Functional and anatomical outcomes of vitreoretinal surgery for posterior segment complications after elective cataract surgery

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PURPOSE: To assess the outcomes in patients who required 1 or more vitreoretinal interventions for posterior segment complications arising from elective uneventful cataract surgery.

SETTING: Tertiary referral center, single-center study.

METHODS: A retrospective interventional case series included 56 consecutive patients who were referred for surgical correction of posterior segment complications within 6 months of cataract surgery. The study period was between 1996 and 2003, and the minimum follow-up was 5 months.

RESULTS: Posterior segment complications were resolved with a single surgical intervention in 40 cases (71.4%). Within 5 months of primary surgical correction, persisting or newly arising posterior segment complications were noted in 16 cases (28.6%). After a mean of 2.1 $\pm$ 1.4 (SD) additional surgeries, the number of eyes with posterior segment problems decreased to 7 (12.5%) ($P = .035$). Posterior segment complications requiring more than 1 vitreoretinal intervention included retinal detachment, endophthalmitis, and choroidal hemorrhages. After primary correction surgery, the mean best corrected visual acuity increased from 0.15 $\pm$ 0.24 to 0.37 $\pm$ 0.33 ($P = .001$) after a single intervention and to 0.39 $\pm$ 0.32 ($P > .05$) after additional interventions. Although the intraocular pressure (IOP) decreased from 21.8 $\pm$ 16.6 mm Hg to 14.9 $\pm$ 3.4 mm Hg ($P = .008$), 4 (7.1%) consecutive vascular optic atrophies occurred. A reduction in corneal transparency was observed in 46.4% of patients before primary surgical correction and 12.5% after primary surgical correction ($P < .001$).

CONCLUSIONS: In many cases, posterior segment complications arising from cataract surgery could be repaired with favorable functional and anatomical outcomes by a single vitreoretinal intervention. Additional surgery, if requested, provided stabilization of the anatomical and functional outcomes.

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Although the incidence of intraoperative complications associated with cataract surgery is on the decline, some, such as posterior capsule rupture, will never be eliminated.[1–5] Surgical experience is a key determinant of the frequency and outcomes of intraoperative complications. Early recognition and proper handling of unexpected intraoperative events can minimize and confine the extent of tissue trauma without compromising the pseudophakic state or visual outcomes.[6–8] The risk for medical malpractice litigation may be lower when in complicated case, patients are satisfied with the final functional outcomes.[9]

Although intraoperative complications associated with cataract surgery are well documented,[10–12] the long-term outcomes of surgical treatments for these have been less extensively studied. If complications arise, they cannot be treated by a single surgical intervention in 25% of cases. Hence, we wished to analyze retrospectively the functional and anatomical outcomes of revision surgery for the posterior segment complications associated with cataract surgery in a consecutive case series. The retrospective study design and the limited sample size permitted comparison of the functional and anatomical outcomes of primary and additional vitreoretinal surgeries, but not an assessment of the surgical success relating to individual complications.

PATIENTS AND METHODS

In a retrospective interventional case-series, all patients who had been referred to the clinic for Vitreoretinal clinic at the University of Bern and who had been treated by the same surgeon (JGG) for any posterior segment problem incurred after cataract surgery between 1996 and 2003 were identified. Complications diagnosed later than 6 months after cataract surgery were considered to be not obviously attributable to cataract surgery and these

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cases were excluded. Other exclusion criteria were primary vitreoretinal surgery elsewhere, vitreoretinal surgery before cataract surgery, preexisting proliferative vitreoretinopathy (PVR) or vitreoretinal traction of any origin, preexisting retinal degeneration or high myopia (spherical equivalent greater than 8.00 diopters), preexisting glaucoma of any origin, history of blunt ocular trauma, pseudoexfoliation syndrome with or without preoperative lentodonesis, and follow-up after the last surgical correction of fewer than 5 months.

