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Original Article

Outcomes of resident physician-performed cataract surgery in a diverse veterans affairs health system population

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Purpose: To evaluate visual acuity (VA) outcomes and complications from resident physician-performed cataract surgery in a diverse Veterans Affairs Hospital population. **Methods:** A retrospective chart review was conducted for patients who underwent cataract surgery performed by resident physicians from 01/01/2013 to 12/31/2015 at the Veterans Affairs Medical Center. Intraoperative and postoperative clinical information, best-corrected VA (BCVA) (1 day, months 1, 2-3, and 6), and surgery complications were extracted. Univariable and multivariable linear regression models were performed for risk factors of BCVA change. **Results:** This study included 1183 patients, with mean (SD) age of 70.8 (9.3) years. 1154 (97.5%) were males, 493 (41.7%) African-American, and 681 (57.6%) Caucasian. The mean (SD) VA in logMAR was 0.69 (0.74) at baseline, improved to 0.19 (0.36) at 1 month, 0.16 (0.34) at 2-3 months, and 0.14 (0.36) at 6 months. 1080 (91.3%) patients experienced VA improvement from baseline and 1023 (86.5%) patients achieved at least 20/40 BCVA at 1 month. There were 86 (7.3%) complications, most commonly including 47 (4.0%) posterior capsular tears and 64 (5.4%) vitreous loss. In multivariable analysis, younger age ($P < 0.0001$), worse baseline VA ($P < 0.0001$), and absence of iris prolapse ($P < 0.001$) were significantly associated with greater improvement in VA at 1 month. **Conclusion:** In a diverse VAMC, resident-performed cataract surgeries achieved significant improvement in VA with a cumulative complication rate lower than previously reported. Resident physician education may benefit from specific focus on prevention of iris prolapse and better incision construction during surgery as these intraoperative events often led to delayed stabilization of visual outcome beyond 1 month.

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Cataract surgery is one of the most commonly performed surgical procedures across the globe, with growing demand as society ages. Therefore, training resident physicians to perform cataract surgery and ensuring quality of care delivery are a particularly important part of an ophthalmology residency program. Furthermore, the increasing emphasis on outcome-based approaches to resident physician education over simple minimum requirements drives the need for evaluation of resident physician-performed procedures.[1] Although there are many studies examining the complications and outcomes of resident physician-performed cataract surgery,[2-12] they are difficult to apply to individual institutions due to the wide range of patient populations and comorbidities, resident physician curriculums, surgical volumes, and due to different phacoemulsification technologies (more ECCE cases) and residency training structures in older studies (1984-1997).[2-12,10] A more recent study analyzed 1290 resident physician-performed cataract surgeries;[13] however, the authors focused on visual outcomes and complication rates at a tertiary-care county hospital as compared to other training hospitals and did not find significant predictors for complications or poor visual outcomes.

Studies focusing on the Veterans Health Administration (VHA) are impactful given the high volume and frequency of cases with resident physicians as primary surgeons. A multi-institutional study across five VHA medical centers involving 4,221 cases evaluated multiple intraoperative and postoperative factors and found that resident physician-operated cases with and without intraoperative complications had an overall significant improvement in (VA) and visual function.[3] However, follow-up time and demographic diversity were limited, necessitating further study of resident physician-operated cataract surgery outcomes.[12,14]

Beyond residency-specific training, there have been few studies examining objective functional visual outcomes of

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cataract surgery at a large range of preoperative best-corrected visual acuity (BCVA). Therefore, in this study, we hope to expand on previous studies examining resident physician-performed cataract surgeries to determine visual outcomes, surgery complications, and to identify preoperative risk factors for poor visual outcomes in a diverse population.

Methods

A retrospective chart review was conducted for patients who underwent resident physician-performed phacoemulsification cataract surgery at the Veterans Affairs Medical Center from 01/01/2013 to 12/31/2015. This three-year time period allowed us to assess 15-20 resident physicians as the primary surgeons without including any current resident physicians that would be identifiable. Demographics and information regarding the surgery and outcomes over 6 months after cataract surgery were gathered including previous medical and ocular histories, baseline exam, cataract classification, medication usage, and prior ocular surgery. Intraoperative data were extracted including date, type of cataract surgery, presence of concurrent glaucoma surgery, length of surgery, use of trypan blue, iris hooks, malyugin ring, and capsular tension ring or sutures, as well as surgical complications including hyphema, choroidal effusion, retrobulbar hematoma, dropped nucleus, iris prolapse, anterior capsule tear, posterior capsule tear, zonular dehiscence, and vitreous loss. Data from the complete follow-up examinations and medication use at 1 day, 1 week, 1 month, 2-3 months, and 6 months were collected. Patients were excluded if they did not return for follow-up after surgery. The study was approved by the Veterans Association Institutional Review Board.

Of note, patients were not preselected in any way for residents. Instead, the service was considered to be "resident run," meaning that all cataract cases that present will be completed with the resident as the primary surgeon. In addition, all residents were senior pgy4 residents in the last six months of their residency training.

Statistical analysis

Descriptive statistics were calculated using mean (standard deviation [SD]) for normally distributed data, median (1st quartile, 3rd quartile), minimum and maximum for skewed data, and using frequency and percentage for categorical characteristics and cataract surgery complications. Mean VA change from baseline in logMAR was calculated for 1 day, 1 week, 1 month, 2-3 months, and 6 months postsurgery and were tested for their statistically significant change from baseline using paired t-tests. Univariable and multivariable linear regression models were performed to determine the risk factors for a VA change from baseline and worsening VA at 1 month after cataract surgery. To improve the statistical power, we also evaluated the factors associated with VA change from baseline at week 1, month 1, 2-3, and 6 combined, by using the generalized linear regression model that accounted for both the intereye correlation from patients who contributed data from both eyes and correlations from repeated measures from the same eye. In these analyses, risk factors with P value < 0.10 in univariable analysis were included in the initial multivariable model, and backward variable selection was used to derive the final multivariable models. All statistical analyses were performed in SAS version 9.4 (SAS Institute Inc., Cary, NC), and 2-sided P values < 0.05 were considered statistically significant.

Results

Characteristics of patients

The study included 1183 patients, with mean (SD) age of 70.8 (9.3) years. 1154 (97.5%) of patients were males, 493 (41.7%) African-American, and 681 (57.6%) Caucasian [Table 1].

