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Chronic Diabetic Tractional Retinal Detachment and Poor Visual Acuity: Should We Be Performing Surgery on These Patients?

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Abstract

Purpose: To evaluate the benefits of pars plana vitrectomy (PPV) in subjects with poor visual acuity (VA) and a chronic macula-involving tractional retinal detachment (TRD) secondary to proliferative diabetic retinopathy (PDR). **Methods:** A retrospective, case-controlled chart review was conducted, and patients were divided into (1) a study group that underwent PPV and (2) a control group in which PPV was declined. Both study and control subjects had a baseline VA of hand motions at 3 feet or worse, a PDR-associated macula-involving TRD for more than 6 months, and at least 12 months of follow-up. **Results:** A total of 175 subjects were analyzed. There were no differences in baseline characteristics between cohorts. The change in VA was improved by 0.78 logMAR (95% CI, 0.64-0.90) in the study group compared with 0.03 logMAR (95% CI, −0.15 to 0.22) in the control group ($P < .0001$). The rates of achieving 20/200 or better Snellen VA and 20/50 or better Snellen VA were increased in the study group compared with the control group ($P < .0001$ and $P = .007$, respectively), and the rates of becoming no light perception, developing neovascular glaucoma, or undergoing enucleation/evisceration during the study period were higher in the control group compared with the study group ($P = .02$, $P < .0001$, and $P = .03$, respectively). **Conclusions:** Patients with PDR with poor VA and a macula-involving TRD of more than 6 months duration still may have a more meaningful improvement in vision and fewer adverse events when PPV is performed than when PPV is declined in favor of less invasive options.

Keywords

chronic tractional retinal detachment, diabetic vitrectomy, poor visual acuity

Introduction

There is currently little guidance on how to manage patients with a long-standing tractional retinal detachment (TRD) involving the center of the macula secondary to proliferative diabetic retinopathy (PDR) and poor presenting visual acuity (VA). The retina is reportedly atrophic with photoreceptor degeneration when macula-involving RDs of more than 6 months duration have been assessed, making meaningful restoration of vision, even with successful surgical repair, unlikely.[1] A recent meta-analysis[2] concluded that although anatomical improvement was high following pars plana vitrectomy (PPV) in patients with a diabetic TRD, postoperative VA was often poor. The authors of that study noted that patients with better preoperative vision ended up with better postoperative vision regardless of the chronicity of the TRD.[2] Although a PDR-associated TRD that has recently progressed to involve the center of the macula is a common indication for PPV,[3,4] a difference of opinion exists regarding the advisability of surgery when a macula-involving TRD has been present for longer than 6 months, especially when the presenting VA is severely reduced. The natural history of a diabetic extramacular TRD has been reported,[5] but there is a lack of published data regarding the natural history of a macula-involving diabetic TRD when surgical intervention is declined. In this study, the authors compare the outcomes in patients with PDR with a chronic macula-involving TRD and poor presenting VA when PPV is undertaken vs declined. The purpose was to gain clarity regarding the merits of each option in this difficult-to-manage patient population.

Methods

This retrospective, case-controlled study was conducted according to the principles of the Declaration of Helsinki and was

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Table 1. Chronic Diabetic Tractional Retinal Detachment: Inclusion/Exclusion Criteria.

Inclusion	Exclusion
The patient was diagnosed with type 1 or 2 diabetes mellitus	The study eye was no light perception at baseline
Visual acuity in the study eye was hand motions at 3 feet or worse at baseline	The patient had previously undergone a pars plana vitrectomy for any reason prior to baseline
A tractional retinal detachment secondary to proliferative diabetic retinopathy was present and involved the center of the macula in the study eye at baseline	At baseline, the patient had an underlying condition considered by the examining specialist to be responsible for a reduction in vision such that the vision would have been worse than hand motions at 3 feet, even without the presence of a macula-involving tractional retinal detachment (ie, mature cataract, neovascular or end-stage glaucoma, etc)
The level of vision loss in the study eye was subjectively unchanged for at least 6 months (26 weeks) at baseline	The patient had less than 1 year (52 weeks) of follow-up after the baseline examination

compliant with the Health Insurance Portability and Accountability Act of 1996. Study approval was obtained from the Panhandle Eye Group Institutional Review Board (IORG0009 239; IRB 00011013-16). Informed consent was waived because the data were collected retrospectively, and all identifying patient information was removed. Data were derived from patients receiving care at a private practice facility in Amarillo, Texas, and a university-affiliated teaching hospital in Montemorelos, Mexico, from June 2015 through May 2023.

