# VISUAL PROGNOSIS FOLLOWING ACCIDENTAL VITREOUS LOSS DURING CATARACT SURGERY

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## SUMMARY

**Over the past 7 years there has been a change in the management of accidental vitreous loss during cataract surgery. There has been a reduction in immediate post-operative complications such as hyphaema. No immediate post-operative complications were observed during the last 18 months of the study. Whereas previously many of these patients remained aphakic, there was a change initially to anterior chamber intraocular lenses (IOLs) and now the vast majority receive capsule-supported sulcus-fixated posterior chamber IOLs. All patients had improved vision post-operatively by a mean of 4 Snellen lines, although they did not achieve the acuities of age- and sex-matched controls ($p$=0.015).**

Cataract surgery is the commonest ophthalmic surgical procedure and vitreous loss is the commonest significant operative complication of such surgery. There is little recent literature on the long-term effects on visual outcome of accidental vitreous loss during cataract surgery, despite the recent changes in the surgical management of cataract, accidental vitreous loss, and the use of intraocular lenses (IOLs) after vitreous loss.

The potential importance of vitreous loss has been recognised and the significance of correct management has long been stressed.[1,2] Potential complications include retinal detachment, vitreous haemorrhage, macular oedema, corneal decompensation, aphakic or pseudophakic glaucoma and phthysis,[2] but neither general[2] nor specialist[3] textbooks quantify the current risks when this complication occurs. We have therefore conducted a retrospective analysis of all such cases on a single high-volume cataract-orientated firm for the period 1985 to 1991.

## MATERIALS AND METHODS

Patients who had simultaneous cataract and vitreous surgery were identified from the operating theatre registers for a single surgical firm. The patients' clinical notes were obtained and data abstracted to a spreadsheet for analysis. Patients who had planned vitreous surgery were excluded.

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Data recorded included sex and age at time of surgery, pre-operative visual acuity, type of surgery planned, timing of vitreous loss, procedure following vitreous loss, post-operative visual acuity and complications, refraction, any further subsequent surgical procedures and numbers of clinic visits. In order to compare the visual outcome, those patients without known amblyopia or pre-existing anatomical macular defects were compared with age- and sex-matched controls with uncomplicated cataract surgery.

## RESULTS

We identified 44 cases of accidental vitreous loss during cataract surgery between 1 January 1985 and 30 June 1991 from a total of 2588 cataract extractions. This gives an incidence of 1.7%. One set of notes could not be located (2.3%); 43 sets were available for study. Mean follow-up was 22 months. Thirty-four patients (79%) had a minimum of 1 year follow-up and there were 27 (63%) with more than 2 years of follow-up. A small group of 9 had less than 1 year of follow-up (mean follow-up 5.2 months).

The study group consisted of 18 women and 25 men. There was no difference in gender frequency comparing the 27 patients who had surgery before the 1 January 1990 with the 16 who had surgery after this date. Mean ages were 71.0 ± 16.0 (SD) years (range 37–87 years) for women and 62.5 ± 15.6 years (range 26–82 years) for men. These are not statistically different.

Thirty-three cases occurred during planned conventional corneal section extracapsular cataract extraction (ECCE) and 10 during planned phacoemulsification. All the cases which occurred during phacoemulsification have occurred since 1990 in keeping with the introduction of the technique. Thirty-eight of the operations were undertaken with general anaesthesia and 5 under local anaesthesia.

Vitreous loss occurred most frequently during the irrigation/aspiration phase of cortical removal (65%); the other times at which vitreous loss occurred are shown in Table I. All cases had automated vitrectomy using a 20

**Table I.** Details of the stage of surgery during which vitreous loss occurred for 43 cases of accidental vitreous loss during cataract surgery

| Stage of surgery when vitreous loss occurred | Number |
|---|---|
| Irrigation/aspiration | 28 |
| Nuclear expression | 7 |
| Phacoemulsification | 7 |
| IOL insertion | 1 |

gauge guillotine-action vitrectomy instrument, with low suction and a high cutting rate. A bimanual technique was used with minimum infusion.

