

# Results of Combined Endocyclophotocoagulation and Phacoemulsification in Patients of African Descent: A Retrospective Study

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## Research Article

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# Abstract

**Background:** To evaluate the outcomes of combined endocyclophotocoagulation (ECP) and phacoemulsification in regards to vision, refraction, intraocular pressure, medication dependence, and complications in patients of African descent at a tertiary care glaucoma practice.

**Methods:** A retrospective chart review including all cases of ECP combined with phacoemulsification cataract surgery from October 2015 to March 2017 was performed. Exclusion criteria consisted of patients who were not of African descent and patients with < 1 month follow up. The primary outcome measured was IOP at the latest follow-up.

**Results:** 32 eyes of 29 patients were included in the study. Average IOP decreased from  $17.30 \pm 6.30$  mmHg preoperatively to  $15.88 \pm 4.23$  mmHg at the last post-operative visit ( $p = 0.301$ ). 2/8 patients who did not demonstrate a difference in pre- and post-operative IOP changes were able to be weaned off all of their IOP lowering medications. The average follow-up was  $5.05 \pm 4.08$  months with a range of 1 to 18 months. The average number of medications used per patient for IOP control decreased from  $2.59 \pm 1.01$  preoperatively to  $1.97 \pm 1.38$  ( $p = 0.045$ ). Average visual acuity improved from 20/50 preoperatively to an average of 20/25 ( $p = 0.002$ ). The post-operative complication rate was low.

**Conclusions:** ECP combined with phacoemulsification can be effective at decreasing IOP lowering medication dependence in patients of African descent while also demonstrating variable IOP outcomes. While some patients with primary open angle glaucoma (POAG) and prior glaucoma surgery may experience a robust response to this treatment, others may not. We found that combined ECP and phacoemulsification can lead to a significantly decreased dependence on IOP lowering drops, with some patients demonstrating complete independence from drops following surgery. Although there was not a significant decrease in IOP post-operatively when analyzed collectively, larger studies may be able to find such an association. Combined ECP and phacoemulsification has been shown to be a safe combination in patients with refractive glaucoma and may be considered if a patient desires less dependence on IOP lowering drops once other first-line methods have failed, or as a bridge between conservative and more definitive surgical treatment.

**Keywords:** Endocyclophotocoagulation, phacoemulsification, African decent

## Background

Minimally invasive glaucoma surgeries (MIGS) have risen in popularity in recent years due to a higher safety profile than traditional, invasive glaucoma surgeries such as trabeculectomies or glaucoma drainage devices<sup>1</sup>. Endocyclophotocoagulation (ECP) is a MIGS option that has been utilized since the 1980s and has commonly been reserved for refractory or end-stage glaucoma<sup>2</sup>. In such cases, all other treatment options including maximal medical therapy, laser, and surgical intervention have already been utilized yet the patient's glaucoma continues to progress or the IOP continues to remain above acceptable standards. ECP involves the use of an endoscopic probe with a camera and diode laser to ablate the

ciliary body. This results in decreased aqueous production and subsequently a lower intraocular pressure (IOP)<sup>3</sup>. ECP has been shown to be successful as both a stand-alone procedure or in combination with cataract surgery<sup>4</sup>. Several studies have been published looking at the outcomes of ECP in advanced and refractory glaucomas. Such studies include a prospective trial by Lima et al<sup>5</sup> which compared ECP to the Ahmed glaucoma valve (AGV) in refractory glaucomas that have already undergone at least one prior trabeculectomy and found no difference in the success rate between AGV and ECP. In fact, they found more complications with use of the AGV than with the ECP. In another study, Kahook et al<sup>6</sup> compared ECP treatment at one site versus two sites, evaluating the effect that extended treatment would have on IOP lowering. ECP has been reviewed in pediatric patients and also in studies looking for refractive outcomes as well<sup>7,8</sup>. Recently, Smith et al. studied the effects of combined phacoemulsification and 360 degree ECP over 3 years in 84 patients with uncontrolled glaucoma and no prior history of glaucoma surgery. They found that 58.3% of cases had met failure criteria at the end of 3 years<sup>9</sup>. Despite the literature on ECP, there has only been one study comparing ECP outcomes in patients of African descent<sup>10</sup>. Given that refractory glaucoma is very common in this population when compared to other populations, additional treatment options in these patients may be of use<sup>11</sup>. This retrospective review serves to evaluate the outcomes of one-site ECP combined with cataract surgery in terms of vision, intraocular pressure, refractive error, and IOP lowering medication dependence in order to evaluate its effectiveness as an additional treatment option for patients of African descent.

