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# Macular Evaluation by Optical Coherence Tomography after Pars Plana Vitrectomy with Silicone Oil Tamponade in Cases of Primary Rhegmatogenous Retinal Detachment

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ORIGINAL ARTICLE

# Macular Evaluation by Optical Coherence Tomography after Pars Plana Vitrectomy with Silicone Oil Tamponade in Cases of Primary Rhegmatogenous Retinal Detachment

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Abstract

*Background:* ***Rhegmatogenous retinal detachment (RRD) is a disorder that can cause blindness in the eyes. RRD is present in 6.3 to 17.9 persons per 100,000, with individuals between 60 and 69 having the highest frequency.***

*Objectives:* ***To evaluate the macular changes by OCT after pars plana vitrectomy (PPV) with silicone oil injection in cases of primary RRD.***

***Subjects and methods: This prospective interventional study included (40) eyes with recent RRD and was done at Al-Azhar University Hospitals.***

*Result:* ***There was a significant difference between two weeks after vitrectomy and 3 months after (P1= 0.01). There was a substantial difference between 2 weeks after vitrectomy and 6 months after (P2= 0.014). There was a significant difference between 2 weeks after vitrectomy and 6 months after vitrectomy at BCVA score 1.7, (P2= 0.03), 2 weeks after vitrectomy, and 3 months after vitrectomy at score 1.5, (P1= 0.03). Between 2 weeks after and 6 months after vitrectomy, the BCVA score was 1.3 (P2= 0.04).***

*Conclusion:* ***For the treatment of primary RRD, PPV combined with SO injection is a safe and effective surgical technique. More extensive multicenter clinical studies are yet required to corroborate and confirm our results completely.***

*Keywords:* Macular evaluation; Optical coherence tomography; RRD

## 1. Introduction

Several well-established main risk factors, including cataract surgeries, high myopia, extensive ocular traumas, lattice degeneration, and glaucoma, have been found to have a substantial impact on the development of RRD.[1]

Retinal reattachment surgery aims to relieve abnormal vitreoretinal traction, seal retinal breaks with laser photocoagulation or cryotherapy, and induce reattachment of the neurosensory retina to the retinal pigment epithelium (RPE) internally with tamponade and pars plana vitrectomy (PPV) or externally with a scleral buckle (SB).[2]

The utilization of a tampon, described as "a plug inserted firmly into a wound, orifice and so on, to stop hemorrhage," is referred to as "tamponade." Tamponade agents are used with retinal detachment (RD) surgery to create surface tension across retinal fractures. This stops more fluid flow into the subretinal region till retinopexy creates a permanent seal. The two most widely utilized categories of tamponade agents are gases and silicone oils.[3]

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Silicone oil injection is now a standard procedure used in conjunction with vitreoretinal surgery to enhance the prognosis of complicated RD related to ocular trauma, proliferative diabetic retinopathy, massive retinal tears, and proliferative vitreoretinopathy (PVR).[4]

When used as an intraocular tamponade in the context of RD treatment, silicone oil was found to have fewer postoperative problems, improve visual acuity, and increase the likelihood of successful reattachment in eyes compared to sulfur hexafluoride gas.[5]

After vitrectomy, silicone oil stabilizes and provides internal tamponade for the retina. On the other hand, silicone oil used for an extended period may result in long-term consequences, namely keratopathy, glaucoma, and cataracts. As a result, once the stable retinal state is attained, silicone oil excision, or SOR, is recommended.[6]

Although silicone oil has been proven to be one of the best vitreous substitutes, it could be accompanied by many adverse events when left in place for prolonged periods. Commonly reported complications involve corneal decompensation, extensive cataract formation, and elevated intraocular pressure (IOP) or secondary glaucoma. It also causes a decrease in the visual acuity if it emulsifies with time. Owing to the previously reported adverse events, silicone oil is often removed after a period of retinal stability. As it repositions a mobile detached retina, removal sometimes leads to redetachment.[7]

Optical coherence tomography (OCT) has been considered a non-invasive technology that delivers high-resolution pictures of the macular layers. When the media are explicit in SiO-filled eyes, OCT may be utilized to investigate the posterior segments. Many consequences, which include epiretinal membrane (ERM), macular holes (MH), macular edema, sensory separation, and retinal layer thinning, might be clinically overlooked. These problems, if present, might have an impact on visual results, and some of them necessitate a change in the surgical technique used to remove SiO.[8]

The current work aimed to assess the macular changes by OCT after PPV with silicone oil injection in cases of primary RRD.