Fifteen patients had no IOL implanted at the primary procedure but in 3 cases planned surgery did not include implantation. Eight patients received primary anterior chamber (AC) IOLs (Kelmann omniflex type) and 20 primary posterior chamber (PC) IOLs, all single piece polymethylmethacrylate lenses with a 7 mm optic diameter. All these lenses were sulcus-fixated; in this series there were no cases where a scleral-sutured lens was required. Six of the patients initially left aphakic have subsequently received secondary AC-IOLs. Since 1990 all patients have received an IOL as part of their primary surgery, with a shift towards almost exclusive use of PC-IOLs (Table II).

Immediate post-operative complications were rare: in no case was vitreous incarcerated in the wound, but in 2 cases residual vitreous was present in the AC. Four patients had small hyphaemas. One patient had an iris prolapse noted on the first post-operative day; this was repositied in theatre immediately. No immediate post-operative complications have occurred in the 16 patients who had surgery since the 1 January 1990 ($p<0.05$ Fisher's exact probability test).

Longer-term complications (present at or after 2 weeks post-operatively) were sought in the notes of the 34 patients with more than 1 year of follow-up. No cases of retinal detachment were found. The commonest complication was clinically significant cystoid macular oedema, present in 4 patients of whom 2 eventually recovered 6/6 vision. Two patients developed post-operative glaucoma: a diabetic patient became rubeotic 9 months after surgery and a patient with an AC-IOL and a single patent peripheral iridectomy developed pupil block 24 months after surgery. Many of the patients with these longer-term complications enjoyed good final visual acuities (see Table III).

All patients had better visual acuity post-operatively than pre-operatively. The mean improvement for all patients was by 4.3 Snellen lines (±2.2, range 1–9). There was no difference in the improvement in acuity of those followed for less than 1 year ($p=0.62$ by $t$-test). Overall, 29 (67%) enjoyed a post-operative acuity of 6/12 or better. Fourteen patients had post-operative acuities of 6/18 or worse and in 4 cases this could be attributed to clearly documented macular pathology present pre-operatively. Thus 10 patients (23%) failed to achieve 6/12 vision post-operatively.

**Table II.** Comparison of primary IOL implantation following vitreous loss before and after 1 January 1990

| | No IOL | AC-IOL | PC-IOL |
|---|---|---|---|
| Pre 1990 | 15 | 7 | 5 |
| After 1990 | 0 | 1 | 15 |

The probablilty of this distribution occurring by chance is $p=0.00000915$ by chi-squared test.
AC-IOL, anterior chamber intraocular lens; PC-IOL, posterior chamber intraocular lens.

Patients who received primary PC-IOLs enjoyed a better improvement in acuity (mean improvement 4.7 Snellen lines) than patients with primary AC-IOLs (3.4 Snellen lines); details are shown in Tables IV and V. The differences in improved visual acuity between the four groups (aphakia, primary AC-IOL, primary PC-IOL and secondary AC-IOL) are, however, not statistically significantly different. The mean post-operative refractive cylinder for those patients receiving small-incision surgery in this study was 1.6 DC (dioptre cylinder) ±1.2 and for the others 2.1 DC ±1.6.

These patients required a mean of 3.26 (±0.96, range 2–6) follow-up visits in the first 3 months following surgery. However, a comparison of patients receiving surgery before and after 1 January 1990 shows a reduction from a mean of 3.4 visits (±1.1, range 2–6) to 3.0 visits (±0.7, range 2–4) and this is statistically significant ($p=0.048$ by paired $t$-testing).

There were 31 patients who had accidental vitreous loss and no history of amblyopia or known anatomical macular defect; these were compared with age- and sex-matched controls without vitreous loss. The match for age was within 2 years in all cases. The mean visual acuity for the vitreous loss patients was 6/13 (±12) and for the controls 6/7 (±2); by paired $t$-test the difference is significant at the level of $p = 0.015$.