## Methods

The study followed the tenets of the Declaration of Helsinki, met local Ethical Clearance, and was approved by the institutional review board (IRB) of Boston Medical Center. A retrospective chart review of all cases of ECP combined with phacoemulsification cataract surgery via the Centurion® (Alcon, Fort Worth, TX) at Boston Medical Center from October 2015 to March 2017 was performed. Demographic data including age, race, and gender were obtained (Table 1-2).

Pre-operative ocular parameters included glaucoma type and stage, previous surgeries, visual acuity, IOP, number of IOP lowering medications used, and surgical refractive target. Post-operative measures included visual acuity, refraction, IOP and surgical complications (Table 1). Glaucoma was staged according to the consolidated staging scheme developed by Ng et al<sup>12</sup>. All types and stages of glaucoma were included in this study. Exclusion criteria included patients who were not of African descent and those who were lost to follow-up prior to 1 month. A paired t-test was used for statistical analysis of visual acuity, number of IOP lowering medications the patient remained dependent on, and IOP at the latest visit.

Intraocular pressure was measured with Goldmann applanation (Haag-Steit Diagnostics, Bern, Switzerland) by a physician at the minimum on 1 day, 1 week, and 1 month following surgery for all patients. If patients were followed between the above listed visits or for longer than 1 month, these IOPs and the latest IOP was recorded as well. Best corrected visual acuity with Snellen chart and manifest

refraction were completed at least 1 month post-op. Residual refractive outcomes were also evaluated by determining the difference between the spherical equivalent of the refractive goal and the post-operative manifest refraction.

## **Outcome Measures**

The primary outcome measured was IOP at the last visit. Secondary outcomes included best corrected visual acuity at least 1 month after surgery, refractive outcomes, number of IOP lowering drops the patient remained dependent on, and complications.

Complete success was defined as an IOP lowering of  $\geq 20\%$  from the pre-operative IOP while the patient remained off all glaucoma medications, while qualified success was defined as an IOP lowering of  $\geq 20\%$  regardless of IOP lowering medication dependence.

## **Surgical method**

After phacoemulsification with intracapsular intraocular lens placement was performed, the sulcus was inflated with viscoelastic (Provisc®, Alcon Ft. Worth, TX). A 19-gauge ECP (Beaver Visitek® Endo Optiks®) probe was then inserted into the main wound and the camera was focused on the ciliary body processes with an optimal view of 4-6 ciliary processes at a time (Figure 1). A power of 0.20-0.25mw on a continuous setting was used to treat 4-6 clock hours (120 to 180 degrees) of ciliary body processes. The viscoelastic was then removed via the irrigation and aspiration handpiece, and the wounds were sealed with balanced salt solution.

## **Post-operative regimen and follow up**

The post-operative regimen included subconjunctival injection of cefazolin and dexamethasone and topical prednisolone acetate 1% (Allergan, Madison, NJ, USA) 6 times per day tapered over 6 weeks, a fourth generation ofloxacin (Vigamox, Alcon, Ft. Worth, TX, USA) 4 times a day for 1 week, and ketorolac 0.5% (Allergan, Madison, NJ, USA) 4 times a day for 1 month to the operated eye. Prostaglandin analogs were stopped immediately post-operatively; however, all other glaucoma medications were continued in the immediate post-operative period at day 0. The patient was followed at 1 day, 1 week, 1 month and then as directed by the surgeon based on IOP and inflammation. IOP medications were then either added or subtracted at each subsequent visit at the surgeon's discretion.

# **Results**

## **Demographics and Ocular Parameters**

32 eyes of 29 patients were included in the study. 20 females and 9 males were included with an average age of  $68.4 \pm 8.6$  years as seen in Table 1. The majority of patients were either of African American or Haitian decent but patients of Jamaican, Cape Verdean, Moroccan, and Trinidadian descent were also represented (Table 2). 10/32 (31%) eyes had advanced primary open angle glaucoma (POAG), while 7/32

(22%) had moderate POAG, 3/32 (9%) had mild POAG, and 2/32 (6%) had an indeterminate stage of POAG. 7/32 (22%) had advanced chronic angle closure glaucoma (CACG). There was 1 patient each with ocular hypertension, uveitic glaucoma, and pigment dispersion glaucoma. Previous laser intervention and surgical treatment are represented in Table 3.