Patient Demographics

The age and sex of each patient, the type of cataract surgery, intraoperative complications, time between cataract surgery and posterior segment correction surgery, and the functional and anatomical findings on admission were recorded. In patients whose retinas could not be visualized well preoperatively, the preoperative data were supplemented with intraoperative findings.

Intraoperative Data: Primary Revision Surgery

The type of revision surgery, duration of surgery, intraoperative findings relating to vitreoretinal surgery, and type of anesthesia were recorded for each patient.

Patient Examinations

On admission, all eyes had a thorough examination. Patients having surgical correction were scheduled for postoperative visits at day 1 and after 1 to 2 weeks, 1 month, and 5 to 6 months. On each occasion, the following parameters were recorded: best corrected visual acuity (BCVA) using decimal notation, intraocular pressure (IOP), and anterior segment and posterior segment morphology. The morphology reports included the position of the intraocular lens (IOL); preexisting and new pathologies of the optic-nerve head, macula, and peripheral retina; and optically relevant irregularities and disturbances. Additional examinations were performed if new or changing ocular signs or symptoms manifested. In cases of retinal detachment (RD) surgery, surgical success was defined as complete and stable retinal reattachment posterior to the encircling band 5 months after the last revision surgery. Hypertension was defined as an IOP above 21 mm Hg, and hypotony was defined as IOP below 6 mm Hg.

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Statistical Analysis

Statistical analysis was performed using SPSS for Windows, version 11.5. Quantitative data were expressed as means ± SD and minimum and maximum values (range). Qualitative data were displayed in absolute numbers and percentages. In cases of macular degeneration or amblyopia, the BCVA was not used for statistical analysis. For statistical purposes, decimal visual acuity was converted into the logMAR equivalent [logMAR = −log(decimal acuity)]. Hand motions and counting fingers at 60 cm corresponded approximately to visual acuities of 0.001 and 0.01, respectively. Data recorded before revision surgery, 5 months after primary revision surgery, and after additional surgery were statistically compared. The data were confirmed to be normally distributed using Shapiro-Wilk statistics. The equality of variances was evaluated using the Levene test. Quantitative data were compared by analysis of variance in combination with Scheffé post hoc analysis. Qualitative data were compared using the Pearson chi-square test. Differences between sets of data were considered to be significant if, on the basis of 2-tailed tests, the *P* value was 0.05 or less.

RESULTS

Patient Demographics

Of the 118 patients identified, 31 were excluded for complications diagnosed later than 6 months after cataract surgery; 1 each for having primary vitreoretinal correction surgery elsewhere, vitreoretinal surgery before cataract surgery, preexisting retinal degeneration, or high myopia; 3 for preexisting PVR or vitreoretinal traction, 6 for preexisting glaucoma, 2 for a history of blunt ocular trauma, 7 for pseudoexfoliation syndrome, and 9 for follow-up after the last surgical correction of fewer than 5 months. Hence, 56 patients were eligible for the study.

The mean age of the 56 patients was 75.5 ± 9.2 years (range 53 to 92 years); 33 (58.9%) were women. The right eye was involved in 23 cases (41.1%). The mean time between cataract surgery and primary revision surgery was 27.7 ± 31.3 days (range 0 to 130 days). All patients had had routine elective phacoemulsification under local anesthesia before IOL implantation. A complication at the time of cataract surgery was reported in 49 eyes (87.5%). In 46 eyes (82.1%), an IOL was implanted in the posterior chamber. Ten eyes (17.9%) remained aphakic. No patient had anterior chamber IOL implantation. Intraoperative posterior capsule rupture occurred in 49 cases (87.5%).

Posterior Segment Complications Before Surgical Correction

Table 1 shows the posterior segment complications before and after vitreoretinal surgery. The most common complication after cataract surgery was loss of lens fragments into the vitreous cavity, which occurred in 23 eyes (41.1%) and led to phacolytic uveitis in 17 eyes (30.4%). Primary RD was associated with vitreous prolapse in

Table 1. Frequency of posterior segment complications before and after vitreoretinal surgery (N = 56).

