Effect of Laser Iridoplasty on Pulsatile Ocular Blood Flow in Primary Angle-closure Glaucoma and Primary Angle-closure Suspects

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EFFECT OF LASER IRIDOPLASTY ON PULSATILE OCULAR BLOOD FLOW IN PRIMARY ANGLE-CLOSURE GLAUCOMA AND PRIMARY ANGLE-CLOSURE SUSPECTS

by

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ABSTRACT

Angle-closure glaucoma is a leading cause of blindness in the United States and around the world. New research has indicated that intraocular pressure is not the only risk factor associated with glaucomatous optic neuropathy. In recent years, a vascular deregulation in ocular blood flow has been considered a possible risk factor in glaucoma. A laser peripheral iridoplasty is a standard treatment option in non-pupillary block angle-closure glaucoma. The present study employed a secondary retrospective design and utilized patient's data from an ophthalmologist's practice. The purpose of this study was to examine the effect of laser peripheral iridoplasty on pulsatile ocular blood flow in primary angle-closure glaucoma and primary angle-closure suspects. A sample of 30 eyes from 17 patients was analyzed for this study. A significant increase in pulsatile ocular blood flow was found among primary angle-closure suspects. Additional data analysis was performed through SPSS software to examine the effect on these variables by age, sex and medical history as a total sample and in each group. Primary angle-closure suspects who were 51-60 years old showed a significant increase in intraocular pressure after laser treatment, however, primary angle-closure glaucoma patients who were 71-80 years old showed a significant decrease in intraocular pressure. Furthermore, a significant increase in pulsatile ocular blood flow was found in female subjects among primary angle-closure suspects, supporting the need for gender medicine research. Lastly, the pulsatile ocular blood flow increased significantly among primary angle-closure suspects who were also suffering from cardiovascular disease. Among primary angle-closure glaucoma patients who were suffering from both cardiovascular disease and diabetes mellitus, a significant decrease in intraocular pressure was observed.

Keywords: glaucoma, angle-closure glaucoma, pulsatile ocular blood flow, laser peripheral iridoplasty

DEDICATION

In Memory of Felipe A. Cetina, M.D., D.O.
(1958 - 2015)

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LIST OF ABBREVATIONS

OAG	Open-angle glaucoma
ACG	Angle-closure
PACG	Primary angle-closure glaucoma
PACS	Primary angle-closure suspect
POBF	Pulsatile ocular blood flow
IOP	Intraocular pressure

INTRODUCTION

Glaucoma is a category of eye diseases characterized by damage to the optic nerve head. According to a systematic review, glaucoma is presently the second most common cause of blindness worldwide (Pascolini & Mariotti, 2011). It is estimated that 61 million people were affected by glaucoma in 2010 with 8.4 million bilaterally blind from the disease (Yanoff & Duker, 2014). This is projected to increase to 79.6 million people in 2020 with 11.1 million bilaterally blind (Quigley & Broman, 2006). Within the United States, there are 2 million people with glaucoma, not including approximately 2.4 million who have undetected and untreated glaucoma (Shaikh, Yu, & Coleman, 2014). In fact, "the majority of glaucoma in the world remains undiagnosed" (Shaarawy, 2015, p. 1).

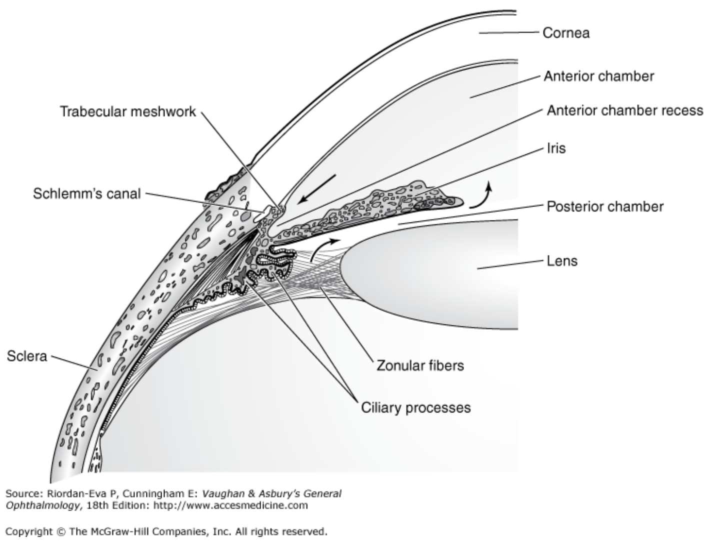

Figure 1: Normal aqueous humor flow (Riordan-Eva, Cunningham, Vaughan, & Asbury, 2011).

<u>Main Types of Glaucoma</u>

Apposition of the peripheral iris against the trabecular meshwork is called angle-closure glaucoma (ACG) (Allingham, 2005). In contrast, open-angle glaucoma (OAG) is characterized as a degenerative process in the trabecular meshwork due to extracellular material (Riordan-Eva, Cunningham, Vaughan, & Asbury, 2011). "Both forms of glaucoma are characterized by a progressive optic neuropathy with visual field loss and characterized structural changes, including thinning of the retinal nerve fiber layer and excavation of the optic nerve head" (Quigley, 2005.). As seen in Figure 1, "the aqueous humor produced by the ciliary process is released into the posterior chamber and finds its way to the anterior chamber, where it is absorbed by Schlemm's canal" (Samsam, 2013, p. 624). In OAG[1], aqueous humor has free access to the trabecular

[1] open-angle glaucoma

meshwork, but poor drainage to the canal of Schlemm. In ACG[2], the flow of aqueous humor to the trabecular meshwork is obstructed (Yanoff & Duker, 2014). In 2010, it was estimated that 44.7 million people had OAG and 15.7 million had ACG. The prevalence of OAG and ACG is expected to increase to 58.6 million people and 21 million people, respectively in 2020 (Quigley & Broman, 2006). Bilateral blindness due to ACG occurred in approximately 3.9 million people in 2010. This is estimated to rise to 5.2 million people in 2020 (Quigley & Broman, 2006). This obviously has a great impact on the patient's daily life. In fact, low visual acuity was associated with the occurrence of suicidal ideation or a suicide attempt, according to a recent study in South Korea (Rim, C. Lee, S. Lee, Chung, & Kim, 2015). Consequently, it is important that ophthalmologists prevent the onset of glaucoma or treat the glaucoma patient. The ophthalmologist providing the data for this research therapeutically treats ACG suspects and ACG patients with lasers to prevent an acute angle-closure attack. Acute angle-closure is an ophthalmic emergency that in rare cases can lead to permanent blindness. While the prevalence of OAG is greater than ACG in the United States and Europe, the number of people blinded by each type of glaucoma is nearly equal due to the higher morbidity of ACG (Yanoff & Duker, 2014). As a result, the broad focus of this study is to contribute to the knowledge of ACG and help prevent this disease in future patients.

ACG can be further broken down into primary angle-closure suspect, primary-angle closure, and primary angle-closure glaucoma. **Table 1** includes a definition of ACG (Foster, Buhrmann, Quigley, & Johnson, 2002; Yanoff & Duker, 2014).

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[2] angle-closure glaucoma

Table 1: Classification of Angle-Closure Glaucoma	
Primary angle-closure suspect (PACS)	Exhibits iridotrabecular contact (commonly defined as ≥ 180° IOP is not elevated No peripheral anterior synechiae (PAS)
Primary angle closure (PAC)	Patient meets criteria for PACS Elevated IOP, PAS, or both Suffered adverse sequelae of the iridotrabecular contact No optic nerve damage
Primary angle-closure glaucoma (PACG)	Patients meet the criteria for PAC Has optic nerve damage

Risk Factors

The demographic risk factors attributed to ACG[3] are ethnicity, sex, age, and genetics. "East Asians of China, Mongolia, and South-East Asian people of Chinese descent all experience a higher prevalence of PACG compared to people of other ethnic origins" (Shaarawy, 2015). However, the Alaskan Eskimos have the highest prevalence of ACG (Yanoff & Duker, 2014). Furthermore, females have a higher prevalence of experiencing an acute angle-closure attack as well as developing PACG compared to males, especially with increased age (Yanoff & Duker, 2014). While the genes responsible for developing PACG are unknown, the heritable anatomic features are known to increase an individual's risk in developing the disease (Yanoff & Duker, 2014). Other risk factors related to anatomical features, include: shallow anterior chamber depth, thick lens, short axial length, small diameter of cornea and thick peripheral iris roll (Yanoff & Duker, 2014).

Mechanisms of Angle-Closure Glaucoma

Although the clinical progression and features of glaucomatous optic neuropathy (GON) are well described, the cellular mechanisms that guide the pathogenesis of the disease are inadequately known (Yanoff & Duker, 2014). Among the many multifactorial ideas that may contribute to this optic neuropathy, there are two principal theories. According to the mechanical theory, introduced by Heinrich Müller, increased intraocular pressure (IOP) causes damage to retinal ganglion cell axons due to stretching of the laminar beams (Flammer et al., 2002). The vascular theory, suggested by Eduard von Jaeger, states that GON is a result of insufficient blood supply due to either increased

[3] angle-closure glaucoma

IOP or other risk factors reducing ocular blood flow (OBF). Although there are multiple conditions that can satisfactorily explain GON due to an increase in IOP, including: congenital glaucoma, ACG or secondary glaucomas, there are other conditions such as normal-tension glaucoma that indicate that other factors might be involved either directly or by rendering the eye more sensitive to IOP[4] (Flammer et al., 2002). Both of these theories have been vigorously studied and supported for over a century, but further investigation is still needed.

Treatment

Depending on the mechanism causing the angle closure, there are multiple treatment options, including: laser peripheral iridotomy, laser iridoplasty, trabeculectomy, lens extraction, localized ciliary body ablation and pharmacological agents. However, the definite treatment for primary angle-closure is a laser peripheral iridotomy, which creates a hole in the iris as an alternate drainage system for aqueous humor. If effective, this allows the IOP pressure to return to normal in both the posterior and anterior chambers of the eye and will open the angle. It has been proven to be effective in eliminating pupillary block, one of many mechanisms to cause angle closure (Shaarawy, Sherwood, Crowston, & Hitchings, 2015). In cases where the laser iridotomy fails to open the angle due to a non-pupillary block mechanism, a laser peripheral iridoplasty is the next standard treatment. "The procedure consists of applying a series of laser burns of lower power, large spot size, and long duration perpendicular to the extreme peripheral iris" (Shaarawy, Sherwood, Crowston, & Hitchings, 2015, p. 716). This has shown to not only pull the iris stroma away from the angle, but also to thin the iris tissues near

Figure 2: Laser iridoplasty burns (arrow) (Ritch, Tham, & Lam, 2007).

