weeks (range 1–203). In multivariable logistic regression analysis poor visual outcome was independently associated with poor preoperative vision (BCVA <6/12) (OR 3.78, 95% CI 1.76–8.11), age-related macular degeneration (OR 3.04, 95% CI 1.16–8.00), cystoid macular edema (OR 3.85, 95% CI 1.29–11.51), and secondary pars plana vitrectomy (PPV) for nuclear fragment loss (OR 4.42, 95% CI 1.03–19.02). Primary PPV for nuclear fragment loss, age >70, ocular comorbidity, axial length, vitreous loss during irrigation/aspiration, or lens implantation, anterior chamber lens, and secondary lens implantation were not significant associations ($p \geq 0.05$). In 33 (14.5%) eyes BCVA was reduced by at least one Snellen line compared to before surgery.*
CONCLUSIONS. *Poor visual outcome was associated with poor preoperative vision, age-related macular degeneration, cystoid macular edema, and secondary PPV following nuclear fragment loss. Primary PPV for nuclear fragment loss was not a significant association. (Eur J Ophthalmol 2009; 19: 247-53)*

KEY WORDS. *Cataract, Phacoemulsification, Vitreous loss, Prognostic factors*

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INTRODUCTION

Posterior capsule tear (PCT) is a relatively common complication during cataract surgery with reports on the incidence ranging from 1.5 to 4.3% (1-3). This variation most likely reflects the difference between patient cohorts but also the increasing experience with phacoemulsification. PCT is considered a significant complication, as is it associated with reduced visual outcome (2, 4, 5). When accompanied by vitreous loss, it increases the risk of retinal detachment and endophthalmitis (1, 6, 7). In a recently published audit the rate of vitreous loss due to PCT dur-

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ing phacoemulsification surgery was 1.1% (3). Vitreous loss may also occur as a result of dehiscence of the lens zonules during surgery (8).

Most studies have focused on reporting the visual outcomes of cataract surgery complicated by PCT (2, 4, 5, 9). Although they have attempted to identify parameters that determine visual outcome, their main limitation has been the small sample size (2, 4). Chan et al, in a mixed study of phacoemulsification and extracapsular cataract extraction (ECCE) with PCT, identified that older age, ocular comorbidity, and vitreous loss were associated with reduced visual outcome (2). Ionides et al reported reduced visual outcome associated with PCT but, due to the small cohort with this complication, could not examine parameters that might have affected the outcomes (4).

Although it is known that PCT increases the risk of poor outcome compared to uncomplicated phacoemulsification surgery (4), we could not identify any study that has quantified the risk of vision being poorer than before surgery. The effect on visual outcome of factors, such as secondary lens implantation and stage of surgery during which vitreous loss occurs, has not been investigated. In addition, the management of nuclear fragment dislocation into the vitreous cavity and the optimum timing of pars plana vitrectomy (PPV) remains a topic of debate (10-13). In this study we have evaluated a large cohort of patients undergoing phacoemulsification surgery complicated by vitreous loss, in order to identify preoperative, intraoperative, and postoperative factors that may determine visual outcome.

METHODS

The cohort consisted of all patients who underwent phacoemulsification surgery complicated by vitreous loss between June 2000 and December 2005 at the Southampton Eye Unit. Patients were identified from the hospital computer database that registers all patients undergoing phacoemulsification surgery. Information recorded on this database includes patient details and intraoperative complications. All patients with vitreous loss were identified from this database and included in the study. Patients undergoing planned ECCE are not registered in this database and were therefore not included in the study. The medical records of patients with vitreous loss were subsequently reviewed and data extracted.

Patient data

Information collected from the preoperative assessment included patient sex and date of birth, Snellen best-corrected visual acuity (BCVA) (spectacles or pinhole), axial length (AL) of operated eye, and the presence of ocular comorbidity (as defined by presence of amblyopia, age-related macular degeneration [AMD], glaucoma, diabetic retinopathy, pseudoexfoliation, and trauma resulting in cataract). Diabetic retinopathy and AMD were not subclassified.