Table 1: Preoperational characteristics (*n*=1183)

Preoperational Characteristics	*n* (%)
Age (years): Mean (SD)	70.8 (9.3)
Race	
Asian	4 (0.3%)
Black	493 (41.7%)
White	681 (57.6%)
Other	5 (0.4%)
Gender	
Female	29 (2.5%)
Male	1154 (97.5%)
Visual acuity (logMAR): Median (1st quartile, 3rd quartile)	0.4 (0.3, 0.7)
Baseline IOP in mmHg: Mean (SD)	14.8 (3.5)
Nuclear sclerosis	
0	40 (3.4%)
0.5	8 (0.7%)
1	181 (15.3%)
2	545 (46.2%)
3	357 (30.3%)
4	49 (4.2%)
Cortical spokes	
0	473 (40.3%)
0.5	48 (4.1%)
1	230 (19.6%)
2	273 (23.2%)
3	123 (10.5%)
4	28 (2.4%)
Posterior subcapsular cataract	
0	554 (47.1%)
0.5	70 (6.0%)
1	196 (16.7%)
2	173 (14.7%)
3	139 (11.8%)
4	43 (3.7%)
Cup to disc ratio: Mean (D)	0.4 (0.2)
Number of glaucoma medications: Mean (SD)	0.1 (0.3)
Number of glaucoma drops: Mean (SD)	0.1 (0.5)
Alpha blocker	338 (28.6%)
Medical history	
Ocular trauma	103 (8.7%)
Diabetes	643 (54.4%)
Hypertension	929 (78.5%)
Retinal surgery	25 (2.1%)
Glaucoma surgery	15 (1.3%)
Corneal surgery	2 (0.2%)
Refractive surgery	2 (0.2%)
Uveitis	3 (0.3%)

Preoperative VA had a median (interquartile range) of 0.4 (0.3, 0.7) logMAR (Snellen: Median 20/50, interquartile 20/100 to 20/40), ranging from 20/25 to count finger. Furthermore, demographics and systemic comorbidities are shown in Table 1. In terms of cataract type and grade, 1140 (96.6%) were noted to have nuclear sclerosis (NS), 710 (59.7%) cortical spokes (CS), and 629 (52.9%) posterior subcapsular cataracts (PSC) with further characterization in Table 1. Duration of surgery was on average 51.2 minutes (standard deviation 49.7 minutes) [Table 1] and was not significantly associated with grade of cataract, complication rate, or visual acuity outcomes [Supplementary Tables 1-3].

When considering intraoperative characteristics. 28 (2.4%) had glaucoma surgery performed at the time of cataract surgery [Table 2]. In cataract surgery, 60 (5.1%) used trypan blue, 432 (36.5%) used iris hooks, 498 (42.1%) used a malyugin ring, 24 (2.0%) used a capsular tension ring, and 376 (31.8%) used a suture.

Table 2: Intraoperative characteristics and complications (*n*=1183)

Intraoperative characteristics	Statistics
Glaucoma surgery done at the same time	28 (2.4%)
Length of surgery (min): Mean (SD)	51.2 (49.7)
Retrobulbar hematoma	1 (0.1%)
Trypan blue	60 (5.1%)
Iris hooks	432 (36.5%)
Malyugin ring	498 (42.1%)
Capsular tension ring	24 (2.0%)
Suture	376 (31.8%)
Complications	
Hyphema	4 (0.3%)
Choroidal effusion	0 (0%)
Dropped nucleus	21 (1.8%)
Iris prolapse	10 (0.8%)
Anterior capsule tear	7 (0.6%)
Posterior capsule tear	47 (4.0%)
Zonular dehiscence	13 (1.1%)
Vitreous loss	64 (5.4%)

Complications of cataract surgery

Intraoperative complications of cataract surgery occurred in 86 (7.3%) patients, including hyphema (n = 4, 0.3%) patients, dropped nucleus (n = 2, 1.8%) in patients, iris prolapse (n = 10, 0.8%) patients, anterior capsular tears (n = 7, 0.6%) in patients, posterior capsular tears (n = 47, 4.0%) in patients, zonular dehiscence (n = 13, 1.1%) in patients, and vitreous loss (n = 64, 5.4%) in patients [Table 2]. Eleven patients (0.9%) required a revision or repeat surgery within 30 days for complications including dropped nucleus, retained nuclear fragment, dislocated intraocular lens, wound leak, uncontrolled elevation in IOP, and retinal detachment.

Visual acuity outcome

After cataract surgery, patients showed the greatest VA improvement from baseline by week 1 (logMAR 0.69 at baseline, 0.19 at week 1). VA was relatively stable from week 1 to month 6 [Table 3]. Grouping by baseline VA demonstrated that patients with baseline logMAR 0.3 (20/40) or better did not experience a significant improvement in VA from baseline [Table 3]. In contrast, patients with baseline logMAR 0.3 to 0.5 or 0.5-1.0, and >1.0 experienced significant improvement in VA from baseline, with worse preoperative VA associated with a greater improvement from baseline [Table 3].

Given that VA remained stable after week 1 in this population [Table 3], univariate [Supplementary Table 1] and multivariate [Table 4] risk factor analysis for VA change from baseline at 1 month was performed. In multivariable analysis, younger age ($P < 0.0001$), worse baseline VA ($P < 0.0001$), and absence of iris prolapse ($P < 0.001$) were significantly associated with greater VA improvement from baseline [Table 4]. In longitudinal analysis combining all VA measures at 1 week and after, younger age ($P < 0.0001$) and worse baseline VA ($P < 0.0001$) remained significantly associated with greater VA improvement from baseline.

Analysis for factors associated with any worsening in VA postoperatively was also performed through univariable analysis [Supplementary Table 2] and multivariable

Table 3: Change of visual acuity after surgery overall and segmented by baseline operative visual acuity

Visual acuity outcome# of eyes at baseline	Time	All subjects *n*=1183	Baseline Visual Acuity logMAR Group				
			≤0.3 *n*=116	>0.3–≤0.5 *n*=616	>0.5–≤1.0 *n*=307	>1.0 *n*=144	*P**
Mean visual acuity in logMAR (SD)	Baseline	0.69 (0.74)	0.13 (0.08)	0.37 (0.07)	0.72 (0.17)	2.45 (0.76)	-
	Day 1	0.47 (0.59)	0.35 (0.05)	0.40 (0.02)	0.51 (0.03)	0.83 (0.05)	<0.0001
	Week 1	0.20 (0.39)	0.16 (0.04)	0.14 (0.02)	0.26 (0.02)	0.39 (0.03)	<0.0001
	Month 1	0.19 (0.36)	0.14 (0.03)	0.12 (0.01)	0.25 (0.02)	0.41 (0.03)	<0.0001
	Month 2-3	0.16 (0.34)	0.15 (0.04)	0.10 (0.02)	0.19 (0.02)	0.37 (0.03)	<0.0001
	Month 6	0.14 (0.36)	0.13 (0.05)	0.09 (0.02)	0.20 (0.03)	0.30 (0.05)	<0.0001
Mean visual acuity change from baseline in logMAR (SD)	Day 1	-0.22 (0.84)	0.22 (0.06)	0.02 (0.03)	-0.22 (0.04)	-1.62 (0.05)	<0.001
	Week 1	-0.49 (0.76)	0.04 (0.04)	-0.24 (0.02)	-0.47 (0.03)	-2.05 (0.04)	<0.001
	Month1	-0.47 (0.72)	0.02 (0.04)	-0.25 (0.02)	-0.47 (0.03)	-1.98 (0.04)	<0.001
	Month 2-3	-0.51 (0.70)	0.02 (0.05)	-0.27 (0.02)	-0.53 (0.03)	-2.01 (0.04)	<0.001
	Month 6	-0.49 (0.68)	0.00 (0.06)	-0.29 (0.02)	-0.52 (0.04)	-2.00 (0.06)	<0.001

*For test of any difference in mean visual acuity or mean visual acuity change from baseline across baseline visual acuity groups. **There was subject attrition over the course of the study time period such that *n*=1171 on day 1, 1166 on week 1, 1034 on month 1, 867 on months 2-3, and 600 on month 6

analysis [Table 5] stratified by the baseline preoperative glaucoma status. In multivariate analysis among patients without baseline glaucoma, worse baseline VA (OR = 0.04, $P < .0001$) and higher baseline IOP (OR = 0.48, p. 02) were associated with lower risk of worsening VA. Vitreous loss was significantly associated with higher risk of worsened VA after surgery (OR = 13.5, $P < 0.0001$). When considering patients with glaucoma, older age (OR = 0.52, $P = 0.02$) and worse baseline VA (OR = 0.21, $P = 0.01$) were found to be associated lower risk of worsening VA postoperatively, whereas suture use was associated with a significantly higher risk of VA worsening postoperatively (OR = 3.53, $P = 0.01$) [Table 5, Supplementary Table 3].