[4] intraocular pressure

the crowded angle (Liu, Lamba, & Belyea, 2013) (Figure-2). This procedure can be done in acute angle attacks and non-acute situations.

Since intraocular pressure is a risk factor for the disease, it is closely examined in patients with glaucoma. A Goldmann applanation tonometer is the gold standard for measuring IOP and has been used in multiple related studies (Shaarawy, Sherwood, Crowston, & Hitchings, 2015). However, since the vascular theory has become an important component of glaucoma research, it is important to measure the ocular blood flow as well. Methods to estimate the retinal blood flow include the "laser Doppler velocimetry, fluorescein angiography, and the blue field entoptic technique" (Agarwal, Gupta, & Sihota, 2002). Choroidal blood flow can be measured using "colour Doppler ultrasonography, fundus pulsation measurement with laser interferometer or the pneumotonometric method of measuring pulsatile ocular blood flow (POBF)" (Agarwal, Gupta, & Sihota, 2002). The last method is currently an acceptable means of measuring the pulsatile component of choroidal blood flow with limitations (Agarwal, Gupta, Sihota, 2002). "This pulsatile component of ocular blood flow is measured by recording the amplitude of IOP pulse wave causing changes in the ocular volume during the cardiac cycle" (Mahar, 2006). Choroidal volume and IOP vary with the cardiac cycle, with a peak during systole and a trough during diastole (Mahar, 2006). It is limited in that it measures IOP rather than true blood flow (Harris, 2009).

Current Studies

Literature review of studies that investigated the effect of a laser iridoplasty on pulsatile ocular blood flow in angle-closure glaucoma resulted in no major studies in this topic. The literature review was conducted using Google Scholar and UCF's library databases. Only one relevant study was found that investigated the pulsatile ocular blood flow in primary chronic angle-closure glaucoma (PCACG). This study found that the POBF in eyes with advanced primary chronic ACG[5] were significantly lower than fellow eyes and eyes of healthy controls (Agarwal, Gupta, & Sihota, 2002).

[5] angle-closure glaucoma

However, this relationship was not evident in patients with early or moderate glaucomatous defects (Agarwal, Gupta, & Sihota, 2002). Furthermore, there were two studies found on laser iridoplasty that were relevant to this research proposal. Investigators conducted a case study to see the effect of a laser iridoplasty on plateau iris syndrome. It was previously believed that the laser caused the peripheral iris stroma to contract, pulling the iris away from the angle and relieving the closure (Liu, Lamba, & Belyea, 2013). The researchers discovered that the laser not only caused the peripheral iris to contract, but also thinned the iris tissue at the crowded angle (Liu, Lamba, & Belyea, 2013). Another article of a randomized, controlled trial compared "the efficacy and safety of laser peripheral iridotomy with or without laser peripheral iridoplasty in the treatment of eyes with synechial primary angle-closure or primary angle-closure glaucoma" (Sun et al., 2010). The researchers found that there was a "significant and equivalent" reduction in IOP in both groups, and that the iridoplasty group showed a reduction in peripheral anterior synechiae (Sun et al., 2010).

Although laser peripheral iridoplasty is considered standard treatment after an ineffective laser iridotomy, there are few studies on the long-term outcomes of either of these procedures. As a result, the objective of this research is to analyze the effect of laser peripheral iridoplasty on pulsatile ocular blood flow in primary angle-closure suspects and primary angle-closure glaucoma patients. The main hypothesis is that the POBF[6] will decrease in parallel with intraocular pressure after a laser iridoplasty in both PACG[7] and PACS[8]. The student also hypothesizes that age will have a negative correlation in the effectiveness of the laser on increasing POBF. Moreover, the student presumes that the laser will be less effective in increasing POBF in females compared to males. Lastly, the student believes that laser iridoplasty will be less effective in increasing the POBF and decreasing the IOP in patients suffering from cardiovascular disease, diabetes mellitus, or both.

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[6] pulsatile ocular blood flow
[7] primary angle-closure glaucoma
[8] primary angle-closure suspects

METHODOLOGY

Study Design

A secondary retrospective design was employed in order to analyze the POBF before and after a laser iridoplasty in PACG and PACS. This was accomplished by gathering patient data previously collected by a professional ophthalmologist. A sample of thirty eyes from seventeen patients were placed into two separate groups; eyes diagnosed with PACG and eyes suspected for the same disease. The patient's eyes were placed into one of these two groups based off the diagnosis provided on the de-identified patient reports. No control group was possible for this study because a few subjects had the laser treatment performed on both eyes.

Experimental and Null Hypotheses

H_1: The POBF will decrease in parallel with IOP after a laser iridoplasty in both PACG and PACS.

H_0: There will be no association between POBF and IOP after a laser iridoplasty in both PACG and PACS.

Alternative Hypotheses:

H_{a1}: Age will have a negative correlation on the effectiveness of the laser on POBF.

$H_{a2:}$ The laser iridoplasty will be less effective in increasing POBF in females compared to males.

$H_{a3:}$ The laser iridoplasty will be less effective in increasing POBF and decreasing IOP in patients suffering from cardiovascular disease, diabetes mellitus, or both.

Sampling Methodology

This secondary retrospective study was designed to access the effect of laser iridoplasty on POBF. Approval from the Institutional Review Board (IRB) at UCF was obtained prior to data collection. Furthermore, a representative from the ophthalmologist's office signed a written agreement, stating that the researcher had permission to conduct the study and collect the data. The samples were taken from a report created by a professional ophthalmologist at Premier Visual Health, LLC who met the following criteria. The patient's eye(s) were either diagnosed with PACG or

considered a suspect for the same disease. Selected eyes previously had a blood flow analysis performed before and after a laser iridoplasty. In order to further examine the wellbeing of the patient's eyes, selected eyes were required to previously have a visual field test and a spectral domain optical coherence tomography (SD-OCT) test performed at or before baseline. As a result, this excluded eyes diagnosed with secondary ACG. This also excluded eyes that experienced an acute angle-closure attack prior to baseline or during the study timeframe. Selected eyes did not have a surgical iridectomy performed prior to baseline, but may have undergone a laser peripheral iridotomy or selective laser trabeculoplasty at least six months prior to baseline as is commonly practiced.

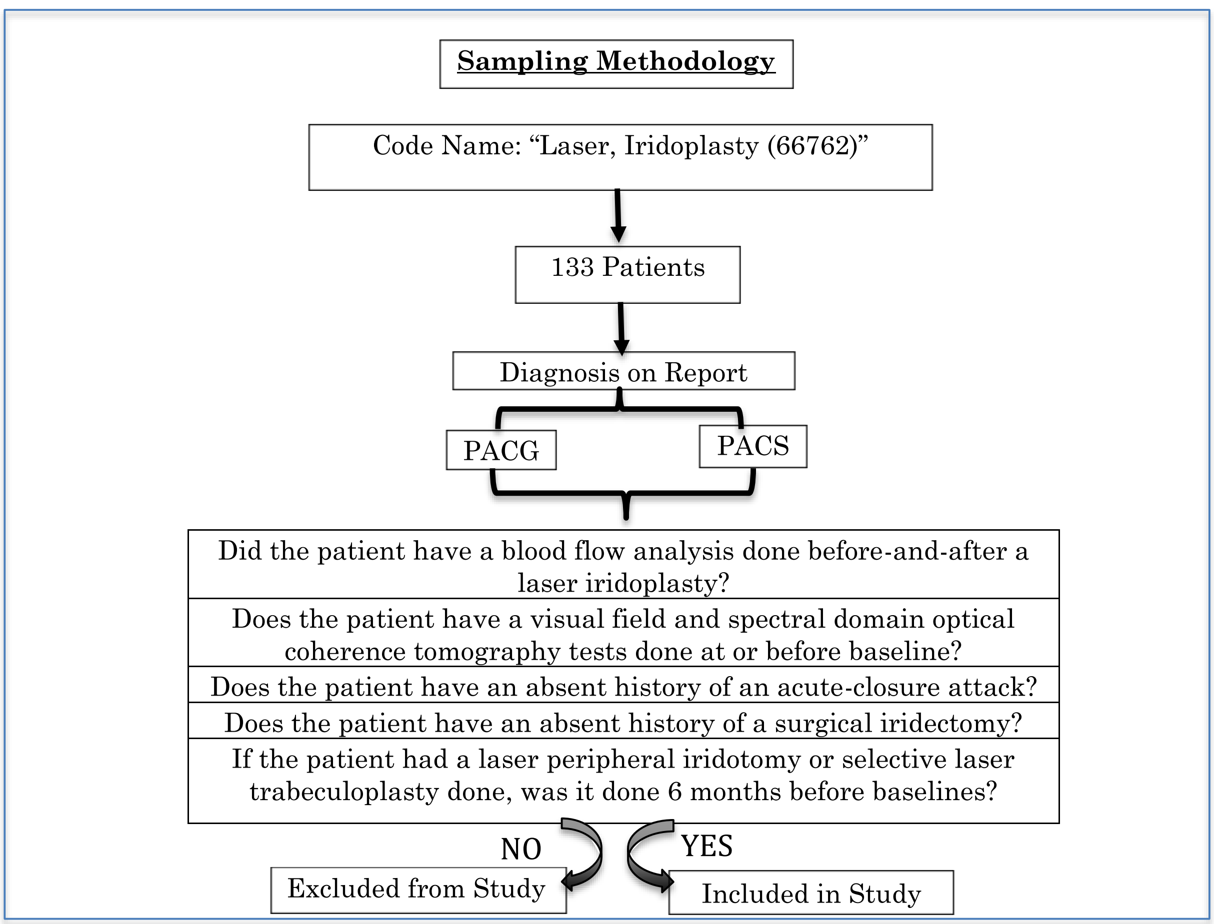

Figure 3: Sampling methodology

Instrumentation and Measurement

The data examined was gathered using archival data in the form of a report from a professional ophthalmologist. Considering that the researcher is not a trained medical doctor, this was the best possible instrument to be used in order to answer the proposed research questions. Furthermore, only one professional ophthalmologist who used a POBF analyzer regularly in his practice was willing to share his data with the researcher. Within the report, the patient's age, sex, race, ethnicity, family history, medical history, ocular findings, POBF test results, Goldmann applanation tonometer results, iVue SD-OCT test results, and Oculus Centerfield perimetry test results were provided. The variables included within each test can be seen in Appendix C. Concerning the iVue SD-OCT, there is "substantial equivalence between the iVue with normal database and the predicate RTVue with normal database for GCC parameters, RNFL thickness parameters, Optic Disc parameters, and Retina thickness parameters" ("Optovue iVue," 2013). No normal values were found for the TonoPlus POBF analyzer and the Oculus Centerfield Perimetry.