Intraoperative cause of vitreous loss (anterior capsule tear extending to PCT, zonule dehiscence, PCT during phacoemulsification, irrigation/aspiration [IA], or intraocular lens [IOL] implantation) was recorded. Loss of nuclear fragment into the vitreous cavity, position of implanted IOL (anterior chamber [AC], posterior chamber [PC]), and further surgery, such as primary PPV, were also recorded. The size of dislocated nuclear fragment was not investigated. Surgeon grade was not examined, as in trainee cases the degree of involvement of the supervising surgeon was not clearly documented in the operation notes.

Postoperative data included the following parameters: maximum intraocular pressure (IOP) within 2 months of surgery, a second surgical procedure, defined as secondary anterior vitrectomy, IOL implantation, or PPV, and the presence of cystoid macular edema (CME) (diagnosed on funduscopy, angiography, or optical coherence tomography), retinal detachment (RD), or endophthalmitis. Snellen BCVA at discharge or most recent appointment was recorded.

Statistical analysis

Univariate logistic regression analysis was carried out on preoperative, intraoperative, and postoperative variables in order to identify factors potentially associated with poor visual outcome. To control for the effect of baseline differences, confounding factors, and covariates, multivariable logistic regression was applied to statistically significant and borderline associations identified in univariate models. As per previous studies, poor visual outcome was defined as BCVA less than 6/12, and good visual outcome as 6/12 or better (1-3). Statistical Package for Social Science (SPSS, version 14) was used for statistical analysis. Chi-square and Mann-Whitney *U* tests were used to evaluate differences between the groups of poor and good visual outcome. p Value of less than 0.05 was considered statistically significant.

RESULTS

The database had 9367 phacoemulsification procedures recorded. Vitreous loss was recorded in 230 consecutive cases (eyes). The rate of vitreous loss was 2.46% (230 cases). Two cases with incomplete medical records were not included in outcome analyses.

Mean age of patients with vitreous loss was 78.4 years (SD 11). Patient characteristics are summarized in Table I. Median follow-up was 13.4 weeks (range 1–203); this large range is due to patients with preexisting ocular comorbidity, such as glaucoma or diabetic retinopathy, remaining under review (Tab. II).

Visual acuity outcome

Postoperative BCVA was 6/9 or better in 124 (53.9%) eyes and 6/12 or better in 156 (67.8%) eyes. This was significantly better than preoperative vision (Tab. III). In 33

TABLE I - PATIENT CHARACTERISTICS

Patient details	Number (%)
Sex	
Male	101 (43.9)
Female	129 (56.1)
Preoperative BCVA	
≥6/9	53 (23.0)
≥6/12	98 (42.6)
Ocular comorbidity	
Any	104 (45.2)
AMD	57 (24.8)
Glaucoma	37 (16.1)
Diabetic retinopathy	16 (7)
Trauma	10 (4.4)
Pseudoexfoliation	5 (2.2)

BCVA = best-corrected visual acuity; AMD = age-related macular degeneration.

TABLE II - DETAILS OF TIME INTERVAL BETWEEN SURGERY AND FINAL VISUAL ACUITY RECORD

Time of final visual acuity, wk	Number (% total)	Good visual outcome, n (%)
≤4	51 (22.4)	42 (82.4)
5 to 12	38 (16.7)	26 (68.4)
13–26	33 (14.5)	21 (63.6)
27–52	34 (14.9)	25 (73.5)
>52	72 (31.6)	42 (58.3)

Good visual outcome was defined as best-corrected visual acuity 6/12 or better.

