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Retinal Detachment Symposium 1

The Feasibility and Outcomes of Vitrectomy in the Office-Based Operation Room

- Taku Wakabayashi, MD, PhD
- Kotaro Tsuboi, MD
- Yusuke Oshima, MD, PhD

Objective: To assess the feasibility and outcomes of vitrectomy in the office-based operation room.

Purpose: To evaluate the feasibility, safety, and surgical outcomes of office-based vitrectomy for various adult vitreoretinal diseases.

Methods: This retrospective multicenter study included patients who underwent pars plana vitrectomy (PPV) in the office-based operation room (OR) at three private practices in Japan from January 2012 to January 2025. Patients with a postoperative follow-up of at least three months were included. The office-based ORs were fully equipped, meeting the same standards as hospital and ambulatory surgical center (ASC) ORs, with high-quality air filtration, pressure control, and a backup power system. To ensure patient safety, comprehensive preoperative and perioperative assessments were conducted in collaboration with primary care physicians, with surgical clearance obtained as needed. Patients requiring advanced monitoring by an anesthesiologist, such as those with severe heart failure, were not considered candidates for office-based vitrectomy.

Results: A total of 4,377 eyes underwent PPV in an office-based OR. All procedures were performed under local anesthesia (posterior sub-Tenon's anesthesia with 2% lidocaine) without intravenous sedation. Surgical indications included macular diseases (1,551 eyes), vitreous hemorrhage (397 eyes), subretinal hemorrhage (125 eyes), retained lens fragments or intraocular lens (IOL) dislocation requiring IOL fixation (983 eyes), rhegmatogenous retinal detachment (RRD) (1,046 eyes), proliferative vitreoretinopathy (87 eyes), diabetic tractional retinal detachment (37 eyes), endophthalmitis (4 eyes), and other conditions (147 eyes). All cases were performed using 25- and 27-gauge vitrectomy systems. The single-surgery anatomical success rate for RRD was 96.5%. Postoperative visual acuity improved significantly from 0.44±0.32 preoperatively to 0.14±0.26 postoperatively ($P<0.001$). No patients experienced severe intraoperative systemic complications necessitating perioperative intervention or transfer to a hospital for further management. No eyes developed endophthalmitis in this study.

Conclusion: Office-based PPV demonstrated favorable anatomic and visual outcomes with a high safety profile. Potential advantages include improved efficiency, high-quality perioperative care, and reduced turnover times. However, office-based vitrectomy is not indicated for pediatric patients or cases requiring general anesthesia, such as severe open-globe injuries.

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Retinal Detachment Symposium 1

The Use of Incorrect Intraocular Gas Tamponades During Vitreoretinal Surgery

- Gaurav Shah, MD
- Lawrence Chan, MD
- Andrew Lin, MD
- Georgia Kamboj, MBBS, PhD
- J. Michael Jumper, MD, FASRS
- Ryan Bucsi
- Linda Harrison, PhD

Objective: Incorrect gas mixtures during vitreoretinal surgery are a multifactorial issue that results in catastrophic visual loss and significant financial repercussions.
Purpose: To characterize cases of incorrect intraocular gas mixtures during vitreoretinal surgery to determine trends in their incidence, root causes and impact on physicians and their patients.
Methods: Retrospective consecutive case series study of errors during vitreoretinal surgery. Twelve patients and twelves eyes were identified by the Ophthalmic Mutual Insurance Company from closed case files, with a final resolution reached either by withdrawal, settlement or adjudication. Snellen visual acuities were converted to logMAR units for analysis. CF, HM, LP and NLP vision were recorded as 1.9, 2.3, 2.7, and 3.0 logMAR units, respectively.
Results: Of the 12 patients, 5 (41.7%) were male and 7 (58.3%) were female with 5 (41.7%) right eyes and 7 (58.3%) left eyes affected. All surgical cases occurred between 2009 and 2017 with an average total settlement of $462,365 (range: $95,000 – $1,000,000). 6 (50%) cases were of rhegmatogenous retinal detachments, 5 (41.6%) from full thickness macular holes, and 1 (8.3%) from a tractional retinal detachment secondary to proliferative diabetic retinopathy. The average initial VA was 20/70 (range: 20/20 – 20/400) with an average final VA of LP (range: CF – NLP). 8 (66.7%) were related to C3F8 gas and 4 (33.3%) were related to SF6 gas. At least one (8.3%) eye was reported to become phthisical requiring enucleation.
Conclusion: Vitreoretinal specialists face a higher risk of malpractice litigation due to the serious nature of the conditions they treat, which often involve significant risk of visual impairment or blindness. Moreover, the complexity of vitreoretinal surgery generally surpasses that of standard ophthalmic procedures. Incorrect gas mixtures during vitreoretinal surgery can lead to catastrophic consequences for both physicians and their patients, including a significant and often irreversible loss of vision. For these twelve patients, the average final prognosis was light perception vision. Furthermore, these errors come with substantial financial repercussions, with an average indemnity of over $460,000. It is critical to note that these twelve cases only capture those incidents that resulted in indemnity lawsuits, whereas there are likely many other occurrences that were settled without legal action or in the context of near misses.

