KASTAMONU MEDICAL JOURNAL

Original Article

DOI: 10.51271/KMJ-0187

Kastamonu Med J. 2025;5(1):70-75

Outcomes of 25-gauge pars plana vitrectomy using silicone oil versus C3F8 gas tamponades in rhegmatogenous retinal detachment

Zübeyir Yozgat

Department of Ophthalmology, Faculty of Medicine, Kastamonu University, Kastamonu, Turkiye

Cite this article as: Yozgat Z. Outcomes of 25-gauge pars plana vitrectomy using silicone oil versus C3F8 gas tamponades in rhegmatogenous retinal detachment. *Kastamonu Med J.* 2025;5(1):70-75.

Received: 17.01.2025 ◆ **Accepted:** 14.02.2025 ◆ **Published:** 04.03.2025

ABSTRACT

Aims: To compare the visual and anatomical outcomes, intraocular pressure (IOP) changes, and complications of 25-gauge pars plana vitrectomy (PPV) using silicone oil (SO) versus perfluoropropane (C3F8) gas tamponade in the management of rhegmatogenous retinal detachment (RRD).

Methods: This retrospective study analyzed 43 eyes of 43 patients treated with 25-gauge PPV for RRD. Patients were divided into two groups: group 1 (SO, n=25) and group 2 (C3F8 gas, n=18). Visual acuity, IOP, and postoperative complications were evaluated over a 52-week follow-up period. Statistical comparisons were conducted using the SPSS software, and a significance level of $p<0.05$.

Results: Both groups demonstrated significant improvements in best-corrected visual acuity (BCVA) at the 52nd week. Mean BCVA improved from 2.23±0.89 logMAR to 0.30±0.21 logMAR in the SO group and from 2.07±0.87 logMAR to 0.19±0.05 logMAR in the C3F8 group. Recurrent retinal detachment was observed in 8% of SO cases and 16.7% of C3F8 cases, with successful reattachment achieved in all reoperations. IOP increased mildly in the SO group but decreased significantly in the C3F8 group. Anti-glaucomatous therapy was initiated in 16% of patients in the SO group and 16.7% in the C3F8 group.

Conclusion: Both SO and C3F8 gas tamponades are effective in achieving visual and anatomical success following 25-gauge PPV for RRD. C3F8 gas demonstrated better IOP stabilization, whereas SO was effective for more complex cases. These findings support the tailored use of tamponades based on individual patient and disease characteristics.

Keywords: 25-gauge vitrectomy, rhegmatogenous retinal detachment, silicone oil, C3F8 gas, visual outcomes, intraocular pressure

INTRODUCTION

Rhegmatogenous retinal detachment (RRD) is a sight-threatening condition that requires prompt surgical intervention to restore and preserve vision.[1] Pars plana vitrectomy (PPV) is a widely adopted surgical technique for treating RRD, and advances in minimally invasive surgical technology have made 25-gauge vitrectomy an increasingly popular choice due to its smaller sclerotomy size, reduced postoperative inflammation, and faster recovery times.[2,3]

The advent of minimally invasive vitreous surgery (MIVS) has revolutionized the approach to retinal surgeries, with 25-gauge vitrectomy gaining significant popularity due to its less invasive nature and favorable outcomes compared to earlier gauges like 20- and 23-gauge systems. Studies have demonstrated that this technique not only improves surgical efficiency but also minimizes complications, such as suture-related issues and postoperative discomfort, which were more common with larger gauge instruments.[4,5] Advancements in surgical equipment have significantly improved its stability and precision, solidifying its position as a standard in modern vitreoretinal surgery.[6,7] As this study aims to evaluate outcomes associated with 25-gauge vitrectomy, it aligns with the growing trend in retinal surgery toward adopting smaller gauge systems that ensure optimal patient care and surgical success.

The choice of endotamponade, whether silicone oil or intraocular gases like perfluoropropane (C3F8), is critical in achieving successful surgical outcomes. Silicone oil provides long-term retinal tamponade and is often preferred for complex cases, including those with inferior breaks or proliferative vitreoretinopathy (PVR).[8] However, it requires a secondary procedure for removal and may carry risks such as emulsification and increased intraocular pressure (IOP).[9,10] On the other hand, C3F8 gas offers a self-resorbing alternative that eliminates the need for additional surgery, although it

Corresponding Author: Zübeyir Yozgat, zubeyiryozgat@gmail.com

may impose strict postoperative positioning requirements and is contraindicated in certain patient populations.[11,12]

Recent studies have aimed to compare the efficacy of these tamponade agents in various clinical settings, with a particular focus on visual acuity outcomes, retinal reattachment rates, and complications. For instance, Özal et al.[12] analyzed macular displacement and endotamponade variations in RRD repair, emphasizing the nuanced impacts of these agents on surgical results and recovery dynamics.