## 2. Patients and methods

This prospective interventional study comprised (40) eyes with recent RRD and was done at Al-Azhar University Hospitals from January 2022 to May 2023.

Inclusion criteria: Age (20-70). Recent primary RRD. Phakic or pseudophakic eye, and transparent media enough to document macular changes by OCT.

Exclusion criteria: Old retinal detachment. Traction retinal detachment. Aphakic retinal detachment. Recurrent retinal detachment. Diabetic retinopathy. Known glaucoma patient. History of intra-ocular surgery rather than uncomplicated phacho operation. Silicone oil total emulsification or hemorrhage, opacifying the view, and unsuccessful RD surgery.

All patients were subjected to the following:

2.. History taking:

2.2. Ophthalmic examination: Evaluation of uncorrected visual acuity (UCVA) and best corrected Visual acuity (BCVA) using Landolt's bracken ring chart and converted into logarithm of minimum angle of resolution (log MAR scale) at 2 weeks after silicone oil injection then after 3 months and finally after 6 months. Cycloplegic refraction by autorefractometer. Slit lamp (SL) examination of anterior segment to assess: cornea to detect any opacity, iris and lens to detect any rubeosis iridis or cataract. Posterior segment examination was done using an indirect ophthalmoscope, and SL biomicroscopy was performed using a non-contact +78D lens. IOP measurement is done by applying a tonometer preoperatively and post-op. At (2nd week, 3rd month and 6th month).

2..3 Procedure:

PPV with silicone oil (s1000) tamponade.

2.4. Operation: Three sclerotomies were done, 23 gauge size, one for infusion line typically in the inferior temporal quadrant and then two superior for light pipe and vitrector was placed near the 10 and 2 o'clock position. Anterior vitrectomy, core vitrectomy, injection of triamcinolone to complete core vitrectomy and for induction of posterior vitreous detachment, injection of perfluorocarbon (PFC) to flatten the retina, air-fluid exchange, then silicon air exchange, then removal of trocars.

Postoperative: Topical antibiotics, cycloplegics, and corticosteroids were administered as usual and reduced over 4-6 weeks. They were positioned to make a good seal against retinal breaks.

Follow-up: Follow up after vitrectomy operation by complete ocular examination including indirect ophthalmoscope 1 day, 1 week, 2 weeks 3 and 6 months.

2.5. Investigation

Optical coherence tomography (OCT): All patients were investigated by cross-section OCT (Topcon DRI OCT Triton) within 2 weeks after injection of silicone, after 3 months and finally at 6 months to assess the thickness of macula, detect any macular changes. Using SS-OCT, macular thickness and retinal thickness were evaluated. The macular edema type, subretinal fluid (SRF), and interruption of the outer retina were also

assessed. Using SS-OCT, The area between the inner Scleral border and the outer border of the RPE/Bruch's membrane complex was designated as the choroid.

Using SS-OCT, choroidal thickness was measured subfovea 1mm away from the fovea nasally, temporally, superiorly and inferiorly. Those readings were measured manually using caliber.

2.6. Ethical Consideration:

The study protocol was submitted to the Al Azhar University Faculty of Medicine's IRB for approval. Both individually and in groups, the participants received an explanation of the study's goals. Throughout the investigation, the researcher was reachable. Written informed permission was acquired from every individual involved in the research. At every stage of the study, privacy and confidentiality were upheld. The families received assurances that their participation in the study was entirely voluntary and that their assessment process would not be impacted by their decision to quit. No additional uses were made of the collected data.