Table 1 shows the inclusion and exclusion criteria used in this study. The study group included subjects who underwent PPV, and the control group included subjects who declined PPV (whether by the choice of the patient or surgeon). For the purposes of this study, the baseline examination was considered the evaluation during which the decision was made either to perform or decline PPV. For patients with more than 36 months of follow-up beyond their baseline evaluation, their "final" follow-up data collection was performed at 36 months ($\pm$ 6 months). The study permitted only 1 eye per patient to be analyzed. When the conditions were satisfied for both eyes to be included, simple randomization (a random number generating program) determined which eye was selected. Coexisting vitreous hemorrhage (VH) and/or rhegmatogenous RD could be present as long as the TRD met the inclusion/exclusion criteria. For the purpose of this study, a TRD was considered when preretinal membranes exerted sufficient traction that resulted in observable subretinal fluid in the center of the macula on optical coherence tomography (OCT) (Heidelberg Engineering) and/or B-scan ultrasonography whenever applicable. Neovascular glaucoma (NVG) was defined as clinically observable rubeosis with an intraocular pressure (IOP) of 30 mm Hg or higher in the study eye.

For patients in the study group, an antivascular endothelial growth factor (anti-VEGF) intravitreal injection was preoperatively administered 1 to 14 days prior to PPV. A 23- or 25-gauge PPV (Constellation Vision System, Alcon) was conducted by 8 fellowship-trained vitreoretinal specialists, using peribulbar or retrobulbar anesthesia. Cutting rates of 10 000 to 20 000 cuts per minute were used, and endodiathermy placement, endolaser application, and fibrovascular tissue removal were performed according to the unique circumstances of each patient. Meticulous fibrovascular tissue removal was conducted until all regions of traction were satisfactorily relieved. Endolaser treatment was performed on each quadrant up to the vitreous base and beyond when appropriate. Endodiathermy and surgeon-induced IOP elevations achieved hemostasis. Indocyanine green–assisted membrane peeling and internal limiting peeling were undertaken according to the operating surgeon's preference. The selection of a vitreous substitute was made according to the best judgment of the operating surgeon. Subjects were instructed to postoperatively position according to their own circumstance and the preference of the operating surgeon. All postoperative interventions and complications in the study group were recorded from the medical record. We searched the medical records for the following specific postoperative adverse events: development of NVG, recurrence of RD, persistence of VH (observed from postoperative day 1 until $>$ 90 postoperative days), and recurrence of VH (occurring after a period of documented clear media). Other postoperative complications unrelated to diabetic retinopathy were also recorded.

Control group patients were managed with 1 or more anti-VEGF injections, 1 or more panretinal photocoagulation (PRP) sessions, a combination of anti-VEGF therapy and PRP, or observation alone according to the judgment of the managing specialist. All control group interventions and complications during the study period were recorded.

In the study group, same-session cataract surgery was offered to phakic patients who lacked pecuniary resources and/or access to future care (because of traveling distance). Cataract surgery was performed during the postoperative period in the study group or during the study period in the control group if the specialist thought that the development or progression of a cataract was responsible for more than 2 lines of vision loss.

Primary and Secondary Outcomes

The primary outcome was change in VA during the study interval between cohorts. The secondary outcomes were the rate of patients attaining 20/200 or better Snellen acuity; the rate of patients attaining 20/50 or better Snellen acuity; and the rates of

Table 2. Chronic Diabetic Tractional Retinal Detachment Management: Baseline Details.