Data Collection Procedures

The findings from the equipment listed above were included in a de-identified patient report provided by a professional ophthalmologist. The report was created using the keywords "laser iridoplasty" through IO Practiceware, in which a list of patients, who had received this procedure, was produced. After the ophthalmologist reviewed the list of patients, he was able to create a report of the specific test results for the researcher to analyze. The researcher analyzed the original patient reports at the ophthalmologist's office and recorded the relevant information. The reports were not taken out of the office and the confidentiality of the patients was protected with the upmost respect. However, the de-identified data was downloaded into SPSS and analyzed outside the office.

Data Analysis Plan

Descriptive and frequency tests were performed to examine the mean, standard deviation, and spread in age as well as the percentage for sex, ethnicity, and number of patients in both groups. An independent-samples *t* test examined the statistical significance in age and a chi-square examined

the statistical significance in sex, ethnicity and race between both groups. To examine the wellbeing of the eyes in each group, multiple independent-samples *t* tests were employed, comparing the results of the visual field test, SD-OCT test, retinal nerve fiber layer test, and ganglion cell concentration test. Additionally, multiple paired-samples *t* tests were utilized to examine the effect of laser iridoplasty on POBF and IOP by age, sex, and medical history among the total sample and in PACG and PACS separately. Lastly, a one-way ANOVA analyzed the effect of laser iridoplasty on POBF and IOP with regard to the timeframe between the laser and post-laser recordings in the total sample and in PACG and PACS separately.

Ethical Considerations

The variables needed from the de-identified patient reports were recorded in a word document on the researcher's laptop and later transferred into SPSS for data analysis. The data analysis was saved in a locked file. No confidential information was included in the report in order to secure patient confidentiality. However, each report included a code referencing the patient's digital records that only the ophthalmologist knew. The study was submitted to the Institutional Review Board (IRB) at UCF for approval and was approved.

RESULTS

Demographic and Descriptive Analysis

Among the 133 patients listed in the report provided by the ophthalmologist, only 30 eyes (or subjects) from 17 patients met the criteria for this study. The distribution of the age of subjects showed a negative skew with a mean age of 66.5 and a standard deviation of 11.802. This observation is expected due to the fact that the risk for glaucoma increases with age. Among the total sample, 36.7% were males and 63.3% were females. The racial breakdown consisted of 53.3% white, 20% black or African American, and 26.7% declined to specify. The ethnicity breakdown consisted of 53.3% Hispanic or Latino and 46.7% not Hispanic or Latino. Furthermore, 23.3% of subjects are in the PACG group and 76.7% of subjects are in the PACS group.

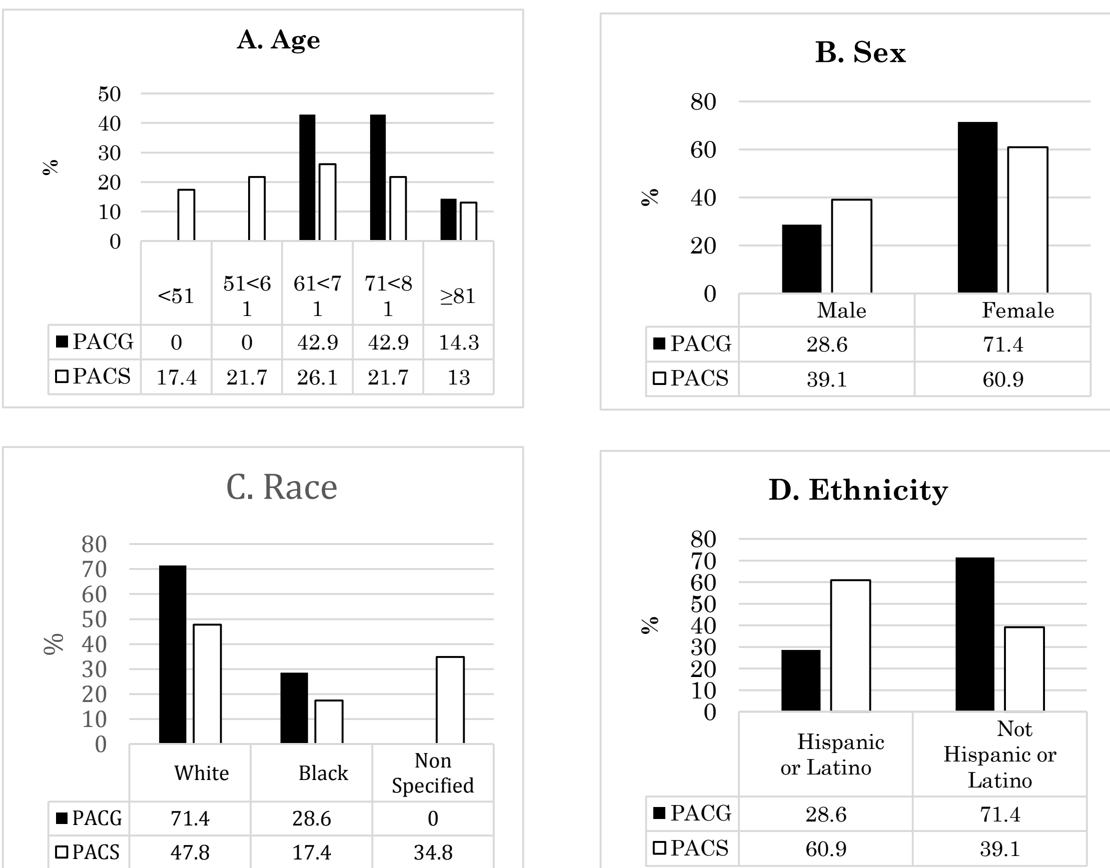

Figure 4: Demographics among PACG and PACS

As seen in **Tables 2A-2B**, an independent *t* test comparing the average age between PACG and PACS found a significant difference ($t(28) = 2.098$, $p < 0.05$). The average age among PACS was significantly lower ($m = 64.17$, $sd = 12.254$) than the average age among PACG subjects ($m = 74.29$, $sd = 5.589$). Furthermore, a chi-square test of independence was calculated comparing the sex, ethnicity, and race between PACG and PACS subjects (**Tables 3A-5B**). No significant difference was found in sex ($X^2(1) = 0.258$, $p > 0.05$), ethnicity ($X^2(1) = 2.249$, $p > 0.05$), or race ($X^2(1) = 3.331$, $p > 0.05$).

Table 2A: Age Between PACG and PACS

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Age	PACG	7	74.29	5.589	2.112
	PACS	23	64.17	12.254	2.555

Table 2B: Age Between PACG and PACS

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Age	Equal variances assumed	4.879	.036	2.098	28	.045	10.112	4.820	.239	19.985
	Equal variances not assumed			3.050	22.982	.006	10.112	3.315	3.253	16.970

Table 3A: Sex Between PACG and PACS

Crosstab

			Group		
			PACG	PACS	Total
Male/Female	Male	Count	2	9	11
		% within Male/Female	18.2%	81.8%	100.0%
		% within Group	28.6%	39.1%	36.7%
		% of Total	6.7%	30.0%	36.7%
	Female	Count	5	14	19
		% within Male/Female	26.3%	73.7%	100.0%
		% within Group	71.4%	60.9%	63.3%
		% of Total	16.7%	46.7%	63.3%
Total		Count	7	23	30
		% within Male/Female	23.3%	76.7%	100.0%
		% within Group	100.0%	100.0%	100.0%
		% of Total	23.3%	76.7%	100.0%

Table 3B: Sex Between PACG and PACS

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.258[a]	1	.612		
Continuity Correction[b]	.004	1	.952		
Likelihood Ratio	.265	1	.607		
Fisher's Exact Test				1.000	.485
Linear-by-Linear Association	.249	1	.618		
N of Valid Cases	30				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.57.
b. Computed only for a 2x2 table

Table 4A: Ethnicity Between PACG and PACS

Crosstab

			Group		
			PACG	PACS	Total
Ethnicity	Hispanic or Latino	Count	2	14	16
		% within Ethnicity	12.5%	87.5%	100.0%
		% within Group	28.6%	60.9%	53.3%
		% of Total	6.7%	46.7%	53.3%
	Not Hispanic or Latino	Count	5	9	14
		% within Ethnicity	35.7%	64.3%	100.0%
		% within Group	71.4%	39.1%	46.7%
		% of Total	16.7%	30.0%	46.7%
Total		Count	7	23	30
		% within Ethnicity	23.3%	76.7%	100.0%
		% within Group	100.0%	100.0%	100.0%
		% of Total	23.3%	76.7%	100.0%

Table 4B: Ethnicity Between PACG and PACS

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.249[a]	1	.134		
Continuity Correction[b]	1.139	1	.286		
Likelihood Ratio	2.291	1	.130		
Fisher's Exact Test				.204	.143
Linear-by-Linear Association	2.174	1	.140		
N of Valid Cases	30				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 3.27.
b. Computed only for a 2x2 table

Table 5A: Race Between PACG and PACS

Crosstab

			Group		
			PACG	PACS	Total
Race	White	Count	5	11	16
		% within Race	31.3%	68.8%	100.0%
		% within Group	71.4%	47.8%	53.3%
		% of Total	16.7%	36.7%	53.3%
	Black or African American	Count	2	4	6
		% within Race	33.3%	66.7%	100.0%
		% within Group	28.6%	17.4%	20.0%
		% of Total	6.7%	13.3%	20.0%
	Declined to specify	Count	0	8	8
		% within Race	0.0%	100.0%	100.0%
		% within Group	0.0%	34.8%	26.7%
		% of Total	0.0%	26.7%	26.7%
Total		Count	7	23	30
		% within Race	23.3%	76.7%	100.0%
		% within Group	100.0%	100.0%	100.0%
		% of Total	23.3%	76.7%	100.0%

Table 5B: Race Between PACG and PACS

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.331[a]	2	.189
Likelihood Ratio	5.083	2	.079
Linear-by-Linear Association	2.426	1	.119
N of Valid Cases	30		

a. 4 cells (66.7%) have expected count less than 5. The minimum expected count is 1.40.