2.7. Statistical Analysis:

Microsoft Excel codes, inputs, and analyzes historical data and essential clinical examinations, laboratory tests, and outcome measurements. After that, data were transferred into the analytical program SPSS V. 20.0. Depending on the kind of data, the following tests were employed to determine if differences were significant: Pearson's correlation or Spearman's correlation for qualitative data, which are represented as numbers and percentages, and mean ± SD for quantitative data. Regarding all the previous tests, results were considered significant if the P value <0.05.

## 3. Results

Table 1. showed that 21 (52.5%) of the 40 patients were females, 25 (62.5%) patients had the disease in their right eye, 10 (25%) patients were students, 15 (37.5%) were housewives, 12 (30%) were Workers, 3 (7.5%) were teachers and 5 (12.5%) patients were smokers. (Mean age was 49 ± 5.5). 13 patients were 51 to 60. Twelve patients were from 41 to 50 years old. Seventeen patients were from 31 to 40 years old. Four patients were from 20 to 30 years old. And 4 patients were between 61 and 70 years old.

There was a significant difference between 2 weeks after vitrectomy and 6 months after vitrectomy at BCVA score 1.7, (P2= 0.03), between 2 weeks after vitrectomy and 3 months after vitrectomy at score 1.5, (P1= 0.03). Between 2 weeks after vitrectomy and 6 months after vitrectomy, the BCVA score was 1.3 (P2= 0.04) Table 2.

There was a significant difference between 2 weeks after vitrectomy and 3 months after (P1= 0.01). There was a substantial difference between 2 weeks after vitrectomy and 6 months after (P2= 0.014). There was an insignificant difference between 3 months after vitrectomy and 6 months after (P3= 0.98) Table 3.

There was a significant difference between IOP 2 weeks after vitrectomy and 6 months after (P1= 0.002). And between IOP 3 months weeks after vitrectomy and 6 months after vitrectomy (P1= 0.0007) Table 4.

Table 5. showed that 14 patients showed Normal OCT findings, 9 showed Attenuated IS/OS and RPE, 7 showed Epiretinal membrane, 3 showed strophic maculopathy and diffuse retinal thinning, 3 showed Cystoid macular edema (CME), only one patient had localized macular edema, 2 patients had diffuse retinal edema, Serous macular detachment, macular hole or Corrugated retinal pigment epithelium, 3 patients had Intraretinal cysts, and only one patient had Perfluorocarbon under retina, Persistent subretinal fluid or Multiple pigmented epithelium detachment.

Table 1. Demographic data and Age group

| PREOPERATIVE CHARACTERISTICS | N | % |
|---|---|---|
| SEX | | |
| FEMALE | 21 | 52.5 |
| MALE | 19 | 47.5 |
| EYE | | |
| RIGHT | 25 | 62.5 |
| LEFT | 15 | 37.5 |
| AGE MEAN ± SD YEAR | 49 ± 5.5 | |
| OCCUPATION | | |
| STUDENT | 10 | 25 |
| HOUSE WIFE | 15 | 37.5 |
| WORKER | 12 | 30 |
| TEACHER | 3 | 7.5 |
| SMOKING | | |
| YES | 5 | 12.5 |
| NO | 35 | 87.5 |
| AGE RANGE | | |
| 20-30 YEARS | 4 | 10 |
| 31-40 YEARS | 7 | 17.5 |
| 41- 50 YEARS | 12 | 30 |
| 51- 60 YEARS | 13 | 32.5 |
| 61-70 YEARS | 4 | 10 |