This study aims to contribute to the growing body of evidence by comparing the one-year outcomes of 25-gauge vitrectomy with silicone oil and C3F8 gas tamponade in patients treated for RRD. By analyzing visual acuity, IOP changes, and complication rates, this study aims to provide insights into the optimal choice of endotamponade for achieving favorable surgical outcomes.

METHODS

Ethics

The study adhered to the tenets of the Declaration of Helsinki and received approval from the Kastamonu University Clinical Researches Ethics Committee (Date: 10.12.2024, Decision No: 2024-KAEK-137).

Study Design and Patients

This study included patients who presented to the ophthalmology outpatient clinic with RRD. All patients underwent a comprehensive preoperative ophthalmological examination, which included best-corrected visual acuity (BCVA, logMAR) assessment, IOP measurement, and anterior and posterior segment evaluation through slit-lamp biomicroscopy.

For the identification of retinal breaks and detailed posterior segment evaluation, a thorough peripheral retinal examination was performed using a Goldmann three-mirror lens. After the initial evaluation, all patients were treated with 25-gauge PPV, which was performed as the surgical intervention for RRD.

Inclusion and Exclusion Criteria

This study included patients diagnosed with RRD requiring surgical intervention. Inclusion criteria were as follows: patients aged 18 years or older, those with retinal breaks confirmed via a detailed peripheral retinal examination using a Goldmann three-mirror lens, and patients treated with 25-gauge PPV as the primary surgical intervention. Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Patients with non-rhegmatogenous retinal detachments, such as exudative or tractional retinal detachments, were excluded. Other exclusion criteria included a history of previous ocular surgeries other than uncomplicated phacoemulsification, significant corneal or lens opacities that interfered with adequate visualization of the retina or posterior segment evaluation, and any ocular or systemic conditions that could compromise postoperative outcomes or imaging quality.

Surgical Procedures

All surgeries were performed by a single experienced retinal surgeon (Dr. Zübeyir Yozgat). Patients who were phakic underwent combined phacoemulsification and PPV during the same surgical session. For combined procedures, trocars were inserted first, followed by the phacoemulsification procedure. All surgeries were performed under general anesthesia, and all patients had at least one year of archival follow-up records.

Phacoemulsification Procedure

Phacoemulsification surgery was initiated by creating side ports in the upper and lower corneal quadrants using a 20-gauge MVR blade. A dispersive viscoelastic (Sodium hyaluronate, Protectalon 3%, VSY Biotechnology, Istanbul, Turkey) was injected into the anterior chamber, and a 2.4 mm clear corneal incision was made in the temporal quadrant using a keratome knife. A round capsulorrhexis with a diameter of 5 mm was performed with capsulorrhexis forceps. Hydrodissection was achieved by injecting a balanced salt solution under the capsule using a hydrodissection needle, and the nucleus was rotated. The nucleus was then divided using the Direct Chop method and emulsified with a PHACO handpiece (DORC, Zuidland, the Netherlands). Cortical remnants were removed using bimanual irrigation and aspiration cannulas. A foldable monoblock hydrophobic intraocular lens (Sensar, Johnson & Johnson Surgical Vision, Santa Ana, CA, USA) was implanted in the capsular bag. The anterior chamber was created by hydrating the side ports with a balanced salt solution.