Variable	Study Group (Vitrectomy) (n = 118)	Control Group (No Vitrectomy) (n = 57)	*P* Value
Age, mean (95% CI) years	56.5 (55.1-57.9)	58.0 (55.9-60.1)	.24
Male sex (%)	42.4	40.4	.80
Type 2 diabetes mellitus classification (%)	98.3	100.0	.21
Subjective duration of vision loss, mean (95% CI) months	12.1 (10.7-13.5)	12.5 (10.4-14.5)	.78
History of panretinal photocoagulation (%)			.80
Yes	29.7	31.6	
No	70.3	68.4	
Hemoglobin A1C, mean (95% CI) %	9.8 (9.5-10.1)	9.5 (9.0-10.0)	.37
Visual acuity, mean (95% CI) logMAR	2.35 (2.33-2.37)	2.40 (2.37-2.43)	.09
Lens status (%)			.93
Pseudophakia	15.2	15.8	
Phakic	84.8	84.2	
Indication for PPV, %			.17
TRD alone	49.2	35.1	
TRD with concomitant RRD	4.2	8.8	
TRD with concomitant VH	46.6	56.1	

Abbreviations: PPV, pars plana vitrectomy; RRD, rhegmatogenous retinal detachment; TRD, tractional retinal detachment; VH, vitreous hemorrhage.

developing no light perception (NLP), developing NVG, or undergoing enucleation/evisceration between cohorts during the study period.

Data Analysis

Outcomes that were nominal were analyzed using contingency analysis with likelihood ratios. One-way analysis of variance assessed outcomes that were numerical. Data analysis was conducted using the JMP 11 (SAS Institute) statistical software. VA was measured up to 20/400 Snellen. When VA was worse than 20/400, it was recorded as counting fingers (CF), hand motions (HM), light perception (LP) only, or NLP. For data presentation and analysis, VA has been expressed in logMAR units with Snellen complements noted parenthetically. The ensuing logMAR equivalents were used for low VAs: CF = 2.0, HM = 2.3, LP only = 2.6, and NLP = 3.0.

Results

The study included 175 patients (118 in the study group and 57 in the control group). There were 76 subjects from the institution in Texas and 99 subjects from the institution in Mexico. Table 2 shows the baseline details of the study and control groups. There were no statistically significant differences in baseline variables between groups. Reasons listed in the medical record for deferral of PPV in the control group were as follows: PPV was offered but the patient declined (68.4%, 39/57), patient was unable to be medically cleared for PPV (17.5%, 10/57), and surgeon declined PPV secondary to perceived futility (14.0%, 8/57).

Intraoperative Details for the Study Group

The mean time for administration of the preoperative intravitreal anti-VEGF injection was 4.2 (range, 2.2-6.2) days prior to PPV. Same-session cataract surgery was performed in 42.0% of phakic subjects (42/100). The mean surgical time to complete the PPV was 38.2 (range, 26.4-50.0) minutes. Internal limiting membrane peeling was performed in 26.3% of cases (31/118), and administration of 20 mg of sub-Tenon triamcinolone at the end of the surgery was done in 52.5% of cases (62/118). Vitreous substitution was performed with the following agents: 65.2% (77/118) silicone oil, 31.4% (37/118) gas, 1.7% (2/118) balanced salt solution, and 1.7% (2/118) air. Intraoperative complications were as follows: none (30.5%, 36/118), posterior iatrogenic retinal hole(s) (16.9%, 20/118), peripheral iatrogenic retinal hole(s) (33.9%, 40/118), unable to achieve hemostasis (4.2%, 5/118), unable to fully reattach the retina (6.8%, 8/118), and any combination of the above (7.6%, 9/118).

Outcomes

The VA significantly improved in the study group, from 2.35 (range, 2.24-2.45) logMAR (Snellen 20/4500) at baseline to 1.57 (range, 1.47-1.67) logMAR (Snellen 20/750) at final follow-up for a gain of 0.78 logMAR ($P < .0001$). The VA did not improve in the control group, from 2.40 (range, 2.31-2.49) logMAR (Snellen 20/5000) at baseline to 2.37 (range, 2.28-2.46) logMAR (Snellen 20/5000) at final follow-up for a gain of 0.03 logMAR ($P = .61$). The change in VA was significant between groups ($P < .0001$); 39.8% of patients (47/118) in the study group and 3.5% of patients (2/57) in the control group attained 20/200 or better Snellen acuity ($P < .0001$). In the study group,

Table 3. Chronic Diabetic Tractional Retinal Detachment: Outcomes.