Table 2. BCVA according to log MAR chart

| BCVA ACCORDING TO LOG MAR CHART | 2 WEEKS AFTER VITRECTOMY | | 3 MONTHS AFTER VITRECTOMY | | 6 MONTHS AFTER VITRECTOMY | | P1 | P2 | P3 |
|---|---|---|---|---|---|---|---|---|---|
| | No | % | No | % | N | % | | | |
| 2 | 4 | 10 | 4 | 10 | 2 | 5 | 1 | 0.39 | 0.39 |
| 1.9 | 3 | 7.5 | 6 | 15 | 3 | 7.5 | 0.289 | 1 | 0.289 |
| 1.7 | 5 | 12.5 | 8 | 20 | 13 | 32.5 | 0.36 | 0.03 | 0.2 |
| 1.5 | 10 | 25 | 3 | 7.5 | 7 | 17.5 | 0.03 | 0.4 | 0.17 |
| 1.3 | 8 | 20 | 7 | 17.5 | 2 | 5 | 0.77 | 0.04 | 0.07 |
| 0.5 | 5 | 12.5 | 6 | 15 | 6 | 15 | 0.7 | 0.7 | 1 |
| 0.6 | 4 | 10 | 4 | 10 | 5 | 12.5 | 1 | 0.7 | 0.7 |
| 0.8 | 1 | 2.5 | 2 | 5 | 2 | 5 | 0.556 | 0.556 | 1 |

BCVA: best corrected visual acuity, P1: P value between 2 weeks after vitrectomy and 3 months after vitrectomy. P2: P1: P value between 2 weeks after vitrectomy and 6 months after vitrectomy. P3: P1: P value between 3 months after vitrectomy and 6 months.

Table 3. CMT

| CMT | 2 WEEKS AFTER VITRECTOMY | 3 MONTHS AFTER VITRECTOMY | 6 MONTHS VITRECTOMY | P 1 | P 2 | P 3 |
|---|---|---|---|---|---|---|
| MEAN± SD | 305.66±157.38 | 273.76±105.77 | 252.11 ±105.5 | 0.01 | 0.014 | 0.98 |

P1: P value between 2 weeks after vitrectomy and 3 months after vitrectomy. P2: P1: P value between 2 weeks after vitrectomy and 6 months after vitrectomy. P3: P1: P value between 3 months after vitrectomy and 6 months.

Table 4. IOP

| IOP | 2 WEEKS AFTER VITRECTOMY | 3 MONTHS AFTER VITRECTOMY | 6 MONTHS AFTER VITRECTOMY | P 1 | P2 | P 3 |
|---|---|---|---|---|---|---|
| MEAN± SD | 18.09 ± 3.51 | 17.02 ± 3.7 | 15.09 ± 2.11 | 0.74 | 0.002 | 0.0007 |

P1: P value between 2 weeks after vitrectomy and 3 months after vitrectomy. P2: P1: P value between 2 weeks after vitrectomy and 6 months after vitrectomy. P3: P1: P value between 3 months after vitrectomy and 6 months.

Table 5. OCT finding

| VARIABLES | NO. (N=40) | % |
|---|---|---|
| NORMAL OCT FINDINGS | 14 | 35 |
| ATTENUATED IS/OS AND RPE | 9 | 22.5 |
| EPIRETINAL MEMBRANE | 7 | 17.5 |
| ATROPHIC MACULOPATHY & DIFFUSE THINNING OF RETINAL LAYERS | 3 | 7.5 |
| CME | 3 | 7.5 |
| LOCALIZED MACULAR OEDEMA | 1 | 2.5 |
| DIFFUSE RETINAL OEDEMA | 2 | 5 |
| SEROUS MACULAR DETACHMENT | 2 | 5 |
| MACULAR HOLE | 2 | 5 |
| CORRUGATED RPE | 2 | 5 |
| PERFLUOROCARBON UNDER RETINA | 1 | 2.5 |
| INTRARETINAL CYSTS | 3 | 7.5 |
| PERSISTENT SUBRETINAL FLUID | 1 | 2.5 |
| MULTIPLE PIGMENTED EPITHELIUM DETACHMENT | 1 | 2.5 |

### 3.1.CASES PRESENTATION

Case 1: 58 years old male patient, not diabetic, phakic and underwent Lt PPV and SO injection (5000 cs) for Lt RRD with detached macula. OCT of the macula was done within 2weeks, after 3ms and after 6ms and showed foveal thinning