To analyze the wellbeing of the eyes in each group, an independent-samples *t* test was performed. This test examined the results from the subject's visual fields, retinal nerve fiber layer, optic nerve head, and ganglion cell concentration findings (**Tables 6A-6B)**. Analysis of the wellbeing of the eyes showed a statistically significant difference in ONH V. C/D between PACG and PACS ($t(28) = 2.184$, $p < 0.05$). The average ONH V. C/D ratio was significantly lower in PACS ($m = 0.5813$, $sd = 0.18371$) than the average ONH V. C/D ratio in PACG ($m = 0.7400$, $sd = 0.09183$).

Table 6A: Wellbeing of Eyes Between PACG and PACS

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Mean Deviation	PACG	7	-1.4286	3.62518	1.37019
	PACS	22	-1.6359	2.22918	.47526
Pattern Standard Deviation	PACG	7	3.5200	1.80521	.68230
	PACS	22	3.8577	1.15167	.24554
Average RNFL Thickness	PACG	7	90.00	18.833	7.118
	PACS	23	92.09	11.966	2.495
Average Superior RNFL	PACG	7	92.00	20.067	7.584
	PACS	23	94.30	12.216	2.547
Average Inferior RNFL	PACG	7	87.57	17.813	6.732
	PACS	23	89.83	12.331	2.571
ONH Area C/D	PACG	7	.5414	.08572	.03240
	PACS	23	.4039	.17207	.03588
ONH V. C/D	PACG	7	.7400	.09183	.03471
	PACS	23	.5813	.18371	.03831
ONH H. C/D	PACG	7	.8071	.10641	.04022
	PACS	23	.7109	.15015	.03131
ONH Rim Area (mm^2)	PACG	7	1.0543	.25825	.09761
	PACS	23	1.2604	.39711	.08280
ONH Disc Area (mm^2)	PACG	7	2.2971	.42311	.15992
	PACS	23	2.1578	.46757	.09749
ONH Cup Volume (mm^3)	PACG	7	.33214	.127176	.048068
	PACS	23	.20657	.163649	.034123
GCC Avg. Thickness Total	PACG	7	82.71	10.673	4.034
	PACS	23	89.30	10.641	2.219
GCC Avg. Thickness Superior	PACG	7	82.57	10.937	4.134
	PACS	23	89.52	11.321	2.361
GCC Avg. Thickness Inferior	PACG	7	82.86	12.321	4.657
	PACS	23	89.00	10.510	2.191
FLV (%)	PACG	7	4.18786	3.825250	1.445809
	PACS	23	2.83604	2.758592	.575206
GLV (%)	PACG	7	12.96643	9.580976	3.621269
	PACS	23	7.37374	6.913579	1.441581

Table 6B: Wellbeing of Eyes Between PACG and PACS

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Mean Deviation	Equal variances assumed	2.091	.160	.183	27	.856	.20734	1.13039	-2.11202	2.52670
	Equal variances not assumed			.143	7.500	.890	.20734	1.45027	-3.17625	3.59092
Pattern Standard Deviation	Equal variances assumed	2.816	.105	-.587	27	.562	-.33773	.57500	-1.51754	.84209
	Equal variances not assumed			-.466	7.618	.654	-.33773	.72514	-2.02460	1.34915
Average RNFL Thickness	Equal variances assumed	1.443	.240	-.352	28	.727	-2.087	5.926	-14.227	10.053
	Equal variances not assumed			-.277	7.534	.789	-2.087	7.543	-19.669	15.496
Average Superior RNFL	Equal variances assumed	1.680	.205	-.374	28	.711	-2.304	6.158	-14.919	10.310
	Equal variances not assumed			-.288	7.404	.781	-2.304	8.001	-21.016	16.407
Average Inferior RNFL	Equal variances assumed	1.442	.240	-.381	28	.706	-2.255	5.910	-14.361	9.852
	Equal variances not assumed			-.313	7.833	.763	-2.255	7.207	-18.936	14.426
ONH Area C/D	Equal variances assumed	2.910	.099	2.021	28	.053	.13752	.06803	-.00184	.27687
	Equal variances not assumed			2.845	21.090	.010	.13752	.04834	.03701	.23802
ONH V. C/D	Equal variances assumed	2.605	.118	2.184	28	.037	.15870	.07265	.00988	.30751
	Equal variances not assumed			3.070	21.014	.006	.15870	.05169	.05120	.26619
ONH H. C/D	Equal variances assumed	.386	.540	1.572	28	.127	.09627	.06126	-.02921	.22176
	Equal variances not assumed			1.889	14.066	.080	.09627	.05097	-.01300	.20554
ONH Rim Area (mm^2)	Equal variances assumed	1.235	.276	-1.285	28	.209	-.20615	.16047	-.53486	.12256
	Equal variances not assumed			-1.611	15.547	.127	-.20615	.12800	-.47814	.06585
ONH Disc Area (mm^2)	Equal variances assumed	.305	.585	.704	28	.487	.13932	.19788	-.26602	.54465
	Equal variances not assumed			.744	10.879	.473	.13932	.18730	-.27348	.55211
ONH Cup Volume (mm^3)	Equal variances assumed	.726	.401	1.858	28	.074	.125578	.067578	-.012849	.264004
	Equal variances not assumed			2.130	12.692	.053	.125578	.058949	-.002088	.253243
GCC Avg. Thickness Total	Equal variances assumed	.177	.677	-1.434	28	.163	-6.590	4.596	-16.005	2.825
	Equal variances not assumed			-1.431	9.931	.183	-6.590	4.604	-16.858	3.677
GCC Avg. Thickness Superior	Equal variances assumed	.118	.734	-1.432	28	.163	-6.950	4.852	-16.889	2.988
	Equal variances not assumed			-1.460	10.254	.174	-6.950	4.760	-17.522	3.621
GCC Avg. Thickness Inferior	Equal variances assumed	.436	.514	-1.303	28	.203	-6.143	4.715	-15.801	3.516
	Equal variances not assumed			-1.194	8.833	.264	-6.143	5.147	-17.819	5.534
FLV (%)	Equal variances assumed	2.084	.160	1.037	28	.308	1.351814	1.303223	-1.317718	4.021345
	Equal variances not assumed			.869	7.995	.410	1.351814	1.556029	-2.236782	4.940409
GLV (%)	Equal variances assumed	1.383	.249	1.713	28	.098	5.592689	3.265449	-1.096280	12.281659
	Equal variances not assumed			1.435	7.998	.189	5.592689	3.897659	-3.395799	14.581178

Effect of a Laser Iridoplasty on POBF and IOP

Effect of Laser Iridoplasty on POBF and IOP in Total Sample

A paired-samples *t* test was calculated to compare the mean pre-POBF and pre- IOP score to their mean post-POBF and post-IOP in all subjects, respectively (**Tables 7A-7B**). The mean pre-POBF was 565.33 (sd = 184.274), and the mean post-POBF was 637.33 (sd = 273.520). A significant increase from pre-POBF to post-POBF was found (t(29) = 2.196, p <0.05). Furthermore, the mean pre-IOP was 20.643 (sd = 5.1459), and the mean post-IOP was 19.950 (sd = 5.2164). No significant difference from pre-IOP to post-IOP was found (t(29) = -0.886, p > 0.05).

Table 7A: Effect of Laser Iridoplasty on POBF and IOP in Total Sample

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Post-Calculated Pulsatile Flow	637.33	30	273.520	49.938
	Pre-Calculated Pulsatile Flow	565.33	30	184.274	33.644
Pair 2	Post-Avg. IOP	19.950	30	5.2164	.9524
	Pre- Avg. IOP	20.643	30	5.1459	.9395

Table 7B: Effect of Laser Iridoplasty on POBF and IOP in Total Sample

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper			
Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	72.000	179.586	32.788	4.942	139.058	2.196	29	.036
Pair 2	Post-Avg. IOP - Pre-Avg. IOP	-.6933	4.2864	.7826	-2.2939	.9072	-.886	29	.383

Effect of Laser Iridoplasty on POBF and IOP in PACG and PACS

A paired-samples *t* test was performed to determine if the POBF decreased in parallel with IOP in both groups (**Tables 8A-8B, Figure 5**). Within the PACG group, the average pre-POBF was 474.29 (sd = 182.652), and the average post-POBF was 511.43 (sd = 175.160). No significant difference from pre-POBF to post-POBF was found (t(6) = 1.148, p > 0.05). The average pre-IOP was 22.757 (sd = 3.4952), and the average post-IOP was 21.771 (sd = 5.4319). No significant difference from pre-IOP to post-IOP was found (t(6) = -0.619, p > 0.05) within the PACG group. On the other

hand, the average pre-POBF was 593.04 (sd = 179.505), and the average post-POBF was 675.65 (sd = 289.260) in the PACS group. A significant difference from pre-POBF to post-POBF was found (t(22) = 1.981, p < 0.05). The average pre-IOP was 20.000 (sd = 5.4516), and the average post-IOP was 19.396 (sd = 5.1425). No significant difference from pre-IOP to post-IOP was found within the PACS group (t(22) = -0.659, p > 0.05).