In addition, statistically significant IOP elevations were observed on day 1 in glaucomatous eyes compared to eyes without glaucoma (2.81 vs. 0.12 mmHg, $P < 0.0001$); however, there were no statistically significant differences in IOP changes between glaucomatous and nonglaucomatous eyes at week 1 or after [Supplementary Table 4].

History of diabetes, hypertension, retinal surgery, glaucoma surgery, corneal surgery, or refractive surgery was not significantly associated with change in visual acuity (from baseline) or visual acuity worsening (from baseline) [Supplementary Tables 1-3]. The population was further segmented by those with POAG or narrow angle glaucoma, and similarly history of diabetes, hypertension, retinal surgery, glaucoma surgery, corneal surgery, or refractive surgery was not significantly associated with change in visual acuity (from baseline) or visual acuity worsening (from baseline) [Supplementary Tables 1-3].

Discussion

Building on previous studies examining resident physician-performed cataract surgeries, we sought to evaluate the VA outcome and surgical complication rate and to identify risk factors for poor visual outcomes in resident physician-performed cataract surgery in a diverse population. We found that VA improved by approximately 0.5 logMAR by 1 week, with 91% of showing BCVA improvement from baseline and 87% of patients achieving 20/40 or better at 1 month (replicated with 3- and 6-month data with fewer patients). We found younger age, worse baseline VA, and absence of iris prolapse intraoperatively were significantly associated with greater improvement in VA at 1 month. Complications from cataract surgery were minimal with an overall rate of 7% including hyphema, dropped nucleus, iris prolapse, anterior capsular tears, posterior capsular tears, zonular dehiscence, and vitreous loss.

With respect to demographics, this population is unique, with over 40% patients identifying as African-American, a population considered more likely to have cataracts and less likely to obtain cataract surgery.[15,16] This population was also

Table 4: Multivariable analysis for factors association with visual acuity change from baseline at month 1 VA change from baseline at all follow-up visits

Characteristics	VA Change from baseline at month 1		VA Change from baseline at week 1, months 1, 2-3, and 6	
	Adjusted Mean (SE)	*P*	Adjustment Mean (SE)	*P*
Age (years)	0.01 (0.00)	<0.0001	0.01 (0.00)	<0.0001
Baseline visual acuity (logMAR)	-0.88 (0.02)	<0.0001	-0.89 (0.02)	<0.0001
Iris prolapse		<0.001		
No (*n*=1027)	-0.48 (0.01)			
Yes (*n*=7)	0.03 (0.13)			

Table 5: Multivariable analysis for factors association with VA worsening* at 1 month among eyes with and without POAG or narrow angle glaucoma**

Patient characteristics	VA worsening at 1 month in patients without glaucoma (*n*=865)			VA worsening at 1 month in patients with glaucoma (*n*=169)		
	VA worsening (%)	OR (95%CI)	*P*	VA worsening (%)	OR (95%CI)	*P*
Age (years)					0.52 (0.50-0.53)	0.02
Baseline visual acuity (per logMAR increase)		0.04 (0.01-0.15)	<0.0001		0.21 (0.06-0.52)	0.01
Baseline IOP (per 1 mmHg increase)		0.48 (0.45-0.50)	0.02			
Vitreous loss			<0.0001			
No	46 (5.6%)	Reference				
Yes	13 (28.9%)	13.5 (5.8-31.1)				
Suture			0.23			0.01
No	36 (6.1%)	Reference		8 (7.5%)	Reference	
Yes	23 (8.4%)	1.40 (0.81-2.40)		13 (20.6%)	3.53 (1.31-9.52)	

*VA worsening was defined as a visual acuity at clinical presentation that was worse than their preoperative baseline visual acuity. **The definition of glaucoma for this analysis was a preoperative clinical diagnosis of primary open angle glaucoma (e.g., glaucomatous VF defect and/or IOP >=22 mmHg and/or CDR >.7, etc.) or narrow angle glaucoma (IOP >=22 and/or glaucomatous VF defect and/or CDR >.7 and narrow angles on gonioscopy)

predominantly male, and in the 8.7% of patients of ocular trauma in the eye with cataract surgery, a rate higher than previously reported in the literature. Although ocular trauma may predispose to earlier cataract development, it was not predictive of worst visual outcome post cataract surgery. Most patients had cataract classification consisting of NS 2+; however, there was still a higher percentage of CS and PSC patients than previously reported in the literature.[17] This population also had a higher level of comorbidities including diabetes (54.5%) and hypertension (78.5%) than in comparable published studies (DM type II prevalence 47%),[18-20] providing insight into the effects of comorbidities on resident physician performed cataract surgery. Lastly, although previous studies have examined resident physician-performed cataract surgery at a variety of levels, to our knowledge, this is the largest population of patients treated entirely by senior third-year resident physicians prior to becoming attending surgeons and therefore were more likely to be more experienced with less complications.[13]

In this study, the mean VA improved significantly after surgery (with mean improvement of approximately 0.5 logMAR by 1 week), and only minimal complications (0.6% anterior capsule tears, 1.1% zonular dehiscence, and 0.9% requiring a revision or repeat surgery within 30 days), relatively low for a "training population," and expected given the higher level of training of these resident physicians. As expected in the literature, posterior capsule tears and vitrectomy were relatively uncommon (4% and 5.4%, respectively) and were treated according to standard of care (anterior vitrectomy) in most cases.[21] Overall, 86.5% of patients achieved visual outcome BCVA of 20/40, comparable to the rates of 74% to 97.8% in the literature.[4-8] Predictive factors for postoperative VA included baseline VA (worse preop VA predicted more improvement in VA), which is likely a factor of how advanced their cataracts were to begin with. In addition, trypan blue was also associated with a greater improvement from baseline, likely related to the fact that very dense nuclear cataracts or 3+ or more cortical cataracts are the indications for using trypan blue needed to visualize the anterior capsule in these dense cataracts. These denser cataracts were correlated with the greatest improvement of VA postoperatively. A lack of intraoperative iris prolapse was found to be significantly associated with improvement in VA. The reason for this is not known, however, iris prolapse has been thought to traumatize the iris, leading to increased postoperative inflammation, transillumination defects, iris distortion, and pupillary abnormalities which may decrease the quality of vision and/or patient's level of satisfaction.[22] In addition, after iris prolapse, attending surgeons are more likely to instruct residents to suture the wounds, which could have led to temporary suture induced astigmatism. This is further suggested by the improvement in vision in the iris prolapse patients after 1-month post-op suture removal. In considering ways of preventing iris prolapse, it is also important to consider whether the risk can be mitigated by encouraging more frequent use of malyugin ring.

