

THE INCIDENCE OF RETINAL BREAKS INDUCED BY POSTERIOR HYALOID SEPARATION DURING 27-GAUGE PARS PLANA VITRECTOMY.

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## ABSTRACT:

### Purpose:

As advances are made in smaller gauge vitrectomy, it is important to characterize the associated risks. This allows the surgeon to anticipate complications and also appropriately counsel patients. The incidence of iatrogenic retinal breaks in 25 and 23 gauge vitrectomy is known, but no studies exist looking at the incidence in 27 gauge vitrectomy with an attached posterior hyaloid face. This study set out to characterize the incidence.

### Methods:

A retrospective, consecutive, observational study of patients undergoing 27 gauge transconjunctival sutureless vitrectomy (TSV) for macular pathology or floaters. This was a single surgeon series conducted between 2015 and 2017 at Calderdale Royal Hospital, UK. Inclusion criteria included only those with an attached posterior hyaloid face at the disc, identified intraoperatively.

### Results:

Data was collected and analysed in 94 patients. Preoperative diagnosis frequency was as follows: Epiretinal membrane 24 (25.5%), Macular hole 47 (50.0%), Vitreo-macular traction 11 (11.7%) and Floaters 12 (12.8%). In 82 out of 94 patients (89.1 %), 27g vitrectomy was combined with 2.2 mm micro-incisional phakoemulsification with lens implantation. The incidence of iatrogenic retinal breaks associated with PHF separation during 27-gauge PPV was 17% (16 cases).

### Conclusions:

This is the first study to report the incidence of peripheral retinal breaks induced by PHF separation during 27 g vitrectomy. Our single surgeon case series of 27 gauge PPV for all elective vitreoretinal indications, in eyes with attached vitreous, yielded an iatrogenic break rate of 17%. However, no post-operative retinal detachments followed. Statistical analysis revealed no specific risk factors to be significantly associated with the outcome (incidence of retinal tear).

## Introduction:

Iatrogenic breaks during pars plana vitrectomy increase the likelihood of a post-operative rhegmatogenous retinal detachment which can adversely affect the final outcome for the patient. It also has implications in terms of time and cost, which is particularly relevant in a resource limited setting.

The reported incidence of iatrogenic retinal breaks is highly variable. Ramkissoon et al<sup>1</sup> reported an incidence of 15.2% in 20 gauge vitrectomy. Since then, several authors<sup>2-4</sup> have analysed the incidence of retinal breaks in patients undergoing small gauge vitrectomy (23 and 25 gauge). They found the incidence of retinal break caused by induction of PVD to vary from 15-18%.<sup>4</sup>

Since the initial report of 27g TSV system by Oshima et al<sup>5</sup>, this technique is being widely adopted. Whilst various authors<sup>6-9</sup> have confirmed its safety and efficacy compared to traditional small gauge vitrectomy systems, the risk for iatrogenic retinal breaks has not been quantified thus far.

This study set out to characterize the incidence and risk factors for iatrogenic retinal breaks in a single surgeon case series, for all elective vitreoretinal indications in eyes with attached vitreous for 27-gauge PPV.

## Methods and Materials:

This was a retrospective, single surgeon, consecutive, observational study of patients undergoing 27-gauge PPV carried out between 2015 and 2018 at Calderdale Royal Hospital, UK. The local research and development department highlighted that ethical approval was not deemed necessary for this study as it did not affect the standard of care for patients.

Data was collected at the time of surgery in a Vitreo-retinal Database and reviewed retrospectively for analysis. Only breaks attributed to suction-induced posterior hyaloid face separation were included. Iatrogenic breaks related to sclerostomy or caused by retinal touch during membrane peeling were excluded, as were pre-existing atrophic holes.

27g vitrectomy was combined with 2.2 mm micro-incisional phakocoemulsification with lens implantation in patients who were phakic on presentation. The incidence of iatrogenic retinal breaks associated with PHF separation during 27-gauge PPV was recorded at 17% (16 cases).

## Statistical Methods

Demographic data (age, gender) and indication for surgery were recorded for each patient. Inclusion criteria were patients undergoing 27-gauge PPV for macula hole (MH), epi-retinal membrane (ERM), vitreo-macular traction (VMT) or visually significant floaters. All patients had no pre-existing posterior vitreous detachment.

The outcome measure was dichotomised into retinal tear or no retinal tear. Additional biometrical data (Lens status (categorized as phakic or pseudophakic), tamponade agent (categorized as air, SF<sub>6</sub> or C<sub>2</sub>F<sub>6</sub>), and follow-up time in months was collected on certain patients.