	Number (%)		
Posterior Segment Complication	Before First Intervention	After First Intervention	After Additional Intervention(s)
Lens fragments in the vitreous cavity	23 (41.1)	0	0
Phacolytic uveitis	17 (30.4)	0 (0.0)	0 (0.0)
Partially or completely luxated IOL	12 (21.4)	3 (5.4)	3 (5.4)
Prolapse of vitreous into AC	14 (25.0)	0	0
Vitreal hemorrhage obscuring fundus view	3 (5.4)	0	0
Primary retinal detachment	13 (23.2)	11 (19.6)	1 (1.8)
Cystoid macular edema	5 (8.9)	3 (5.4)	2 (3.6)
Early-onset endophthalmitis	7 (12.5)	0	0
Choroidal hemorrhage	4 (7.1)	2 (3.6)	2 (3.6)
Vascular optic atrophy	0	1 (1.8)	4 (7.1)

AC = anterior chamber; IOL = intraocular lens

84.6% of cases. The mechanism of RD was tractional and rhegmatogenous in 5 cases each (38.5%). In the other 3 cases (23.1%), traction was presumed to be the cause. In all cases of early-onset endophthalmitis, cataract surgery was reported to be uneventful. No late-onset endophthalmitis was observed in any patient. One patient (1.8%) with extended choroidal hemorrhage developed an expulsive choroidal hemorrhage. In 1 case in which vitreous hemorrhage obscured the fundus view, the hemorrhage was the result of incarceration of the iris into the corneoscleral tunnel incision, with resulting primary hyphema.

Functional Status Before Vitreoretinal Correction Surgery

Four eyes with macular degeneration or amblyopia were excluded from the statistical analysis of BCVA. The mean BCVA in these eyes was 0.11 $\pm$ 0.11 (range 0.01 to 0.23). In the remaining 52 eyes, the mean BCVA before primary vitreoretinal correction surgery was 0.15 $\pm$ 0.24 (range 0.01 to 1.00).

Phacolytic uveitis was closely associated with the development of secondary glaucoma in 14 (82.4%) of 17 eyes. Secondary glaucoma occurred in 18 (32.1%) of 56 eyes and hypotony, in 6 eyes (10.7%).

Characteristics of Vitreoretinal Correction Surgery

Primary vitreoretinal correction surgery was complicated by significantly decreased corneal transparency in 26 eyes (46.4%) and resulted in delay of further revision surgery in 12 eyes (21.4%). The number of eyes with reduced corneal transparency decreased to 7 (12.5%) after the first intervention ($P < .001$) and to 1 (1.8%) after additional intervention ($P = .028$).

Surgery was performed under local anesthesia in 49 cases (87.5%). The mean duration of the primary intervention was 63.6 $\pm$ 22.0 minutes (range 15 to 120 minutes). Table 2 shows the intraoperative techniques used. All eyes with RD had placement of an encircling band. At the end of surgery, the retina was reattached in all cases. In eyes with acute-onset endophthalmitis, vitrectomy was supported by intraoperative intravitreal and intravenous injection of imipenem–cilastin and intravenous administration of prednisolone (initial dose 0.5 to 1.0 mg per kg of body weight).

All first interventions were uneventful. Patients having primary treatment for vitreoretinal complications of cataract surgery were hospitalized for a mean of 4.23 $\pm$ 2.7 days (range 1 to 16 days). After primary vitreoretinal surgery, no eye was left aphakic. In 7 cases (12.5%), the IOL had to be explanted and replaced. Of eyes that had secondary IOL implantation (Table 2), 14 (25.0%) had sulcus implantation and 3 (5.4%) required additional transscleral suturing. No anterior chamber IOLs were implanted. Additional vitreoretinal surgery was required in 16 cases (28.6%); the mean number of additional interventions per eye was 2.06 $\pm$ 1.4 (range 1 to 5). Table 2 shows the additional interventions.