Variable	Study Group (Vitrectomy) (n = 118)	Control Group (No Vitrectomy) (n = 57)	*P* Value
Total follow-up, mean (95% CI) months	26.6 (25.5-27.8)	25.8 (24.1-27.5)	.41
Follow-up visits during the study period, mean (95% CI) no.	14.3 (12.2-16.4)	12.6 (10.1-15.1)	.24
Final visual acuity, mean (95% CI) logMAR	1.57 (1.44-1.70)	2.37 (2.18-2.55)	<.0001
Development of no light perception during the study period (%)			.02
Yes	5.9	17.5	
No	94.1	82.5	
IOP > 30 mm Hg during the study period (%)			.002
Yes	15.2	36.8	
No	84.8	63.2	
Development of NVG (%)			<.0001
Yes	6.8	29.8	
No	93.2	70.2	
Administration of ≥1 non–operating room procedures during the study period (%)[a]			.01
Yes	24.6	77.2	
No	75.4	22.8	
Type of procedure (n)			
Anti-VEGF injection(s)	18	5	
Panretinal photocoagulation session(s)	3[b]	12	
YAG capsulotomy	4	2	
Combination of ≥1 procedures	4	25	
Administration of ≥1 operating room procedures during the study period (%)[c]			.22
Yes	24.6	19.3	
No	75.4	80.7	
Type of treatment (n)			
GDD	3	6	
Enucleation/evisceration	2	5	
PPV for SO removal	10		
PPV for a postoperative complication	14		

Abbreviations: GDD, glaucoma drainage device; IOP, intraocular pressure; NVG, neovascular glaucoma; PPV, pars plana vitrectomy; SO, silicone oil; VEGF, vascular endothelial growth factor.

[a]This does not include the preoperative intravitreal anti-VEGF injection administered prior to the initial PPV in the study group.

[b]All 3 of these subjects underwent panretinal photocoagulation in the postoperative period to apply laser spots to areas that had persistent subretinal fluid after fluid-air exchange; therefore, endolaser uptake could not be achieved during surgery.

[c]This does not include the initial PPV in the study group and does not include cataract surgery during the study period for either the study or control group.

7.6% of patients (9/118) achieved 20/50 or better Snellen acuity, whereas no patients in the control group did so ($P = .007$). During the study period, 5.9% of patients (7/118) in the study group and 17.5% of patients (10/57) in the control group developed NLP ($P = .02$).

Table 3 shows the other outcomes in the study and control groups. The single surgery reattachment rate in the study group was 88.1% (104/118). The study group had the following postoperative complications: none (57.6%, 68/118), recurrent RD (11.9%, 14/118), recurrent VH (5.1%, 6/118), persistent VH(16.1%, 19/118), NVG (6.8%, 8/118), macular hole development (0.6%, 1/118), and a combination of 1 or more of any of the above (1.7%, 2/118). Of the 14 patients in the study group who underwent a secondary PPV for a postoperative complication, 5 were for recurrent RD and 9 were for VH (recurrent or persistent). In the study group, 72.7% of patients (56/77) received silicone oil tamponade during the initial PPV and retained the silicone oil at the study's end. Of the 58 patients in the study group who were still phakic after the initial PPV, 77.6% (45/58) underwent cataract surgery during the postoperative study period. In the control group, 12.3% of patients (7/57) underwent cataract surgery during the study period.

During the study period, 1.7% of patients (2/118) in the study group and 8.8% of patients (5/57) in the control group underwent enucleation/evisceration ($P = .03$). Resolution of the subretinal fluid in the macula was observed in 5.2% of cases (3/57) in the control group during the study interval. Of these 3 cases, 2 had 1 or more anti-VEGF treatments during the study

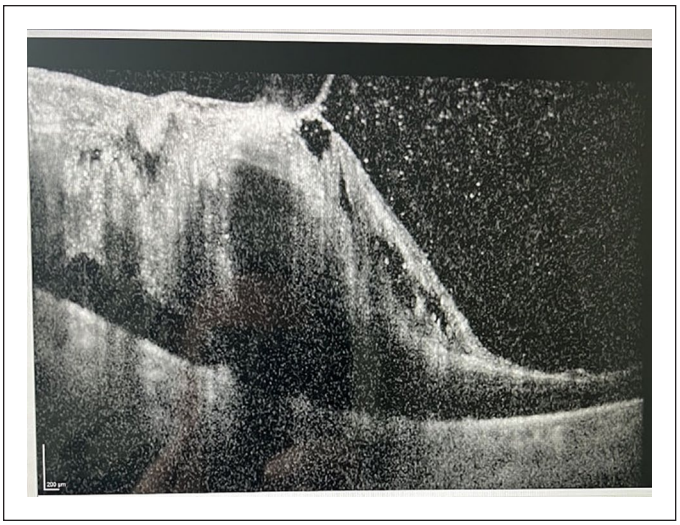

Figure 1. Optical coherence tomography in a 64-year-old woman with type 2 diabetes at baseline in the study group. The patient reported extremely poor vision for 8 months, and her visual acuity was measured as hand motions. The image demonstrates severe preretinal traction in the central macula, with profound distortion of the retinal architecture and subretinal fluid consistent with a diabetic tractional retinal detachment involving the fovea. A mild vitreous hemorrhage is also evident.