25-Gauge PPV Procedure

All patients underwent a 3-port, 25-gauge PPV technique, utilizing a non-contact wide-angle viewing system (EIBOS2, Haag-Streit Surgical, Germany) in conjunction with a vitrectomy platform (EVA, D.O.R.C. International, Zuidland, Netherlands). The operated eye was prepared with an ophthalmic drape, and a lid speculum was placed. The eye was treated with 5% povidone-iodine for two minutes, followed by irrigation. Transconjunctival 25-gauge ports were inserted at the 10, 2, and 7.5 o'clock positions. An infusion cannula was secured in the 7.5 o'clock position, and the superior ports were used for the endoilluminator and vitreous cutter. All 25-gauge trocars were inserted in a beveled 2-step manner with a first partial insertion at an oblique angle of 15° to 20° tangential to the scleral surface followed by entry into the vitreous cavity at an angle of 30° to 40°. Careful and meticulous removal of the posterior hyaloid was done. Preservative-free triamcinolone acetonide (40 mg/ml) was used to stain the posterior hyaloid when required. All retinal breaks and related abnormalities were identified, and each one was marked with endodiathermy. PVR membranes or retinal bands, if present, were stained with membrane blue (brilliant blue G+trypan blue; DORC, Zuidland, the Netherlands) dye and removed using vitreoretinal forceps. Perfluorocarbon liquid (PFCL) was applied to stabilize the posterior pole up to the level of the retinal tears. PFCL was used selectively to stabilize the posterior pole and facilitate retinal reattachment before the fluid-air exchange. It was applied gradually using a soft-tip cannula until the retinal breaks were flattened, ensuring minimal subretinal migration. Peripheral vitreous shaving was performed under bimanual indentation using the vitrectomy system's shaving mode to ensure complete vitreous base cleaning. Retinal folds were flattened and relaxed. Fluid-air exchange was done to aspirate the subretinal fluid through a preexisting break or posterior drainage retinotomy. Laser photocoagulation was applied around the breaks. After laser photocoagulation, the PFCL was meticulously removed

before the endotamponade was introduced. The choice of endotamponade was based on retinal detachment complexity and the presence of PVR. Silicone oil (5000 cSt) was used in cases with inferior retinal breaks, high PVR risk, or recurrent detachments. It was injected slowly through a 25-gauge cannula after complete fluid-air exchange. Patients receiving silicone oil were scheduled for a secondary procedure for oil removal. For cases with superior breaks and no significant PVR, 14% perfluoropropane (C3F8) gas was used as a tamponade. The gas-air exchange was carefully performed to ensure the complete filling of the vitreous cavity, allowing gradual self-resorption over 6-8 weeks. The transconjunctival ports were removed, and subconjunctival injections of gentamicin and dexamethasone were administered. The eye was treated again with 5% povidone-iodine for two minutes, irrigated, and the procedure was concluded by removing the lid speculum and drape.

Postoperative Care and Follow-up

Postoperative follow-up included routine evaluations on postoperative day 1, week 1, and month 1, followed by monthly visits thereafter. During each follow-up, patients underwent comprehensive ophthalmological examinations, including BCVA, IOP measurement using Goldmann applanation tonometry, and detailed slit-lamp biomicroscopy of the anterior and posterior segments.

Patients were instructed on appropriate postoperative positioning, such as prone positioning, when necessary. Standard postoperative regimens, including topical antibiotics and anti-inflammatory medications, were applied for one month and tapered gradually. Anti-glaucoma treatment was initiated in cases where elevated IOP was observed and deemed clinically significant.

Data from follow-ups at postoperative months 1, 3, 6, and 12 were recorded for analysis. These data included BCVA, IOP, and any documented complications.

Statistical Analysis

Data were analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were presented as mean±standard deviation (SD) or median [interquartile range (IQR)], depending on the data distribution, while categorical variables were summarized as frequencies and percentages. The normality of the data was assessed using the Shapiro-Wilk test. Comparisons between the two groups (e.g., silicone oil versus C3F8 gas) were performed using independent T tests or Mann-Whitney U tests for continuous variables, based on the data distribution, and chi-square or Fisher's exact tests for categorical variables. Longitudinal changes in continuous variables, such as BCVA and IOP, were analyzed using repeated-measures ANOVA or Friedman tests. Post-hoc pairwise comparisons were conducted using paired t-tests or Wilcoxon signed-rank tests with Bonferroni correction for multiple comparisons. A p-value <0.05 was considered statistically significant for all analyses.

RESULTS

Baseline Characteristics

The study included 43 eyes of 43 patients, divided into group 1 (silicone tamponade, n=25) and group 2 (C3F8 gas tamponade, n=18). Baseline demographic and ocular characteristics are summarized in **Table 1**. The mean age was 60.9±12.4 years in group 1 and 68±9.5 years in group 2, with a statistically significant difference (p=0.048). Gender distribution was similar between the groups, with 24% females in group 1 and 27.8% females in group 2 (p=0.779).