In the context of intraocular gas mixtures during vitreoretinal surgery, the correct preparation and administration of the gas is a critical step, which does not a specialized standard protocol. The current Universal Protocol as set by the Joint Commission includes verifying the correct procedure, patient and site, marking the procedure site and laterality, as well as a pre-incisional timeout, which again reviews the correct site, patient identity and procedure. There are several factors that can contribute to incorrect gas mixtures. One key issue is the lack of an end-of-case time-out, when the gas is typically injected. This would otherwise serve as a critical safety step to confirm the gas mixture. Fatigue, especially in long or complicated surgeries, can lead to lapses in attention and judgment. Furthermore, both the surgical team and the physician may fail to double-check the gas mixture. It is important to note that the non-uniformity of equipment and standard operating procedures between different operating rooms or institutions may also contribute to inconsistencies. Ultimately, human error remains a fundamental risk, particularly in high-stress environments where multiple factors intersect. All of these elements highlight the importance of rigorous protocols and effective communication to prevent such errors.

To safeguard against incorrect gas mixtures during vitreoretinal surgery, a series of proactive measures can be implemented to minimize risk. First, ensuring that "lights on" protocols are followed—where all necessary checks are done with full attention and clarity—can help prevent oversight. A standardized time-out procedure at the end of the case allows the entire surgical team to confirm key aspects, including the correct gas mixture, before gas instillation. Additionally, clearly documenting the gas mixture percentage and verbally confirming it with the team ensures that everyone is on the same page. Surgeons should also take the responsibility of drawing up the gas themselves or closely supervising the technician or nurse doing so. It is vital to check the gas type, expiration date, and ensure the mixing procedure is accurately followed, all of which should be thoroughly documented. Labeling the syringe clearly provides another layer of assurance. Finally, if any doubt arises at any point in the process, all steps should be repeated to verify the mixture’s accuracy. These protocols are essential to reducing the likelihood of gas-related errors and ensuring optimal outcomes for patients.

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Age	Sex	Date	Amount Paid (USD)	Pre-Op Dx	Procedure	Gas Type	Initial VA	Final VA	Laterality	Phthsical	State
76	M	2009	125,000	Mac-on RRD	23g PPV/EL/GFx	C3F8 15%	20/80	NLP	OD	No	ID
68	F	2009	125,000	Stage 3 MH	PPV/MP/Cryo/GFx	C3F8 20%	20/400	NLP	OS	N/A	FL
66	M	2011	433,376	MAC-ON RRD	SB/PPV/MP/EL/GFX	SF6 25%	20/40	CF	OD	N/A	AZ
59	F	2014	1,000,000	RRD	PnR	C3F8 100% (2cc)	N/A	HM	OD	N/A	VA
65	F	2015	1,000,000	FTMH	PPV/MP/GFx	SF6 25%	20/70	20/300	OD	No	MA
50	M	2016	325,000	Mac-on RRD	PPV/GFx	C3F8 14%	20/20	LP	OD	No	CA
48	F	2013	600,000	PDR w/ VH and TRD	PPV/EL/GFx	SF6 25%	20/30	NLP	OD	Yes	NJ
59	M	2015	95,000	RRD	PPV/MP/EL/GFx	C3F8 12%	20/100	HM	OD	No	KS
58	F	2016	995,000	FTMH	PPV/MP/GFx	SF6 25% (was given 100%)	20/200	NLP	OS	No	PA
69	F	2017	225,000	FTMH	PPV/MP/GFx	C3F8 14% (given 25%)	20/80	HM	OS	No	FL
N/A	F	2017	250,000	FTMH	PPV/MP/GFx	SF6 25% (Was given C3F8 25%)	N/A	NLP	OS	Yes (Enuc)	UT
65	M	2017	375,000	MAC-ON RRD	PPV/EL/Cryo/GFx	C3F8 14%	20/200	NLP	OS	No	FL

Summary of Patient Data

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Retinal Detachment Symposium 1

Lincoff vs Artificial Intelligence: A Reappraisal of Lincoff's Rules for Finding the Retinal Tear

- John Thompson, MD
- Viviana Li

Objective: To compare Lincoff's rules for predicting the location of the tear in eyes with rhegmatogenous retinal detachment to an artificial intelligence algorithm using a new dataset of over 1,000 eyes.