Posterior Segment Complications After Vitreoretinal Correction Surgery

Posterior segment complications were treated with a single surgical intervention in 40 cases (71.4%). Five months after primary vitreoretinal correction surgery, the frequency of persisting or newly arising posterior segment complications decreased to 28.6% (16/56) ($P < .001$). After additional interventions, the frequency of persisting or secondary posterior segment problems decreased further to 12.5% (7/56) ($P = .035$) (Figure 1).

The incidence of RD, the most frequent complication after primary vitreoretinal correction surgery, decreased

Table 2. Surgical techniques applied in primary and additional intervention(s).

	Number (%)	
Surgical Technique	First Intervention	Additional Intervention(s)
Pars plana vitrectomy	52/56 (92.9)	26/37 (70.3)
Intraocular tamponade		
Air	46/52 (88.5)	3/26 (11.5)
SF_6–air mixture	5/52 (10.9)	7/26 (26.9)
Silicone oil (5000 sci)	1/52 (1.9)	13/26 (50.0)
Silcone oil removed	0/56	3/26 (11.5)
Removal of retained lens fragments	22/56 (39.2)	0
Secondary implantation of an IOL		
Total number	17/56 (30.3)	3/37 (8.1)
With transscleral suture fixation	3/56 (5.4)	3/37 (8.1)
With explantation of primary IOL	7/56 (12.5)	0
Placement of encircling band	13/56 (23.2)	6/37 (16.2)
Intravitreal antibiotics (imipenem–cilastin 5 mg/L)	7/56 (12.5)	0
Repositioning of subluxated IOL	6/56 (10.7)	0
Drainage of a choroidal hemorrhage	3/56 (5.4)	1/37 (2.7)
Macular peeling	2/56 (3.6)	1/37 (2.7)

IOL = intraocular lens; SF_6 = sulfur hexafluoride

slightly after the first intervention (Table 1) (*P* = .645); these included 5 patients with recurrent RD and 6 with newly developed RD, 4 of whom had acute endophthalmitis and 2, choroidal hemorrhage (Table 1). The main cause of RD after primary vitreoretinal surgery was PVR, which was present in 9 (81.8%) of 11 cases. In 2 patients, the cause of RD was rhegmatogenous. The treatment of RD after primary vitrectomy required a mean of 2.1 ± 1.4 further vitreoretinal interventions per eye (range 1 to 5 interventions) within the following 5 months. After further posterior segment surgery, the incidence of RD decreased significantly (*P* = .03). The 1 patient with RD after additional surgery was treated for an expulsive choroidal hemorrhage. He presented with a persisting and stable PVR-associated RD after 2 vitrectomies with silicone oil tamponade, which did not necessitate further surgical intervention.

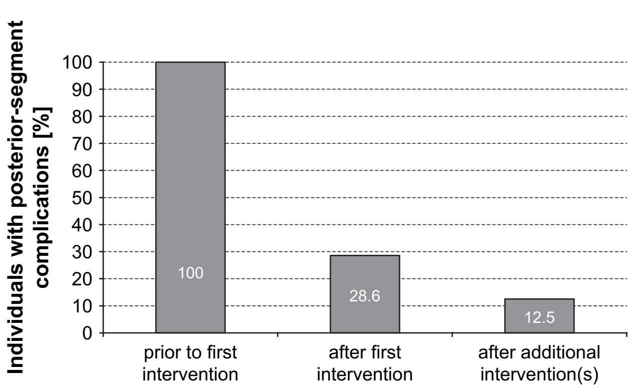

Figure 1. Frequency of posterior segment complications after primary and additional vitreoretinal correction surgery.