Surprisingly, anterior capsule tear, posterior capsule tear, zonular dehiscence, and vitreous loss were not significantly associated with lessening of postoperative VA, which may be explained by effective intraoperative management of the complications. The rate of intraoperative and postoperative complications was lower than published in the literature (0-19.7%) [Table 6].[2-12,13] In other studies of hospital systems, vitreous loss was commonly reported ranging from 3.8% to 11.2%, with the rate of vitreous loss at this training hospital on the lower end (5.4%).[23] The prevalence of cystoid macular edema (CME) and corneal edema in our study also falls below previously reported ranges (0.56% to 4.6% and 0.6% to 8.1%, respectively) [Table 6].[2,3] However, it is important to note that this ignores any contribution of racial or ethnic demographics or cataract types.[13] Furthermore, this study also demonstrated a high rate (~30-40%) of intraoperative device use of iris hooks, malyugin ring, and suture, speaking to the characteristically challenging nature of cataracts in this population, with similar outcomes throughout.[13]

VA results stratified by levels of baseline VA were also illuminating. Although most patients did experience significant improvement in VA, individuals with a baseline VA of logMAR 0.3 (20/40) or better did not experience significant improvement in VA from baseline, possibly due to the ceiling effect of the maximum possible change in VA improvement. While recent studies have suggested that the widely accepted criterion for cataract surgery being worse than 20/40 may not apply to the American population,[16,25,26] this result further suggests that further evaluation of VA outcomes segmented by pre-op VA and type of cataract (cortical vs PSC) may be helpful to better optimizing timing of surgery and post-op vision. It is possible that patients in this resident physician training population may benefit from delaying cataract surgery until vision is 20/40 or worse.

Predictors for worsening VA, defined as VA at clinical presentation that was worse than preoperative baseline visual acuity, were also evaluated. Multivariable analysis demonstrated that among eyes without glaucoma, worse baseline VA was significantly associated with better postoperative VA. This was in line with our findings above, suggesting that patients are more likely to experience significant benefits from surgery with pre-op VA of worse than 20/40. Vitreous loss was associated with greater likelihood of VA worsening after surgery, suggesting that special attention should focus on decreasing the rate of this complication in resident physician-performed surgery. However, this may have been more a factor of the intraoperative challenges that led to vitrectomy. Higher IOP was also associated with decreased likelihood of VA worsening among eyes without glaucoma at baseline. Only older age and worse baseline VA was associated with lower risk of VA worsening postoperatively. The use of suture was significantly associated with higher risk of worsening VA at 1 month, likely because sutures are indicated when wound integrity may be questioned at the completion of surgery. Sutures that are left in can also cause astigmatism. A leak observed at the completion of surgery, necessitating suture placement, may be indicative of increased mechanical trauma intraoperatively with ensuing increased inflammation. Of note, after 1 month, worsening VA was not associated with use of suture, which further suggests that suture-induced astigmatism may have induced a temporarily worse acuity that would improve after suture removal.

It is important to note the main limitations of this retrospective study. First, the data collection is retrospective and therefore limited by resident physician documentation and potentially limited follow-up in the patient population, which

Table 6: Intraoperative and postoperative complications of resident physician-performed cataract surgery in the literature

Reference	Study Design / Setting	Intraoperative Complications								
		Retrobulbar hematoma	Hyphema	Choroidal effusion	Dropped nucleus	Iris Prolapse	Anterior Capsule Tear	Posterior Capsule Tear	Zonular dehiscence	Vitreous Loss
# Current Study	Veterans Affairs Medical Center (*n*=1183)	0%	0.20%	0%	1.80%	0.80%	0.60%	4.00%	1.10%	5.40%
# Payal *et al.* 2016[3]	Veterans Affairs Ophthalmic Surgery Outcomes Database Project across 5 Veterans Affairs Medical Centers (*n*=4221)	--	--	0.02%		2.49%	3.48%	4.40%	1.59%	3.79%
# Briszi *et al.* 2012[2]	Tertiary care center (*n*=600)	--	--	--	1.16%	--	--	3.80%	--	3.00%
# Corey and Olson 1998[4]	Urban, rural tertiary care academic center, and Veterans Affairs Medical Center (*n*=396)	--	--	--	--	--	--	2.60%	--	1.80%
# Rogers *et al.* 2009[5]	Veterans Affairs Medical Center (*n*=320)	--	--	--	--	--	--	7.17%	--	3.77%
# Allinson *et al.* 1992[8]	Tertiary care center (*n*=136)	--	--	--	--	--	--	--	--	14.70%
# Tarbet *et al.* 1995[9]	Tertiary care center (*n*=300)	--	--	--	--	--	--	3.30%	--	5.30%
# Smith and Seiff 1997[10]	Public county hospital (*n*=218)	--	0.40%	--	0.40%	--	--	10%	--	6%
# Rutar *et al.* 2009[11]	Veterans Affairs Medical Center (*n*=320)	--	--	--	0.90%	--	--	1.50%	--	3.10%
# Clarke *et al.* 2017[13]	Tertiary care center (*n*=1290)	--	0.50%	0.10%	0.60%	1.20%	4.0$	7.00%	2.90%	6.70%
# Blomquist *et al.* 2012[17]	Urban public county hospitals (*n*=2434)	--	--	--	--	--	--	--	--	3.80%
# Gharaee *et al.* 2020[23]	Public county hospital in Iran (*n*=475)	--	--	--	0%	--	5.30%	5.30%	0.50%	5.30%
## Unal *et al.* 2006[24]	Tertiary care center (*n*=296)	--	--	--	2.70%	0%	5.30%	2.60%	0%	6.10%

#Design: Retrospective data analysis of deidentified data. ##Design: Prospective intervention (retrobulbar vs topical anesthesia)

Reference	Postoperative Complications							
	Further surgery within 30 days	Endophthalmitis	Retinal detachment	CME	Choroidal hemorrhage	Retained nucleus	Hypopnea	Epithelial defect
# Current Study	0.00%	0.00%	0.08%	0.08%	0.08%	0.17%	0.08%	4.17%
# Payal *et al.* 2016[3]	0.64%	0.16%	0.26%	2.44%	0.02%	2.39%	--	0.14%
# Briszi *et al.* 2012[2]	--	--	--	--	--	--	--	--
# Corey and Olson 1998[4]	--	--	--	--	--	--	--	--
# Rogers *et al.* 2009[5]	--	--	--	--	--	--	--	--
# Allinson *et al.* 1992[8]	--	--	--	--	--	--	--	--
# Tarbet *et al.* 1995[9]	--	--	--	--	--	--	--	--
# Smith and Seiff 1997[10]	--	0.40%	0%	4.60%	--	--	--	--
# Rutar *et al.* 2009[11]	--	--	--	--	--	--	--	--
# Clarke *et al.* 2017[13]	--	0.10%	0.90%	4.70%	--	1.90%	--	1.90%
# Blomquist *et al.* 2012[17]	--	--	--	--	--	--	--	--
# Gharaee *et al.* 2020[23]	--	--	--	--	--	--	--	--
## Unal *et al.* 2006[24]	--	0.67%	0.30%	4.60%	--	--	--	--