## **IOP and Medications**

The pre- and post-operative IOP and number of dependent IOP lowering medications used pre- and post-operatively were listed in Table 1 and Table 3, respectively. The average pre-operative IOP was  $17.3 \pm 6.30$  mmHg. Each patient was taking  $2.59 \pm 1.01$  IOP lowering medications on average. Following surgery, each patient was on  $1.97 \pm 4.23$  IOP lowering drops ( $p = 0.004$ ) - a 24% decrease in medication dependence. The post-op IOP was reviewed for each patient on post-operative day 1, week 1, and month 1 as well as on the latest visit past the 1 month post-operative period. The average patient follow-up was  $5.05 \pm 4.08$  months with a range of 1 to 18 months. At day 1, the average IOP was  $21.4 \pm 8.0$  mmHg, at week 1 it was  $17.3 \pm 4.9$  mmHg, and at month 1 it was  $17.7 \pm 4.5$  mmHg. 13 eyes followed-up 3 months after surgery and the average IOP for this time frame was  $16.4 \pm 2.0$  mmHg. 12 eyes completed follow-up between 4 and 6 months after surgery and the average IOP was  $15.1 \pm 3.8$  mmHg. 3 eyes had follow-up between 7 and 10 months and the IOP in this group averaged  $14.7 \pm 2.3$  mmHg. 4 eyes had follow-up between 11 and 18 months after surgery, and among these, the average IOP was  $19.5 \pm 3.9$  mmHg (Table 3, Figure 2). The average IOP at the last visit for all patients without considering length of follow-up after 1 month post-operatively was  $15.88 \pm 4.23$  mmHg compared to  $17.3 \pm 6.30$  mmHg pre-operatively ( $p = 0.130$ ). This represented an 8.2% drop in IOP from before surgery. 2/32 (6%) patients achieved complete success while 9/32 (28%) achieved qualified success. Also, 6/9 (67%) patients in the qualified success group were able to achieve an IOP lowering of >30% and two patients demonstrated an IOP lowering of >40%. 8/32 (25%) patients ended up with higher IOPs than their pre-operative IOP. Additionally, 7/32 (22%) experienced no change in their IOP compared to their pre-operative IOP. However, 2/7 of these patients were able to be weaned off of their IOP lowering medications completely. In the qualified success group, 6/9 (66%) had moderate to advanced POAG. Of the 8 that worsened, 6 had POAG and the other 2 had CACG.

## **Visual Acuity and Refractive Outcomes**

The average pre-op visual acuity was logMAR  $0.403 \pm 0.454$  which improved to an average of logMAR  $0.114 \pm 0.226$  post-operatively ( $p = 1.004$ ) (Table 1). Refractive outcomes were also evaluated by comparing the post-operative spherical equivalent to the spherical equivalent of the refractive goal based on the intraocular lens (IOL) selection and IOL calculations obtained pre-operatively. A target refraction within 1.0 diopters (D) of the refractive target was considered meeting the patient's refractive goal. 27/32 eyes met the refractive goal<sup>13</sup>. However, 5/32 (16%) were >1.0D away from their goal, with 3/5 experiencing a myopic surprise and 2/5 experiencing a hyperopic surprise. Additionally, 14/32 (44%) were found to be  $> \pm 0.50D$  of goal with 8 of these ending up more myopic and 5 of these eyes ending up more hyperopic. Overall, 18/32 (56%) were found to be within  $\pm 0.50D$  of goal (Table 4).

## Complications

Complications were noted as early (< 1 month after surgery) and late (> 1 month after surgery) and occurred in 10/32 eyes (Table 5). The most common complication was an IOP spike defined as an increase in IOP of >10mmHg from baseline on post-operative day 1 (POD 1) which occurred in 8/32 (25%). These patients were treated with topical IOP lowering medications and IOP was stabilized prior to the patient leaving clinic. Cystoid macular edema (CME) occurred in 2/32 (6%). Prolonged post-operative inflammation occurred in 1/32 (3%) but resolved with topical steroids. 1 patient developed a hyphema on POD 1 which resolved by the following week. Another patient developed a steroid response that required an additional Baerveldt glaucoma implant to adequately control the IOP.