Table 1. Baseline patient demographics and ocular characteristics

Characteristics	Group 1 (n: 25)	Group 2 (n: 18)	p-value
Mean age±SD, years (median, IQR 25-75)	60.9±12.4 (65, 54-69)	68±9.5 (71, 63-76)	0.048[a]
Gender, n (%)			0.779[b]
Female	6 (24)	5 (27.8)	
Male	19 (76)	13 (72.2)	
Lens status, n (%)			0.707[b]
Phakic	18 (72)	12 (66.7)	
Pseudophakic	7 (28)	6 (33.3)	
Macula status, n (%)			
Macula on	7 (28)	6 (33.3)	0.707[b]
Macula off	18 (72)	12 (66.7)	
Mean BCVA±SD (logMAR) (median, IQR 25-75)	2.2±0.89 (1.8, 1.4-3.1)	2.07±0.87 (1.8, 1.3-3.1)	0.492[a]
IOP±SD mmHG (median, IQR 25-75)	14.4±2.9 (15, 12-16.5)	16.1±1.1 (16, 15-16.25)	0.054[a]

SD: Standard deviation, BCVA: Best-corrected visual acuity, IOP: Intraocular pressure, mean±standard deviation results were given in table (additionally, median, 25 and 75 percentiles were given in parenthesis for nonparametric test results), p<0.05 was considered statistically significant in 95% confidence interval (comparisons between group 1 and group 2), Mann-Whitney U test, chi-squared test

Lens status was predominantly phakic in both groups, with 72% in group 1 and 66.7% in group 2 (p=0.707). Macular status at presentation showed that 28% of eyes in Group 1 and 33.3% in group 2 had macula-on detachments, while the remaining cases were macula-off (p=0.707).

Baseline best-corrected visual acuity (BCVA) was 2.2±0.89 logMAR in group 1 and 2.07±0.87 logMAR in group 2, with no significant difference between the groups (p=0.492). Similarly, baseline intraocular pressure (IOP) was 14.4±2.9 mmHg in group 1 and 16.1±1.1 mmHg in group 2, showing no significant difference (p=0.054).

There were no statistically significant differences in other baseline ocular parameters between the two groups.

Visual Function

The BCVA improved significantly in both groups over the follow-up period. At baseline, the mean BCVA in group 1 (silicone tamponade) was 2.23±0.89 logMAR, which improved to 0.30±0.21 logMAR at the 52nd week (p<0.001). Similarly, in group 2 (C3F8 gas tamponade), the mean BCVA improved from 2.07±0.97 logMAR at baseline to 0.19±0.05 logMAR at the 52nd week (p<0.001).

The improvement in BCVA was evident at the 4th week, where group 1 had a mean BCVA of 0.82±0.36 logMAR, and group 2 had a mean BCVA of 0.53±0.37 logMAR. This trend continued through the 24th week, with group 1 achieving 0.41±0.20 logMAR and group 2 achieving 0.22±0.07 logMAR.

Both groups showed significant improvements in BCVA over time. The mean improvement in BCVA from baseline to the 4th, 24th, and 52nd weeks was observed to be 1.41±0.80 logMAR, 1.82±0.92 logMAR, and 1.93±0.97 logMAR, respectively, in the silicone tamponade group. Similarly, in the C3F8 gas

tamponade group, the mean improvement was 1.54±0.84 logMAR, 1.85±0.89 logMAR, and 1.89±0.88 logMAR, respectively.

The improvement in BCVA between the two groups was comparable at all time points. At the 4th week, 24th week, and 52nd week, the changes in BCVA from baseline (ΔBCVA) showed no statistically significant differences between the two groups (p=0.622, p=0.553, and p=0.674, respectively).

These findings indicate that both silicone and C3F8 gas tamponades were equally effective in improving visual acuity following RRD surgery. Neither tamponade demonstrated a clear advantage in visual recovery during the 52-week follow-up period, suggesting comparable efficacy in terms of visual function improvement. Detailed information is presented in Table 2 and Figure.