After the first intervention, the incidence of partially or completely dislocated IOLs decreased significantly (Table 1) (*P* = .006). The mean number of additional surgeries in the 3 eyes with a completely dislocated IOL was 1.0 ± 0.0. The frequency of macular edema also decreased from before the first intervention to after additional interventions(s), although the decrease was not significant (*P* = .475). After the first intervention, the incidence of persisting choroidal hemorrhage decreased, but not significantly (*P* = .592). In the 2 cases in which the hemorrhage persisted, it could not be completely removed by additional surgery. In both cases, a PVR-associated RD also developed.

The only posterior segment complication that increased in frequency after vitreoretinal correction surgery was vascular optic atrophy, which occurred in 1 case (1.8%) after the primary intervention and in 4 cases (7.1%) after the second intervention(s) (*P* =.069) (Table 1). Of the 4 patients with vascular optic atrophy, 2 had endophthalmitis and 2 had secondary glaucoma.

Functional Outcomes After Vitreoretinal Correction Surgery

The mean BCVA improved from 0.15 ± 0.24 (range 0.01 to 1.0) before the primary vitreoretinal correction surgery to 0.37 ± 0.33 (range 0.01 to 1.00) 5 months after the intervention (*P* = .001). Additional surgery resulted in stabilization of the mean BCVA, which was 0.39 ± 0.32 (range 0.01 to 1.00) (*P* =.907) (Figure 2).

The BCVA was 0.5 or better in 9 cases (16.1%) before the initial vitreoretinal intervention and in 25 eyes (44.6%) 5 months after (*P* = .01). Five months after

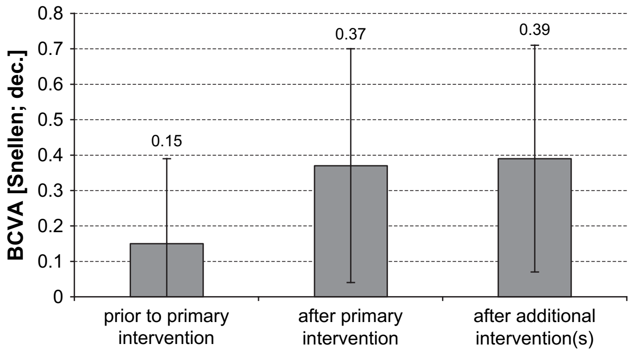

Figure 2. Course of BCVA after 1 or more vitreoretinal correction surgeries.

additional intervention(s), BCVA was 0.5 or better in 29 eyes (51.8%) ($P = .449$) (Figure 3).

Five months after primary vitreoretinal correction surgery, the mean IOP decreased from 21.8 $\pm$ 16.6 mm Hg (range 2 to 59 mm Hg) preoperatively to 14.9 $\pm$ 3.4 mm Hg (range 5 to 24 mm Hg) ($P = .008$). In patients requiring more than 1 intervention, the mean IOP further normalized to a mean of 11.9 $\pm$ 3.6 mm Hg (range 7 to 22 mm Hg) ($P = .138$) (Figure 3). Primary vitreoretinal intervention led to a decrease in hypotony cases from 6 (10.7%) to 1 (1.8%) ($P = .051$); after additional intervention(s), the frequency decreased to 0% ($P = .315$). The number of secondary glaucoma/hypertony cases after primary revision decreased from 18 (32.1%) to 4 (7.1%) ($P = .001$). After additional surgery, 2 eyes (3.6%) still had secondary glaucoma/hypertony ($P = .401$).

DISCUSSION

According to our interventional case series, more than 70% of all posterior segment complications occurring after routine cataract surgery can be successfully treated by a single vitreoretinal correction surgery. In most cases, BCVA increased and IOP decreased. In the remaining cases, a mean of 2 additional interventions were required to achieve a stable anatomical result, which was generally accompanied by moderately better BCVA and lower IOP than after the first vitreoretinal intervention. Excluding the 1 patient who refused further surgical intervention, posterior segment complications were successfully treated by vitreoretinal correction surgery. More than 1 surgical intervention may be required in more complex situations, such as bacterial endophthalmitis, early postoperative RD, or choroidal hemorrhage.[13–22]