The sample was summarised descriptively. Pearson's chi-squared test for association was conducted to assess the evidence for the significance of the association between diagnosis and the incidence of retinal tear. The magnitude of the association was assessed by Cramer's V statistic.

A multiple logistic regression model was also constructed to assess the effect of a pre-operative diagnosis of ERM, floaters and VMT against the reference category of MH in a controlled model. This model also included age, gender and axial length as controlling variables. Model calibration was assessed using the Hosmer-Lemeshow statistic and goodness-of-fit was assessed using Nagelkerke's pseudo-R<sup>2</sup> statistic.

## Results

Data was collected on 94 patients (31 males, 63 females) with ages ranging from 39.7 to 91.2 years. Pre-operative diagnosis frequency was as follows: MH 47 (50.0%); ERM 24 (25.5%); Floaters 12 (12.8%); VMT 11 (11.7%).

The incidence rate for retinal tear over the entire cohort was 16 out of 94 patients (17.0%). A 95% confidence interval for the proportion in the population is given by (9.43%, 24.6%).

Two cases were noted to have atrophic holes in areas of lattice degeneration. One patient had preexisting lattice and developed multiple breaks after induction of PHF.

The sample is summarised descriptively in Table 1. Numerical parameters are summarised as mean (SD).

Table 1: descriptive summary of sample

	MH (n=47)	ERM (n=24)	Floater (n=12)	VMT(n=11)	All patients (n=94)
Age (years)	70.8 (7.62) (n=41)	70.7 (12.8)	57.6 (10.8)	76.6 (7.94)	69.7 (10.9) (n=88)
Axial length (mm)	20.3 (7.92) (n=46)	23.5 (1.39) (n=18)	25.1 (1.52) (n=12)	22.9 (1.43) (n=11)	21.9 (6.09) (n=87)
Gender					
Males	13 (27.7%)	10 (41.7%)	6 (50.0%)	2 (18.2%)	31 (33.0%)
Females	34 (72.3%)	14 (58.3%)	6 (50.0%)	9 (81.8%)	63 (67.0%)
Lens status					
Phakic	42 (91.3%)	20 (83.3%)	11 (100.0%)	9 (81.8%)	82 (89.1%)
Pseudophakic	4 (8.7%) (n=46)	4 (16.7%)	0 (0.0%) (n=11)	2 (18.2%)	10 (10.9%) (n=92)
Tamponade agent					
SF <sub>6</sub>	13 (31.7%)	10 (41.7%)	1 (9.1%)	4 (40.0%)	28 (32.6%)
C <sub>2</sub> F <sub>6</sub>	28 (68.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	28 (32.6%)
Air	0 (0.0%) (n=41)	14 (58.3%)	10 (90.9%) (n=11)	6 (60.0%) (n=10)	30 (34.9%) (n=86)
Follow-up time (months)	5.73 (6.04)	4.75 (3.39)	5.23 (5.91) (n=11)	10.2 (16.4)	5.95 (7.53) (n=93)
Cryotherapy/endolaser outcome					
Retinal tear	6 (12.8%)	7 (29.2%)	1 (8.3%)	2 (18.2%)	16 (17.0%)
No retinal tear	41 (87.2%)	17 (70.8%)	11 (91.7%)	9 (81.8%)	78 (83.0%)

Pearson's chi-squared test for association revealed no evidence for an association between procedure and outcome ( $\chi^2_{(3)}=3.76$ ;  $p=0.288$ ). The effect was of low-to-moderate magnitude (Cramer's  $V=0.200$ ).

A multiple logistic regression analysis, including gender, age and axial length as controlling variables, and with MH as the reference diagnosis category, revealed no evidence that outcomes (incidence of retinal tear or break) in ERM, Floaters or VMT patients were significantly different (at the 5% significance level) from outcomes in MH patients in a controlled analysis ( $p=0.159$  for ERM patients;  $p=0.250$  for Floaters patients;  $p=0.605$  for VMT patients). There was also no evidence that axial length was significantly associated with the outcome measure ( $p=0.363$ ). There was also no evidence that the controlling variables of age and gender were significantly associated with the outcome ( $p=0.365$  for age;  $p=0.839$  for gender).

There was no evidence that the model was not adequately calibrated according to the Hosmer and Lemeshow procedure ( $\chi^2_{(8)}=6.54$ ;  $p=0.588$ ) and the model was an adequate fit to the data

(Nagelkerke's pseudo-R<sup>2</sup>=0.114). The events-to-variable ratio was acceptable at about 16:1. All parameters from the multiple logistic regression model are summarised in Table 2.