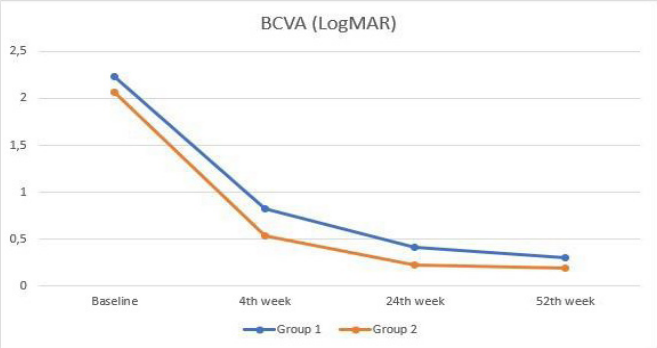

Figure. Best-corrected visual acuity changes over the study period

Intraocular Pressure

Both groups demonstrated significant changes in intraocular pressure (IOP) over time compared to baseline. In the silicone tamponade group, the mean IOP was 14.4±2.9 mmHg at baseline, which increased to 15.8±2.8 mmHg at the 4th week (p=0.035), 16.7±3.1 mmHg at the 24th week (p=0.002), and 16.2±2.9 mmHg at the 52nd week (p=0.024). In the C3F8 gas tamponade group, the mean IOP was 16.1±1.1 mmHg at baseline, which increased to 19.4±7.1 mmHg at the 4th week (p=0.047), remained at 16.7±4.9 mmHg at the 24th week (p=0.373), and decreased to 14.3±1.4 mmHg at the 52nd week (p=0.001).

When comparing changes in IOP from baseline between the two groups, the following results were observed:

4th week: The mean change in IOP from baseline was 1.40±2.91 mmHg in the silicone tamponade group and 3.33±6.95 mmHg in the C3F8 gas group, with no statistically significant difference between the groups (p=0.266).

24th week: The mean IOP change was 2.32±3.18 mmHg in the silicone tamponade group and 0.61±5.11 mmHg in the C3F8 gas group, showing a statistically significant difference (p=0.007).

52nd week: The mean IOP change was 1.76±3.04 mmHg in the silicone tamponade group and -1.72±1.99 mmHg in the C3F8 gas group, indicating a highly significant difference (p<0.001).

These findings suggest that while both groups experienced significant changes in IOP compared to baseline, their patterns of change differed. The silicone tamponade group demonstrated a gradual increase in IOP over time, whereas the C3F8 gas tamponade group initially showed an increase in IOP at the 4th week, followed by a significant reduction by the 52nd week.

Detailed information is presented in Table 2.

Complications and Surgical Success

In this study, recurrent retinal detachment was observed during follow-up in 2 patients (8%) from group 1 (silicone tamponade) and in 3 patients (16.7%) from group 2 (C3F8 gas tamponade). These patients underwent repeat surgery using the same surgical procedure, and anatomical success was achieved in all cases following reoperation.

During follow-up, anti-glaucomatous therapy was initiated in 4 patients (16%) in the silicone tamponade group and in 3 patients (16.7%) in the C3F8 gas tamponade group due to elevated intraocular pressure.

Table 2. Changes in best-corrected visual acuity and intraocular pressure within groups separately during the study

	Group 1 (n: 25)				Group 2 (n: 18)			
BCVA (logMAR)	Mean±SD (Median, IQR 25-75)	95% CI of mean, lower/upper	p-value	95% CI of the difference, lower/upper	Mean±SD (Median, IQR 25-75)	95% CI of mean, lower/upper	p-value	95% CI of the difference, lower/upper
Baseline	2.23±0.89 (1.8, 1.4-3.1)	1.86/2.60			2.07±0.97 (1.8, 1.3-3.1)	1.63/2.50		
4th week	0.82±0.36 (0.70, 0.70-0.90)	0.67/0.97	<0.001 [a]	1.08/1.74	0.53±0.37 (0.45, 0.30-0.52)	0.34/0.71	<0.001 [a]	1.13/1.97
24th week	0.41±0.2 (0.40, 0.20-0.55)	0.33/0.49	<0.001 [a]	1.44/2.20	0.22±0.07 (0.20, 0.15-0.30)	0.18/0.26	<0.001 [a]	1.40/2.3
52th week	0.30±0.21 (0.15, 0.15-0.45)	0.21/0.39	<0.001 [a]	1.52/2.33	0.19±0.05 (0.20, 0.15-0.20)	0.16/0.21	<0.001 [a]	1.45/2.33
IOP, mmHG								
Baseline	14.4±2.9 (15, 12-16.5)	13.2/15.6			16.1±1.1 (16, 15-16.25)	15.5/16.6		
4th week	15.8±2.8 (15, 13.5-19)	14.6/16.9	0.035 [a]	-2.6/-0.2	19.4±7.1 (18, 15-23.25)	15.8/22.9	0.047 [a]	-6.8/0.12
24th week	16.7±3.1 (17, 14.5-19.5)	15.4/18	0.002 [a]	-3.6/-1	16.7±4.9 (15, 14-16)	14.2/19.1	0.373 [a]	-3.2/1.9
52th week	16.2±2.9 (16, 15-18.5)	14.9/17.4	0.024 [a]	-3/-0.5	14.3±1.4 (15, 13.5-15)	13.6/15	0.001 [a]	0.7/2.7