#Design: Retrospective data analysis of deidentified data. ##Design: Prospective intervention (retrobulbar vs topical anesthesia)

may affect our assessment of VA outcome and complication rate. This extends to the operative record, and therefore, it is possible that the complication rate may be underestimated. Similarly, as this was a retrospective review of chart data, subject attrition over the course of the study limited the power of analyses at 6 months. Second, this review is limited in its ability to compare to the general population due to lack of literature on populations like the demographic at this site. Third, we focus on a resident physician population in their final 6 months of training; however, a subgroup analysis of residents in different years of training would be helpful in future studies to reflect the learning curve over the course of residency training. In addition, although this study focuses on resident physicians at similar levels of training, we could not evaluate outcomes by the duration of time on a particular rotation of residency training and therefore cannot address learning and improvement during the rotation on service, although all residents had very similar exposure (5-10 cases) to phacoemulsification cataract surgery prior to the start of this block based on the rotation structure of this particular residency program. Furthermore, surgical education is incredibly complex, and although these data allow for a discussion on certain steps of surgery such as the incision and complications such as iris prolapse, there are many important surgical issues and challenges that we do not discuss. For example, the capsulorrhexis, hydrodissection, challenging IOL implantations, and a plethora of technical details are a crucial component of resident physician education. However, in this study we are not able to speak to the impact of these key steps on surgical outcomes. Furthermore, our complication rate was very low, and therefore, we did not perform analysis for determining predictive risk factors for complication. Given the presence of an attending physician in each case, it is also possible that the intraoperative complications were mitigated by the presence of the attending; however, there are no available data on attending takeover for each of these cases limiting our ability to assess this effect. Additionally, this study focuses on cases utilizing phacoemulsification surgery, but does not examine ECCE or small incision cataract surgery (SICS). Therefore, future studies may benefit from comparing outcomes of resident performed ECCE, SICS, and phacoemulsification surgery as these techniques have a wide range of duration, exposure, and training during residency as well as types and incidence of complications. Finally, as this is a retrospective study, it was not possible to create a control group of surgeries performed by experienced surgeons in the same environment to further validate outcomes of surgeries performed by residents. In this population, residents were automatically designated as primary surgeons, and only in sparse cases of extremely complicated cataracts or patient request would an attending be designated as a primary surgeon, therefore even if the small cohort of attending performed surgeries was analyzed, these particular cases would not be comparable to those performed by residents. Future studies may benefit from further analysis directly comparing resident and attending performed outcomes in the same population. Future studies may also benefit from standardization protocols to corroborate preoperative VA with grade of cataract. Although the authors included history of diabetes, hypertension, retinal surgery, glaucoma surgery, corneal surgery, and refractive surgery to capture other etiologies for improvement or lack of improvement in VA after cataract surgery, it would be helpful for future studies to further delineate differences in outcomes, complications, and VA improvement after cataract surgery segmented by the presence of specific posterior segment, retinal, or macular pathologies (e.g. vitreous haze and retinal vessel abnormalities).

Conclusion

In conclusion, this study leverages a large cohort of resident physician-performed cataract surgery in a population with complex comorbidities and cataracts and extensive follow-up, suggesting that in this population, resident physician-performed surgeries achieve significant improvement in BCVA without a significantly greater complication rate than found in the literature.[3,23,27] This study demonstrated minimal complications, only slightly higher than nonresident-performed cataract surgery in the VHA population ranging from 1.1 to 3.6%.[28,29] Matching the consistency of surgical outcomes with patient safety is crucial to considering training paradigms. The results of this study further reinforce that resident-performed surgery can be beneficial to both patients and trainees without additional risk to patients. Resident physician education may benefit from specific focus on prevention of iris prolapse and better incision construction during the surgery as these intraoperative events often led to the need for suturing of the cataract incision and delaying the stability of the visual outcome until beyond 1 month.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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Supplementary Table 1: Univariate analysis for association between baseline and intra-operational characteristics and change in VA at month 1 and association between baseline and intra-operational characteristics and change in VA (longitudinal analysis including visits at week 1, month 1, month 2-3 and month 6

Patient characteristics	Univariable			Univariable		
	# of subjects at month 1 (*n*=1034) *n*	Change in VA at month 1 (from baseline)		# of subjects (*n*=1183) *n*	Mean change in VA at week 1, month 1, month 2-3 and month 6 (from baseline)	
		Mean (SE)	*P*		Mean (SE)	*P*
Age (years)		0.01 (0.00)	<0.0001		0.01 (0.00)	<0.0001
Race			0.27			0.001
Black	432	-0.51 (0.03)		493	-0.60 (0.04)	
White	596	-0.45 (0.03)		681	-0.47 (0.02)	
Other	6	-0.27 (0.29)		9	-0.10 (0.13)	
Gender			0.75			0.91
Female	27	-0.43 (0.14)		29	-0.54 (0.12)	
Male	1007	-0.47 (0.02)		1154	-0.52 (0.02)	
Laterality			0.29			0.14
OD	532	-0.50 (0.03)		603	-0.55 (0.03)	
OS	502	-0.45 (0.03)		580	-0.49 (0.03)	
Baseline visual acuity (logMAR)		-0.89 (0.02)	<0.0001		-0.90 (0.02)	<0.0001
Baseline IOP		0.01 (0.01)	0.22		0.01 (0.01)	0.12
Nuclear sclerosis			<0.0001			<0.0001
0	35	-0.82 (0.12)		40	-0.87 (0.17)	
0.5	8	-0.87 (0.24)		8	-0.88 (0.37)	
1	155	-0.42 (0.06)		181	-0.49 (0.05)	
2	466	-0.35 (0.03)		545	-0.39 (0.02)	
3	325	-0.52 (0.04)		357	-0.57 (0.04)	
4	42	-1.28 (0.11)		49	-1.44 (0.16)	
Cortical spokes			0.03			0.12
0	412	-0.52 (0.03)		473	-0.57 (0.04)	
0.5	44	-0.28 (0.11)		48	-0.37 (0.08)	
1	196	-0.45 (0.05)		230	-0.48 (0.04)	
2	236	-0.43 (0.05)		273	-0.49 (0.04)	
3	113	-0.43 (0.07)		123	-0.48 (0.06)	
4	25	-0.80 (0.14)		28	-0.82 (0.18)	
Posterior subcapsular cataract			<0.0001			<0.0001
0	493	-0.46 (0.03)		554	-0.51 (0.03)	
0.5	68	-0.33 (0.09)		70	-0.34 (0.05)	
1	163	-0.39 (0.06)		196	-0.42 (0.04)	
2	150	-0.40 (0.06)		173	-0.42 (0.05)	
3	119	-0.67 (0.06)		139	-0.76 (0.06)	
4	33	-0.96 (0.12)		43	-1.11 (0.14)	
Cup to disc ratio		0.01 (0.12)	0.92		-0.05 (0.12)	0.67
Number of glaucoma medications at baseline		0.08 (0.07)	0.25		0.10 (0.08)	0.21
Number of glaucoma medications at baseline			0.47			0.33
0	937	-0.48 (0.02)		1080	-0.53 (0.02)	
1	93	-0.41 (0.07)		99	-0.42 (0.07)	
2	4	-0.16 (0.36)		4	-0.37 (0.77)	
Number of glaucoma drops at baseline		0.02 (0.04)	0.64		0.03 (0.05)	0.58
Number of glaucoma drops at baseline			0.86			0.54
0	946	-0.48 (0.02)		1089	-0.53 (0.02)	

Contd...

