

Evaluation of cataract progression after *pars plana* vitrectomy in young patients with rhegmatogenous retinal detachment

Avaliação da progressão da catarata após vitrectomia da *pars plana* em pacientes jovens com descolamento de retina regmatogênico

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ABSTRACT

Objective: To evaluate the rate and risk factors associated with cataract progression post *pars plana* vitrectomy in young patients with rhegmatogenous retinal detachment.

Method: This retrospective study was conducted between January 2020 to January 2025 involving patients with ages between 18 to 45 years old undergoing *pars plana* vitrectomy for uncomplicated rhegmatogenous retinal detachment.

Results: A total of 125 eyes (from 125 patients) were recruited. Cataracts developed in 105/125 (84%) eyes after *pars plana* vitrectomy. Nuclear sclerotic cataract developed in 55/105 (52%), while posterior subcapsular cataract in 42/105 (40%), and cortical cataract in 8/105 (8%) eyes respectively. Cataracts developed more frequently in macula-off rhegmatogenous retinal detachment (76%) compared to macula-on rhegmatogenous retinal detachment (24%) ($p = 0.014$). Longer surgical time of more than 60 minutes was associated with higher rate of cataract formation in 60% of patients.

Conclusion: Cataract formation after *pars plana* vitrectomy is a known complication. It can happen in young patients and cause visual significant disturbances as well. Even though the rate of formation is lesser in patients younger than 35 years old, the condition needs to be addressed as they are young functioning adults.

RESUMO

Objetivo: Avaliar a taxa e os fatores de risco associados à progressão da catarata após vitrectomia da *pars plana* em pacientes jovens com descolamento de retina regmatogênico.

Método: Este foi um estudo retrospectivo realizado entre janeiro de 2020 e janeiro de 2025 envolvendo pacientes com idades entre 18 e 45 anos submetidos à vitrectomia da *pars plana* para descolamento de retina regmatogênico não complicada.

Resultados: Foram recrutados 125 olhos (de 125 pacientes). Cataratas se desenvolveram em 105/125 (84%) olhos após a vitrectomia da *pars plana*. Catarata esclerótica nuclear se desenvolveu em 55/105 (52%), enquanto catarata subcapsular posterior em 42/105 (40%) e catarata cortical em 8/105 (8%) olhos, respectivamente. As cataratas se desenvolveram com maior frequência em descolamento de retina regmatogênico sem mácula (76%) em comparação com descolamento de retina regmatogênico com mácula (24%; $p = 0.014$). Tempo cirúrgico mais longo, superior a 60 minutos, foi associado a uma maior taxa de formação de catarata em 60% dos pacientes.

Conclusão: A formação de catarata após a vitrectomia da *pars plana* é uma complicação conhecida. Pode ocorrer em pacientes jovens e causar distúrbios visuais significativos. Embora a taxa de formação seja menor em pacientes com menos de 35 anos, a condição precisa ser tratada, visto que são adultos jovens e funcionais.

INTRODUCTION

Rhegmatogenous retinal detachment (RRD) tends to happen in a bimodal distribution, in which both the young and the elderly are affected.⁽¹⁾ The latter tends to occur in the presence of posterior vitreous detachment (PVD). In the young, however, PVD can happen especially in myopic eyes. There are various treatment options for RRD, which include pars plana vitrectomy (PPV), scleral buckling (SB), and pneumatic retinopexy. Recent studies showed that PPV has been shown to increase the rate of cataract formation, particularly nuclear sclerotic cataracts (NSC) and posterior subcapsular cataracts (PSC) formation with minimal lens changes in other treatment modalities. There are several mechanisms hypothesized. Increased in oxygen saturation in the vitreous cavity after PPV, prolonged exposure to saline during intraoperative period and use of long-acting gas tamponade are a few mechanisms proposed to cause cataract progression.^(2,3) To date, data on post-PPV cataract formation in young patients is still limited, as most of the time SB will be the preferred way of RRD repair because PVD is usually absent.⁽⁴⁻⁶⁾ The aim was to analyse the rates and risk factors associated with cataract progression in young patients who underwent PPV for RRD.