## Discussion

ECP has been used since the 1980s<sup>2</sup> for the treatment of many types of glaucoma. Our study aimed to look at ECP outcomes specifically in patients of African descent with varied types and stages of glaucoma. Recently, a study by Francis et al<sup>14</sup> has shown ECP combined with phacoemulsification to be effective at lowering IOP and decreasing IOP lowering medication dependence specifically in eyes with mild to moderate glaucoma that were previously controlled with IOP lowering medications. However, a recent study by Smith et al. indicated that those results are temporary<sup>9</sup>. Other studies have focused on ECP results without phacoemulsification in advanced and refractory glaucoma and found ECP to have similar efficacy when compared to AGV in patients with refractory glaucoma who have had a prior trabeculectomy<sup>5</sup>. Our results were consistent with the above findings<sup>5,14</sup>. Another prospective study by Gayton et al<sup>15</sup> comparing ECP combined with phacoemulsification to phacoemulsification alone in patients with prior trabeculectomy found comparable IOP lowering results and decreased IOP lowering medication dependence. A retrospective review by Chen et al. also found ECP to be safe and effective in refractory glaucomas of various types, including in patients who have had previous trabeculectomy or tube shunts<sup>16</sup>. Recently, Murakami et al. noted ECP to function equivalently to a second glaucoma drainage device in eyes that have had a prior drainage device implanted<sup>17</sup>. ECP has even been studied in difficult pediatric glaucoma cases including congenital glaucoma, aphakia, Sturge-Weber syndrome, and aniridia<sup>7,18</sup>. Despite the limited but varied data regarding ECP, only one previous study has looked specifically at results of ECP in a population of patients of African descent. This study found post-operative inflammation to be higher in patients of African descent but did not find any differences in IOP or BCVA when compared to patients of Caucasian decent<sup>10</sup>. Studying the effects of combined ECP procedures in patients of African decent is important since refractory glaucoma is very common amongst these individuals despite maximal medical therapy and surgical interventions, thus rendering further options necessary<sup>10,19</sup>.

In our retrospective review, it appears that four patients received a robust IOP lowering of up to 40%. Specifically, a patient with severe stage CACG s/p trabeculectomy had a 42% reduction, another patient with severe stage POAG s/p AGV demonstrated a 42% reduction, a patient with severe stage POAG s/p

selective laser trabeculoplasty (SLT) had a 38% reduction and a patient with moderate POAG with no prior intervention showed a 38% reduction. However, some patients did not respond to combined phacoemulsification and ECP. A review of the literature demonstrates both a similar degree of successful IOP lowering as well as failures resulting in IOP worsening and need for further surgery<sup>20</sup>. Thus, it is clear that not all patients will experience significant IOP lowering or even success from this procedure. When analyzing subsets of our population, 3 patients who had undergone either a prior trabeculectomy or AGV achieved significant IOP lowering. Combined ECP and phacoemulsification may be quite effective in these particular patients, which is consistent with results of prior studies<sup>5,16</sup>. Combined ECP and phacoemulsification was successful in 6 of 9 (67%) patients who have POAG. In seven of thirty eyes (22%) the IOP worsened following the procedure. Of these seven eyes, four of them were on fewer IOP lowering drops post-operatively than pre-operatively. Latanoprost or an equivalent prostaglandin analog was stopped after surgery. Perhaps discontinuing IOP lowering medications post-operatively caused the IOP to rise. Additionally, 2/7 (29%) patients who had a higher post-operative IOP developed CME. One patient with CME had POAG and another had chronic angle closure glaucoma. Of the patients who demonstrated worsening IOP post-operatively, there was a mix of glaucoma states and types and none had undergone prior filtering or tube shunt surgeries.

In our study, 4-6 clock hours, or 120-180 degrees of ciliary processes were treated through a single incision. While a previous study by Uram<sup>21</sup> found this same amount of treatment to be efficacious, a few other studies seem to suggest that a greater treatment area is necessary to achieve adequate IOP lowering. One such study by Patel, et al. recommends treating at least 180 degrees while another by Zabrin, et al. found treating 240 degrees to be more effective<sup>2,22</sup>. More recently, Kahook compared 1-site of 240 degree ECP treatment versus 2-site ECP treatment of 240-360 degrees of ciliary processes in total and found that 2-site ECP combined with phacoemulsification resulted in a statistically significant lowering of IOP compared to 1-site ECP treatment. He also noted that 2-site ECP treatment resulted in less IOP medication dependence and that there was no difference in inflammation or complication rate in the 2-site group when compared to the 1-site group. Our lower complication rate in comparison to other studies may be related to the relatively smaller degree of ciliary processes treated; however, larger treatment areas may be more effective and may have a similar safety profile when compared to a smaller treatment area<sup>6</sup>. This may be a future area of comparison in patients of African descent.