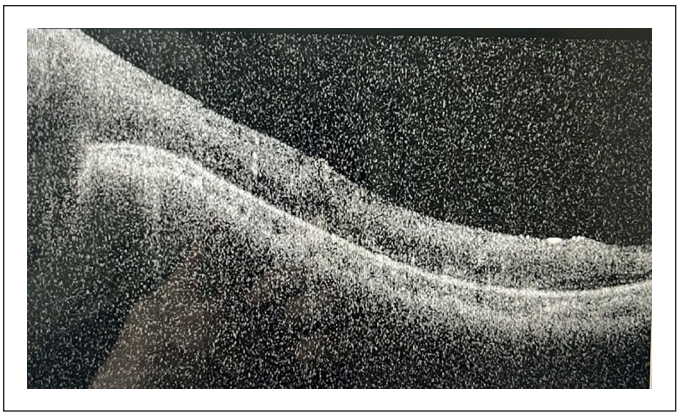

Figure 2. Optical coherence imaging approximately 6 months after the patient had pars plana vitrectomy with perfluoropropane gas. The patient's visual acuity improved to 20/100. The image shows resolution of preretinal membranes with retinal reattachment, although the macular architecture remains disordered, and the central foveal depression is absent.

interval; however, none of the 3 cases demonstrated improved vision by the end of the study period, despite resolution of the subretinal fluid.

Subgroup analysis was performed regarding duration of the TRD and baseline VA, and there were no statistically significant findings as they relate to the overall final VA, the likelihood of attaining 20/200 or better Snellen acuity, or the likelihood of attaining 20/50 or better Snellen acuity for either the study or control group. Subgroup analysis was also performed regarding study group subjects with preoperative concomitant VH vs TRD alone, and there was no statistically significant difference in final VA (1.39 vs 1.68, respectively; $P = .12$) between subgroups. Figures 1 and 2 display a representative case example of a study group patient from this analysis.

Discussion

In their review of chronic diabetic TRDs, Ho et al[6] stated that detachments of the center of the macula for more than 6 months usually preclude the recovery of useful vision on account of the resultant atrophic retina and extensive, tightly adherent fibrovascular preretinal tissue. Some specialists suggest observation alone for these long-standing macula-involving TRDs,[3,7] whereas others suggest surgical intervention given the advancement in surgical techniques and equipment, including for chronic detachment cases that were formerly deemed inoperable.[4,8–10] While a long-standing detachment of the macula has been recognized as a risk factor for poor visual outcomes regardless of management,[2,3] Abunajma et al[11] reported that vision stabilized or improved in 90% of cases with a detached macula for at least 6 months in this patient population. A post hoc analysis of the authors' previous work suggests an anatomic success rate of more than 80%, with stable or improved VA in more than 90% at 6 months post-PPV when chronic PDR-associated macula-involving TRDs underwent surgical repair using small-gauge PPV instrumentation and preoperative anti-VEGF administration.[4] However, analysis was not performed regarding the presenting level of VA prior to PPV in that study.

The VA was conspicuously improved in our study when PPV was performed, whereas the average VA was largely unchanged after approximately 2 years of follow-up when PPV was declined. The visual outcomes in the PPV cohort of this study were broadly on par with the above-referenced studies[4,11] regarding the high number of subjects attaining stable or improved visual acuity after PPV, even though baseline visual acuities were poor in this study. Approximately 8% of cases and 40% of cases achieved 20/50 or better and 20/200 or better Snellen acuity, respectively, when PPV was performed on what has historically been considered an inoperable condition by many specialists. Of note, approximately 3 times fewer patients developed NLP, and 4 times fewer patients developed NVG during the study period in the PPV cohort compared with the PPV declined cohort.