METHODS

This is a retrospective cohort study of patients aged between 18 to 45 years old with no prior ocular surgery undergoing PPV for RRD repair between 2020 to 2025 at a Hospital ophthalmology department. Primary PPV was chosen if pre-operative PVD was present. The study adheres to the tenets of the Declaration of Helsinki and was approved by the Malaysian Medical Research Ethics Committee (NMRR ID 20-3176-58748). No informed consents were obtained due to the retrospective nature of the study. Exclusion criteria for the study included pseudophakic or aphakic eyes, eyes requiring lens extraction at the time of initial RRD repair, and combined detachments (tractional or exudative). Eyes with mild preoperative cataracts were included in the analysis.

The primary outcome of this study is cataract formation rate after RRD repair. The study included both visually and clinically significant cataracts. Objectively, cataract formation was recorded based on type: NSC, PSC, and cortical. The severity was recorded pre-operatively, at post-operative month 1 (POM1) and at post-operative month 3 (POM3). The Lens Opacities Classification System, version II (LOCS II) scale of 1 to 4 (with 4 being the worst) was used.⁽⁷⁾ Secondary outcomes include changes

in pre- and post-cataract formation visual acuity (VA) and correlations between age, macula status, surgical time and cataract development or progression. The majority of retinal detachments have stable VA 3 to 6 months after repair due to the reorganization of the attached retinal layers and resolution of gas tamponade. Therefore, post-operative month 3 was selected to minimize effects of intraocular gas on VA in our analysis.

Fisher's exact test was performed for categorical covariates and Mann-Whitney U tests were performed for numeric covariates. Statistical analysis was performed with the SPSS program (version 29.0, IBM Corp., Armonk, NY).

We have received informed consent of all patients that participated in the research.

RESULTS

A total of 125 eyes (125 patients) undergoing PPV were included in this study. All surgeries were performed by single vitreoretinal surgeon. The average age at PPV was 38.49 ± 7.26 years with 80/125 (64%) female. The crystalline lens was clear in all eyes. 23-gauge vitrectomy was performed using Stellaris elite machine in all eyes. Perfluoropropane (C₃F₈) gas was used in all eyes. There was no lens touch with the instrumentation during all of the surgeries. The average surgical time was 45 ± 17 minutes. Average follow-up length was 725 ± 700 days with all retinas attached at the latest follow-up.

Significant cataracts were seen in 105/125 (84%) eyes after PPV in which all of them develops within the first 3 months after PPV. Nuclear sclerotic cataracts, PSC, and cortical cataracts developed in 55/105 (52%), 42/105 (40%), and 8/105 (8%) eyes, respectively. The average cataract grading at post-operative visits are shown in table 1. The average NSC and PSC grading increased in PPV eyes through 3 months. NSC grading at POM1 ($p = 0.041$) and POM3 ($p = 0.02$) were significant. On the other hand, PSC grading at POM1 ($p = 0.034$) and POM3 ($p = 0.005$) were significant as well for both post-operative periods.

Table 1. Average cataract grading after pars plana vitrectomy

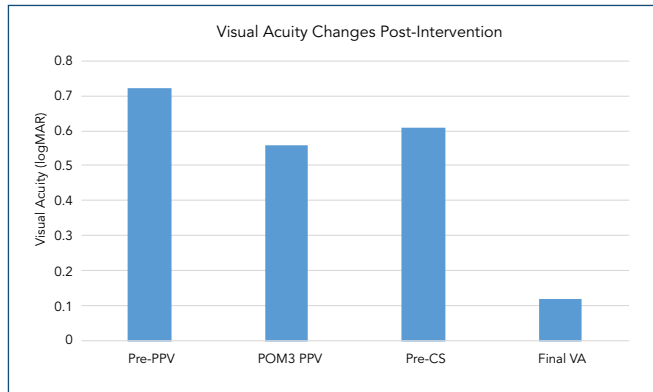
		Pre-operative	POM1	POM3
NSC	Grade	0.00	0.47	0.62
	p-value	-	0.041	0.02
PSC	Grade	0.00	0.21	0.52
	p-value	-	0.034	0.005

p-value < 0.05 is statistically significant.

