

# Visual acuity outcomes following vitreous loss in glaucoma and diabetic patients

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CLINICAL STUDY

## Abstract

**Purpose** To analyze the visual acuity (VA) of patients with and without vitreous loss, while concurrently analyzing the effects of the pre-existing pathologies of glaucoma and diabetes on VA.

**Methods** A retrospective study on 1013 cataract extractions from 1995 to 1999 was performed. Patients included in this study had intraocular lens implantation during phacoemulsification surgery, no intraoperative complications besides vitreous loss, had no other prior ophthalmic condition other than glaucoma or diabetes, and had a postoperative follow-up interval between one and 4 months. When indicated, vitrectomy was performed concurrently with phacoemulsification following vitreous loss. Patients diagnosed with both glaucoma and diabetes were excluded. The identified subjects were then placed into six groups: (1) patients with uncomplicated surgery; (2) patients with surgery complicated by vitreous loss; (3) glaucoma patients with uncomplicated surgery; (4) glaucoma patients with surgery complicated by vitreous loss; (5) diabetic patients with uncomplicated surgery; and (6) diabetic patients with surgery complicated by vitreous loss. A two-tailed, heteroscedastic *t*-test and power calculation were performed on the preoperative and postoperative visual acuities of the groups. **Results** There were statistically significant differences ( $P < 0.05$ ) in the postoperative VA between patients with and without vitreous loss at the time of surgery. Patients with the pre-surgical conditions of diabetes or glaucoma did not display a statistically significant difference in postoperative VA when compared to controls. However, the pre-surgical condition of glaucoma displayed a trend, which showed it may contribute to a

poorer postoperative VA ( $P = 0.072$ , power = 0.430).

**Conclusions** Vitreous loss is a risk factor for a decreased postoperative VA. Also while the pre-surgical condition of glaucoma may play a role in decreasing postoperative VA, diabetes does not.

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**Keywords:** cataract surgery; phacoemulsification; complications; vitreous loss; visual acuity; diabetes; glaucoma

## Introduction

Vitreous loss is the most prevalent complication of cataract surgery. The occurrence of vitreous loss is associated with an increased frequency of retinal detachment, cystoid macular edema, corneal decompensation, and pseudophakic glaucoma, among other complications.<sup>1–5</sup> However, previous studies show conflicting results concerning the effect of vitreous loss on visual acuity (VA). Claoue and Steele showed a significant difference in VA between vitreous loss and non-vitreous loss patients during cataract surgery while Nishi and Bowbrow did not.<sup>5–7</sup>

There is little recent literature discussing the effect of specific preoperative diseases on VA during cataract surgery. Although studies have shown pre-existing eye disease contributes to a poorer postoperative VA, no study to date has focused specifically on the influence of pre-existing glaucoma or diabetes on postoperative VA.<sup>8</sup> For example, it is known that cases of cataract and glaucoma are surgically difficult to manage because patients often have small pupils and uncontrolled intraocular pressures.<sup>1,2,9–11</sup> Also, diabetic eyes

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often resist dilatation of the pupil. Because cases with these pre-existing pathologies frequently are surgically more cumbersome, the frequency of complications such as vitreous loss may increase. It is thus vital to understand whether vitreous loss is a risk factor for decreased improvement in VA postoperatively, and if so, how prior conditions such as glaucoma and diabetes complicate the outcome of cataract surgery. The final VA could be an important factor for both the physician and patient in deciding whether this postoperative acuity is worth the risk of surgery. In this report, we conduct a retrospective analysis of cases to evaluate the VA of patients with and without vitreous loss, while concurrently analyzing the effects of the pre-existing pathologies of glaucoma and diabetes on VA.

### Materials and methods

Both patients with uncomplicated cataract surgery, and those with cataract surgery complicated by vitreous loss, were identified from medical records in the Department of Ophthalmology and Visual Science at the University of Chicago. Data from 1995 through 1999 were collected on a standard form detailing preoperative and postoperative VA and intraoperative complications, among other information. All the relevant data were assimilated and abstracted onto a spreadsheet for analysis. The patients included in the study underwent cataract extraction by phacoemulsification and intraocular lens implantation. The patients did not have planned vitreous surgery, had no intraoperative complications besides vitreous loss, no secondary surgical intervention, no report of postoperative glaucoma, had no other prior ophthalmic condition other than glaucoma or diabetes, and had a postoperative follow-up interval between one and 4 months.<sup>5,12</sup> Vitrectomy was performed concurrently with phacoemulsification, when indicated, following vitreous loss. Patients diagnosed with both glaucoma and diabetes were excluded.