TABLE III - UNIVARIATE ANALYSIS OF FACTORS POTENTIALLY ASSOCIATED WITH VISUAL ACUITY OUTCOME

Variable	Odds ratio (95% CI)	p value
Age, yr		
≤70	Baseline	
>70	3.38 (1.25–9.09)	0.016
Sex		
Female	Baseline	
Male	0.72 (0.41–1.28)	0.26
Preoperative BCVA		
≥6/12	Baseline	
<6/12	4.21 (2.20– 8.01)	<0.001
Ocular comorbidity		
Absent	Baseline	
Present	2.44 (1.38–4.32)	0.002
Age-related macular degeneration		
Absent	Baseline	
Present	3.96 (2.10–7.46)	<0.001
Axial length (mm)		
22.01–24.99	Baseline	
≤22.00	2.56 (1.15–5.71)	0.021
≥25.00	2.52 (1.04–6.09)	0.041
Surgeon grade		
Trainee	Baseline	
Consultant	2.28 (1.25–4.19)	0.008
Cause vitreous loss		
Other	Baseline	
IA or IOL implantation	0.53 (0.29–0.98)	0.042
Implanted IOL		
PC IOL	Baseline	
AC IOL	3.14 (1.45–6.79)	0.004
Nuclear loss in vitreous cavity		
Absent	Baseline	
Present	1.83 (0.69–4.84)	0.227
IOP ≥30 mm Hg		
Absent	Baseline	
Present	1.38 (0.7–2.72)	0.353
Cystoid macular oedema		
Absent	Baseline	
Present	2.39 (0.95–6.04)	0.065
Secondary IOL implantation		
Absent	Baseline	
Present	2.4 (1.02–5.64)	0.045
Pars plana vitrectomy for nuclear loss		
Absent	Baseline	
Primary	1.18 (0.21–6.58)	0.855
Secondary	4.11 (1.16–14.54)	0.028

BCVA = best-corrected visual acuity; IA = irrigation/aspiration; IOL = intraocular lens; PC = posterior chamber; AC = anterior chamber; IOP = intraocular pressure.

(14.5%) eyes postoperative BCVA was reduced by at least 1 Snellen line compared to before surgery; 1 in 6.9 eyes experienced loss of BCVA. Nineteen eyes (8.3%) experienced BCVA loss of 2 or more Snellen lines (Tab. IV).

Preoperative factors and visual outcome

Univariate analysis showed a significant association between poor visual outcome and age, preoperative vision, AL, ocular comorbidity, and AMD (Tab. III). Eyes with preoperative BCVA ≥6/12 were more likely to achieve good visual outcome than eyes with BCVA <6/12 (p<0.001). Individuals aged more than 70 years were more likely to have a poor visual outcome (p<0.02). Ocular AL ≤22 mm and ≥25 mm were associated with poor visual outcome when compared to AL 22.01–24.99 (p<0.03, p<0.05, respectively).

Ocular comorbidity was present in 104 (45.2%) eyes. In the absence of comorbidity, 78 (61.9%) eyes achieved postoperative BCVA 6/9 or better and 97 (77.0%) 6/12 or better, compared to 46 (44.2%) and 59 (56.7%) eyes respectively with comorbidity. In univariate analysis, comorbid eyes were 2.4 times more likely to achieve a poor visual outcome (p<0.003). The presence of AMD, examined as a separate parameter, was also associated with poor visual outcome (p<0.001).

Intraoperative factors and visual outcome

Univariate analysis showed that poor visual outcome was significantly associated with cause of vitreous loss and position of implanted IOL. Nuclear fragment loss in the vitreous cavity was not a significant association (Tab. III).

The commonest cause of vitreous loss was PCT during phacoemulsification (40.8%) and IA (25.7%). Other causes included zonule dehiscence (14.4%), posterior extension of anterior capsule tear (10.4%), and PCT during IOL implantation (10%). Vitreous loss during IA or IOL implantation was associated with half the risk of poor visual outcome compared to earlier stages of surgery (OR 0.53, p<0.05).