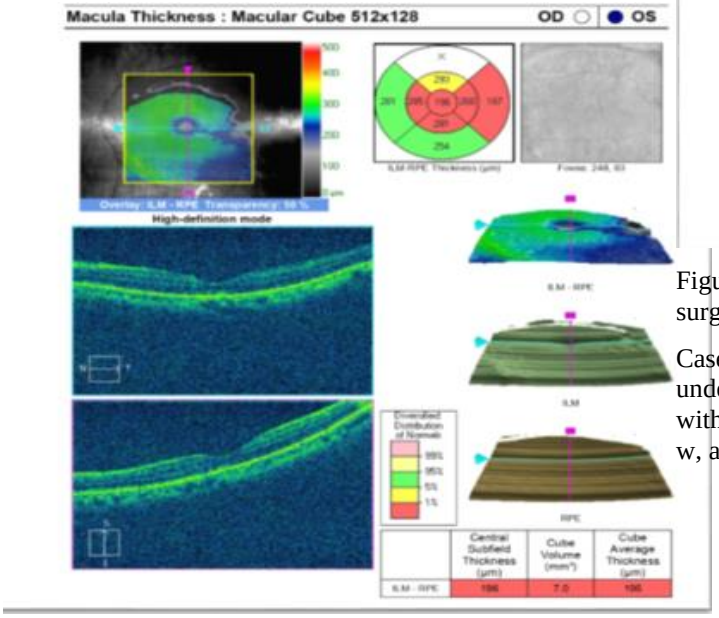


Figure 1. OCT of macula of Lt eye of patient number (1), 2 weeks after surgery showed photoreceptor disruption. CMT = 196 microns.

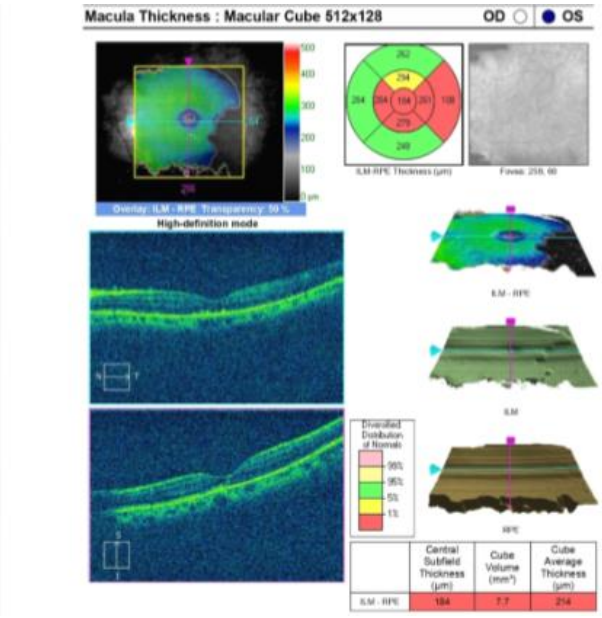


**Figure** 2. OCT of macula of the same patient 3 months after surgery. CMT = 184microns

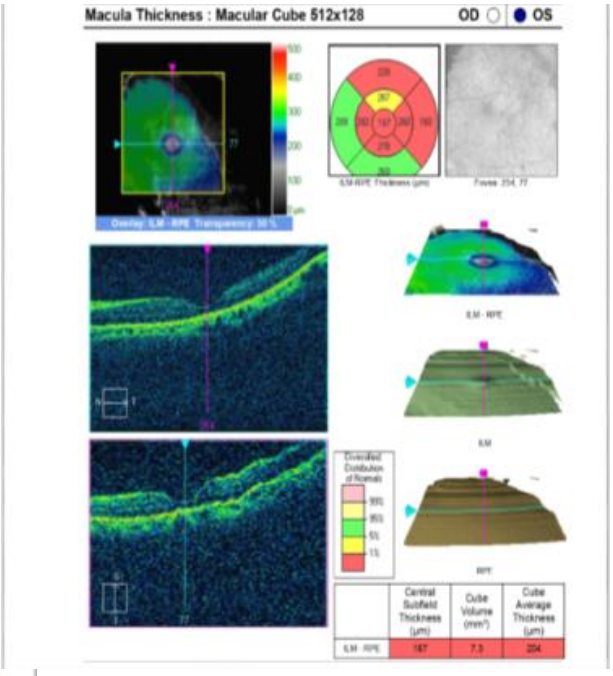


Figure 3. OCT of macula of the same patient 6 months after surgery. CMT = 167 microns (foveal thinning).