We define visual acuity (VA) using the standard Snellen charts. Intraocular pressure (IOP) was measured using standard tonometry. In this study, glaucoma is defined as a combination of elevated IOP (>22 mmHg), increased cup-to-disc ratio, and glaucomatous visual field changes, necessitating treatment. Finally, we define diabetics as those patients receiving treatment for elevated blood glucose levels.

There were a total of 404 patients, placed into six groups: (1) patients with uncomplicated surgery ( $n = 268$ ); (2) patients with surgery complicated by vitreous loss ( $n = 26$ ); (3) glaucoma patients with uncomplicated surgery ( $n = 25$ ); (4) glaucoma patients with surgery

**Table 1** Preoperative and postoperative visual acuities of patient groups

Group	Patients	Characteristics of group	Preop	Postop
1	268	No vitreous loss, no glaucoma, no diabetes	0.35	0.75
2	26	Vitreous loss, no glaucoma, no diabetes	0.29	0.60
3	25	No vitreous loss, glaucoma, no diabetes	0.36	0.67
4	7	Vitreous loss, glaucoma, no diabetes	0.24	0.48
5	67	No vitreous loss, no glaucoma, diabetes	0.29	0.72
6	11	Vitreous loss, no glaucoma, diabetes	0.24	0.48

complicated by vitreous loss ( $n = 7$ ); (5) diabetic patients with uncomplicated surgery ( $n = 67$ ); and (6) diabetic patients with surgery complicated by vitreous loss ( $n = 11$ ). A two-tailed, heteroscedastic *t*-test and power calculation were performed on the preoperative and postoperative visual acuities of the groups (*P*-values less than 0.05 were considered significant).

### Results

During the study period, there were a total of 1013 cataract extractions. This study focuses on 44 cases, all of which had vitreous loss. The patient group consisted of 16 males with an average age at time of surgery of  $69.8 \pm 11.5$  (SD) years (range 41–85 years) and of 28 females with an average age at time of surgery of  $74.0 \pm 14.0$  (SD) years (range 40–92 years). Because diabetes and glaucoma can complicate cataract surgery, patients who had these diseases were identified. Eleven cases of diabetes and seven cases of glaucoma from the 44 cases were analyzed. The best-corrected preoperative and postoperative VA of these patient groups are summarized in Table 1 (decimal notation was used for visual acuity). A two-tailed, heteroscedastic *t*-test of the data comprising the averages listed in Table 1 was performed. The preoperative and postoperative *P*-values are reported in Tables 2 and 3, respectively.

Table 2 shows that none of the preoperative *P*-values

**Table 2** Statistical comparison of preoperative visual acuity (*P*-values)

Groups	2	3	4	5	6
1	0.175	0.835	0.143	0.053	0.064
2		0.241	0.576	0.875	0.506
3			0.152	0.202	0.091
4				0.466	0.987
5					0.364

**Table 3** Statistical comparison of postoperative visual acuity (P-values)

Groups	2	3	4	5	6
1	0.014*	0.072	0.045*	0.341	0.017*
2		0.322	0.358	0.065	0.282
3			0.141	0.326	0.086
4			0.069	0.958	
5					0.032*

Statistically significant P-values are marked by an asterisk (\*).

were significant; hence, differences between the groups can be attributed to the significance of their postoperative values. However, the three P-values less than 0.10 indicate that patients with diabetes may have a disposition toward a poorer preoperative VA.