Nuclear fragment loss in the vitreous cavity occurred in 18 (7.8%) eyes. In univariate analysis, nuclear fragment drop was associated with 1.8 times increased risk of poor visu-

TABLE IV - DETAILS OF EYES THAT EXPERIENCED LOSS OF BCVA BY 2 SNELLEN LINES OR MORE

Case	Preoperative BCVA	Ocular comorbidity	Surgical details	Postoperative BCVA	Recorded cause of poor BCVA
1	6/9	Nil	Zonule dehiscence, secondary AC IOL	HM	AION
2	6/60	Narrow angle glaucoma	Phaco PCT, AC IOL, secondary PPV	HM	RD
3	6/9	Nil	IA PCT, sulcus IOL	6/24	Calcified IOL
4	6/18	AMD	Phaco PCT, sulcus IOL	6/36	Vitreous to section, dry AMD progression
5	6/9	Nil	Phaco PCT, sulcus IOL	6/60	RVO
6	6/24	AMD, glaucoma	Phaco PCT, AC IOL	6/60	None recorded
7	6/12	Nil	ACT, PCT, sulcus IOL	6/36	Vitreous to section, ERM
8	6/24	Nil	Phaco PCT, sulcus IOL	6/60	CME/ERM
9	6/12	AMD	ACT, PCT, AC IOL	6/60	CME
10	6/24	AMD	IOL PCT, sulcus IOL	6/60	SRNVM
11	6/9	Nil	Phaco PCT, nuclear loss, sulcus IOL, secondary PPV	6/18	None recorded
12	6/24	AMD	Phaco PCT, secondary AC IOL, tilted IOL	6/60	IOL dislocation
13	6/24	Glaucoma	IOL PCT, IOL in bag	NPL	Endophthalmitis
14	6/9	AMD, glaucoma	Phaco PCT, sulcus IOL	6/24	Vitreous to section, glaucoma progression
15	6/18	AMD	Zonule dehiscence, secondary AC IOL	6/60	None recorded
16	6/18	Nil	IA PCT, secondary sulcus IOL	CF	CRAO
17	6/18	AMD	IA PCT, sulcus IOL, secondary PPV	CF	Endophthalmitis
18	6/6	Nil	IA PCT, AC IOL	6/60	CME
19	6/18	Nil	Phaco PCT, aphakia	LP	Suprachoroidal hemorrhage

BCVA = best-corrected visual acuity; AC = anterior chamber; IOL = intraocular lens; HM = hand movement; AION = anterior ischemic optic neuropathy; PCT = posterior capsule tear; PPV = pars plana vitrectomy; RD = retinal detachment; IA = irrigation & aspiration; AMD = age-related macular degeneration; RVO = retinal vein occlusion; ERM = epiretinal membrane; CME = cystoid macular edema; ACT = anterior capsule tear; SRNVM = subretinal neovascular membrane; phaco = phacoemulsification; NPL = no perception of light; CF = counting fingers; CRAO = central retinal artery occlusion; LP = light perception.

al outcome but this was not statistically significant (p=0.22). Nuclear fragment drop was treated with primary PPV in 6 (2.6%) eyes and secondary PPV at a later date in 11 (4.8%) eyes. One eye did not have further surgery. In eyes with nuclear fragment drop in the vitreous cavity, secondary PPV was associated with poor visual outcome (p=0.03); primary PPV was not (p=0.86).

Sulcus fixated PC IOL was implanted in 166 (72.2%) eyes, AC IOL in 47 (20.4%), and PC IOL in the capsular bag in 17 (7.4%) eyes. Patients with an AC IOL were three times more likely to have a poor visual outcome compared to patients with a PC IOL (p<0.005). Twenty-seven (11.7%) eyes did not have an IOL implanted during the primary procedure. Three (1.3%) eyes underwent conversion to ECCE.