SD: Standard deviation, BCVA: Best-corrected visual acuity, IOP: Intraocular pressure, CI: Confidence interval, mean±standard deviation results were given in table (additionally, median, 25 and 75 percentiles were given in parenthesis for nonparametric test results), p<0.05 was considered statistically significant in 95% confidence interval (comparisons between baseline and other visits), Wilcoxon signed ranks test

Overall, anatomical surgical success was achieved in all patients, demonstrating the effectiveness of both tamponade agents in maintaining retinal reattachment after primary and secondary procedures.

DISCUSSION

Our study highlights the outcomes of 25-gauge PPV for RRD, comparing two endotamponades-silicone oil (SO) and perfluoropropane (C3F8) gas. Both tamponades achieved comparable surgical success, with no statistically significant differences in final BCVA or complication rates, although notable differences in IOP changes and tamponade-specific management nuances were observed.

Both tamponade groups demonstrated significant improvements in BCVA over the follow-up period. By the 52nd week, mean BCVA improvement was 1.93±0.97 logMAR in the silicone group and 1.89±0.88 logMAR in the gas group (p=0.674). These findings align with prior studies reporting no significant differences in BCVA outcomes between silicone oil and C3F8 gas tamponades. For example, Dell'Omo et al.[10] observed comparable visual acuity improvements with both tamponades, emphasizing that the choice of tamponade is more dependent on the complexity of the detachment rather than visual outcomes. Similarly, the silicone study report 2 demonstrated similar visual outcomes between SO and gas tamponades, emphasizing that the choice of tamponade does not significantly influence final visual recovery in most cases of RRD[13] Furthermore, Lee et al.[14] reported no significant differences in BCVA outcomes when comparing retinal layer segmentation after SO and gas tamponades for macula-on RRD, supporting the findings of our study.

In current study, baseline mean BCVA in the silicone group was 2.23±0.89 logMAR, improving to 0.30±0.21 logMAR by the 52nd week. Similarly, in the gas group, baseline mean BCVA was 2.07±0.87 logMAR, improving to 0.19±0.05 logMAR by the same time point. These results further corroborate findings from prior studies, such as those reported by the silicone study report 3, which highlighted comparable BCVA improvements between the two tamponades in RRD cases.[15] These findings suggest that both tamponades are equally effective in visual recovery. The slightly better visual outcomes observed in the gas tamponade group, although not statistically significant, may reflect the surgeon's preference for using gas tamponade in cases with superior breaks and less complex detachments, which may influence visual recovery outcomes.

When comparing surgical gauges, 25-gauge PPV has consistently been shown to be as effective as 23-gauge PPV in achieving visual recovery, while offering additional benefits such as reduced postoperative inflammation, faster recovery times, and improved patient comfort. In a study by Nam et al.,[5] 25-gauge PPV resulted in a mean BCVA improvement of 1.2±0.8 logMAR over a 12-month follow-up, comparable to the 1.1±0.7 logMAR improvement observed with 23-gauge PPV, demonstrating no significant difference in visual outcomes between the two gauges (p>0.05). Similarly, Nagpal et al.[7] reported that 25-gauge PPV achieved mean BCVA gains of 1.5±0.9 logMAR compared to 1.4±0.8 logMAR with 23-gauge systems, highlighting the equivalence in visual recovery. More recently, Saleh et al.[6] compared 25-gauge and 23-gauge systems in the context of macula-on and macula-off RRDs and found that both gauges resulted in significant visual improvements, with mean BCVA gains of 1.8±0.7 logMAR for 25-gauge and 1.7±0.8 logMAR for 23-gauge (p=0.34). These studies reinforce the suitability of 25-gauge vitrectomy, particularly in cases where minimal surgical trauma and faster postoperative recovery are desirable. In our study, patients undergoing 25-gauge PPV for RRD achieved substantial visual improvements, with mean BCVA improving from 2.23±0.89 logMAR at baseline to 0.30±0.21 logMAR at the 52nd week in the silicone group, and from 2.07±0.87 logMAR to 0.19±0.05 logMAR in the gas group. These results align closely with the findings of prior studies, confirming that 25-gauge PPV provides excellent visual recovery outcomes in both macula-on and macula-off cases, while maintaining the benefits of a minimally invasive approach.