Purpose: To evaluate Lincoff's rules for predicting the location of a tear in eyes with rhegmatogenous retinal detachment (RRD) and comparing the accuracy of artificial intelligence in predicting the location of one or more tears in these eyes.
Methods: The records of 1,055 eyes with primary RRD (phakic or pseudophakic) were evaluated in an IRB approved retrospective case series from a single surgeon. Eyes were excluded for posterior retinal breaks, retinal dialyses, prior vitrectomy, prior laser to tears and pneumatic retinopexy, leaving 1,031 eligible eyes for the AI model. All eyes had careful documentation of the location of one or more retinal tears as well as the extent of the retinal detachment in the preoperative records and operative reports. Lincoff's rules were focused on identifying a single tear while the current study evaluated eyes with 1-3 retinal tears. A random forest artificial intelligence machine learning model (AI model) was trained on 80% of the dataset and 20% was reserved to test the model. Several AI models were tested and the random forest model was best as it combines multiple decision trees to reach a single prediction. The AI model also evaluated additional data including patient age, right or left eye where the location of retinal tears are mirror images (11:00 tear OD same as 1:00 tear OS), lens status and extent of retinal detachment.
Results: The mean age was 57.6 years with 46.1% right eyes and 53.9% left eyes. Eyes were phakic in 61.1%, pseudophakic in 37.9% and aphakic in 0.9 %. There was 1 retinal tear in 50.1%, 2 tears in 27.4% and 3 tears in 11.1%. There were 4 or more tears in 11.2% of eyes ranging from 4 to 15 tears. Eyes with 4 or more tears were excluded from the AI model. The coefficient of correlation squared (R^2) for eyes with one tear was 0.59, with 1 or 2 tears 0.54 and 1-3 tears 0.50. The predictions of the AI model were accurate within 1 clock hour in 70% of eyes with 1 tear, 67% of eyes with 2 tears and 80% of eyes with 3 tears. The AI model agreed with Lincoff's rule 1 in 79.3% of eyes where the tear is located within 1.5 clock hours of the highest border. The AI model agreed with Lincoff's rule 2 in 84.8% where the detachment crosses the 12 o'clock meridian and the break is within 1.5 clock hours of 12 o'clock. The AI model was less accurate at 30% for Lincoff's rule 3 for inferior retinal detachments where the retinal tear is located on the most superior side of the RRD. The AI model was more accurate for Lincoff's rule 4 at 64.5% in eyes with inferior bullous RD indicating a tear above the horizontal meridian.
Conclusion: Artificial intelligence is a powerful tool to identify patterns in datasets and can be used to potentially assist with identifying the locations of retinal tears in eyes with rhegmatogenous retinal detachment. The AI model in this study was more accurate in identifying the location of the retinal tears in eyes with superior RRDs and less accurate for inferior RRDs. The utilization of AI models on larger datasets will allow improved predictions of the location of retinal breaks in eyes with RRD and may eventually surpass the predictions from Lincoff's rules.

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Retinal Detachment Symposium 1

Minimally Invasive Suprachoroidal Buckling Using a Novel Injector: Preclinical Evaluation in Human Cadaver Eyes

- Gareth Mercer, MD, PhD
- Peter Kertes, MD, FRCS(C)
- Kenneth Eng, MD, FRCS(C)
- Yoreh Barak, MD
- Keren Mano Tamir