Table 8A: Effect of Laser Iridoplasty on POBF and IOP in PACG and PACS

Paired Samples Statistics

Group			Mean	N	Std. Deviation	Std. Error Mean
PACG	Pair 1	Post-Calculated Pulsatile Flow	511.43	7	175.160	66.204
		Pre-Calculated Pulsatile Flow	474.29	7	182.652	69.036
	Pair 2	Post-Avg. IOP	21.771	7	5.4319	2.0531
		Pre-Avg. IOP	22.757	7	3.4952	1.3210
PACS	Pair 1	Post-Calculated Pulsatile Flow	675.65	23	289.260	60.315
		Pre-Calculated Pulsatile Flow	593.04	23	179.505	37.429
	Pair 2	Post-Avg. IOP	19.396	23	5.1425	1.0723
		Pre-Avg. IOP	20.000	23	5.4516	1.1367

Table 8B: Effect of Laser Iridoplasty on POBF and IOP in PACG and PACS

Paired Samples Test

			Paired Differences							
						95% Confidence Interval of the Difference				
Group			Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
PACG	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	37.143	85.579	32.346	-42.005	116.290	1.148	6	.295
	Pair 2	Post-Avg. IOP - Pre-Avg. IOP	-.9857	4.2136	1.5926	-4.8827	2.9113	-.619	6	.559
PACS	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	82.609	200.028	41.709	-3.890	169.107	1.981	22	.060
	Pair 2	Post-Avg. IOP - Pre-Avg. IOP	-.6043	4.3979	.9170	-2.5061	1.2974	-.659	22	.517

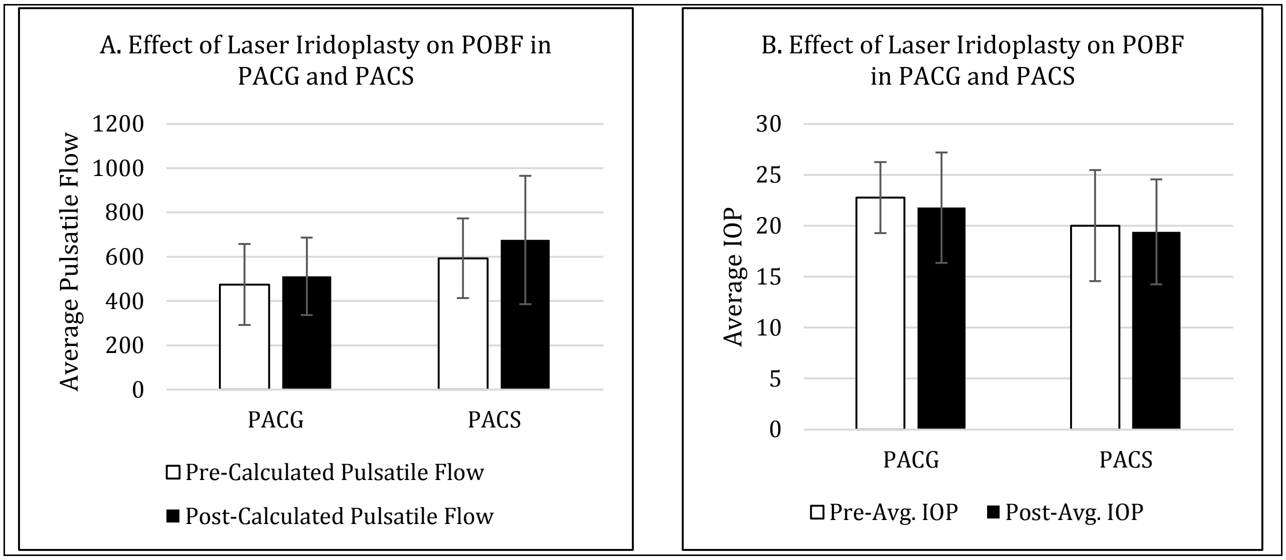

Figure 5: Effect of Laser Iridoplasty on POBF and IOP in PACG and PACS

Effect of Laser Iridoplasty on POBF and IOP by Age Group in Total Sample

Paired-samples *t* tests were performed to examine the effect of the laser iridoplasty on POBF and IOP by age group in the total sample (**Tables 9A-9B**). Among all the age groups, there was only one statistically significant difference. The average pre-IOP was 17.600 (sd = 3.0373), and the average post-IOP was 20.380 (sd = 1.8700) among the 51-60 year old age group. A significant increase in IOP was found (t(4) = 2.909, $p < 0.05$). Although there was a great increase in POBF among eyes <51, 71-80, and >80 years old, no statistically significant difference was found.

Table 9A: Effect of Laser Iridoplasty on POBF and IOP by Age Group in Total Sample

Paired Samples Statistics

Age Grouping			Mean	N	Std. Deviation	Std. Error Mean
<51	Pair 1	Post-Calculated Pulsatile Flow	917.50	4	347.407	173.704
		Pre-Calculated Pulsatile Flow	722.50	4	89.954	44.977
	Pair 2	Post-Avg. IOP	17.200	4	8.3243	4.1621
		Pre-Avg. IOP	21.875	4	3.7695	1.8848
51-60	Pair 1	Post-Calculated Pulsatile Flow	420.00	5	188.547	84.321
		Pre-Calculated Pulsatile Flow	374.00	5	120.540	53.907
	Pair 2	Post-Avg. IOP	20.380	5	1.8700	.8363
		Pre-Avg. IOP	17.600	5	3.0373	1.3583
61-70	Pair 1	Post-Calculated Pulsatile Flow	582.22	9	154.416	51.472
		Pre-Calculated Pulsatile Flow	577.78	9	150.481	50.160
	Pair 2	Post-Avg. IOP	20.944	9	3.9246	1.3082
		Pre-Avg. IOP	21.256	9	4.5423	1.5141
71-80	Pair 1	Post-Calculated Pulsatile Flow	753.75	8	278.308	98.397
		Pre-Calculated Pulsatile Flow	662.50	8	169.179	59.814
	Pair 2	Post-Avg. IOP	19.025	8	7.1320	2.5215
		Pre-Avg. IOP	20.100	8	7.7633	2.7447
>80	Pair 1	Post-Calculated Pulsatile Flow	520.00	4	252.587	126.293
		Pre-Calculated Pulsatile Flow	425.00	4	166.633	83.317
	Pair 2	Post-Avg. IOP	21.775	4	3.0401	1.5201
		Pre-Avg. IOP	22.925	4	2.7403	1.3701

Table 9B: Effect of Laser Iridoplasty on POBF and IOP by Age Group in Total Sample

Paired Samples Test

Age Grouping			Paired Differences					t	df	Sig. (2-tailed)
			Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
						Lower	Upper			
<51	Pair 1	Post-Calculated Pulsatile Flow – Pre-Calculated Pulsatile Flow	195.000	264.890	132.445	-226.499	616.499	1.472	3	.237
	Pair 2	Post-Avg. IOP – Pre-Avg. IOP	-4.6750	5.1874	2.5937	-12.9293	3.5793	-1.802	3	.169
51-60	Pair 1	Post-Calculated Pulsatile Flow – Pre-Calculated Pulsatile Flow	46.000	80.498	36.000	-53.952	145.952	1.278	4	.270
	Pair 2	Post-Avg. IOP - Pre-Avg. IOP	2.7800	2.1371	.9557	.1265	5.4335	2.909	4	.044
61-70	Pair 1	Post-Calculated Pulsatile Flow – Pre-Calculated Pulsatile Flow	4.444	136.575	45.525	-100.537	109.425	.098	8	.925
	Pair 2	Post-Avg. IOP – Pre-Avg. IOP	-.3111	4.6477	1.5492	-3.8836	3.2614	-.201	8	.846
71-80	Pair 1	Post-Calculated Pulsatile Flow – Pre-Calculated Pulsatile Flow	91.250	225.733	79.809	-97.467	279.967	1.143	7	.290
	Pair 2	Post-Avg. IOP – Pre-Avg. IOP	-1.0750	4.3071	1.5228	-4.6758	2.5258	-.706	7	.503
>80	Pair 1	Post-Calculated Pulsatile Flow – Pre-Calculated Pulsatile Flow	95.000	166.233	83.116	-169.513	359.513	1.143	3	.336
	Pair 2	Post-Avg. IOP – Pre-Avg. IOP	-1.1500	1.1705	.5852	-3.0125	.7125	-1.965	3	.144

Effect of Laser Iridoplasty on POBF by Age Group in PACG and PACS

To examine the effect of the laser iridoplasty on POBF by age group in both PACG and PACS, a paired-samples *t* test was employed (**Table 10A-10B**). The paired-samples *t* test could not be computed for POBF among subjects older than 80 years old with PACG because the sum of case weights was equal to 1. Furthermore, there were no patients within the PACG group who were less than 61 years old. As seen in **Table 10B**, no statistically significant difference was found. The POBF increased in every age group, except among 61-70 years within the PACG group, in which the POBF decreased by 20.

Table 10A: Effect of Laser Iridoplasty on POBF by Age Group in PACG and PACS

Paired Samples Statistics

Group	Age Grouping			Mean	N	Std. Deviation	Std. Error Mean
PACG	61-70	Pair 1	Post-Calculated Pulsatile Flow	440.00	3	156.205	90.185
			Pre-Calculated Pulsatile Flow	460.00	3	105.357	60.828
	71-80	Pair 1	Post-Calculated Pulsatile Flow	633.33	3	161.967	93.512
			Pre-Calculated Pulsatile Flow	580.00	3	185.203	106.927
	>80	Pair 1	Post-Calculated Pulsatile Flow	360.00	1[a]	.	.
			Pre-Calculated Pulsatile Flow	200.00	1[a]	.	.
PACS	<51	Pair 1	Post-Calculated Pulsatile Flow	917.50	4	347.407	173.704
			Pre-Calculated Pulsatile Flow	722.50	4	89.954	44.977
	51-60	Pair 1	Post-Calculated Pulsatile Flow	420.00	5	188.547	84.321
			Pre-Calculated Pulsatile Flow	374.00	5	120.540	53.907
	61-70	Pair 1	Post-Calculated Pulsatile Flow	653.33	6	100.929	41.204
			Pre-Calculated Pulsatile Flow	636.67	6	138.948	56.725
	71-80	Pair 1	Post-Calculated Pulsatile Flow	826.00	5	324.083	144.934
			Pre-Calculated Pulsatile Flow	712.00	5	157.385	70.385
	>80	Pair 1	Post-Calculated Pulsatile Flow	573.33	3	280.416	161.898
			Pre-Calculated Pulsatile Flow	500.00	3	88.882	51.316

a. The correlation and t cannot be computed because the sum of caseweights is less than or equal to 1.

Table 10B: Effect of Laser Iridoplasty on POBF by Age Group in PACG and PACS

Paired Samples Test[a]

Group	Age Grouping			Paired Differences					t	df	Sig. (2-tailed)
				Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper			
PACG	61-70	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	-20.000	81.854	47.258	-223.335	183.335	-.423	2	.713
	71-80	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	53.333	49.329	28.480	-69.206	175.873	1.873	2	.202
PACS	<51	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	195.000	264.890	132.445	-226.499	616.499	1.472	3	.237
	51-60	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	46.000	80.498	36.000	-53.952	145.952	1.278	4	.270
	61-70	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	16.667	163.177	66.617	-154.577	187.910	.250	5	.812
	71-80	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	114.000	293.649	131.324	-250.614	478.614	.868	4	.434
	>80	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	73.333	196.554	113.480	-414.933	561.600	.646	2	.584

a. No statistics are computed for one or more split files

Effect of Laser Iridoplasty on IOP by Age Group in PACG and PACS

To analyze the affect that the laser treatment had on IOP in PACG and PACS by age group, a paired-samples *t* test was employed (**Tables 11A-11B**). The paired-samples *t* test could not be computed for IOP in subjects who were older than 80 years old within the PACG group because the sum of case weights was equal to 1. Furthermore, there were no patients within PACG group who were less than 61 years old. Among subjects who were 71 to 80 years old in the PACG group, the IOP decreased significantly by 4.9667 from 21.533 to 16.567 ($t(2) = -4.382$), $p < 0.05$). Furthermore, the

IOP increased significantly by 2.780 from 17.600 to 20.380 among 51-60 years old in the PACS group ($t(4) = 2.909$, $p < 0.05$).