POM: post-operative month; NSC: nuclear sclerotic cataracts; PSC: posterior subcapsular cataracts.

On average, cataracts developed 80 ± 30 days after PPV. Sixty (48%) eyes were subsequently subjected for cataract extraction and intraocular lens implant.

Visual acuity changes over the period of study are shown in figure 1. After PPV, average VA improved to logMAR 0.3 from 1.0 ($p = 0.023$). There was a slight decrease in average VA from logMAR 0.3 to 0.6 when comparing three months after PPV to before cataract extraction ($p = 0.045$). The average time to cataract extraction was 315 days (range: 95–405) after PPV with 50% extractions occurring within 1 year of PPV. VA gains were significant after cataract surgery (CS) with an improvement from logMAR 0.6 to 0.2 at the latest visit ($p = 0.003$).



PPV: pars plana vitrectomy; POM: post-operative month; CS: cataract surgery; VA: visual acuity.

Figure 1. Visual acuity changes after intervention.

Cataracts developed in 50/105 (48%) eyes in patients below 35 years compared to 65/105 (52%) of eyes in patients above 35 years ($p = 0.240$) (Table 2). Cataracts were found to develop faster in patients over 35 years (60 ± 22 days) compared to under 35 years (83 ± 27 days) but was not statistically significant ($p = 0.250$).

Table 2. Risk factors for cataract progression after pars plana vitrectomy

	Cataract rate	Time to cataract development (days)
Age, years old		
< 35	50/105 (48%)	83 ± 27
≥ 35	65/105 (52%)	60 ± 22
p-value	0.240	0.250
Macula status		
On	35/105 (24%)	87 ± 33
Off	80/105 (76%)	65 ± 26
p-value	0.014	0.120
Surgical time, minutes		
< 60	42/105 (40%)	90 ± 27
≥ 60	63/105 (60%)	61 ± 22
p-value	0.026	0.038

p-value < 0.05 is statistically significant.

Cataracts developed at higher rates after macula-off RRDs (80/105, 76%) compared to macula-on RRDs (35/105, 24%) ($p = 0.014$). Cataracts also developed sooner after macula-off RRD (65 ± 26 days) compared to

macula-on RRD (87 ± 33 days) and was statistically significant ($p = 0.014$).

Other risk factor for cataract development such as surgical time was associated with increased cataract formation rates or increased time for cataract formation. The study showed that cataract occurred more frequently in PPV taking over 60 minutes 63/105 (60%) compared to below 60 minutes 42/105 (40%) and it was statistically significant. Univariate logistic regression analysis is tabulated in table 3 and revealed statistically significant correlation between macula status (odd ratio = 5.22) ($p = 0.035$) and surgical time (odd ratio = 1.18) ($p = 0.021$) with overall cataract formation.

Table 3. Odds ratios of risk factors associated with cataract formation after pars plana vitrectomy

Cataract	Odds ratio	95% Confidence interval	p-value
Age	1.39	0.44-9.38	0.346
Macula status	5.22	1.47-56.34	0.035
Surgical time	1.18	0.33-5.57	0.021

p-value < 0.05 is statistically significant.

DISCUSSION

Retinal detachment repair in young patients remained a challenge for many surgeons. Scleral buckle is still the preferred choice in young phakic patients with no PVD.⁽⁸⁾ However, recent studies showed that PPV can have excellent outcome as well in patients less than 45 years of age. The majority of successful single operative success came from presence of PVD at presentation, which makes the surgery easier and poses less risk of causing iatrogenic breaks.^(9,10) Success rate was up to 87% compared to 65% in patients with no pre-operative PVD.⁽¹¹⁻¹⁴⁾ Nevertheless, cataract formation and progression are a known long-term complication in patients undergoing PPV. There are studies that found out that 80% of patients developed cataracts that were visually significant after 2 years undergoing PPV and required cataract extraction and lens exchange.⁽¹⁵⁻¹⁷⁾ It was more visually disturbing for young patients due to their ability to accommodate.⁽¹⁸⁻²⁰⁾ Only few studies focused on cataract progression after PPV in retinal detachment in young patients. Thus, the primary aim of this study is to evaluate the risk and rate of progression of cataract after PPV for RRD in young patients.