The complication rate was low with a POD 1 IOP spike being the most common complication. This IOP spike resolved in all patients with the use of topical IOP lowering medications in the office. After adding Diamox 500mg by mouth post-operatively to all patients, no further POD 1 IOP spikes were noted. Only 1 patient required an AGV to further lower IOP; however, this patient had a pre-operative IOP of 48 mmHg and post-ECP/phacoemulsification the patient's IOP dropped to 28 mmHg. Combined ECP/phacoemulsification was attempted in this patient prior to an AGV since the patient wanted to try a less invasive procedure prior to considering a drainage device. No patients developed severe complications such as hypotony, choroidal detachments, or fibrin in the anterior chamber. As mentioned above our lower complication rate in comparison to other studies could be related to the relatively smaller

degree of ciliary processes treated. Only 1/32 (3%) developed a small hyphema which resolved without complication and 1/32 (3%) developed postoperative iritis which resolved with topical steroids. Both of these patients had POAG. In total, 2/32 (6%) developed CME. In a recent review from Kaplowitz, et al., complication rates were found to be higher than what was reported in our study: fibrin in the anterior chamber was noted in 22% of eyes, hyphema was noted in 11%, and CME was noted in 10%<sup>19</sup>. Our lower complication rate may be attributed to a smaller treatment area as noted previously.

Postoperatively, 2/32 (6%) achieved complete success with an IOP lowering of  $\geq 20\%$  off all IOP lowering medications. Despite the low percentage of complete success, no other studies have used this strict criterion for complete success in the setting of ECP. Both patients with complete success were of Haitian descent and had POAG. Qualified success, defined as IOP lowering of 20% from baseline at the last visit regardless of IOP lowering medication use, was found in 9/32 (28%). Similar criteria for qualified success have been used in other studies in the glaucoma literature<sup>23,24</sup>. In the qualified success group 5 were of Haitian descent. 7/9 had moderate to advanced POAG, 1 had advanced CACG and 1 had ocular hypertension. Thus, considering the complete and qualified success groups as a whole, POAG and Haitian descent seemed to be associated with significant IOP lowering post-operatively. When compared to the literature, our complete and qualified success rates are lower than that found in a recent study by Clement, et al. who used similar success criteria and found success in 55.5% of eyes at 12 months<sup>24</sup>. Perhaps this higher success rate was due to a larger area of treatment and shorter follow-up time. In our study, patients who were followed for greater than 12 months demonstrated a rise in IOP, perhaps suggesting that the pressure lowering effect of ECP is only temporary. However, due to the limited length of follow-up and with only 4/32 patients having reached the 12 month follow-up period, it would be difficult to make that conclusion without a larger sample size. ECP results have been variable, with some studies showing continued IOP lowering success for up to 2 - 3 years<sup>5,9,25</sup>. Perhaps our lower success rate over time could also be attributed to our population which has a higher proportion of advanced and refractory glaucoma, and to our smaller ECP treatment zone. Overall, IOP was decreased on average by 5% from baseline and on average all patients were able to be weaned off of 1 IOP lowering medication. Roberts et al. found that combined ECP and phacoemulsification resulted in lower IOPs early on, but IOP steadily increased throughout the 12-month follow-up period. This study stratified outcomes based on race but did not find any statistical difference amongst race. It noted that the only outcome associated with successful treatment was pre-operative IOP<sup>25</sup>. Our results are similar to a recent review of ECP combined with phacoemulsification by Rathi and Radcliffe<sup>26</sup>. Although as a whole we did not find a statistically significant drop in IOP status post treatment, we did find a statistically significant decreased dependence on IOP lowering medication following treatment.

In regards to postoperative visual acuity, the outcomes are excellent with an average BCVA of 20/26 (logMAR 0.114), including patients with limited visual potential due to advanced glaucoma or retinal pathology (i.e. epiretinal membrane). Furthermore 19/32 (59%) ended up with a BCVA of 20/20 (logMAR 0) and 28/32 (88%) achieved an BCVA of  $>20/30$ . Such visual acuity results compare to a study by Siegel et al<sup>27</sup> which compared the results of ECP and phacoemulsification with phacoemulsification alone.