Table 11A: Effect of Laser Iridoplasty on IOP by Age Group in PACG and PACS

Paired Samples Statistics

Group	Age Grouping			Mean	N	Std. Deviation	Std. Error Mean
PACG	61-70	Pair 1	Post- Avg. IOP	25.600	3	1.8735	1.0817
			Pre-Avg. IOP	22.767	3	.8021	.4631
	71-80	Pair 1	Post-Avg. IOP	16.567	3	3.7233	2.1497
			Pre-Avg. IOP	21.533	3	5.2080	3.0068
	>80	Pair 1	Post-Avg. IOP	25.900	1[a]	.	.
			Pre-Avg. IOP	26.400	1[a]	.	.
PACS	<51	Pair 1	Post-Avg. IOP	17.200	4	8.3243	4.1621
			Pre-Avg. IOP	21.875	4	3.7695	1.8848
	51-60	Pair 1	Post-Avg. IOP	20.380	5	1.8700	.8363
			Pre-Avg. IOP	17.600	5	3.0373	1.3583
	61-70	Pair 1	Post-Avg. IOP	18.617	6	1.9323	.7888
			Pre-Avg. IOP	20.500	6	5.5408	2.2620
	71-80	Pair 1	Post-Avg. IOP	20.500	5	8.6504	3.8686
			Pre-Avg. IOP	19.240	5	9.4574	4.2295
	>80	Pair 1	Post-Avg. IOP	20.400	3	1.5875	.9165
			Pre- Avg. IOP	21.767	3	1.7926	1.0349

a. The correlation and t cannot be computed because the sum of caseweights is less than or equal to 1.

Table 11B: Effect of Laser Iridoplasty on IOP by Age Group in PACG and PACS

Paired Samples Test[a]

Group	Age Grouping			Paired Differences: Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference: Lower	Upper	t	df	Sig. (2-tailed)
PACG	61-70	Pair 1	Post-Avg. IOP - Pre-Avg. IOP	2.8333	1.9088	1.1020	-1.9083	7.5749	2.571	2	.124
	71-80	Pair 1	Post-Avg. IOP - Pre-Avg. IOP	-4.9667	1.9630	1.1333	-9.8430	-.0903	-4.382	2	.048
PACS	<51	Pair 1	Post-Avg. IOP - Pre-Avg. IOP	-4.6750	5.1874	2.5937	-12.9293	3.5793	-1.802	3	.169
	51-60	Pair 1	Post-Avg. IOP - Pre-Avg. IOP	2.7800	2.1371	.9557	.1265	5.4335	2.909	4	.044
	61-70	Pair 1	Post-Avg. IOP - Pre-Avg. IOP	-1.8833	4.9199	2.0086	-7.0465	3.2798	-.938	5	.391
	71-80	Pair 1	Post-Avg. IOP - Pre-Avg. IOP	1.2600	3.5161	1.5725	-3.1058	5.6258	.801	4	.468
	>80	Pair 1	Post-Avg. IOP - Pre-Avg. IOP	-1.3667	1.3317	.7688	-4.6747	1.9414	-1.778	2	.217

a. No statistics are computed for one or more split files

Effect of Laser Iridoplasty on POBF and IOP by Sex in Total Sample

A paired-samples *t* test was used to determine which sex was most affected by the laser iridoplasty among the total sample (**Tables 12A-12B**). The average POBF increased by 134.737 and the average IOP decreased by 1.0632 in female subjects. A significant difference was found in average POBF ($t(18) = 3.136$, $p < 0.01$), however, no significant difference was found in average IOP ($t(18) = -1.108$, $p > 0.05$). On the other hand, the average POBF decreased by 36.364 and the average IOP decreased by 0.545 in male subjects. No significant difference was found in average POBF ($t(10) = -1.206$, $p > 0.05$) or IOP ($t(10) = -0.039$, $p > 0.05$) in male subjects among the total sample.

Table 12A: Effect of Laser Iridoplasty on POBF and IOP by Sex in Total Sample

Paired Samples Statistics

Male/Female			Mean	N	Std. Deviation	Std. Error Mean
Male	Pair 1	Post-Calculated Pulsatile Flow	542.73	11	158.688	47.846
		Pre-Calculated Pulsatile Flow	579.09	11	201.318	60.700
	Pair 2	Post-Avg. IOP	17.682	11	4.9418	1.4900
		Pre-Avg. IOP	17.736	11	5.8365	1.7598
Female	Pair 1	Post-Calculated Pulsatile Flow	692.11	19	312.900	71.784
		Pre-Calculated Pulsatile Flow	557.37	19	178.912	41.045
	Pair 2	Post-Avg. IOP	21.263	19	5.0307	1.1541
		Pre-Avg. IOP	22.326	19	3.9477	.9057

Table 12B: Effect of Laser Iridoplasty on POBF and IOP by Sex in Total Sample

Paired Samples Test

			Paired Differences							
						95% Confidence Interval of the Difference				
Male/Female			Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Male	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	-36.364	100.027	30.159	-103.563	30.836	-1.206	10	.256
	Pair 2	Post-Avg. IOP - Pre-Avg. IOP	-.0545	4.5938	1.3851	-3.1407	3.0316	-.039	10	.969
Female	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	134.737	187.272	42.963	44.475	224.999	3.136	18	.006
	Pair 2	Post-Avg. IOP - Pre-Avg. IOP	-1.0632	4.1813	.9593	-3.0785	.9522	-1.108	18	.282

Effect of Laser Iridoplasty on POBF and IOP by Sex in PACG and PACS

To determine which sex was most affected by the laser iridoplasty in PACG and PACS, a paired-samples *t* test was calculated (**Tables 13A-13B**). Among females in the PACS, the average pre-POBF was 587.14 (sd = 159.636), and the average post-POBF was 760.71 (sd = 319.891). A significant increase from pre-POBF to post-POBF ($t(13) = 3.268$, $p < 0.01$). No other significant difference was observed, as seen in **Table 13B**.

Table 13A: Effect of Laser Iridoplasty on POBF and IOP by Sex in PACG and PACS

Paired Samples Statistics

Male/Female	Group			Mean	N	Std. Deviation	Std. Error Mean
Male	PACG	Pair 1	Post-Calculated Pulsatile Flow	540.00	2	14.142	10.000
			Pre-Calculated Pulsatile Flow	475.00	2	49.497	35.000
		Pair 2	Post-Avg. IOP	14.450	2	.9192	.6500
			Pre-Avg. IOP	18.850	2	3.3234	2.3500
	PACS	Pair 1	Post-Calculated Pulsatile Flow	543.33	9	177.341	59.114
			Pre-Calculated Pulsatile Flow	602.22	9	216.897	72.299
		Pair 2	Post-Avg. IOP	18.400	9	5.2182	1.7394
			Pre- Avg. IOP	17.489	9	6.3891	2.1297
Female	PACG	Pair 1	Post-Calculated Pulsatile Flow	500.00	5	213.073	95.289
			Pre-Calculated Pulsatile Flow	474.00	5	222.329	99.428
		Pair 2	Post-Avg. IOP	24.700	5	2.5544	1.1424
			Pre-Avg. IOP	24.320	5	2.2084	.9876
	PACS	Pair 1	Post-Calculated Pulsatile Flow	760.71	14	319.891	85.494
			Pre-Calculated Pulsatile Flow	587.14	14	159.636	42.664
		Pair 2	Post-Avg. IOP	20.036	14	5.1835	1.3853
			Pre-Avg. IOP	21.614	14	4.2430	1.1340

Table 13B: Effect of Laser Iridoplasty on POBF and IOP by Sex in PACG and PACS

Paired Samples Test

				Paired Differences							
							95% Confidence Interval of the Difference				
Male/Female	Group			Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Male	PACG	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	65.000	63.640	45.000	-506.779	636.779	1.444	1	.386
		Pair 2	Post-Avg. IOP - Pre-Avg. IOP	-4.4000	2.4042	1.7000	-26.0005	17.2005	-2.588	1	.235
	PACS	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	-58.889	94.133	31.378	-131.246	13.469	-1.877	8	.097
		Pair 2	Post-Avg. IOP - Pre-Avg. IOP	.9111	4.4594	1.4865	-2.5167	4.3389	.613	8	.557
Female	PACG	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	26.000	97.108	43.428	-94.576	146.576	.599	4	.582
		Pair 2	Post-Avg. IOP - Pre-Avg. IOP	.3800	4.1264	1.8454	-4.7436	5.5036	.206	4	.847
	PACS	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	173.571	198.712	53.108	58.839	288.304	3.268	13	.006
		Pair 2	Post-Avg. IOP - Pre-Avg. IOP	-1.5786	4.2287	1.1302	-4.0201	.8630	-1.397	13	.186

Relationship Between Medical History and POBF and IOP in Total Sample

To examine the association between the POBF and IOP and the subject's medical history, a paired-samples *t* test was performed (**Tables 14A-14B**). The medical history was divided into four groups, indicating that the subject had diabetes mellitus, cardiovascular disease, both, or neither. As seen in **Table 14B**, a significant difference was found in POBF among subjects with cardiovascular disease ($t(10) = 2.515$, $p < 0.05$). The average pre-POBF was 556.36 (sd = 127.928), and the average post-POBF was 693.64 (sd = 274.528). No other significant difference was found in POBF or IOP in any of the other medical history groups.