Objective: To demonstrate pre-clinical proof of concept for performing suprachoroidal buckle surgery using an investigational suprachoroidal space injector.
Purpose: The Everads Injector (Everads Therapy Ltd., Tel Aviv, Israel) utilizes a non-sharp tissue separator which, via tangential blunt dissection, opens a channel to the suprachoroidal space (SCS). This study evaluates the reliability of this novel injector for performing suprachoroidal buckling in human ex vivo eyes and models the relationship between injection volume, injection location, and buckle morphology.
Methods: Fresh whole human eyes were obtained from the Eye Bank of Canada and experiments performed within 4 days of death (standard deviation, SD: 1). 0.1, 0.2 or 0.3mL of sodium hyaluronate 2.3% was injected into the SCS using the injector with its needle tip inserted 6, 10 or 15mm posterior to the limbus. Height, longitudinal basal diameter (LBD) and transverse basal diameter (TBD) of the resulting buckles were measured using B-scan ultrasound. The relationships between these parameters were estimated using linear regression.
Results: 27 eyes were injected (63% phakic). All but one resulted in successful suprachoroidal buckle creation (Fig. 1). One eye, injected 15mm from the limbus, showed subretinal penetration of viscoelastic and was excluded. On average, a 0.1mL injection resulted in a buckle with a heigh of 2.6mm (95% confidence interval, CI: 2.3-2.9), TBD of 9.0mm (95% CI: 8.3-9.7), and LBD of 8.2mm (95% CI: 7.6-8.8). There was a linear relationship between volume of viscoelastic injected and height, TBD and LBD of the SCS buckle (R2 0.70, 0.65 and 0.75, respectively; Fig. 2). Within the range of values tested, a 0.1mL increase in volume was associated with a height increase of 0.9mm (95% CI: 0.6-1.1), TBD increase of 1.8mm (95% CI: 1.3-2.4), and LBD increase of 2.0mm (95% CI: 1.5-2.5). Needle insertion distance did not significantly influence buckle height or diameter.
Conclusion: We demonstrated successful pre-clinical proof of concept for performing suprachoroidal buckling using the Everads Injector and provide a model of expected buckle dimensions across a range of clinically relevant injection volumes. Further research is needed to determine whether injection sites near the equator of the globe have higher risk of subretinal viscoelastic injection.