Postoperative factors and visual outcome

CME developed in 20 (8.7%) eyes, RD in 6 (2.6%) eyes, and culture positive endophthalmitis in 3 (1.3%) eyes. In univariate analysis, eyes with CME were 2.39 times more likely to achieve poor visual outcome, although this was of borderline statistical significance (p=0.065). Raised IOP was common in the postoperative period; IOP 25 mmHg or higher was recorded in 76 (33%) eyes and 30 mmHg or higher in 47 (20.4%) eyes. There was no significant association between high IOP (³30 mm Hg) and poor visual outcome (p=0.35) (Tab. III).

Twenty-five eyes underwent secondary IOL implantation, with 16 eyes having an AC and 9 eyes a PC IOL implanted. Patients with secondary IOL implantation were 2.4 times more likely to have poor visual outcome compared to patients with IOL implantation during the initial procedure (p<0.05). Maximum IOP recorded in the first 2 months following initial surgery was not significantly different in the groups that had primary and secondary IOL implantation (p=0.86). In total, 46 (20%) eyes underwent a second surgical procedure, defined as secondary anterior vitrectomy, IOL implantation, or PPV (including for RD and endophthalmitis), at a later date.

Details of eyes that experienced 2 or more Snellen line loss of BCVA compared to before surgery are outlined in Table IV.

Prognostic indicators of poor visual outcome

Multivariable logistic regression analysis was applied to statistically significant and borderline associations: age, preoperative BCVA, ocular comorbidity, AMD, AL, cause of vitreous loss, implanted IOL, CME, secondary IOL implantation, and PPV for nuclear fragment loss (Tab. V). Preoperative BCVA, AMD, CME, and secondary PPV for nuclear fragment loss in the vitreous cavity maintained an independent association with poor visual outcome.

TABLE V - MULTIVARIABLE ANALYSIS OF FACTORS POTENTIALLY ASSOCIATED WITH POOR VISUAL OUTCOME

Variable	Odds ratio (95% CI)	p value
Age, yr		
≤70	Baseline	
>70	1.80 (0.60–5.37)	0.292
Preoperative BCVA		
≥6/12	Baseline	
<6/12	3.78 (1.76–8.11)	0.001
Ocular comorbidity		
Absent	Baseline	
Present	1.22 (0.50–2.98)	0.663
Age-related macular degeneration		
Absent	Baseline	
Present	3.04 (1.16–8.00)	0.024
Axial length		
22.01–24.99	Baseline	
≤22.00	1.92 (0.75–4.86)	0.172
≥25.00	2.36 (0.82–6.80)	0.154
Cause vitreous loss		
Other	Baseline	
IA or IOL implantation	0.74 (0.35–1.59)	0.440
Implanted IOL		
PC IOL	Baseline	
AC IOL	1.98 (0.80–4.92)	0.141
Cystoid macular oedema		
Absent	Baseline	
Present	3.85 (1.29–11.51)	0.016
Secondary IOL implantation		
Absent	Baseline	
Present	1.54 (0.57–4.19)	0.400
PPV for nuclear loss		
Absent	Baseline	
Primary	1.52 (0.22–10.46)	0.674
Secondary	4.42 (1.03–19.02)	0.046

BCVA = best-corrected visual acuity; IA = irrigation & aspiration; IOL = intraocular lens; PC: posterior chamber, AC = anterior chamber; PPV = pars plana vitrectomy.

DISCUSSION

In this study, we examined the short and medium term visual outcome in phacoemulsification surgery complicated by vitreous loss. A total of 77% of eyes with no ocular comorbidity and 56.7% of eyes with ocular comorbidity achieved a good visual outcome (final BCVA ≥6/12). These results are comparable to previous studies. In the absence of comorbidity, Tan and Karwatowski reported good visual outcome in 86% (5), and Chan et al in 87.0% of eyes (2). We found that 14.5% of eyes had reduction of Snellen acuity compared to before surgery. Our results suggest that the majority of eyes experience improvement in vision following cataract extraction complicated with vitreous loss.