Supplementary Table 1: Contd...

Patient characteristics	Univariable			Univariable		
	# of subjects at month 1 (*n*=1034) *n*	Change in VA at month 1 (from baseline)		# of subjects (*n*=1183) *n*	Mean change in VA at week 1, month 1, month 2-3 and month 6 (from baseline)	
		Mean (SE)	*P*		Mean (SE)	*P*
1	36	-0.43 (0.12)		36	-0.43 (0.12)	
2	35	-0.38 (0.12)		41	-0.40 (0.10)	
≥3	17	-0.47 (0.17)		17	-0.57 (0.26)	
Alpha blocker			0.21			0.03
No	725	-0.49 (0.03)		845	-0.55 (0.03)	
Yes	309	-0.43 (0.04)		338	-0.45 (0.03)	
History of ocular trauma			0.64			0.66
No	943	-0.47 (0.02)		1080	-0.52 (0.02)	
Yes	91	-0.51 (0.08)		103	-0.55 (0.07)	
History of diabetes			0.36			0.58
No	461	-0.45 (0.03)		540	-0.51 (0.03)	
Yes	573	-0.49 (0.03)		643	-0.53 (0.03)	
History of hypertension			0.34			0.55
No	214	-0.43 (0.05)		254	-0.50 (0.04)	
Yes	820	-0.48 (0.03)		929	-0.53 (0.02)	
History of retinal surgery			0.29			0.21
No	1012	-0.47 (0.02)		1158	-0.52 (0.02)	
Yes	22	-0.63 (0.15)		25	-0.76 (0.19)	
History of glaucoma surgery			0.99			0.91
No	1019	-0.47 (0.02)		1168	-0.52 (0.02)	
Yes	15	-0.47 (0.18)		15	-0.50 (0.18)	
History of corneal surgery			0.79			0.22
No	1032	-0.47 (0.02)		1181	-0.52 (0.02)	
Yes	2	-0.34 (0.51)		2	-0.36 (0.06)	
History of refractive surgery			0.64			0.17
No	1032	-0.47 (0.02)		1181	-0.52 (0.02)	
Yes	2	-0.24 (0.51)		2	-0.19 (0.06)	
Glaucoma surgery done at the same time			0.03			0.001
No	1007	-0.48 (0.02)		1155	-0.53 (0.02)	
Yes	27	-0.18 (0.14)		28	-0.26 (0.06)	
Length of surgery (per 100 min increase)		0.03 (0.04)	0.52		0.01 (0.03)	0.6
Length of surgery (min)			0.22			0.12
≤34	270	-0.47 (0.04)		317	-0.48 (0.03)	
>34 and ≤43	254	-0.53 (0.04)		290	-0.59 (0.04)	
>43 and ≤60	256	-0.40 (0.04)		293	-0.48 (0.04)	
>60	254	-0.49 (0.04)		283	-0.54 (0.05)	
Retrobulbar hematoma			0.95			0.32
No	1033	-0.47 (0.02)		1182	-0.52 (0.02)	
Yes	1	-0.43 (0.72)		1	-0.35 (0.00)	
Trypan blue			<0.0001			<0.0001
No	987	-0.44 (0.02)		1123	-0.49 (0.02)	
Yes	47	-1.07 (0.10)		60	-1.23 (0.15)	
Iris hook			0.03			0.07
No	629	-0.43 (0.03)		751	-0.49 (0.03)	
Yes	405	-0.53 (0.04)		432	-0.57 (0.04)	

Contd...

Supplementary Table 1: Contd...

Patient characteristics	Univariable			Univariable		
	# of subjects at month 1 (*n*=1034) *n*	Change in VA at month 1 (from baseline)		# of subjects (*n*=1183) *n*	Mean change in VA at week 1, month 1, month 2-3 and month 6 (from baseline)	
		Mean (SE)	*P*		Mean (SE)	*P*
Malyugin ring			0.12			0.35
No	583	-0.44 (0.03)		685	-0.50 (0.03)	
Yes	451	-0.51 (0.03)		498	-0.55 (0.04)	
Capsular tension ring			0.28			0.14
No	1011	-0.48 (0.02)		1159	-0.53 (0.02)	
Yes	23	-0.31 (0.15)		24	-0.32 (0.13)	
Suture			0.17			0.7
No	696	-0.49 (0.03)		807	-0.53 (0.02)	
Yes	338	-0.43 (0.04)		376	-0.51 (0.04)	
Hyphema			0.62			0.74
No	1030	-0.47 (0.02)		1179	-0.52 (0.02)	
Yes	4	-0.65 (0.36)		4	-0.40 (0.35)	
Dropped nucleus			0.2			0.49
No	1016	-0.48 (0.02)		1162	-0.53 (0.02)	
Yes	18	-0.26 (0.17)		21	-0.34 (0.26)	
Iris prolapse			0.02			0.14
No	1027	-0.48 (0.02)		1173	-0.53 (0.02)	
Yes	7	0.17 (0.27)		10	-0.07 (0.28)	
Anterior capsule tear			0.96			0.66
No	1028	-0.47 (0.02)		1176	-0.52 (0.02)	
Yes	6	-0.49 (0.29)		7	-0.39 (0.30)	
Posterior capsule tear			0.33			0.57
No	993	-0.48 (0.02)		1136	-0.53 (0.02)	
Yes	41	-0.37 (0.11)		47	-0.43 (0.17)	
Zonular dehiscence			0.96			0.81
No	1022	-0.47 (0.02)		1170	-0.52 (0.02)	
Yes	12	-0.48 (0.21)		13	-0.47 (0.23)	
Vitreous loss			0.18			0.45
No	979	-0.48 (0.02)		1119	-0.53 (0.02)	
Yes	55	-0.35 (0.10)		64	-0.42 (0.13)	
Uveitis			0.54			0.13
No	1031	-0.47 (0.02)		1180	-0.52 (0.02)	
Yes	3	-0.22 (0.41)		3	-0.17 (0.11)	

Supplementary Table 2: Univariable analysis for association of baseline and intra-operational characteristics with VA worsening at month 1 (among eyes without POAG or Narrow Angle Glaucoma)