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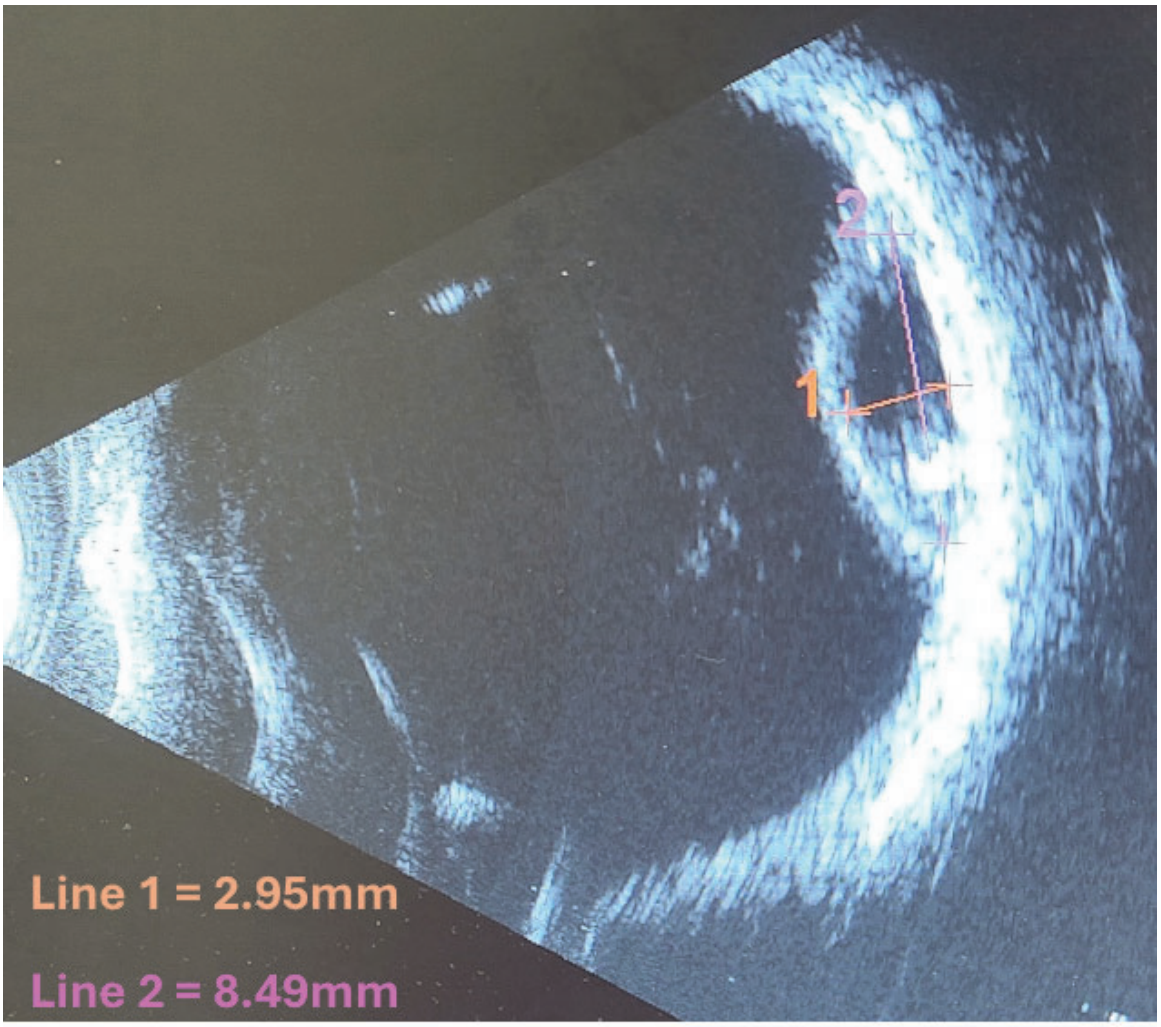
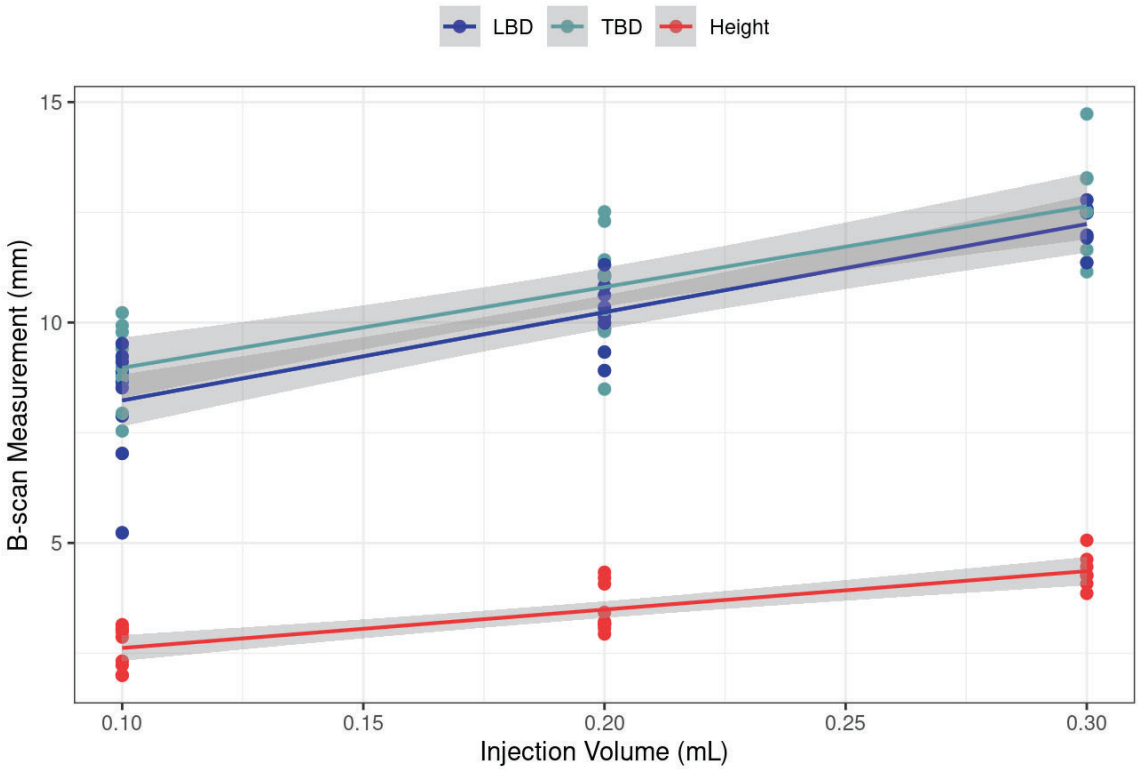


B-scan measurements of representative 0.1mL SCS viscoelastic buckle.



Relationship between injection volume and SCS buckle height, TBD and LBD.

