




# Retinal displacement following pars plana vitrectomy with silicone oil tamponade for rhegmatogenous retinal detachment

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## Abstract

**Purpose** To evaluate the frequency of retinal displacement after pars plana vitrectomy (PPV) using silicone oil tamponade in patients with rhegmatogenous retinal detachment (RRD).

**Methods** Patients with fresh RRD were enrolled in this prospective interventional case series. A standard 3-port PPV with silicone oil tamponade was performed in all cases. A complete ocular examination, optical coherence tomography and fundus autofluorescence (FAF) imaging were performed at 1 and 3 months follow-up. Orthoptic examinations including synoptophore and light on–off tests were also performed at 3 months.

**Results** Twenty-three eyes from 23 patients with mean age of  $56.6 \pm 11$  (range: 38–82) years were included. All patients were pseudophakic. Downward retinal displacement was found in 2 eyes (8.7%) showing hyperautofluorescent lines parallel to retinal

vessels in FAF image. The patients with retinal displacement did not complain of metamorphopsia and did not show abnormality in orthoptic tests.

**Conclusion** Unintentional retinal shift following PPV with silicone oil tamponade for RRD is uncommon and might have little clinical significance.

**Keywords** Retinal displacement · Pars plana vitrectomy · Silicone oil tamponade · Rhegmatogenous retinal detachment

## Introduction

Pars plana vitrectomy (PPV) with either intraocular gas or silicone oil tamponade is the most commonly performed vitreoretinal surgery for rhegmatogenous retinal detachment (RRD) [1]. PPV showed favorable outcome in patients with RRD with re-attachment rate of about 95% after one or multiple surgeries [2].

Recently, Shiragami et al. [3] showed the unintentional retinal slippage after PPV in patients with RRD. Retinal displacement could be detected using fundus autofluorescence (FAF) imaging which shows hyperautofluorescent lines parallel to major retinal vessels. These lines were considered as preoperative location of retinal vessels which were visualized after unmasking the underlying retinal pigment epithelium (RPE) [3–5].

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Retinal shift in FAF imaging has been reported in up to 72% of patients with RRD following PPV with gas tamponade [6, 7]. However, only one study assessed the retinal slippage rate in patients with silicone oil tamponade [6]. In this study, we evaluated the retinal displacement frequency following PPV using silicone oil tamponade in patients with RRD after re-attachment.

## Methods

This prospective interventional case series was conducted between March 2018 and June 2019 in Farabi Eye Hospital, Tehran, Iran. Tehran University of Medical Sciences ethical board committee approved the study protocol. Following the tenets of Declaration of Helsinki, all patients provided informed consent.

Patients with macular involving fresh RRD (defined as less than 2 weeks from onset of symptoms) with no PVR-C were included in this study. All cases required silicone oil tamponade based on patient's characteristics or surgeon's preference. Eyes with postoperative epiretinal membrane or cystoid macular edema (CME; defined as central subfield thickness of 300  $\mu\text{m}$  or greater) in Spectralis (Heidelberg Engineering, Heidelberg, Germany) macular optical coherence tomography (OCT) were excluded. Since the results of orthoptic tests may be uninterpretable in low visual acuity, patients with postoperative best-corrected visual acuity (BCVA) of less than 20/200 were also excluded. Other exclusion criteria were as follows: history of intraocular surgery except phacoemulsification, patients with other retinal disease including age-related macular degeneration and retinal vascular diseases.

A standard 23-gauge 3-port PPV was performed in all patients using Accurus (Alcon Laboratories Inc., Fort Worth, Texas, USA) vitrectomy system under general or retrobulbar anesthesia by two vitreoretinal surgeons [F.B and H.R]. All patients were pseudophakic. One of the surgeons [H.R] preferred using perfluorocarbon (PFCL; DK-line, Bausch & Lomb, Waterford, Ireland) liquid (9 eyes). Endodiathermy was performed to mark retinal breaks. A 360° of vitreous base shaving was performed with aid of scleral depression. Internal limiting membrane peeling was not performed in any patient. Endolaser photocoagulation was performed around the retinal breaks or

on 360° peripheral retina. Then, PFCL (if used) was removed and subretinal fluid was drained during air-fluid exchange. Silicone oil (5700 centistokes) was used as tamponade in all cases. All patients were instructed to maintain a face down position for 3 days.