Case 2: 46 years old male patient, pseudophakic and underwent Lt PPV and SO injection (5000 cs) for Lt RRD with detached macula. OCT of Lt macula was done within 2 w, after 3ms and after 6ms and showed large foveal cyst.

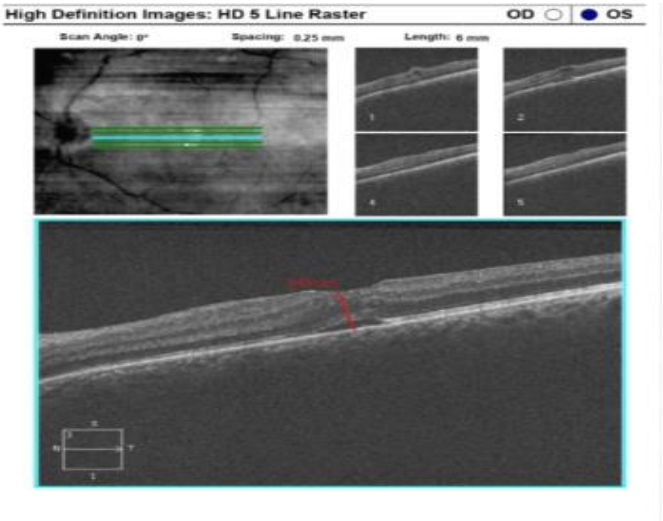


Figure 4. OCT of macula of Lt eye of patient number (3), 2 weeks after surgery revealed neurosensory detachment. CMT=344 microns.

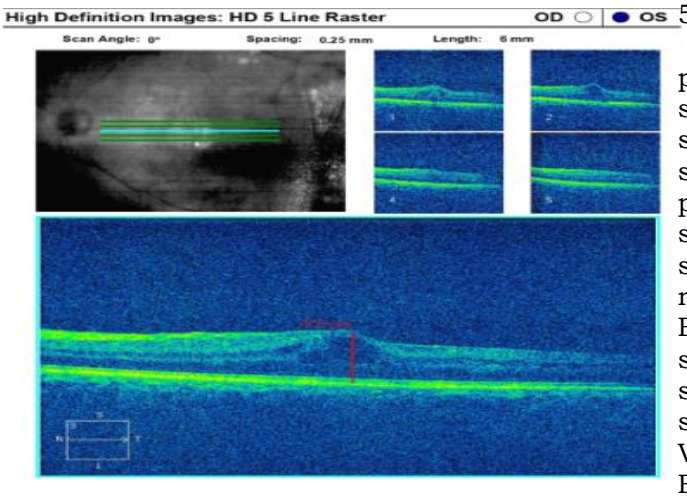


Figure 5. OCT of macula of the same patient 3 months after surgery revealed CME. CMT=400 microns.

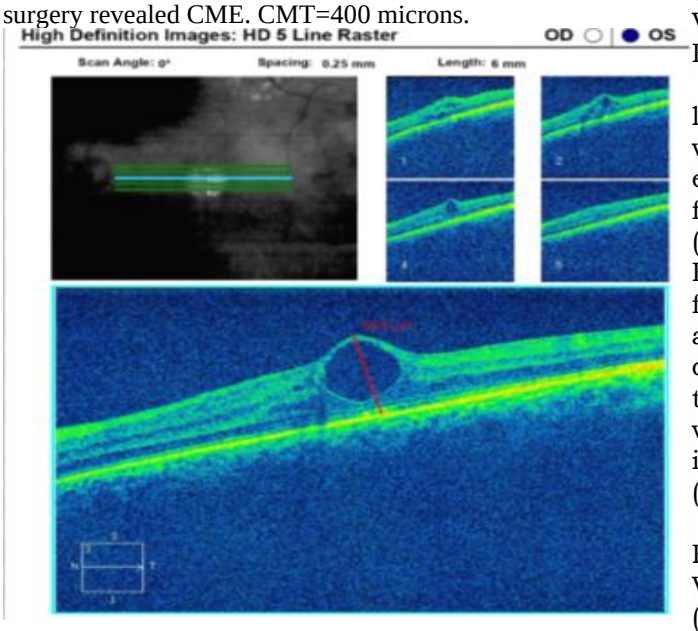


Figure 6. OCT of macula of the same patient 6 months after surgery revealed large foveal cyst. CMT=564 microns.