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Retinal Detachment Symposium 1

Preoperative OCT Biomarkers of Outer Retinal Alterations in Rhegmatogenous Retinal Detachment: Predictors of Postoperative Visual Outcomes

- Eoi Jong Seo, MD, PhD

Objective: To evaluate the relationship between preoperative OCT indicators of outer retinal damage and subsequent postoperative visual acuity in eyes with acute rhegmatogenous retinal detachment.
Purpose: To identify preoperative optical coherence tomography (OCT) biomarkers indicative of outer retinal alterations in rhegmatogenous retinal detachment (RRD) and to assess their prognostic impact on postoperative best-corrected visual acuity (BCVA).

Methods: A retrospective analysis was performed according to the following inclusion criteria: acute macula-off RRD with a detachment duration of less than 2 weeks, availability of a preoperative macular OCT scan, and a follow-up period of at least 6 months. These strict criteria were designed to capture outer retinal alterations that occur specifically in the acute phase of RRD. Patients were excluded if they had macula-on RRD, chronic RRD, proliferative vitreoretinopathy grade C or higher, secondary RRD due to other retinal pathologies (e.g., macular hole, endophthalmitis, or acute retinal necrosis), exudative or tractional detachment, or if the initial surgery failed to achieve reattachment. Preoperative OCT parameters representing outer retinal alterations were measured, including the corrugation index (CI), defined as the ratio of the outer retinal border length to the inner plexiform layer length, corrugation thickness (CT), defined as the maximal outer retinal thickness in areas of corrugation, macular area (MA) measured within 3000 μm of the foveal center, and intraretinal cyst (IRC) area quantified over the same 3000 μm region. In addition, preoperative foveal outer nuclear layer thickness, ellipsoid zone (EZ) thickness, and subfoveal choroidal thickness were also evaluated. Finally, the relationships between these parameters and postoperative BCVA were analyzed.

Results: A total of 152 eyes from 152 patients were included, with a mean detachment duration of 6.9 ± 4.9 days. Best-corrected visual acuity (logMAR) improved from 0.95 ± 0.61 preoperatively to 0.33 ± 0.35 after surgery, and the mean detachment area was 1.8 ± 0.5 quadrants. Thirty-two eyes (21.1%) underwent scleral buckling, 114 eyes (75.0%) underwent pars plana vitrectomy, and 6 eyes (3.9%) underwent combined procedures. The CI showed strong positive correlations with other OCT parameters representing outer retinal alterations such as CT, MA, and IRC area (correlation coefficients 0.684, 0.724, and 0.754, respectively; all $p < 0.001$). Multivariate analysis revealed that a larger preoperative detachment area ($p < 0.001$), higher CI ($p < 0.001$), and greater EZ thickness ($p = 0.001$) were predictive of worse postoperative BCVA after successful reattachment. Furthermore, eyes that developed epiretinal membrane (ERM) or cystoid macular edema (CME) postoperatively ($n = 60$) had significantly higher CI (as well as higher CT, MA, and IRC area) compared to those without ERM/CME ($n = 112$, $p < 0.001$).

Conclusion: Eyes exhibiting severe outer retinal alterations—namely outer retinal edema, intraretinal cysts, and pronounced outer retinal corrugation in the macular area during the acute phase (less than 2 weeks) of RRD—tended to have poorer postoperative BCVA than eyes without such alterations. These findings, along with a larger detachment area and greater EZ thickness, were also associated with a higher incidence of ERM/CME, suggesting that such outer retinal alterations may indicate photoreceptor damage and retinal remodeling.