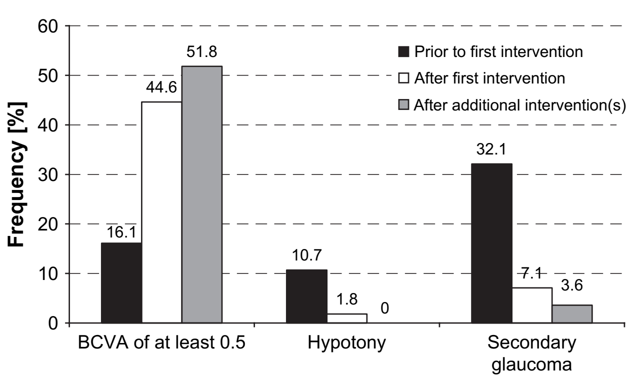

Figure 3. Functional outcomes 5 months after 1 or more vitreoretinal correction surgeries.

Following retention of lens fragments and associated problems, RD is the most common complication of cataract surgery. In the present study, approximately 85% of patients with RD had prolapse of the vitreous that was not treated during cataract surgery. Capsule rupture does not necessarily result in poor functional outcomes.[23–26] If the stability of the retina is not compromised by capsule rupture with consequent vitreoretinal traction or nuclear fragment retention, favorable outcomes can be expected.[19,23,27] The risk for RD after complicated cataract surgery can be lowered by adopting simple prophylactic strategies. Most important, a complete anterior vitrectomy should be performed via the pars plana route. By relieving vitreoretinal traction, this procedure forestalls a secondary prolapse, incarceration of the vitreous, and secondary vitreoretinal traction.[3,28]

A factor that may have been the reason there was only a slight decrease in the incidence of RD after primary vitreoretinal correction surgery was the reduced corneal transparency at the time of the first intervention.[23,29] In our series, retinal visibility was compromised in 46% of the patients at this time. After further interventions, the incidence of reduced corneal transparency decreased to 12.5%. Therefore, in a significant number of cases, primary vitreoretinal correction surgery improved the conditions for further vitreoretinal interventions. In our study, all patients with reduced corneal transparency had posterior segment complications. Therefore, we were unable to distinguish between the effects on BCVA of regained corneal transparency and of the successful management of posterior segment complications. According to ours and existing data,[23,28,30] the overall functional prognosis may be optimistically estimated if no macular pathology is apparent and visibility of the retina is not compromised at the time of referral.[31]

Phacolytic uveitis was frequently associated with the development of a secondary glaucoma/ocular hypertension (82.4%), which was diagnosed in one third of our patients. This incidence corresponds to that reported by other authors.[23,29] Most cases of secondary glaucoma were resolved by removing the vitreous and retained lens fragments.[22,26] The development of vascular optic atrophy was the only posterior segment complication that increased in frequency (to 7.2%). Diffuse nonglaucomatous vascular optic atrophy was observed in 2 individuals with persisting secondary glaucoma and in 2 with endophthalmitis. In the latter 2 cases, it was probably associated with a postoperative hypertensive crisis. Thus, a simple preventive strategy to support vitreoretinal surgery may be early referral of patients with retained lens fragments. This strategy may prevent severe secondary uveitis, secondary glaucoma, and persistent macular problems.[21,31,32]

Additional interventions had no statistical effect on the incidence of cystoid macular edema, secondary glaucoma, atrophy of the optic nerve, or persisting choroidal hemorrhages. However, it stabilized the anatomical success, increased BCVA, and decreased IOP. Therefore, additional surgery conceivably prevented phthisis bulbi or amaurosis.

Despite surgical improvements and the increasing safety of cataract surgery, the continued occurrence of posterior segment complications, such as RD, phacolytic uveitis, secondary glaucoma, and endophthalmitis, clearly indicates the need for careful postoperative monitoring.

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