## 4. Discussion

Our results supported that: 21 (52.5%) of the 40 patients were females, 25 (62.5%) had the disease in their right eye, 10 (25%) were students, 15 (37.5%) were housewives, 12 (30%) were Workers, 3 (7.5%) were teachers and 5 (12.5%) were smokers.

Our results are consistent with Rabina et al.[9], who reported 21 females and 20 males. Also, Fabian et al.[10] attempted to describe a sequence of full-thickness MH that follows RRD PPV. Their study comprised four females and two males.

Our results showed that the mean age was 49 ± 5.5. Thirteen patients were from 51 to 60 years old, 12 were from 41 to 50 years old, 17 were from 31 to 40 years old, 4 were from 20 to 30 years old, and 4 were from 61 to 70 years old.

Our results supported Antoun et al.[11] who reported that the age at the intervention time was 57.6 ± 10.5 years (range, 34–79 years).

We found that 2 weeks after Vitrectomy, 4 patients showed 2 BCVA scores, 3 showed 1.9, 5 showed 1.7, 10 patients showed 1.5, 8 patients showed 1.3, 5 showed 0.5, 4 showed 0.6, and 1 showed 0.8. Three months after vitrectomy 4 patients showed 2 BCVA score, 6 showed 1.9, 8 showed 1.7, 3 showed 1.5, 7 showed 1.3, 6 showed 0.5, 4 showed 0.6 and 2 showed 0.8. 6 months after vitrectomy 2 patients showed 2 BCVA score, 3 showed 1.9, 13 showed 1.7, 7 showed 1.5, 2 showed 1.3, 6 showed 0.5, 5 showed 0.6, and 2 showed 0.8. There was a significant difference between 2 weeks after Vitrectomy and 6 months after Vitrectomy at BCVA score 1.7, (P2= 0.03), between 2 weeks after Vitrectomy and 3 months after Vitrectomy at score 1.5, (P1= 0.03). Between 2 weeks after Vitrectomy and 6 months after Vitrectomy, the BCVA score was 1.3 (P2= 0.04).

Our results were supported by Christensen and la Cour[12], who reported that postoperative BCVA was (>6/24) in SiO eyes. Three of nine (33%) SiO eyes had a final BCVA of £6 60, while 67% had a final BCVA of £6 12. In addition, three of nine (33%) SiO eyes had a significant drop in final BCVA to 36 letters, and six of nine (67%) had a final BCVA of 71 letters (6/12 Snellen). The average duration of SiO tamponade was 145 days, and there was no link between SiO tamponade time and ultimate VA (p=0.72). There was a high association between thinning of the inner retinal layers (IRL) and poor visual results (p=0.004).

Also, Antoun et al. [11] reported that 3 presurgical BCVA was 1.64±0.81 logMAR (20/873 Snellen VA), while the final BCVA was 0.45±0.40 logMAR (20/56 Snellen VA). With a mean of 28.5±11.7, the final BCVA improved by 88.7%. Final BCVA was better in 55 eyes (88.7%), with a mean of 4

Snellen lines, unchanged in 5 (8.1%), and worse in 2 (3.2%). The average length of SO tamponade was 5.12±2.37 months (range, 2-12 months). Within 7.37±3.00 months (2-13 months), 24 of the 30 eyes that remained phakic following Vitrectomy (80.0%) had cataract surgery. During the follow-up period, 35 eyes (56.5%) experienced an increase in IOP. Thirty-one individuals exhibited temporary ocular hypertension that required topical therapy throughout the one-month postoperative period. Only one eye (2.9%) required filtering drainage surgery to manage IOP. Because of the increased IOP, no eyes developed optic neuropathy.