Patient characteristics	*n*=865, *n*	VA worsening *n* (%)	Univariable	
			OR (95%CI)	*P*
Age (years)			1.03 (1.01-1.06)	0.02
Race*				0.81
Black	318	21 (6.6%)	0.94 (0.94-0.94)	
White	541	38 (7.0%)	Ref.	
Other	6	0 (0.0%)	-	
Gender				0.54
Female	25	1 (4.0%)	Ref.	
Male	840	58 (6.9%)	1.78 (0.37-32.08)	
Laterality				0.56
OD	442	28 (6.3%)	Ref.	
OS	423	31 (7.3%)	1.17 (0.69-1.99)	
Baseline visual acuity (logMAR)			0.06 (0.01-0.22)	<0.0001
Baseline IOP			0.92 (0.85-1.00)	0.052
Nuclear sclerosis				0.88
0	28	3 (10.7%)	Ref.	
0.5	6	1 (16.7%)	1.67 (0.07-16.53)	
1	135	8 (5.9%)	0.52 (0.14-2.52)	
2	390	28 (7.2%)	0.64 (0.21-2.82)	
3	267	17 (6.4%)	0.57 (0.17-2.54)	
4	38	2 (5.3%)	0.46 (0.06-2.99)	
Cortical spokes				0.67
0	343	20 (5.8%)	Ref.	
0.5	39	1 (2.6%)	0.43 (0.02-2.13)	
1	168	14 (8.3%)	1.47 (0.71-2.96)	
2	193	14 (7.3%)	1.26 (0.61-2.54)	
3	95	8 (8.4%)	1.49 (0.60-3.37)	
4	21	2 (9.5%)	1.70 (0.26-6.44)	
Posterior subcapsular cataract				0.38
0	408	28 (6.9%)	Ref.	
0.5	58	1 (1.7%)	0.24 (0.01-1.15)	
1	138	12 (8.7%)	1.29 (0.62-2.56)	
2	124	11 (8.9%)	1.32 (0.61-2.67)	
3	98	5 (5.1%)	0.73 (0.24-1.79)	
4	33	2 (6.1%)	0.88 (0.14-3.11)	
Cup to disc ratio			2.61 (0.51-12.30)	0.25
Alpha blocker				0.44
No	596	38 (6.4%)	Ref.	
Yes	269	21 (7.8%)	1.24 (0.70-2.14)	
History of ocular trauma				0.08
No	788	57 (7.2%)	Ref.	
Yes	77	2 (2.6%)	0.34 (0.06-1.13)	
History of diabetes				0.94
No	385	26 (6.8%)	Ref.	
Yes	480	33 (6.9%)	1.02 (0.60-1.75)	
History of hypertension				0.31
No	188	16 (8.5%)	Ref.	
Yes	677	43 (6.4%)	0.73 (0.41-1.36)	
History of retinal surgery				0.73

Contd...

Supplementary Table 2: Contd...

Patient characteristics	*n*=865, *n*	VA worsening *n* (%)	Univariable	
			OR (95%CI)	*P*
No	845	58 (6.9%)	Ref.	
Yes	20	1 (5.0%)	0.71 (0.04-3.54)	
History of glaucoma surgery				-
No	863	59 (6.8%)	Ref.	
Yes	2	0 (0.0%)	-	
History of corneal surgery				-
No	863	59 (6.8%)	Ref.	
Yes	2	0 (0.0%)	-	
History of refractive surgery				-
No	863	59 (6.8%)	Ref.	
Yes	2	0 (0.0%)	-	
Length of surgery (per 100 min increase)			0.54 (0.48-0.61)	0.27
Length of surgery (min)				0.009
≤34	241	8 (3.3%)	Ref.	
>34 and ≤43	217	14 (6.5%)	2.01 (0.84-5.12)	
>43 and ≤60	219	15 (6.8%)	2.14 (0.91-5.42)	
>60	188	22 (11.7%)	3.86 (1.74-9.43)	
Retrobulbar hematoma				-
No	864	59 (6.8%)	Ref.	
Yes	1	0 (0.0%)	-	
Trypan blue				0.29
No	830	58 (7.0%)	Ref.	
Yes	35	1 (2.9%)	0.39 (0.02-1.87)	
Iris hooks				0.30
No	532	40 (7.5%)	Ref.	
Yes	333	19 (5.7%)	0.74 (0.42-1.29)	
Malyugin ring				0.31
No	495	30 (6.1%)	Ref.	
Yes	370	29 (7.8%)	1.32 (0.77-2.24)	
Capsular tension ring				0.20
No	845	56 (6.6%)	Ref.	
Yes	20	3 (15.0%)	2.49 (0.57-7.68)	
Suture				0.23
No	590	36 (6.1%)	Ref.	
Yes	275	23 (8.4%)	1.40 (0.81-2.40)	
Hyphema				0.25
No	861	58 (6.7%)	Ref.	
Yes	4	1 (25.0%)	4.61 (0.23-36.67)	
Dropped nucleus				0.37
No	850	57 (6.7%)	Ref.	
Yes	15	2 (13.3%)	2.14 (0.33-8.00)	
Iris prolapse				0.41
No	859	58 (6.8%)	Ref.	
Yes	6	1 (16.7%)	2.76 (0.14-17.50)	
Anterior capsule tear				0.054
No	859	57 (6.6%)	Ref.	
Yes	6	2 (33.3%)	7.04 (0.96-36.84)	
Posterior capsule tear				<0.0001
No	831	49 (5.9%)	Ref.	

Contd...

Supplementary Table 2: Contd...

Patient characteristics	*n*=865, *n*	VA worsening *n* (%)	Univariable	
			OR (95%CI)	*P*
Yes	34	10 (29.4%)	6.65 (2.90-14.34)	
Zonular dehiscence				0.17
No	855	57 (6.7%)	Ref.	
Yes	10	2 (20.0%)	3.50 (0.52-14.37)	
Vitreous loss				<0.0001
No	820	46 (5.6%)	Ref.	
Yes	45	13 (28.9%)	6.84 (3.27-13.67)	
Uveitis				-
No	864	59 (6.8%)	Ref.	
Yes	1	0 (0.0%)	-	

*Records with category of 0% or 100% incidence were excluded from the univariable analysis. *Multivariable model initially included variables with *P*<0.1 and used backward selection to get the final model

Supplementary Table 3: Univariable analysis for association of baseline and intra-operational characteristics with VA worsening at month 1 (among eyes with POAG or Narrow Angle Glaucoma)

Patient characteristics	*n*=169, *n*	VA worsening *n* (%)	Univariable	
			OR (95%CI)	*P*
Age (years)			1.05 (1.00-1.11)	0.051
Race				0.67
Black	114	15 (13.2%)	1.24 (0.47-3.65)	
White	55	6 (10.9%)	Ref.	
Gender				-
Female	2	0 (0.0%)	Ref.	
Male	167	21 (12.6%)	-	
Laterality				0.0495
OD	90	7 (7.8%)	Ref.	
OS	79	14 (17.7%)	2.55 (1.00-7.08)	
Baseline visual acuity (logMAR)			0.31 (0.06-0.87)	0.02
Baseline IOP			1.04 (0.94-1.14)	0.44
Nuclear sclerosis*				0.58
0	7	1 (14.3%)	Ref.	
0.5	2	0 (0.0%)	-	
1	20	1 (5.0%)	0.32 (0.32-0.32)	
2	76	12 (15.8%)	1.13 (1.13-1.13)	
3	58	7 (12.1%)	0.82 (0.82-0.82)	
4	4	0 (0.0%)	-	
Cortical spokes*				0.39
0	69	8 (11.6%)	Ref.	
0.5	5	1 (20.0%)	1.91 (0.19-19.24)	
1	28	0 (0.0%)	-	
2	43	10 (23.3%)	2.31 (0.83-6.42)	
3	18	2 (11.1%)	0.95 (0.18-4.94)	
4	4	0 (0.0%)	-	
Posterior subcapsular cataract				0.25
0	85	14 (16.5%)	Ref.	
1	25	3 (12.0%)	0.69 (0.15-2.36)	
2	26	1 (3.8%)	0.20 (0.01-1.09)	
3	21	1 (4.8%)	0.25 (0.01-1.38)	

Contd...