Poor preoperative BCVA, age > 70, ocular comorbidity, AMD, AL ≤22.00, and AL ≥25.00 were significant univariate associations of poor visual outcome. Poor preoperative vision and the presence of AMD were the only preoperative factors that maintained independent association. Age, ocular comorbidity, and AMD may be similar risk factors that show close association. As it is difficult to assess these accurately and systematically, particularly in retrospective study, we included all these parameters in our analyses.

Preoperative vision may act as a surrogate measure of the visual potential of the operated eye and, therefore, as a significant predictor factor of visual outcome. It may also reflect the density of the cataract and, therefore, the intraoperative difficulty of the procedure. The effect of AMD on visual outcome in complicated cataract surgery has not been reported. In the study by Chan et al, the presence of ocular comorbidity and older age were independent associations of poor visual outcome following PCT (2). Although not examining complicated surgery exclusively, the UK National Cataract Surgery Survey also showed that ocular comorbidity and older age were independent associations (1). The above studies did not investigate whether the presence of AMD was an independent risk factor. Westcott et al showed that older age was significantly associated with poor visual outcome following uncomplicated surgery, but not following complicated surgery (14).

Our clinical impression prior to the study had been that eyes with vitreous loss in the later stages of surgery, e.g., during IA or IOL implantation, had a better outcome than eyes with vitreous loss at earlier stages of surgery. Univariate analysis showed that vitreous loss during IA or IOL implantation was indeed associated with half the risk of poor visual outcome compared to earlier surgical stages. It also showed that eyes with AC IOL and secondary IOL implantation were more likely to have poor visual outcome. However, when confounders such as CME were controlled for, these parameters did not maintain independent significance.

Postoperative CME was an independent association of poor visual outcome. CME is considered the most important reason for visual loss after PCT (4). PCT has been shown to increase the incidence of clinical CME in phacoemulsification surgery (9). The incidence of CME in our cohort of patients with vitreous loss was 8.7%. In a cohort with PCT, Onal et al reported an incidence of 6.8% (9), and Chan et al an incidence of 13% (2). Although CME is the most common cause of decreased vision in the postoperative period, the reported incidence is very variable (16). This may reflect cohort variance, but also the different definitions of CME. In a recent audit of 1000 consecutive phacoemulsification cases, 1.2% developed clinical CME (3), whereas in a series of 131 eyes examined with optical coherence tomography the incidence was 3.05% (17).

Nuclear fragment loss in the vitreous cavity was not associated with poor visual outcome when primary PPV was carried out. The optimum time of vitrectomy for dislocated nuclear fragment remains a topic of debate (10-13). Kim et al did not detect a statistically significant difference in good final visual outcome, defined as 6/12 or better, between patients who had vitrectomy within 7 days and patients who had vitrectomy later than 7 days. However, there was a trend toward more cases with final visual acuity less than 6/60 when vitrectomy was carried out after 4 weeks (10). Similarly, Margherio and colleagues showed that there was a definite trend towards better visual acuity in eyes undergoing vitrectomy within 7 days, although this did not reach statistical significance (11).

Al-Khaier et al provide stronger evidence that early intervention may be associated with a favorable outcome; the delay of vitrectomy for more than 4 weeks was a statistically significant association of poor visual outcome, defined as 6/12 or worse (12). Carrying out a posterior vitrectomy at the same sitting as cataract extraction has also been supported (13, 15). Kageyama et al showed that combined surgery is safe, with no adverse effect on the corneal endothelium and no cases of secondary glaucoma in this series (13). Our study also supports combined surgery.

In this study we have found that the majority of eyes experience improvement in vision when cataract extraction is complicated with vitreous loss. We have identified that preoperative vision, the presence of AMD, and the development of postoperative CME are significant independent predictors of poor visual outcome. In addition, secondary PPV for nuclear fragment loss is associated with poor outcome, whereas primary PPV is not. These findings are of importance for surgeons when consenting patients and discussing the visual prognosis following complicated cataract surgery.