IOP changes over time revealed notable differences between the two tamponade groups. While both groups exhibited significant changes in IOP from baseline, the C3F8 gas group demonstrated a significant decrease by the 52nd week (-1.72±1.99 mmHg, p=0.001). In contrast, the silicone oil group exhibited a mild increase in IOP (1.76±3.04 mmHg, p=0.024). This trend mirrors findings in previous studies, where SO tamponade was associated with a higher incidence of elevated IOP due to its physical properties and longer duration in the eye.[16,17] Gauge-specific studies also emphasize the impact of surgical technique on IOP outcomes. Saleh et al.[6] and Schoenberger et al.[9] reported that smaller gauge systems, such as 25-gauge PPV, reduce postoperative complications like hypotony and IOP spikes compared to larger gauge systems.

Recurrent retinal detachment was observed in 8% of cases in the silicone group and 16.7% in the gas group, necessitating reoperation. These rates align with findings from prior studies. Wen et al.[18] reported similar recurrence rates, showing slightly higher detachment rates in gas tamponade cases compared to silicone oil (10% vs. 15%, respectively). Another study by Syeda et al.[19] highlighted similar trends, where silicone oil demonstrated lower recurrence rates in cases of complex retinal detachment compared to gas tamponades. In terms of complications, anti-glaucomatous therapy was required in 16% of patients in the silicone group and 16.7% in the gas group. Elevated IOP was more commonly associated with silicone oil tamponade, likely due to its longer intraocular duration and physical properties. Wen et al. further supported this, reporting a significantly higher incidence of IOP elevation in the silicone oil group compared to C3F8 gas (18% vs. 12%). These findings confirm that while both tamponades are effective for retinal reattachment, the choice of tamponade should be tailored to individual patient needs, considering factors such as the complexity of detachment, recurrence risk, and IOP-related complications.

Limitations

This study provides robust data on the outcomes of 25-gauge vitrectomy with different tamponades; however, it is limited by its retrospective design and relatively small sample size. Future research with larger, multicenter cohorts is needed to validate these findings and further explore the impact of surgical technique and tamponade choice on long-term functional outcomes.

CONCLUSION

Both silicone oil and C3F8 gas tamponades are effective in the management of RRD, with comparable visual outcomes

and high anatomical success rates. The choice of tamponade should be guided by patient-specific factors, including the location of retinal breaks, postoperative positioning feasibility, and risk of IOP-related complications. Additionally, 25-gauge PPV offers significant advantages over larger gauges in terms of reduced surgical trauma and faster recovery, making it an ideal choice for modern vitreoretinal surgery.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Kastamonu University Clinical Researches Ethics Committee (Date: 10.12.2024, Decision No: 2024-KAEK-137).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

Acknowledgements

I would like to extend my sincere gratitude to Dr. Gizem İlayda Dumlupınar, Dr. Mehmet Güner, and Dr. Halime Kübra Şahin, assistants in the Department of Ophthalmology, for their invaluable assistance during the archival review process for this study.