Supplementary Table 3: Contd...

Patient characteristics	*n*=169, *n*	VA worsening *n* (%)	Univariable	
			OR (95%CI)	*P*
0.5	10	2 (20.0%)	1.27 (0.18-5.75)	
Cup to disc ratio			2.01 (0.25-17.78)	0.52
Number of glaucoma medications at baseline			2.94 (1.21-7.89)	0.02
Number of glaucoma medications at baseline				0.048
0	72	4 (5.6%)	Ref.	
1	93	16 (17.2%)	3.53 (1.23-12.79)	
2	4	1 (25.0%)	5.67 (0.25-58.27)	
Number of glaucoma drops at baseline			1.40 (0.92-2.11)	0.11
Number of glaucoma drops at baseline				0.09
0	81	5 (6.2%)	Ref.	
1	36	7 (19.4%)	3.67 (1.09-13.28)	
2	35	7 (20.0%)	3.80 (1.12-13.78)	
≥3	17	2 (11.8%)	2.03 (0.27-10.42)	
Alpha blocker				0.59
No	129	17 (13.2%)	Ref.	
Yes	40	4 (10.0%)	0.73 (0.20-2.13)	
History of ocular trauma				0.50
No	155	20 (12.9%)	Ref.	
Yes	14	1 (7.1%)	0.52 (0.03-2.83)	
History of diabetes				0.23
No	76	12 (15.8%)	Ref.	
Yes	93	9 (9.7%)	0.57 (0.22-1.43)	
History of hypertension				0.63
No	26	4 (15.4%)	Ref.	
Yes	143	17 (11.9%)	0.74 (0.25-2.76)	
History of retinal surgery				-
No	167	21 (12.6%)	Ref.	
Yes	2	0 (0.0%)	-	
History of glaucoma surgery				0.57
No	156	20 (12.8%)	Ref.	
Yes	13	1 (7.7%)	0.57 (0.03-3.12)	
History of corneal surgery				
No	169	21 (12.4%)	Ref.	
History of refractive surgery				
No	169	21 (12.4%)	Ref.	
Glaucoma surgery done at the same time				0.12
No	142	15 (10.6%)	Ref.	
Yes	27	6 (22.2%)	2.42 (0.79-6.72)	
Length of surgery (per 100 min increase)			0.63 (0.35-0.85)	0.38
Length of surgery (min)				0.36
≤34	29	3 (10.3%)	Ref.	
>34 and≤43	37	2 (5.4%)	0.50 (0.06-3.19)	
>43 and≤60	37	5 (13.5%)	1.35 (0.30-7.10)	
>60	66	11 (16.7%)	1.73 (0.49-8.14)	
Retrobulbar hematoma				
No	169	21 (12.4%)	Ref.	
Trypan blue				-
No	157	21 (13.4%)	Ref.	
Yes	12	0 (0.0%)	-	

Contd...

Supplementary Table 3: Contd...

Patient characteristics	*n*=169, *n*	VA worsening *n* (%)	Univariable	
			OR (95%CI)	*P*
Iris hook				0.35
No	97	14 (14.4%)	Ref.	
Yes	72	7 (9.7%)	0.64 (0.23-1.63)	
Malyugin ring				0.054
No	88	15 (17.0%)	Ref.	
Yes	81	6 (7.4%)	0.39 (0.13-1.01)	
Capsular tension ring				-
No	166	21 (12.7%)	Ref.	
Yes	3	0 (0.0%)	-	
Suture				0.01
No	106	8 (7.5%)	Ref.	
Yes	63	13 (20.6%)	3.18 (1.26-8.53)	
Hyphema				
No	169	21 (12.4%)	Ref.	
Dropped nucleus				0.03
No	166	19 (11.4%)	Ref.	
Yes	3	2 (66.7%)	15.47 (1.42-342.2)	
Iris prolapse				-
No	168	20 (11.9%)	Ref.	
Yes	1	1 (100.0%)	-	
Anterior capsule tear				
No	169	21 (12.4%)	Ref.	
Posterior capsule tear				0.24
No	162	19 (11.7%)	Ref.	
Yes	7	2 (28.6%)	3.01 (0.41-15.09)	
Zonular dehiscence				-
No	167	21 (12.6%)	Ref.	
Yes	2	0 (0.0%)	-	
Vitreous loss				0.48
No	159	19 (11.9%)	Ref.	
Yes	10	2 (20.0%)	1.84 (0.27-8.05)	
Uveitis				-
No	167	21 (12.6%)	Ref.	
Yes	2	0 (0.0%)	-	

*Multivariable model initially included variables with *P*<0.1 (except Dropped nucleus) and used backward selection to get the final model. *Records with category of 0% or 100% incidence were excluded from the univariable analysis

Supplementary Table 4: Intraocular pressure and its change after surgery overall and segmented by baseline glaucoma status

IOP Outcome	Time # of eyes at baseline		Baseline Glaucoma Status		*P**
		All subjects (*n*=1175)	With Glaucoma (*n*=185)	Without Glaucoma (*n*=990)	
Mean IOP in mmHg (SD)	Baseline	14.80 (3.45)	15.38 (4.36)	14.69 (3.24)	0.04
	Day 1	15.37 (5.66)	18.20 (7.33)	14.83 (5.12)	<0.0001
	Week 1	14.42 (4.36)	15.16 (4.89)	14.28 (4.24)	0.02
	Month 1	13.36 (3.48)	13.87 (4.31)	13.26 (3.28)	0.08
	Month 2-3	12.92 (2.83)	13.44 (3.26)	12.81 (2.71)	0.03
	Month 6	12.63 (2.82)	13.06 (3.30)	12.54 (2.69)	0.12
Mean change in IOP (mmHg) from baseline (SD)	Day 1	0.55 (5.92)	2.81 (7.63)	0.12 (5.44)	<0.0001
	Week 1	-0.37 (4.76)	-0.19 (5.81)	-0.40 (4.55)	0.65
	Month1	-1.44 (4.38)	-1.62 (5.66)	-1.40 (4.08)	0.64
	Month 2-3	-1.91 (4.08)	-2.03 (4.87)	-1.88 (3.89)	0.72
	Month 6	-2.17 (4.20)	-2.40 (4.98)	-2.12 (4.00)	0.59