With regards to refractive outcomes, this study is only the third to look at such data. A recent retrospective review by Wang et al<sup>28</sup> compared refractive results in combined ECP and phacoemulsification to phacoemulsification alone and found that in combined ECP cases, refractive outcomes were less predictable and these same patients often experienced a small myopic shift. Another retrospective review by Kang et al<sup>8</sup> also found there to be more refractive variability postoperatively in eyes who underwent ECP combined with phacoemulsification compared to those who underwent phacoemulsification alone. We found 84% of patients to be within +1.00D which is similar to Kang et al.'s finding of 90% to be within this goal. Furthermore, only 48% of combined ECP cases were within  $\pm 0.50D$  of goal, while 100% of phacoemulsification without ECP cases were within  $\pm 0.50D$  of goal<sup>8</sup>. In our study, 5/32 (16%) were  $>\pm 1.0D$  of goal. Of these 5 cases, 3 resulted in a myopic surprise and 2 resulted in a hyperopic surprise. 4/5 of these patients, 3 with POAG and 1 with CACG, who obtained a refractive surprise had advanced glaucoma, suggesting that perhaps patients with advanced disease are more likely to experience a refractive surprise. 18/32 (56%) ended up within  $\pm 0.50D$  of goal. These outcomes suggest that physicians should take extra care to adjust for intraocular lens power. Currently no formula exists to adjust for ECP combined phacoemulsification refractive outcomes. The quality of each pre-operative biometry, A-scan, and K's were reviewed in our study and were found to be accurate. One explanation for the variable refractive surprises may be that the lens/zonule complex is attached to the ciliary body, which is non-uniformly ablated during ECP. Moreover, having only a small section of ciliary bodies ablated could result in shifts of the entire lens complex. Considering our study and the 2 prior studies, postoperative refractive surprises may be possible and patients need to be counseled accordingly.

## Conclusions

Combined phacoemulsification and ECP and has a low complication rate and may serve as a helpful and safe procedure in the management of glaucoma in this often difficult to treat population. In particular, combined ECP/phacoemulsification may work better on patients who have POAG and have had prior glaucoma surgery when further surgical options are limited. Due to the variability in refractive outcomes after surgery, preoperative planning should be considered. Limitations include the retrospective nature of our study, short follow-up period with only 4/29 patients who followed up to 12 months, lack of a control group and a small sample size. In addition, perhaps a larger treatment area in addition to 4-6 clock hours could result in a higher success rate than what was reported. Overall, ECP combined with cataract surgery can achieve robust IOP lowering in some patients while achieving no improvement or even worsening of IOP in some patients of African descent. It appears that in patients who did not show improvement in IOP following surgery, relying on standard surgical interventions such as AGV or trabeculectomy may be necessary to control IOP. Despite variability in IOP outcomes, there was a significant decrease in reliance on IOP lowering medications across all patients. Considering results as a whole, it appears that combined phacoemulsification and ECP may serve as an additional treatment measure in patients with moderate/advanced POAG who have already undergone trabeculectomies or AGV and still need additional intervention. Combined phacoemulsification and ECP may also serve as a bridge in patients

who have maximized medical therapy but who are not interested in undergoing an invasive glaucoma surgery.

## **Declarations**

### **Ethics approval and consent to participate**

This study followed the tenets of the Declaration of Helsinki and has been approved by the ethics committee of the Department of Ophthalmology, Boston Medical Center, Boston, MA.

### **Consent for publication**

Written informed consent for publication of their clinical details and/or clinical images was obtained from the patient/parent/guardian/relative of the patient. A copy of the consent form is available for review by the Editor of this journal.

### **Availability of data and material**

Datasets generated and analyzed for this study are available upon request from the first author.

### **Competing interests**

The authors declare that they have no competing interests

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Not applicable

### **Authors' contributions**

Study concept and design (CWW, MD, EB); data collection, analysis, interpretation (CWW, MD, EB); preparation and review of manuscript (CWW, ER, EB). All authors had read and approved of the final manuscript.