The anatomic reattachment rate with a single PPV in the study group was very high (>85%), and because the rate of control group subjects undergoing either a glaucoma drainage device procedure or evisceration/enucleation for a "blind painful eye" was not trivial, the rate of operating room procedures (including silicone oil removal in the study group) was similar between cohorts once the initial PPV in the study group occurred. The mean operating time of 38 minutes in the study group is consistent with the reported operating times of 34.2 (range, 28.9-39.5) minutes in published randomized controlled trials and a meta-analysis involving diabetic TRDs.[4,9,10,12–14]

Regarding the higher rate of intraoperative complications in this study compared with the authors' previous meta-analysis[4] evaluating this patient population (70% vs 55%), this difference may be attributed to the fact that all subjects in this study had longer-standing TRDs (mean, 12 months), whereas the TRD duration in the meta-analysis[4] was 6 months. Because longer-standing TRDs tend to have membranes that are more fibrotic and tightly adherent to underlying atrophic retina compared with shorter-duration TRDs, it is reasonable to assume that more chronic TRDs may be more challenging to repair (and therefore have a greater risk of intraoperative complications) than shorter-duration TRDs.

Although the natural history of an extrafoveal diabetic TRD has been well-described,[5,15] there are few reports regarding the natural history of macula-involving diabetic TRDs when surgical intervention is declined. Lin and Hendrick[16] reported that 36% of cases with a macula-involving diabetic TRD regained 2 or more lines of Snellen VA after 1 year of observation alone (74 eyes). They did not report how many patients developed complications such as NVG or became NLP during their observational period. Cohen et al[17] reported that 37.5% of cases (51/136) remained with stable or improved VA after a mean of 4.6 years of follow-up with observation alone. Cohen et al[17] also noted that "spontaneous reattachment" occurred in 20% of cases (27/136). However, the methodology of Cohen et al[17] is unclear regarding the status of the macula in their diabetic TRDs. The authors presume that both macula-involving and extramacular TRDs were included in their analysis, thereby making it unascertainable regarding how specifically the macula-involving cases fared. Because only about 20% of control group subjects in this study were managed by observation alone, our study does not have sufficient numbers for a meaningful subgroup analysis regarding the natural history of this advanced disease. Our study showed only in approximately 5% of cases with macula-involving PDR-associated TRDs did subretinal fluid in the macula resolve during the study period without PPV, and in only 1 case was observation alone (no anti-VEGF therapy or PRP) the management strategy. Although there are a few reports of subretinal fluid resolution in macula-involving diabetic TRDs with observation alone[18] and after anti-VEGF therapy,[19] the incidence of this occurrence is evidently rare given the paucity of reports. Subgroup analysis in our study failed to demonstrate any subgroup in which PPV should be generally avoided, broadly displaying potential visual benefits of PPV regardless of the patient's presenting VA or duration of vision loss.

Strengths of this study include its case-controlled design, long follow-up period, relatively large number of cases included in a sparsely reported-on patient population with chronic macula-involving PDR-associated TRDs and poor baseline vision, and complete data sets. Limitations of this study consist of its retrospective design, potential for selection bias, unbalanced number of study and control group patients, dependence on subjective patient history when determining the duration of the macula-involving TRD, and inclusion of patients from a developing country who were mostly low-income. It is recognized that patients residing in a developed country where access to vitreoretinal services and overall diabetic care is readily available may have better outcomes. Future research to validate the results of this study should be performed in a patient population with similar inclusion/exclusion criteria.

In conclusion, this study demonstrated clinically meaningful vision improvement with fewer adverse events such as development of NVG, becoming NLP, or undergoing enucleation/evisceration during the study period when PPV was performed vs deferred in favor of less invasive options (anti-VEGF therapy, PRP, etc) in patients with PDR with poor baseline VA and a macula-involving TRD of more than 6 months duration. However, even though baseline characteristics between the cohorts in this study were not significantly different, the possibility for bias in case selection for surgery, by the surgeon, is an inherent limitation encountered with the methodology employed in this study, and potentially could have resulted in our study's findings.

Ethical Approval

The study was approved by the Panhandle Eye Group Institutional Review Board (IORG0009239; IRB00011013-16) in accordance with the ethical standards of the Declaration of Helsinki.

Statement of Informed Consent

Informed consent from study patients was waived because this was a retrospective study.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of the article.

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