REFERENCES

1. El-Abiary M, Shams F, Goudie C, Yorston D. The Scottish RD survey 10 years on: the increasing incidence of retinal detachments. *Eye (Lond)*. 2023;37(7):1320-1324. doi:10.1038/s41433-022-02123-1
2. El-Batarny AM. Transconjunctival sutureless 23-gauge vitrectomy for vitreoretinal diseases: outcome of 30 consecutive cases. *Middle East Afr J Ophthalmol*. 2008;15(3):99-105. doi:10.4103/0974-9233.51983
3. Lewis SA, Miller DM, Riemann CD, Foster RE, Petersen MR. Comparison of 20-, 23- and 25-gauge pars plana vitrectomy in pseudophakic rhegmatogenous retinal detachment repair. *Ophthalmic Surg Lasers Imag*. 2011;42(2):107-113. doi:10.3928/15428877-20101223-02
4. Oshima Y, Wakabayashi T, Sato T, Ohji M, Tano Y. A 27-gauge instrument system for transconjunctival sutureless microincision vitrectomy surgery. *Ophthalmology*. 2010;117(1):93-102.e2. doi:10.1016/j.ophtha.2009.06.043
5. Nam Y, Chung H, Lee JY, Kim JG, Yoon YH. Comparison of 25- and 23-gauge sutureless microincision vitrectomy surgery in the treatment of various vitreoretinal diseases. *Eye (Lond)*. 2010;24(5):869-874. doi:10.1038/eye.2009.206
6. Saleh OA, Alshamarti SA, Abu-Yaghi NE. Comparison of characteristics and clinical outcomes in 27-gauge versus 23-gauge vitrectomy surgery. *Clin Ophthalmol*. 2020;14:1553-1558. doi:10.2147/OPTH.S255162
7. Nagpal M, Wartikar S, Nagpal K. Comparison of clinical outcomes and wound dynamics of sclerotomy ports of 20, 25, and 23 gauge vitrectomy. *Retina*. 2009;29(2):225-231. doi:10.1097/IAE.0b013e3181934908
8. Romano MR, Zenoni S, Arpa P, Mariotti C. Mixture of ether and silicone oil for the treatment of inferior complicated retinal detachment. *Eur J Ophthalmol*. 2013;23(2):230-235. doi:10.5301/ejo.5000215
9. Schoenberger SD, Riemann CD. Profound postoperative hypotony with globe collapse after 25-gauge pars plana vitrectomy. *Retin Cases Brief Rep*. 2012;6(4):415-418. doi:10.1097/ICB.0b013e31824f70f6
10. dell'Omo R, Scupola A, Viggiano D, et al. Incidence and factors influencing retinal displacement in eyes treated for rhegmatogenous retinal detachment with vitrectomy and gas or silicone oil. *Invest Ophthalmol Vis Sci*. 2017;58(6):BIO191-BIO199. doi:10.1167/iovs.17-21466
11. Moharana B, Dogra M, Singh SR, et al. Outcomes of 25-gauge pars plana vitrectomy with encircling scleral band for acute retinal necrosis-related rhegmatogenous retinal detachment. *Indian J Ophthalmol*. 2021;69(3):635-640. doi:10.4103/ijo.IJO_1353_20
12. Özal E, Baybora H, Karapapak M, et al. Unveiling macular displacement: endotamponade variations in retinal detachment repair outcomes. *Int Ophthalmol*. 2024;44(1):412. doi:10.1007/s10792-024-03351-y
13. Vitrectomy with silicone oil or perfluoropropane gas in eyes with severe proliferative vitreoretinopathy: results of a randomized clinical trial. Silicone study report 2. *Arch Ophthalmol*. 1992;110(6):780-792. doi:10.1001/archopht.1992.01080180052028
14. Lee SH, Han JW, Byeon SH, et al. Retinal layer segmentation after silicone oil or gas tamponade for macula-on retinal detachment using optical coherence tomography. *Retina*. 2018;38(2):310-319. doi:10.1097/IAE.0000000000001533
15. McCuen BW 2nd, Azen SP, Stern W, et al. Vitrectomy with silicone oil or perfluoropropane gas in eyes with severe proliferative vitreoretinopathy. Silicone study report 3. *Retina*. 1993;13(4):279-284. doi:10.1097/00006982-199313040-00002
16. Ge L, Su N, Fan W, Yuan S. Risk factors and management of intraocular pressure elevation after vitrectomy combined with silicone oil tamponade. *Int J Gen Med*. 2024;17:447-456. doi:10.2147/IJGM.S446617
17. Fan W, Zhang C, Ge L, et al. Prediction model for elevated intraocular pressure risk after silicone oil filling based on clinical features. *Front Med (Lausanne)*. 2024;10:1340198. doi:10.3389/fmed.2023.1340198
18. Wen X, Yang N, Zhang Y, MA W, FU Y, Geng R. Efficacy of C3F8 versus silicone oil tamponade in highly myopic macular hole retinal detachment. *Int Eye Sci*. 2024;12:805-809.
19. Syeda S, Segar S, Abrams GW, Lin X. Surgical timing of fovea-off diabetic tractional detachment repair and outcomes. *Invest Ophthalmol Vis Sci*. 2024;65(7):3216-3216.