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## Tables

**Table 1: Demographics and Ocular Parameters**

	Number of Eyes (%)	Significance
Average Age	68.4	
Total eyes	32	
Total patients	29	
Gender	20 F, 9 M	
Pre-op BCVA Average Visual Acuity (logMAR)	0.403 ± 0.454	
Post-op BCVA Average Visual Acuity (logMAR)	0.114 ± 0.226	p = 1.004
Number of meds pre-op average	2.59 ± 1.01	
Number of meds last visit average	1.97 ± 1.38	p = 0.004
Pre-op IOP average	17.30 ± 6.30	
Post-op IOP average at last visit	15.88 ± 4.23	p = 0.130
Glaucoma Type		
Advanced POAG	10/32 (31%)	
Moderate POAG	7/32 (22%)	
Mild POAG	3/32 (10%)	
Indeterminate POAG*	2/32 (6%)	
Advanced CACG	7/32 (22%)	
Advanced Uveitic glaucoma	1/32 (3%)	
Moderate Pigment Dispersion Glaucoma	1/32 (3%)	
Ocular Hypertension	1/32 (3%)	
Previous Interventions		
SLT	10/32 (31%)	
LPI	7/32 (22%)	
Trabeculectomy	2/32 (6%)	
Ahmed glaucoma valve	4/32 (12.5%)	
PRP	1/32 (3%)	
Pars Plana Vitrectomy	1/32 (3%)	

\*No HVF or OCT data available; F = female; M = male; POAG = primary open angle glaucoma; CACG = chronic angle closure glaucoma; SLT = selective laser trabeculoplasty; LPI = Laser Peripheral Iridotomy; PRP = Panretinal Photocoagulation

**Table 2: Race**

African American	12/29 (41%)
Haitian	11/29 (38%)
Jamaican	2/29 (6%)
Cape Verdean	2/29 (6%)
Trinidadian	1/29 (3%)
Moroccan	1/29 (3%)

**Table 3: IOP Averages at Different Time Points**

Time Period	IOP	Number of eyes
Day 1	21.4 ±8.0	32
Week 1	17.3 ±4.9	32
Month 1	17.7 ±4.5	32
IOP Last		
1-3 Months	16.4 ±2.0	13
4-6 Months	15.1 ±3.8	12
7-10 Months	14.7 ±2.3	3
11-18 Months	19.5 ±3.9	4

\*IOP measured in in mmHg

**Table 4: Refractive Outcomes**

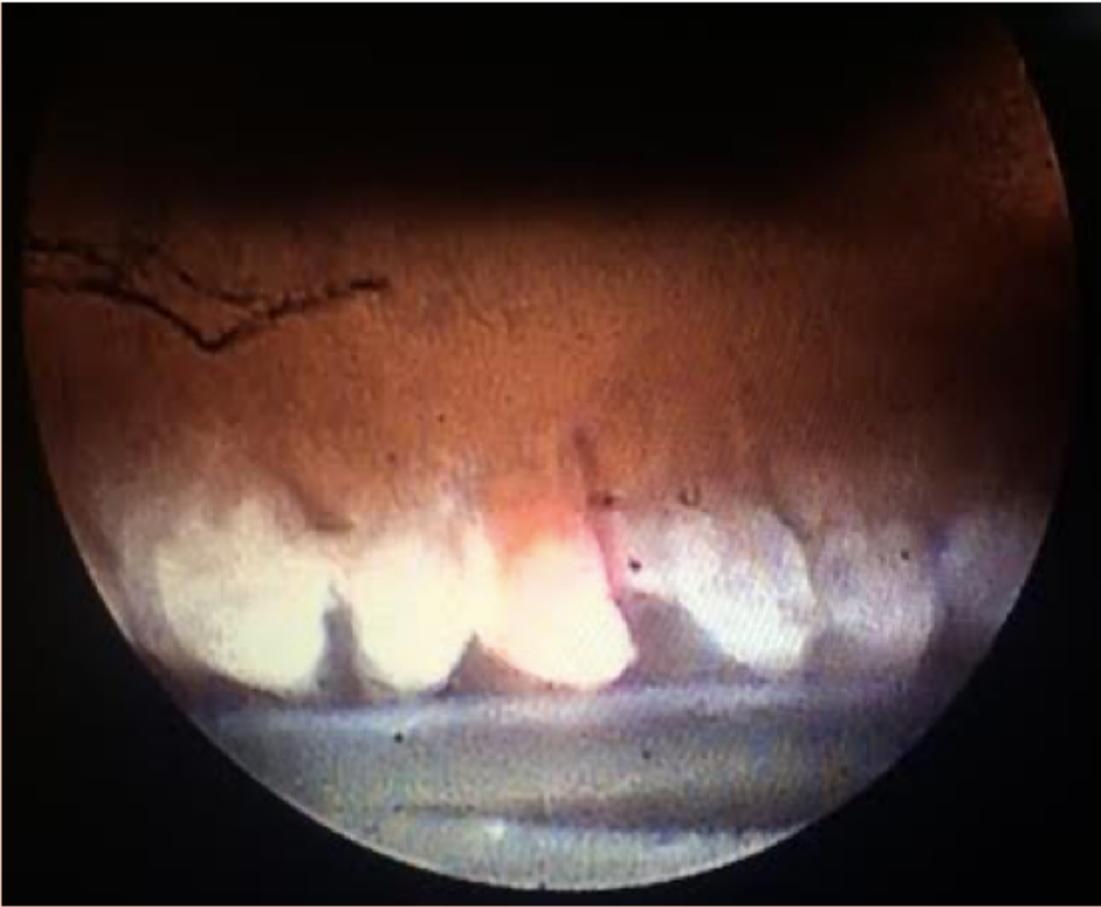
Outcome	Number of Eyes (%)	Average Deviation
<b>&gt;±1.0D of goal<sup>11</sup></b>	5/32 (16%)	
Myopic surprise	3	-1.12 ±0.15
Hyperopic surprise	2	+1.27 ±0.14
<b>&gt;±0.50D of goal</b>	14/32 (44%)	
Myopic deviation	8	-0.81 ±0.27
Hyperopic deviation	5	+0.87 ±0.38
<b>Within ± 0.50D of Goal</b>	18/32 (56%)	+0.02 ±0.30