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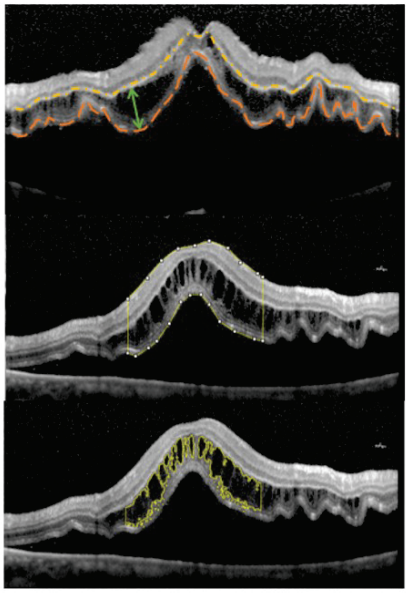
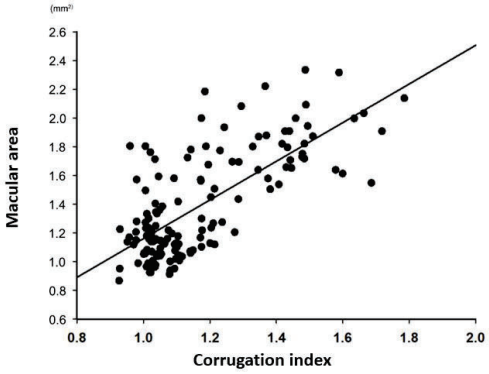
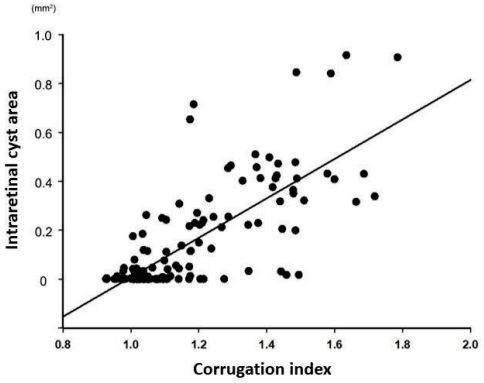
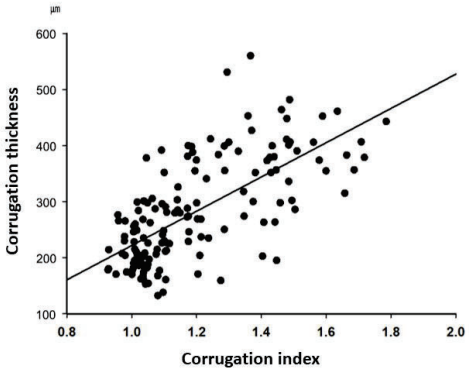


1. **Corrugation index (CI) =** $\dfrac{\text{Length of outer retinal border}}{\text{Length of IPL}}$
2. **Maximum outer retinal thickness (Corrugation thickness, CT)**
3. **Macular area (MA) at center 3000 µm**
4. **Intraretinal cyst (IRC) area at center 3000 µm**

Preoperative OCT parameter measures of outer retinal alterations







	CI	MA	IRC	CT
CI	1	0.724 ***	0.754 ***	0.684 ***
MA		1	0.784 ***	0.849 ***
IRC			1	0.814 ***
CT				1

Pearson correlation coefficient
*** p<0.001

The strong positive correlation of corrugation index to other OCT markers

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Retinal Detachment Symposium 1

Evaluation of Macular Perfusion Post Rhegmatogenous Retinal Detachment Surgery Using Optical Coherence Tomography Angiography: A Systematic Review and Meta-Analysis

- Muhammad Amer Awan, MD, FRCSEd, FRCOphth, FRCS Glasgow, FACS, FASRS
- Abdullah Ahmed, MBBS
- Fiza Shaheen, MBBS, FCPS

Objective: To evaluate the impact of rhegmatogenous retinal detachment (RRD) repair on macular perfusion parameters using optical coherence tomography angiography (OCTA) and to assess its relationship with visual outcomes through a systematic review and meta-analysis.
Purpose: Rhegmatogenous retinal detachment (RRD) is the most prevalent form of retinal detachment, posing a significant risk of visual impairment if untreated. While surgical interventions effectively reattach the retina, the impact on macular perfusion and visual outcomes remains unclear.
Methods: A comprehensive search of PubMed, Scopus, ScienceDirect, and Cochrane databases was conducted for studies published through April 10, 2023. Studies comparing OCTA parameters between RRD eyes post-repair and control eyes were included. The analysis included foveal avascular zone (FAZ) area, foveal vascular density (FVD), parafoveal vascular density (PFVD), perfusion density in choriocapillaris (CC) and best-corrected visual acuity (BCVA). Data were analyzed separately for macula-ON and macula-OFF groups using a random-effects model.