## DISCUSSION

In his classic monograph Vail[4] reviews earlier literature from the experience of Daviel in 1753 (who apparently had a 5% vitreous loss rate) to 1965, and also reports his own 17-year experience of 578 cases of vitreous loss from 7507 cataract extractions (7.7% vitreous loss rate). These patients had a 7% incidence of retinal detachment and 21% had 'maculopathy'. The average acuity was worse than 6/18.

**Table III.** Complications present 2 or more weeks after accidental vitreous loss during cataract surgery for 34 patients with a minimum of 1 year follow-up

| No. of patients | Complications |
|---|---|
| 4 | Clinical CMO at 2 months post-operatively or later: 2 with no IOL and 2 with AC-IOLs (6/6, 6/6, 6/18, 6/36) |
| 2 | Glaucoma: 1 rubeotic at 9 months and 1 AC-IOL pupil block at 24 months despite a patent PI |
| 2 | Choroidal effusions (6/6, 6/5) |
| 1 | Macular ERM (6/36) |
| 1 | Post-operative ptosis (6/12) |
| 1 | Mild corneal oedema which resolved (6/9) |
| 1 | Mild sclerokeratitis (6/9) |

Final visual acuities are shown in parentheses where relevant.
CMO, cystoid macular oedema; ERM, epiretinal membrane; PI, peripheral iridectomy.

**Table IV.** Data on improvement in visual acuity by IOL management

| Group | No. of patients | Mean improvement in Snellen acuity (no. of lines) | SD | Range |
|---|---|---|---|---|
| Primary PC-IOL | 20 | 4.70 | ±2.43 | 1–9 |
| Secondary AC-IOL | 6 | 4.67 | ±2.42 | 1–7 |
| No IOL | 7 | 4.29 | ±1.11 | 2–5 |
| Primary AC-IOL | 8 | 3.37 | ±1.30 | 1–5 |

Data for patients who were left aphakic excludes 2 for whom no IOL was planned because of known limited visual potential due to amblyopia or macular scarring.

The vitreous loss rate seems to have fallen since the mid-1960s, partly in relation to the change to extracapsular techniques. Published rates include 14.7% (phacoemulsification by residents[5]), 10.7% for bilateral simultaneous surgery (intracapsular[6]), 5.8% (intracapsular[7]), 5.5% (phacoemulsification by residents[8]), 4.3% (extracapsular[9]), 2.4% (extracapsular[10,11]), and 2.1% for an experienced surgeon converting to phacoemulsification.[12] Our rate of 1.7% is not atypical of the experiences of others.

Data on complications following accidental vitreous loss have frequently included retinal detachments and secondary glaucoma. The major publications are summarised in Table VI. Recent data[13] suggest that vitreous loss is a risk factor for endophthalmitis, and it is surprising how infrequently this is mentioned in the series quoted. This may be because of the relative rarity of this complication following vitreous loss during cataract surgery (0.06%).[13] Whilst our series is small, it would seem that the incidence of retinal detachment and glaucoma is lower than might be expected. Since we had no cases of retinal detachment, it does not seem appropriate to discuss the pathogenesis or management of this serious complication here.

The management of vitreous loss altered in the mid 1970s as automated guillotine-action vitrectomy instruments became widely available. Despite this, only Berger *et al.*[14] have published data comparing automated vitrectomy with the 'swab and scissors' technique. Their series of 59 patients had a commendable follow-up of 26 months, but may be atypical of today's population as 22% had positive syphilis serology. Nevertheless, the authors were unable to document a superiority for either technique. All our patients presented here had an automated vitrectomy, and where this technology is available it would seem unreasonable not to use it, particularly as it seems less likely to transmit as much traction to the retina via the vitreous base as a swab.