Table 14A: Relationship Between Medical History and POBF and IOP in Total Sample

Paired Samples Statistics

Updated Medical History			Mean	N	Std. Deviation	Std. Error Mean
Cardiovascular Diseases	Pair 1	Post-Calculated Pulsatile Flow	693.64	11	274.528	82.773
		Pre-Calculated Pulsatile Flow	556.36	11	127.928	38.572
	Pair 2	Post-Avg. IOP	20.545	11	5.9209	1.7852
		Pre-Avg. IOP	20.773	11	6.2307	1.8786
Both	Pair 1	Post-Calculated Pulsatile Flow	606.67	6	122.420	49.978
		Pre-Calculated Pulsatile Flow	653.33	6	171.309	69.936
	Pair 2	Post-Avg. IOP	19.700	6	4.9848	2.0350
		Pre-Avg. IOP	23.000	6	4.1732	1.7037
Neither	Pair 1	Post-Calculated Pulsatile Flow	603.85	13	327.351	90.791
		Pre-Calculated Pulsatile Flow	532.31	13	225.985	62.677
	Pair 2	Post-Avg. IOP	19.562	13	5.0668	1.4053
		Pre-Avg. IOP	19.446	13	4.4767	1.2416

Table 14B: Relationship Between Medical History and POBF and IOP in Total Sample

Paired Samples Test

Medical History			Paired Differences: Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference: Lower	Upper	t	df	Sig. (2-tailed)
Cardiovascular Diseases	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	137.273	181.057	54.591	15.637	258.909	2.515	10	.031
	Pair 2	Post-Avg. IOP - Pre-Avg. IOP	-.2273	2.8591	.8620	-2.1480	1.6935	-.264	10	.797
Both	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	-46.667	126.596	51.683	-179.522	86.188	-.903	5	.408
	Pair 2	Post-Avg. IOP - Pre-Avg. IOP	-3.3000	5.1703	2.1108	-8.7259	2.1259	-1.563	5	.179
Neither	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	71.538	181.652	50.381	-38.233	181.310	1.420	12	.181
	Pair 2	Post-Avg. IOP - Pre-Avg. IOP	.1154	4.7060	1.3052	-2.7284	2.9592	.088	12	.931

Relationship Between Medical History and POBF and IOP in PACG and PACS

To determine the relationship between the subject's medical history and the effectiveness of the laser treatment on POBF and IOP in both PACG and PACS, a paired-samples *t* test was calculated (**Tables 15A-15B**). Among subjects with PACS and cardiovascular disease, the average pre-POBF was 592.50 (sd = 121.391), and the average post-POBF was 788.75 (sd = 250.567). A significant increase from pre-POBF to post-POBF was found ($t(7) = 3.187$, $p < 0.05$). Among subjects with PACG, cardiovascular disease, and diabetes mellitus, the average pre-IOP was 21.533 (sd = 5.2080), and the average post-IOP was 16.567 (sd = 3.7233). A significant decrease from pre-IOP to post-IOP was found ($t(2) = -4.382$, $p < 0.05$). No other significant difference was found in both PACG and PACS.

Table 15A: Relationship Between Medical History and POBF and IOP in PACG and PACS

Paired Samples Statistics

Updated Medical History	Group			Mean	N	Std. Deviation	Std. Error Mean
Cardiovascular Diseases	PACG	Pair 1	Post-Calculated Pulsatile Flow	440.00	3	156.205	90.185
			Pre-Calculated Pulsatile Flow	460.00	3	105.357	60.828
		Pair 2	Post-Avg. IOP	25.600	3	1.8735	1.0817
			Pre-Avg. IOP	22.767	3	.8021	.4631
	PACS	Pair 1	Post-Calculated Pulsatile Flow	788.75	8	250.567	88.589
			Pre-Calculated Pulsatile Flow	592.50	8	121.391	42.918
		Pair 2	Post-Avg. IOP	18.650	8	5.8329	2.0622
			Pre-Avg. IOP	20.025	8	7.2755	2.5723
Both	PACG	Pair 1	Post-Calculated Pulsatile Flow	633.33	3	161.967	93.512
			Pre-Calculated Pulsatile Flow	580.00	3	185.203	106.927
		Pair 2	Post-Avg. IOP	16.567	3	3.7233	2.1497
			Pre-Avg. IOP	21.533	3	5.2080	3.0068
	PACS	Pair 1	Post-Calculated Pulsatile Flow	580.00	3	95.394	55.076
			Pre-Calculated Pulsatile Flow	726.67	3	151.438	87.433
		Pair 2	Post-Avg. IOP	22.833	3	4.3363	2.5036
			Pre-Avg. IOP	24.467	3	3.1565	1.8224
Neither	PACG	Pair 1	Post-Calculated Pulsatile Flow	360.00	1[a]	.	.
			Pre-Calculated Pulsatile Flow	200.00	1[a]	.	.
		Pair 2	Post-Avg. IOP	25.900	1[a]	.	.
			Pre-Avg. IOP	26.400	1[a]	.	.
	PACS	Pair 1	Post-Calculated Pulsatile Flow	624.17	12	333.234	96.196
			Pre-Calculated Pulsatile Flow	560.00	12	211.746	61.126
		Pair 2	Post-Avg. IOP	19.033	12	4.9040	1.4157
			Pre-Avg. IOP	18.867	12	4.1353	1.1938

a. The correlation and t cannot be computed because the sum of caseweights is less than or equal to 1.

Table 15B: Relationship Between Medical History and POBF and IOP in PACG and PACS

Paired Samples Test[a]

Updated Medical History	Group			Paired Differences Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper	t	df	Sig. (2-tailed)
Cardiovascular Diseases	PACG	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	-20.000	81.854	47.258	-223.335	183.335	-.423	2	.713
		Pair 2	Post-Avg. IOP - Pre-Avg. IOP	2.8333	1.9088	1.1020	-1.9083	7.5749	2.571	2	.124
	PACS	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	196.250	174.187	61.584	50.626	341.874	3.187	7	.015
		Pair 2	Post-Avg. IOP - Pre-Avg. IOP	-1.3750	2.2620	.7997	-3.2660	.5160	-1.719	7	.129
Both	PACG	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	53.333	49.329	28.480	-69.206	175.873	1.873	2	.202
		Pair 2	Post-Avg. IOP - Pre-Avg. IOP	-4.9667	1.9630	1.1333	-9.8430	-.0903	-4.382	2	.048
	PACS	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	-146.667	87.369	50.442	-363.703	70.370	-2.908	2	.101
		Pair 2	Post-Avg. IOP - Pre-Avg. IOP	-1.6333	7.3921	4.2678	-19.9964	16.7297	-.383	2	.739
Neither	PACG	Pair 1	Post-Calculated Pulsatile Flow - Pre-Calculated Pulsatile Flow	64.167	187.687	54.181	-55.084	183.417	1.184	11	.261
		Pair 2	Post-Avg. IOP - Pre-Avg. IOP	.1667	4.9115	1.4178	-2.9539	3.2873	.118	11	.909

a. No statistics are computed for one or more split files

Relationship Between Post-Laser Timeframe and POBF and IOP in Total Sample

A one-way ANOVA test was computed to examine the effect of the laser iridoplasty on POBF and IOP in relation with the number of weeks these variables were recorded after the laser treatment. (**Tables 16A-16B**). The timeframe was split up into five different groups (less than 3 weeks, 3 weeks < 6 weeks, 6 weeks < 9 weeks, 9 weeks < 12 weeks, and greater than 12 weeks). A significant difference was found between timeframe groups in post-IOP ($F(4, 25) = 2.832$, $p < 0.05$). However, no significant difference was found between timeframe groups in post-POBF ($F(4,25) = 2.567$, $p > 0.05$).

Furthermore, no pattern was observed in average post-POBF and average post-IOP and the number of weeks these values were recorded after the laser treatment (**Table 16A**).

Table 16A: Relationship Between Post-Laser Timeframe and POBF and IOP in Total Sample

Means Test

Laser to Post-BFA		Post-Calculated Pulsatile Flow	Post-Avg. IOP
0<3	Mean	587.14	20.721
	N	14	14
	Std. Deviation	210.254	4.3194
3<6	Mean	620.83	19.475
	N	12	12
	Std. Deviation	295.434	5.1902
6<9	Mean	1000.00	25.200
	N	1	1
	Std. Deviation	.	.
9<12	Mean	1310.00	27.200
	N	1	1
	Std. Deviation	.	.
>12	Mean	570.00	11.150
	N	2	2
	Std. Deviation	56.569	2.0506
Total	Mean	637.33	19.950
	N	30	30
	Std. Deviation	273.520	5.2164

Table 16B: Relationship Between Post-Laser Timeframe and POBF and IOP in Total Sample

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Post-Calculated Pulsatile Flow	Between Groups	631609.286	4	157902.321	2.567	.063
	Within Groups	1537977.381	25	61519.095		
	Total	2169586.667	29			
Post- Avg. IOP	Between Groups	246.044	4	61.511	2.832	.046
	Within Groups	543.071	25	21.723		
	Total	789.115	29			

Relationship Between Post-Laser Timeframe and POBF and IOP in PACG and PACS

To examine the effect of the laser iridoplasty on post-POBF and post-IOP in relation to timeframe among PACG and PACS, a one-way ANOVA and means test were performed (**Tables 17A-17B**). As seen in **Table 17B**, the only significant difference was found between timeframe groups in post-IOP among PACS ($F(4, 18) = 4.514$, $p < 0.05$). Furthermore, no pattern was observed in average post-POBF and average post-IOP and the number of weeks these values were recorded after the laser treatment, as seen in **Table 17A**.

Table 17A: Relationship Between Post-Laser Timeframe and POBF and IOP in PACG and PACS

Means Test

Group	Laser to Post-BFA		Post-Calculated Pulsatile Flow	Post-Avg. IOP
PACG	0<3	Mean	535.00	19.600
		N	2	2
		Std. Deviation	21.213	6.3640
	3<6	Mean	502.00	22.640
		N	5	5
		Std. Deviation	213.354	5.5527
	Total	Mean	511.43	21.771
		N	7	7
		Std. Deviation	175.160	5.4319
PACS	0<3	Mean	595.83	20.908
		N	12	12
		Std. Deviation	227.215	4.2545
	3<6	Mean	705.71	17.214
		N	7	7
		Std. Deviation	330.901	3.8107
	6<9	Mean	1000.00	25.200
		N	1	1
		Std. Deviation	.	.
	9<12	Mean	1310.00	27.200
		N	1	1
		Std. Deviation	.	.
	>12	Mean	570.00	11.150
		N	2	2
		Std. Deviation	56.569	2.0506
	Total	Mean	675.65	19.396
		N	23	23
		Std. Deviation	289.260	5.1425

Table 17B: Relationship Between Post-Laser Timeframe and POBF and IOP in PACG and PACS

ANOVA

Group			Sum of Squares	df	Mean Square	F	Sig.
PACG	Post-Calculated Pulsatile Flow	Between Groups	1555.714	1	1555.714	.043	.845
		Within Groups	182530.000	5	36506.000		
		Total	184085.714	6			
	Post-Avg. IOP	Between Groups	13.202	1	13.202	.403	.553
		Within Groups	163.832	5	32.766		
		Total	177.034	6			
PACS	Post-Calculated Pulsatile Flow	Between Groups	612702.122	4	153175.531	2.245	.105
		Within Groups	1228063.095	18	68225.728		
		Total	1840765.217	22			
	Post-Avg. IOP	Between Groups	291.347	4	72.837	4.514	.011
		Within Groups	290.443	18	16.136		
		Total	581.790	22			

DISCUSSION

Although laser peripheral iridoplasty is considered standard treatment after an ineffective laser iridotomy, there are few studies on the long-term outcomes of either of these procedures. The aim of this secondary study was to analyze the effect of a laser peripheral iridoplasty on POBF and IOP in PACS and PACG patients. Using the search engines, Google Scholar and UCF's library database, no significant research linking the benefit of the laser treatment on POBF was found. Nonetheless, the research addressed four questions: 1) What is the effect of a laser iridoplasty on POBF and IOP in both PACG and PACS? 2) Is there a negative correlation between age and the effectiveness of the laser in increasing POBF? 3) Is the laser treatment less effective in increasing POBF in females compared to males? 4) Is the laser treatment less effective in patients suffering from cardiovascular disease, diabetes mellitus, or both?