Our results showed that the mean CMT at 2 weeks after Vitrectomy was 305.66±157.38, the mean CMT at 3 months after Vitrectomy was 273.76±105.77 and the mean CMT at 6 months after Vitrectomy was 252.11 ±105.5. There was a significant difference between 2 weeks and 3 months after (P1= 0.01). There was a substantial difference between 2 weeks after Vitrectomy and 6 months following Vitrectomy (P2= 0.014). There was an insignificant difference between 3 months after and six months after (P3= 0.98).

Rabina et al.[9] reported tamponade with silicone oil induces a transient reduction in CMT, primarily in the IRL. The mechanism of SO tamponade's action on the retina is unknown.

Christou et al.[13] concluded that SCP alterations occurred in eyes treated with Vitrectomy and intravitreal SO for macula-off RRD. The results of their investigation show a decrease in vascular density in SO-managed eyes, which could reflect postoperative visual outcomes (p=0.001). Postsurgical logMAR VA was considerably lower in managed eyes than in control eyes, and it linked negatively with foveal, parafoveal, and perifoveal VD and PD SCP. There was no association between postoperative VA and FAZ measures.

Our findings showed that 14 patients showed normal OCT findings, 9 showed Attenuated IS/OS and RPE, 7 showed Epiretinal membrane, 3 showed Atrophic maculopathy & diffuse thinning of retinal layers, 3 showed CME, only one patient had Localized macular edema, 2 patients had diffuse retinal edema, serous macular detachment, Macular hole or corrugated retinal pigment epithelium, 3 patients had Intraretinal cysts, and only one patient had Perfluorocarbon under retina, Persistent subretinal fluid or Multiple pigmented epithelium detachment.

Our results were supported by Christensen and la Cour[12], who revealed changes in postoperative OCT findings. After a smooth surgical procedure, eight out of nine SiO patients had vision loss, and three out of nine SiO cases had significant visual impairment (<6/60). Additionally, they saw a considerable reduction in IRL thickness among individuals with extensive visual impairment, suggesting that the death of neurons in the macular area might cause eyesight loss. SiO was employed because the surgeon preferred it or because there were several or large retinal tears.

Prior studies with OCT following surgery for complicated retinal detachments, including detached macules, have revealed a negative correlation between central foveal thickness (CFT) and atrophy and the ultimate visual result.[14-15]

Also, our findings supported Horozoglu et al.[16], who reported that, with a first procedure, retinal reattachment was successful in 18 eyes (90%) out of 18. Following the excision of HSO from two eyes, recurrent detachment with PVR occurred, and following several surgeries, retinal reattachment was accomplished in such two eyes. ILM was eliminated with recurrence in both eyes. After surgery, the macular OCT data were collected and assessed. The CFT ranged from 100 to 274 μm, averaging 191.7 ± 57.5 μm.

Christensen et al.[15] reported that in cases with a preoperatively detached macula, foveal retinal thickness was considerably higher at a mean of two years postoperatively. Furthermore, there was a favorable correlation between postsurgical VA and retinal thickness in the fovea. They concluded that, when tested with OCT six months after surgery for macula-off RD, there is a considerable thickening of the neurosensory retina.

Our study was consistent with Antoun et al. [11], who reported that PPV with SO injection was highly successful and beneficial in treating primary uncomplicated RRD.

Also, Jonas et al.[17] concluded that in patients residing at high altitudes (1,000 m), PPV with SO injection has been considered a safe and effective surgery in the context of primary uncomplicated RRD management. Furthermore, PPV and SO injection were linked to favorable anatomic and functional outcomes.

## 5. *Conclusion*

As regards the treatment of primary RRD, PPV combined with SO injection is a safe and effective surgical technique. More extensive multicenter clinical studies are yet required to corroborate and confirm our results completely.

## Disclosure

The authors have no financial interest to declare in relation to the content of this article.

## Authorship

All authors have a substantial contribution to the article

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## Conflicts of interest

There are no conflicts of interest.

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