**Table V.** Statistical comparison of improvements in visual acuity analysed by paired *t*-testing

| | Primary AC-IOL | Primary PC-IOL | Secondary AC-IOL |
|---|---|---|---|
| Nil | $p = 0.248$ | $p = 0.253$ | $p = 0.638$ |
| Primary AC-IOL | | $p = 0.125$ | $p = 0.428$ |
| Primary PC-IOL | | | $p = 0.30$ |

None of these results is statistically significant, but there is a trend towards better acuity following primary PC-IOLs compared with primary AC-IOLs.

In 1989, Spigelman *et al.*[15] stated that 'implantation of an IOL following vitreous loss . . . is a controversial decision'. As recently as 1991, Hykin *et al.*[16] were able to state that faced with accidental vitreous loss the 'surgeon has the choice of primary or secondary anterior chamber IOL' implantation. Despite these varied opinions, there appears to have been a steady move to implanting an IOL as part of the primary procedure. Whilst initially AC-IOLs were used, our experience is that there is almost invariably adequate capsulo-zonular support for a capsule-supported, sulcus-fixated PC-IOL without the need for fixation by scleral sutures. Our experience is consistent with that of O'Donnell and Santos[10] who report that they were able to insert a PC-IOL in 80% of cases following vitreous loss. Other authors have produced similar data: Nishi[9] was able to implant PC-IOLs in 61% of cases; Spigelman *et al.*[15] in 77%; Allinson *et al.*[5] in 22%; and Cruz *et al.*[8] in 90%. In contrast Pedersen[12] always changed from a planned PC-IOL to using an AC-IOL following vitreous loss during phacoemulsification, although the reason for this is not clear.

The improvement in visual acuity following cataract surgery has a vast literature. It is widely accepted that despite satisfactory surgery some patients do not achieve good levels of post-operative acuity due to pre-existent disease such as macular degeneration, glaucoma or unsuspected amblyopia. If such patients are included, then results may appear worse than expected. In the situation where surgery is complicated by vitreous loss, which is known to increase the risk of sight-threatening complications, it is also important to exclude pre-existing pathology when assessing improvement in vision. Data on visual performance after accidental vitreous loss during cataract surgery are less readily found in the literature, and are not always in a form which allows easy comparison. Vail[4] in his large series quotes an average post-operative acuity of less than 6/18. Mamo[17] reported in 1974 that for intracapsular surgery without IOL implantation, 42% of patients achieved a visual acuity of 6/12 or better following vitreous loss compared with 66% of uncomplicated cases. This is very similar to the results of Kroll *et al.*[7] who reported that 44.6% of their patients achieved

**Table VI.** Complication rates and specific cited complications in publications on vitreous loss during cataract extraction

| Authors | Complication rate after vitreous loss | Specific complications |
|---|---|---|
| Mamo (1974)[17] | 8% (50 patients) | 4% macular cysts<br>2% RD<br>2% glaucoma |
| Berger *et al.* (1980)[14] | NS (59 patients) | 14% chronic CMO<br>10% glaucoma<br>3% RD |
| Kroll *et al.* (1981)[7] | 5.8% (114 patients) | 8% RD<br>6% glaucoma<br>2.6% endophthalmitis<br>0.9% bullous keratopathy<br>0.9% maculopathy |
| Spigelman *et al.* (1989)[15] | NS (26 patients) | 7.7% RD |

RD, retinal detachment; CMO, cystoid macular oedema.

6/12 or better with a follow-up of more than 2 years. In contrast, the results reported by BenEzra and Chirambo[6] with similar surgery is probably much worse, with only 10% achieving 6/9 or better; the reason for this is not clear unless many of their patients achieved 6/12 but not 6/9 vision. However, they do report that only 23% of their uncomplicated cases achieved 6/9 or better, and this seems atypical. MacBeath and David[18] reported 20 cases of unilateral vitreous loss in bilateral cataract surgery, and reported that they were unable to find any statistically significant difference in astigmatism or visual acuity between the two eyes. Despite this, 80% of their patients had worse vision in the eye which suffered vitreous loss, and it seems likely that larger series would require these conclusions to be modified. Berger *et al.*[14] achieved 6/12 vision or better in 78% of 59 patients with vitreous loss during predominantly intracapsular surgery with a mean follow-up of 26 months.