Table 2: multiple logistic regression model parameters

Parameter	P-value	Odd ratio (OR)	95% CI for OR
Diagnosis MH (reference)			
ERM	0.159	2.67	(0.681, 10.5)
Floater	0.250	0.230	(0.0188, 2.81)
VMT	0.605	1.62	(0.263, 9.92)
Gender Male (reference)			
Female	0.839	1.14	(0.316, 4.14)
Age	0.365	0.971	(0.910, 1.04)
Axial length	0.363	1.26	(0.768, 2.06)

## Discussion

Iatrogenic breaks remain a serious intraoperative complication with its potentially serious sequelae of post-operative rhegmatogenous detachment and associated adverse effect on visual acuity. Breaks that develop during PPV have a number of postulated mechanisms. Insertion of instruments through the sclera can cause traction on the proximal vitreous base. Conversely, withdrawal of instruments can lead to incarceration of vitreous in the sclerostomy wounds. Removal of vitreous base can cause traction on peripheral retina, whilst incomplete removal of vitreous has been suggested as a cause of postoperative shrinkage and tearing.<sup>2,10,11</sup> Posterior vitreous detachment induction is additionally thought to be key in promoting breaks with adherent vitreous, requiring membrane blue (DORC limited) and suction, carrying odds nearly 4 times of that of cases requiring suction only in 23 gauge PPV<sup>4</sup>.

Previously performed 20 gauge PPV was found to have an intraoperative iatrogenic break rate of 15.2% in a large one-year retrospective interventional case series. It was similarly found that cases requiring surgical induction of PVD were at higher risk of developing breaks<sup>5</sup>. With regards to the smaller 25 gauge PPV, Tan et al<sup>2</sup> reported a rate of 15.8% in macular surgery and demonstrated a statistically significant relation between PVD induction and presence of breaks.

Ehrlich et al<sup>3</sup> reported that in a series of 184 patients, retinal breaks occurred in 29 patients (15.7%) of which 6 (3.2%) were deemed to be related to the sclerotomies.

In our case series the overall incidence of developing iatrogenic tears, for all indications was 17% (16/94 eyes). Whilst differences in proportions of retinal tears arising from different types of procedures were noted, the analysis reveals that procedure type is not a significant predictor of retinal tear. A pre-existing posterior vitreous detachment was part of the exclusion criteria which accounts for the seemingly higher rate when comparisons are made with studies of larger gauge vitrectomy, where these cases have not been excluded. Rahman et al<sup>4</sup> demonstrated a similar incidence of iatrogenic break induction by posterior hyaloid face separation of 18.2% in 23g vitrectomy. Interestingly, after separation of PHF from the disc with the 27 gauge vitrector, the area of PHF detachment in some cases extended only up to the equatorial retina. Further suction was thus applied at the detached edge of PHF in peripheral quadrants, to allow complete separation of attached vitreous. Data on what proportion of patients this occurred in is not available. However, it was noted to occur in cases where there were difficulties with PVD induction. This may be due to lower flow/suction in 27g instrumentation and has been reported by other authors.<sup>6</sup>

By controlling for variables in a multi regression analysis, we revealed no association with indication for surgery, age, gender or axial length. Despite the high incidence of breaks, none of the patients in our series developed an immediate or late post-operative rhegmatogenous retinal detachment. This finding highlights the importance of a full 360 degree internal search at the end of every vitrectomy. The higher detection rate of peripheral breaks may have been made possible by the surgeon's preference for phaco-vitrectomy, allowing for efficient visualization/detection of peripheral pathology and thorough removal of peripheral vitreous gel.

The single surgeon nature of this study is a strength, allowing for consistency between surgeries and reliability of data. However, the relatively small number leads to wider uncertainty concerning the true incidence of break formation after induction of PHF in the underlying population. Larger comparative studies, which would lead to greater precision in estimates, of various (23, 25, and 27g) small gauge PPV are required.

## Conclusion:

Our single surgeon retrospective case series of 27 gauge PPV for all elective vitreoretinal indications, in eyes with attached vitreous, yielded a 17% incidence of iatrogenic break formation (95% confidence interval 9.43% to 24.6%). Statistical analysis revealed no specific risk factors to be significantly associated with the outcome of retinal tear. However, no post-operative retinal detachments followed. The authors re-iterate the importance of a thorough intra-operative search and treatment of iatrogenic breaks to prevent an adverse outcome.

## Conflict interest & funding:

This work has no proprietary interest or research funding.

## Ethical Approval:

The local research and development department highlighted that ethical approval was not deemed necessary for this study as it did not affect the standard of care for patients.

## Informed Consent:

This study did not reveal the identity of patients or affected the standard of care of patients. Informed consent was obtained from all patients included in this study prior to their operations.

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