Results: Nineteen studies comprising 642 RRD eyes (231 macula-ON, 411 macula-OFF) and 642 control eyes were analyzed. In the macula-OFF group, FAZ area remained significantly enlarged post-repair in both superficial capillary plexus (SCP) (0.07 mm^2, 95% CI: 0.03-0.11) and deep capillary plexus (DCP) (0.14 mm^2, 95% CI: 0.05-0.22). No significant changes were observed in FVD for either group. PFVD showed reduction in DCP (-1.82%, 95% CI: -3.48 to -0.15) for the macula-ON group after sensitivity analysis. CC perfusion density showed no significant changes post-repair. Postoperative BCVA demonstrated significant improvement in the macula-OFF group (-0.79 logMAR, 95% CI: -1.27 to -0.30) and modest improvement in the macula-ON group after sensitivity analysis (-0.07 logMAR, 95% CI: -0.12 to -0.01).
Conclusion: Despite successful anatomical repair of RRD, persistent alterations in macular perfusion parameters were observed, particularly in the macula-OFF group. The enlarged FAZ area and reduced PFVD suggest lasting changes in the retinal microvasculature post-repair. However, significant improvement in BCVA, especially in macula-OFF cases, indicates that functional recovery may occur despite these vascular changes. These findings enhance our understanding of the complex relationship between macular perfusion and visual outcomes following RRD repair. They also highlight the need for comprehensive assessment beyond isolated perfusion metrics when evaluating surgical success in RRD repair.

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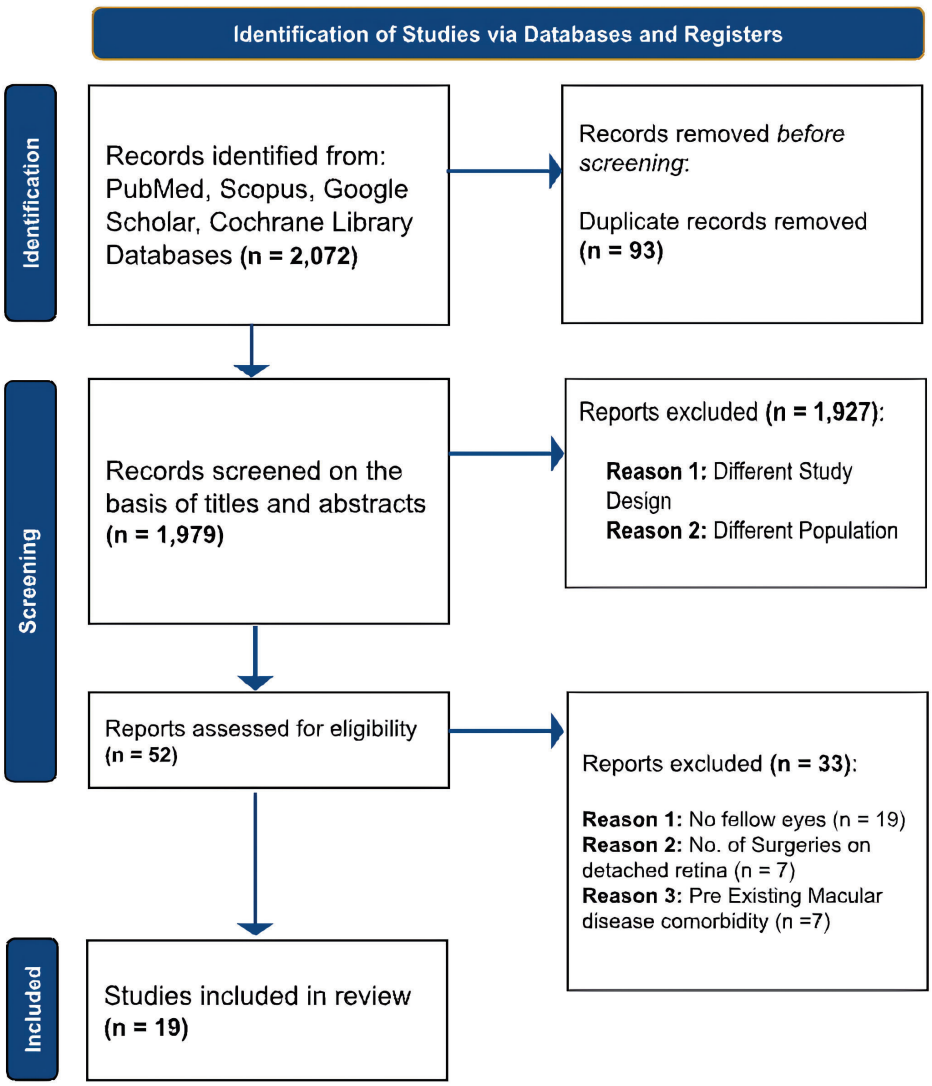

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