The visual results for extracapsular surgery complicated by vitreous loss appear to be superior to those after intracapsular surgery complicated by vitreous loss. Nishi[9] reported that all his patients achieved 6/18 or better with a minimum follow-up of 6 months. Spigelman *et al.*[15] achieved 6/12 or better in 90% of cases, as did Cruz *et al.*[8] Allinson *et al.*,[5] in a paper reporting a high frequency of vitreous loss during phacoemulsification by residents and a low rate for PC-IOL implantation, quote a visual acuity of 6/12 or better for 74% of their patients, but with a follow-up of only 2–4 months. Our findings that 67% achieved 6/12 vision or better with a mean follow-up of 22 months is comparable to the best reported results. It is, however, significantly worse than if no vitreous loss occurs, and this is probably due to mild cystoid macular oedema undetected on routine clinical examination.

Whilst we believe that it is no longer controversial to implant an IOL following accidental vitreous loss, and that there is a steady trend towards the use of PC-IOLs rather than AC-IOLs whenever possible, it would be highly controversial to suggest that this change improves visual acuity. Our finding that patients with PC-IOLs following vitreous loss achieve a greater improvement in visual acuity than those receiving AC-IOLs, whilst not statistically significant, is in line with the results reported by Spigelman *et al.*[15] who found that all patients with PC-IOLs followed for 6 months or more achieved 6/12 vision or better compared with only 67% of those receiving AC-IOLs. This aspect clearly merits further investigation. Like Hykin *et al.*[16] we were unable to find any difference in final acuity whether AC-IOLs were inserted as a primary or a secondary procedure.

Our finding that there is less astigmatism following phacoemulsification complicated by vitreous loss than routine corneal section extracapsular cataract extraction and vitreous loss is merely a reflection of the advantage of small-incision surgery, but confirms that this advantage is not lost if vitreous is lost. We accept that we have merely reported post-operative refractive astigmatism rather than rigidly defined surgically induced astigmatism, but nevertheless this observation has not been documented previously. Since more than 2 of every 3 patients will have good visual acuities despite vitreous loss, a technique for cataract extraction which results in less astigmatism remains an advantage. Furthermore, improvements in the per-operative management of vitreous loss have resulted in significantly fewer follow-up appointments for these patients, which has financial implications.

In summary, we report 43 patients who have had accidental vitreous loss during cataract surgery since 1985. Immediate post-operative complications have effectively disappeared over the past 7 years. There has been a move away from leaving the patients aphakic to inserting an IOL. Whilst initially AC-IOLs were implanted, we believe that it is almost always possible to implant a sulcus-fixated capsule-supported PC-IOL if vitreous loss is managed optimally, and this is supported by our data. The prognosis for vision is not poor after vitreous loss, with 67% of patients achieving 6/12 or better, and long-term complications appear not to be as frequent as suggested by previous series, possibly as a result of alterations in per-operative management. The question of whether a better acuity can be achieved with the use of PC-IOLs than with AC-IOLs following accidental vitreous loss merits further study. Patients who have small-incision surgery (phacoemulsification) complicated by vitreous loss retain the advantage of reduced astigmatism and consequent improved unaided vision compared with those undergoing conventional cataract surgery with accidental vitreous loss. Some of these findings are undoubtedly similar to those experienced by other units, but we believe that the lack of publications describing these trends makes a comparison with the results of previous series necessary.

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Key words: Cataract surgery, Complications, Intraocular lens (IOL), Vitreous loss, Visual acuity.

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