Data were collected at baseline, 1 and 3 months after PPV. A complete ocular examination including slit lamp biomicroscopy, evaluation of manifest refraction and best-corrected visual acuity (BCVA) using Snellen visual acuity charts, and dilated funduscopy was performed in all visits. The Snellen visual acuity was converted to logarithm of minimal angle of resolution (logMAR). The following equations were used for non-numerical visual acuity: counting fingers = 1.7 logMAR; hand motions = 2 logMAR [8].

The FAF imaging (Heidelberg Engineering, Heidelberg, Germany) and macular OCT were performed at 1 and 3 months post-PPV. Orthoptic evaluation including synoptophore examination and light on-off test were performed at 3 months follow-up in all patients. A synoptophore (Clement Clarke International, USA) was used for assessment of vertical and cyclotortional deviation. Light on-off test is an examination evaluating the effect of peripheral versus central fusion. This test was originally introduced for assessing central diplopia caused by dragged fovea in retinal disease such as epiretinal membrane [9].

Data were expressed as mean  $\pm$  standard deviation (SD) and median (range) for quantitative variables, and number and percentage for qualitative variables. Statistical analysis was performed using SPSS software version 16.0 for windows (SPSS Inc., Chicago, IL, USA).

## Results

Forty patients were recruited of which 17 patients were excluded due to CME or postoperative BCVA less than 20/200. Finally, 23 eyes from 23 patients (19 males and 4 females) with mean age of  $56.6 \pm 11$  (range: 38–82) years were enrolled in this study. Median interval between onset of visual loss and surgery was 6 (range: 2–10) days. Baseline characteristics of study patients were illustrated in Table 1.

One week postoperatively, complete retinal attachment was achieved in all cases. BCVA improved from  $1.83 \pm 0.25$  (median: 2; range: 1.1–2) logMAR to

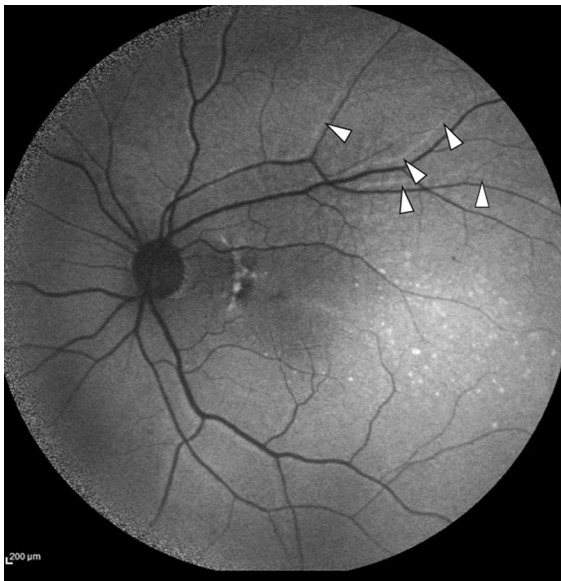
**Table 1** Baseline characteristics in study patients

Variables	
Age, mean $\pm$ SD (years)	56.6 $\pm$ 11
Sex (male)	19 (82.6%)
Laterality (OD)	12 (52.2%)
Using PFCL	9 (39.1%)
Duration of detachment, median (range) [days]	6 (2–10)
Baseline VA (logMAR)	1.83 $\pm$ 0.25
<i>Quadrants of detachment</i>	
2	3 (13%)
3	3 (13%)
4	17 (73.9%)
Inferior retinal break	9 (39.1%)

*SD* Standard deviation, *PFCL* Perfluorocarbon, *logMAR* logarithm of minimal angle of resolution

0.48  $\pm$  0.19 (median: 0.5; range: 0.1–0.7) logMAR at 3 month postoperatively. Central subfield thickness was 245.9  $\pm$  32.6  $\mu$ m at 3 month visit.

At 1 month examination, downward retinal displacement was detected in 2 eyes (8.7%) showing hyperautofluorescent lines parallel to the retinal vessels in FAF (Fig. 1). The displacement was unchanged at 3 months visit. Both of these patients had undergone



**Fig. 1** Fundus autofluorescent image of a patient with retinal displacement at 3 months postoperatively. Arroheads show the hyperautofluorescent lines parallel to retinal vessels indicating the downward shift of retina

PPV using PFCL with final postoperative BCVA of 0.5 and 0.7 logMAR.

The two patients with postoperative retinal slippage did not complain of metamorphopsia or diplopia. Synoptophore examination and light on–off test revealed no deviation in these cases. In contrast, synoptophore and light on–off tests found abnormalities in other 2 and 1 patients, respectively, without signs of retinal displacement in FAF.