In comparison to non-vitreous loss cases, it was demonstrated that the complication of vitreous loss contributed to a lower postoperative VA ( $P = 0.014$ , power = 0.716). Glaucoma itself displayed a trend which showed that it may contribute to a lower postoperative VA even though this value was not statistically significant ( $P = 0.072$ , power = 0.430). More support for the previous statement was garnered by the comparison of subsets 2 and 3, which indicate that similar postoperative VA outcomes were obtained for either patients with glaucoma or patients with a vitreous loss complication ( $P = 0.322$ , power = 0.160). However, the hypothesis that both glaucoma and vitreous loss produced a combined deleterious effect on postoperative VA, was not confirmed ( $P = 0.358$ , power = 0.122 and  $P = 0.141$ , power = 0.261). Of note, although glaucoma patients may display a trend toward a lower postoperative VA, the low power values indicate that the data may have been susceptible to Type II error. Diabetic patients did not appear to have a different postoperative VA, compared to their non-diabetic counterparts ( $P = 0.341$ , power = 0.154). The disparity in postoperative VA in cases of both vitreous loss and diabetes could be solely attributed to vitreous loss ( $P = 0.032$ , power = 0.599). Interestingly, when patients with vitreous loss and diabetes were contrasted with patients with glaucoma, the postoperative VA was not significant ( $P = 0.086$ , power = 0.387). This was not surprising because although the VA was near the significance level, glaucoma itself may contribute to a lower postoperative VA. The low power values might suggest an increased probability of Type II error.

## Discussion

It is known that vitreous loss increases the frequency of certain complications such as retinal detachment,

cystoid macular edema, corneal decompensation, and pseudophakic glaucoma.<sup>1-5</sup> However, conflicting results are observed in the literature regarding the effect of vitreous loss and postoperative VA. Some studies show no significant difference in postoperative VA for surgeries complicated with and without vitreous loss, while others show a decrease in postoperative VA.<sup>5-7</sup>

In this study, we observe that vitreous loss is a risk factor for decreased postoperative VA regardless of a vitrectomy. This poorer vision could be due to a complication such as cystoid macular edema occurring as a result of an 'incomplete vitrectomy,' a procedure characterized by the unintentional retention of vitreous due to surgical error.<sup>4,5</sup> Also, it has been shown that excessive surgical manipulations cause more complications, which in turn can lead to a poorer visual prognosis. For example, when a vitrectomy has to be performed, the patient is immediately placed at risk for a lower postoperative VA.<sup>1,6</sup>

The pre-existing pathology of glaucoma is known to complicate cataract procedures. Reasons for the increased complication rate are uncontrolled IOP and small pupils. Previous studies described that small pupils make the procedure more challenging for the surgeon, and place tissues such as the iris at greater risk for damage.<sup>1,2,9-11</sup> Although the result was not significant, the data indicate that the prior condition of glaucoma might place the patient at risk for a decreased postoperative VA. It again could be implied that because the cataract procedure for a glaucoma patient often involves more surgical manipulation, increased complications and a poorer postoperative VA are inevitable. However, glaucoma patients with a satisfactory surgery generally have lower postoperative VA than non-glaucoma patients with a similar surgery.<sup>5</sup> This supports the notion that glaucoma may play a role in decreasing the postoperative VA of cataract patients. On the other hand, the same is not true for diabetes. Although diabetes may increase the difficulty of cataract surgery by affecting the microvasculature, no correlation is shown to exist between diabetes and a decreased postoperative VA. Despite the relationships elucidated above concerning glaucoma and diabetes and their correlation with postoperative VA, the low power values suggest an increased probability of producing a Type II error.

In order to minimize the variance between patients and increase the power of the statistical test, more patients should be analyzed and future research is indicated. However, the task of increasing the patient population is extremely challenging because the rarity of vitreous loss is compounded by the search for corresponding pathology such as glaucoma or diabetes. Other limitations of this study include its relatively

short follow-up and retrospective analysis. Also, a more conclusive evaluation of factors such as glare, contrast sensitivity, and color appreciation should be analyzed. Because cataract procedures are often aimed toward improving the previous factors, patients who in this study display no improvement in VA may in fact be pleased with their overall visual outcome.<sup>13</sup> In addition, many studies focus on the difficulty of analyzing coexistent ophthalmic conditions such as cataracts and glaucoma. Although the analysis of the individual effect of either glaucoma or cataract on the combined visual field is difficult, our measurement of VA is straightforward.<sup>9,10</sup>

This study demonstrates that vitreous loss automatically places patients at risk for a lower postoperative VA. Vitreous loss is often a complication for residents in training. While residents improved with time and experience, numerous articles detail resident vitreous loss complication rates of 5.5–20%.<sup>14–16</sup> Therefore, residents should be carefully trained and should practise on eyes and simulation programs before being allowed to perform surgery. Beyond that, residents should be careful in case selections, to further minimize the risk of vitreous loss.

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