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Reprint requests to:
Aris Konstantopoulos, MRCOphth
Southampton Eye Unit
MP104
Southampton General Hospital
Tremona Road
Southampton SO16 6YD, UK
ariskons@yahoo.com

REFERENCES

1. Desai P, Minassian DC, Reidy A. National cataract surgery survey 1997–8: a report of the results of the clinical outcomes. Br J Ophthalmol 1999; 83: 1336-40.
2. Chan FM, Mathur R, Ku JJ, et al. Short-term outcomes in eyes with posterior capsule rupture during cataract surgery. J Cataract Refract Surg 2003; 29: 537-41.
3. Zaidi FH, Corbett MC, Burton BJL, Bloom PA. Raising the benchmark for the 21st century–the 1000 cataract operations audit and survey: outcomes, consultant-supervised training and sourcing NHS choice. Br J Ophthalmol 2007; 91: 731-6.
4. Ionides A, Minassian D, Tuft S. Visual outcome following posterior capsule rupture during cataract surgery. Br J Ophthalmol 2001; 85: 222-4.
5. Tan JHY, Karwatowski WSS. Phacoemulsification cataract surgery and unplanned anterior vitrectomy: is it bad news? Eye 2002; 16: 117-20.
6. Tuft SJ, Minassian D, Sullivan P. Risk factors for retinal detachment after cataract surgery: a case-control study. Ophthalmology 2006; 113: 650-6.
7. Bhagwandiem ACE, Cheng YYY, Wolfs RCW, van Meurs JC, Luyten GPM. Relationship between retinal detachment and biometry in 4262 cataractous eyes. Ophthalmology 2006; 113: 643-9.
8. Basti S, Garg P, Reddy MK. Posterior capsule dehiscence during phacoemulsification and manual extracapsular cataract extraction: comparison of outcomes. J Cataract Refract Surg 2003; 29: 532-6.
9. Onal S, Gozum N, Gucukoglu A. Visual results and complications of posterior chamber intraocular lens implantation after capsular tear during phacoemulsification. Ophthalmic Surg Lasers Imaging 2004; 35: 219-24.
10. Kim JE, Flynn HW Jr, Smiddy WE, et al. Retained lens fragments after phacoemulsification. Ophthalmology 1994; 101: 1827-32.
11. Margherio RR, Margherio AR, Pendergast SD, et al. Vitrectomy for retained lens fragments after phacoemulsification. Ophthalmology 1997; 104: 1426-32.
12. Al-Khaier A, Wong D, Lois N, Cota N, Yang YC, Groenewald C. Determinants of visual outcome after pars plana vitrectomy for posteriorly dislocated lens fragments in phacoemulsification. J Cataract Refract Surg 2001; 27: 1199-206.
13. Kageyama T, Ayaki M, Ogasawara M, Asahiro C, Yaguchi S. Results of vitrectomy performed at the time of phacoemulsification complicated by intravitreal lens fragments. Br J Ophthalmol 2001; 85: 1038-40.
14. Westcott MC, Tuft SJ, Minassian DC. Effect of age on visual outcome following cataract extraction. Br J Ophthalmol 2000; 84: 1380-2.
15. Lai TY, Kwok AKH, Yeung Y-S, et al. Immediate pars plana vitrectomy for dislocated intravitreal lens fragments during cataract surgery. Eye 2005; 19: 1157-62.
16. Flach AJ. The incidence, pathogenesis and treatment of cystoid macular oedema following cataract surgery. Trans Am Ophthalmol Soc 1998; 96: 557-634.
17. Ching H-Y, Wong AC, Wong C-C, Woo DC, Chan CW. Cystoid macular oedema and changes in retinal thickness after phacoemulsification with optical coherence tomography. Eye 2006; 20: 297-303.