## Discussion

Retinal displacement following PPV in eyes with RRD has been recently reported by Shiragami et al. [3]. They showed that hyperautofluorescent lines parallel to the retinal vessels, also referred as ‘retinal vessel printings’, in the postoperative FAF indicate the original location of retinal vessels. It has been suggested that RPE cells located under the major retinal vessels unmasked postoperatively. Exposure to light induce hyperactivation of these translocated RPE cells and create hyperautofluorescent lines [3, 4, 10]. Retinal displacement has been attributed to the effect of intraocular tamponade for shifting the residual subretinal fluid and retina downward.

In our study, downward retinal displacement was found only in two eye (8.7%) with silicone oil tamponade. The rate of retinal displacement after PPV using silicone oil tamponade in our study is much lower than previous reports (about 35–70%) using gas tamponade [3, 4, 6, 7, 10–12]. This could be attributed to lower buoyancy (upward force) of silicone oil than gas tamponade. Buoyancy along with specific gravity, surface tension and gravity are main physical properties affecting the intraocular tamponade agent function. The buoyancy effect is referred to upward pressure on a floating object which is equal to weight of displaced fluid, based on Archimedes’ law. This pressure is affected by the ratio between the density of objects and liquids; thus, silicone oil induces lower buoyancy relative to gas because of similarity in specific gravity to aqueous [13]. The other explanation for lower reported rate of retinal displacement in eyes with silicone tamponade could be the lower image quality in silicone filled eyes which could lead to some difficulty in interpretation. Rate of retinal displacement was similar in 1 and 3 months postoperatively in our study. However, some studies showed that the

amount of retinal displacement after PPV decreases in long-term follow-up. [3, 14]

Codenotti et al. [6] reported significantly lower frequency of retinal shift in eyes with silicone oil (22.2%) than in eyes with gas tamponade (71.4%). However, this rate is still higher than our results. In addition, Codenotti et al. [6] reported that, in contrast to our findings, silicone oil tamponade shift the retina upward which has been contributed to difference in surface tension. However, this is not surprising as a recent study also showed that retinal shift after PPV or pneumatic retinopexy could occur in both superior and inferior directions [15]. Furthermore, it should be noted that hyperautofluorescent lines in eyes underwent PPV may have other origins as well, such as outer or inner retinal folds and outer retinal disruption [16].

In this study, the two patients with retinal displacement did not complain of metamorphopsia or diplopia. They also did not showed deviation in synoptophore or light on–off tests. In the other hand, these two orthoptic tests were abnormal in other 3 patients without retinal shift. This finding may indicate that vertical or cyclodiplopia in patients underwent PPV may have other reasons except retinal displacement. In addition, the results of fusional tests in patients with suboptimal visual acuity may be difficult to interpret. The final BCVA of the two patients with retinal slippage was 0.5 and 0.7 logMAR which was roughly equal to mean final postoperative BCVA in our study. The clinical significance of retinal shift after PPV in eyes with RRD is questionable. Some studies showed that retinal shift is associated with abnormal orthoptic tests [3] or symptoms of metamorphopsia [11, 12]. Similar to our study, most of previous investigations didn't report any correlation between retinal shift and postoperative visual acuity [11, 12]. In contrast, a recent study has been reported that patients with retinal slippage after RRD repair have lower visual acuity and more prevalent outer retinal disruption [15]. Moreover, another recent study showed a lower circularity score on OCT angiography in eyes retinal displacement after RRD repair [17].

This study has some limitations including small sample size. Since only two eyes showed retinal displacement in our study, we could not evaluate the role of potential affecting factors such as using PFCL or extent of retinal detachment. However, this study is the first to report downward retinal displacement in eyes with silicone oil tamponade. Another limitation

was not to examine patients after silicone oil removal. Farabi eye hospital is a tertiary center in capital of Iran and most of our patients came from other provinces of the country. Thus, follow-up visits after silicone oil removal routinely performed by regional referring general ophthalmologists.

In conclusion, unintentional retinal displacement is uncommon in eyes underwent PPV with silicone tamponade for repairing RRD. Retinal slippage may have little clinical significance in this condition.

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**Data availability** Data are available to share if needed.

**Declarations**

**Conflicts of interest** No conflict of interest.

**Ethical approval** This protocol of this study was approved by ethical committee of Tehran University of Medical Sciences.

**Consent to participate** All patients provided written informed consent to participate the study.

**Consent for publication** Written informed consent for publication of clinical details and clinical images was obtained from the participants.

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