Results obtained in this study show that the POBF significantly increased among the total sample and PACS. However, no significant difference in POBF was found in PACG and no significant difference in intraocular pressure was observed in either group. Within each group, the POBF increased inversely to IOP. As a result, the researcher failed to reject the null hypothesis. Supplementary research needs to be done as these findings propose that IOP is not significantly affected by a laser iridoplasty in PACS or PACG patients.

In respect to age, the IOP increased significantly among subjects who were 51-60 years old among the total sample and within the PACS group and decreased significantly in subjects who were 71 to 80 years old in the PACG group. Data analysis performed by age group among the total sample and individual groups (PACG and PACS) found no significant increase or decrease in POBF. It is important to note that no statistical computations could be employed for subjects who were younger than 61 years older or older than 80 years old due to limited number of subjects. As a result, a correlation on the effectiveness of the laser in regards to age could not be determined.

Additionally, a significant difference was found between male and female subjects among the total sample. The POBF increased significantly in female subjects, whereas no significant difference was found among male subjects. No noteworthy change in IOP occurred in both sexes among the total sample. Among females in the PACS, the laser was more effective compared to males, with a significant increase in POBF. No other significant differences were observed in IOP or POBF between male or females in PACG and PACS. These findings support the need for gender medicine research as women have been traditionally under-represented in clinical research and yet have clear differences in ocular blood flow compared to men (Schmidl, Schmetterer, Garhöfer, & Popa-Cherecheanu, 2015).

Further analysis was done to determine the effect of the laser treatment on POBF and IOP in relation to timeframe between the laser treatment and post-laser recordings. There was a statistically significant difference in IOP between timeframe groups among the total sample and PACS. However, limited information can be accessed from these findings because only one subject was in the 6<9 weeks group and 9<12 weeks group where the significant increase in IOP was observed.

Lastly, the POBF increased significantly in patients suffering from cardiovascular disease among the total sample, especially among the PACS. Furthermore, the IOP decreased significantly in PACG patients suffering from both cardiovascular disease and diabetes mellitus. These results propose that a laser iridoplasty can improve the POBF and IOP in patients suffering from PACG and PACS along with other vascular-related health conditions.

Nonetheless, the ophthalmologist who provided the research believed that he had witnessed a change in POBF during his career. Recording the POBF and IOP before and after a laser iridoplasty was a common practice of his in the treatment of PACG and PACS. The subjects in each group are very similar to one another due in part to the ophthalmologist's practice of performing laser iridoplasty on both of them in order to manage their glaucoma or reduce the risk factors for

glaucoma. This research is dedicated to him in hope that further research will be conducted to determine the effect of a laser iridoplasty on POBF and IOP in PACG and PACS.

Limitations

In spite of the fact that this secondary study may have contributed to some new information and insight, the findings should be understood in the context of multiple limitations. Predominately, the nature of a secondary study and the researcher's lack of medical school training present many limitations of its own. Secondly, the results are biased considering the small number of subjects in the PACG group compared to the PACS group. This could explain why the wellbeing of the eyes between the two groups are fairly similar. Another limitation is based on the number of different ethnicities accounted for in the study and that the ethnicities and race overlapped with one another, preventing the results to yield relevance to a specific ethnicity. Additionally, a correlation analysis could not be performed to examine the IOP measured by the Goldmann tonometer and TonoPlus pneumotonometer due to overlapping numbers in the patient reports (i.e. a decimal reading with a Goldmann tonometer is invalid). Moreover, the normal values for the variables measured by the TonoPlus pneumotonometer were unable to be found to compare the findings with. Lastly, another major limitation to this study is the current knowledge of POBF and its relationship with ocular blood flow. "Although studies have suggested that POBF is related to ocular blood flow, these assumptions have yet to be confirmed" (Harris, 2009). Furthermore, the POBF analyzer does not measure venous flow, only the pulsatile components of choroidal and retinal perfusion (Harris, 2009). Surprisingly though, multiple studies have used the POBF analyzer in research involving a trabeculectomy, anti-glaucoma medications, daytime variations, age, gender and exercise. It has been noted in these studies that a colour Doppler sonographer would be helpful in providing more information about ocular blood flow; however, the ophthalmologist did not use this equipment.

Conclusion

In conclusion, a significant difference in POBF was observed after laser iridoplasty in PACS only. Moreover, a few significant differences were observed in POBF and IOP by age and sex.

Patients aged 71-80 years old suffering from PACG may benefit more from a laser iridoplasty compared to other age groups as a significant decrease in IOP was found. The findings from this research support the need for gender medicine research as a significant increase in POBF was observed among female subjects. Furthermore, the results propose that a laser iridoplasty can improve the POBF and IOP in PACG patients and PACS who are suffering from other vascular-related health conditions. However, the results from this study should be understood in the context of multiple limitations. Additional research needs to be conducted in order to determine the effect of laser iridoplasty on POBF and IOP in PACG and PACS.

Recommendations for Future Research

Additional research is needed to determine the effect of a laser iridoplasty on POBF and IOP in PACG and PACS. It is recommended that a professional ophthalmologist conduct a primary experimental study to examine the significance of a laser iridoplasty on both of these variables. The nature of a primary study will allow the researcher to establish parameters of the study, considering the impact of time, validity and reliability of equipment used, daytime variations in pulsatile ocular blood flow, patient activity, and much more. It also recommended that more research be done in order to increase the knowledge of POBF and its relation with ocular blood flow.

Appendix A: IRB Approval Letter

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901, 407-882-2012 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

NOT HUMAN RESEARCH DETERMINATION

From : **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To : **Suha Saleh** and Co-PI: **Mathieu Hill**

Date : **August 05, 2015**

Dear Researcher:

On 8/5/2015 the IRB determined that the following proposed activity is not human research as defined by DHHS regulations at 45 CFR 46 or FDA regulations at 21 CFR 50/56:

Type of Review:	Not Human Research Determination
Project Title:	Effect of Laser Iridplasty on Pulsatile Ocular Blood Flow in Primary Angle-Closure Glaucoma and Primary Angle-Closure Suspects
Investigator:	Suha Saleh
IRB ID:	SBE-15-11458
Funding Agency:	
Grant Title:	
Research ID:	N/A

University of Central Florida IRB review and approval is not required. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are to be made and there are questions about whether these activities are research involving human subjects, please contact the IRB office to discuss the proposed changes.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Patria Davis on 08/05/2015 10:03:32 AM EDT

IRB Coordinator

Appendix B: Premier Visual Health, LLC Written Agreement

PREMIER VISUAL HEALTH, LLC

OPHTHALMOLGY
Felipe A. Cetina, M.D., D.O.
Cataract, Anterior Segment and Refractive Surgery Specialist

Agreement

I, Juanita Cetina, hereby consent that the student investigator, Mathieu Hill, has my permission to perform the study and collect the data at Premier Visual Health. I will provide the student with de-identified reports of patient basic demographic information and pulsatile ocular blood flow results before and after a Laser Peripheral Iridoplasty. The student and I agree that the data will be collected at our office where he will transfer the information into a password-protected computer for SPSS data analysis.

Signing this document represents that all parties involved in providing/collecting the data acknowledge the agreement stated above.

Mathieu Hill
Mathieu Hill, Student Signature — 7/15/15 Date

Juanita P. Cetina
Juanita Cetina, Administrator
Premier Visual Health Representative — 7/8/15 Date

810 N. Rose Avenue
Kissimmee, FL 34741

Office: (407) 352-4044 **Fax: (407) 352-4043**

www.premiervisualhealth.com

Appendix C: Data Collection Template

Patient ID:
Age:
Sex:
Ethnicity:
Race:
Group:

VF Test Date:
OCT ONH Date:
Pre-BFA Date:
OD Laser Date:
OS Laser Date:
Post-BFA Date:

VF Test Results:

Nerve Fiber ONH/GCC OU Report

RNFL Analysis (µm)	OD	OS	Inter Eye Diff
Avg. RNFL Thickness			
Avg. Superior RNFL			
Avg. Inferior RNFL			
Intra Eye Diff (S-I)			
ONH Analysis	OD	OS	Inter Eye Diff
Area C/D			
V. C/D			
H. C/D			
Rim Area (mm^2)			
Disc Area (mm^2)			
Cup Vol (mm^3)			
GCC Avg. Thickness (µm)	OD	OS	Inter Eye Diff
Total			
Superior			
Inferior			
Intra Eye Difference (S-I)			
FLV (%)			
GLV (%)			

Pre-BFA:

	OD: Right Eye	OS: Left Eye
Avg. IOP (mmHg)		
Calculated Pulsatile Flow (µL/min)		

Pulse Rate (/min)		
Avg. Pulse Amplitude (mmHg)		
Avg. Pulse Volume (µL)		

Central Corneal Thickness (µm):
OD:
OS:

Pre-IOP Goldmann:
OD:
OS:

Post-BFA

	OD: Right Eye	**OS: Left Eye**
Avg. IOP (mmHg)		
Calculated Pulsatile Flow (µL/min)		
Pulse Rate (/min)		
Avg. Pulse Amplitude (mmHg)		
Avg. Pulse Volume (µL)		

Central Corneal Thickness (µm):
OD:
OS:

Post-IOP Goldmann:
OD:
OS:

Medical History:

Family History:

Ocular History:

Medications:

Ocular Findings:

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