D = diopter

**Table 5: Complications**

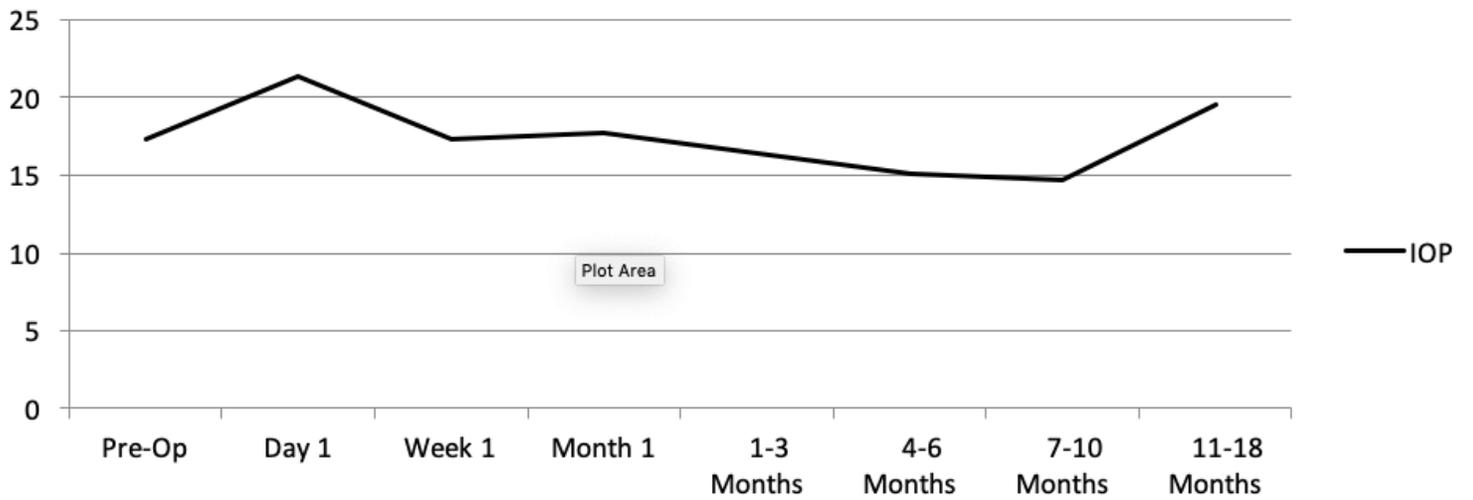
Early Complications (<1 month)	Number of Eyes (%)
POD 1 IOP Spike	8/32 (25%)
Post-op Iritis	1/32 (3%)
Hyphema	1/32 (3%)
<b>Late Complications (&gt;1 month)</b>	
Cystoid Macular Edema	2/32 (6%)
Steroid Response	1/32 (3%)
Further Surgery (Baerveldt glaucoma implant)	1/32 (3%)

POD 1 = post-operative day 1



**Figure 1**

Intraoperative view of ciliary processes status-post laser ablation.



**Figure 2**

Intraocular pressure (IOP) in mmHg over time.