Our results showed that 84% of eyes developed cataract, which is both clinically and visual significant within 3 months after PPV. This is consistent with recent literature. The rate of cataract formation in PPV in our study is almost twice higher compared to scleral buckle in the same age group, ranging from 35-45% in some reported

studies.⁽²¹⁾ In our study, NSC occurred at a higher rate than PSC, which was opposite to other literatures that state that PSC was the most common cataract in vitrectomized eyes.⁽²²⁻²⁴⁾ Therefore, young age does not protect the eyes from NSC formation and progression. The rationale behind the focus on early post-operative period (3 months after PPV) is because at this point of time any gas tamponade has been fully resorbed and thus will represent the visual function of the patients if the retina remained attached. Therefore, any media opacity such as development of visually significant cataract will cause reduction in vision in young patients.

There were many studies evaluating factors such as macula status at the point of diagnosis and surgical time that can affect the cataract progression after PPV. Our study showed that there was increase cataract formation in macula-off RRDs compared to macula-on RRDs. The postulated mechanism for cataract formation after PPV is increased oxygen tension posterior to the lens.⁽²⁵⁻²⁸⁾ Vitreous liquefaction will promote oxygen diffusion from retinal circulation towards the back of the lens.⁽²⁹⁾ More liquefaction is expected in macula-off RRDs due to accumulation of more sub-retinal fluid causing macula detachment.⁽³⁰⁻³²⁾ This in turns causes higher oxygen tension posterior to the lens and thus higher rate of cataract formation in macula-off compared to macula-on RRDs.

Prolonged surgical time has long be associated with increase cataract formation due to increased contact time between balance salt solution infused into the vitreous cavity during the surgery.⁽³³⁻³⁵⁾ Our study showed that patients are more likely to develop cataract when the surgical time exceeds 60 minutes. All our patients who underwent cataract surgery and lens exchange acquire VA gains. This further emphasized that cataract formation post-PPV was a significant factor for poor vision post-retinal detachment repair that has achieved anatomical reattachment.

LIMITATIONS

The limitations of the study were its small sample size and retrospective nature. Cataract gradings during the period of study were obtained retrospectively by looking through the documentations in the case notes. LOCS II grading system is subjective and might differ from different consultants' evaluations. Thus, to reduce discrepancy only grading by the same vitreo-retinal surgeon was obtained. The use of single type of gas (C3F8) in the study might have limited the generalizability but makes the progression of cataract more predictable as various types

of tamponade and its duration in the eye might cause variability to the outcome of our study. We also did not include axial length and refraction of the patients as possible confounding factors, as those measurements were not done in the primary setting. Another downside of the study is its the short duration. As cataract might progress further, longer follow-up might capture more eyes with cataract formation.

CONCLUSION

In conclusion, cataract formation is an inevitable complication after rhegmatogenous retinal detachment repair, even in young patients. The majority of patients starts to develop cataract even within 3 months post-operative. Our study showed that even young patients below 35 years of age had the risk of cataract formation post pars plana vitrectomy albeit statistically insignificant. This however should not deter surgeons from performing vitrectomy in young rhegmatogenous retinal detachment patients, especially those who already had posterior vitreous detachment beforehand. Further prospective studies should be performed to better evaluate the risk factors associated with cataract formation in young patients undergoing retinal surgery.

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AUTHORS' CONTRIBUTION

Chin Shi Tang: First author, involved in data collection and analysis, drafting of the manuscript. Qi Zhe Ngoo: Corresponding author, involved in the verification of data analysis, correction of literature review, and discussion. Zamri Noordin: Co-author, involved in overall supervision of the research including field recruitment of subjects. Ismail Shatriah: Co-author, involved in overall supervision of the research including field recruitment of subjects.

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