

Spontaneous resolution of macular edema after silicone oil removal

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Abstract

• **AIM:** To investigate the macular changes in eyes filled with silicone oil (SO) and course of these changes after SO removal.

• **METHODS:** A retrospective optical coherence tomography scan review was conducted for twenty-four patients who underwent uncomplicated pars plana vitrectomy with SO tamponade for complex retinal detachments were detected with optical coherence tomography before, and one week, one month and three months after SO removal.

• **RESULTS:** Mean duration of SO tamponade was 3.6±1.0mo (range 3–7mo). Cystoid macular edema (CME) was detected in 3 eyes before SO removal. Submacular fluid was represented in 1 eye before silicone SO removal. Resolution of CME and submacular fluid was achieved 1mo after SO removal in all eyes. Mean best corrected visual acuity (BCVA) was 1.15±0.65 (range, hand movement to 0.2) before SO removal in the eyes without macular changes. After SO removal, the mean BCVA values at 1wk and 1 and 3mo, and 0.82±0.23, 0.76±0.21, and 0.70±0.19, all of which were significantly better than baseline ($P=0.030$, 0.017, 0.006 respectively). In the eyes with macular CME and subretinal fluid the mean BCVA was significantly improved at 3mo after SO removal compared with baseline ($P=0.037$).

• **CONCLUSION:** Decreased visual acuity in eyes filled with SO could be caused by macular complications due to SO. CME and subretinal fluid may resolve without any additional macular surgery after SO removal.

• **KEYWORDS:** retinal detachment; silicone oil; macula

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INTRODUCTION

Cibis *et al*^[1] was firstly described the use of of silicone oil (SO) for the treatment of otherwise inoperable retinal detachments. Since the early use, silicone oil has been used increasingly for the anatomical reattachment of the retina in patients with complex retinal detachments, proliferative vitreoretinopathy (PVR), giant retinal tears and trauma^[2-6]. However, silicone oil leads to long-term complications particularly cataract, glaucoma, and keratopathy^[7-10]. Therefore, some authors recommended the removal of the SO as soon as possible as a stable retina situation is achieved^[11-15].

Visual improvement to at least ambulatory vision is reported in up to 67.3% of the patients treated with PVR^[15]. High reattachment rates, defining the anatomical success, are in the contrast to the functional results, which is linked to the functional outcome of the macula. A recently reported study, investigated the macular changes following SO removal after surgery for complicated retinal detachment with PVR. Macular changes was encountered in 87% of the patients^[16]. The aim of this study was to determine the incidence of macular changes in eyes filled with SO for the treatment of rhegmatogenous retinal detachment (RRD) and course of these changes after SO removal.

SUBJECTS AND METHODS

A retrospective optical coherence tomography (OCT) scan review was conducted for 24 eyes of 24 consecutive patients who underwent uncomplicated 3-port pars plana vitrectomy with 1000-centistokes SO tamponade for RRD between February 2012 and March 2013 at Izmir University Department of Ophthalmology comprised the study population. SO was removed by pars plana approach when the eyes were confirmed to have attached retina at at least 3mo of SO endotamponade. The indications for the use of SO were complex retinal detachments associated with PVR in all

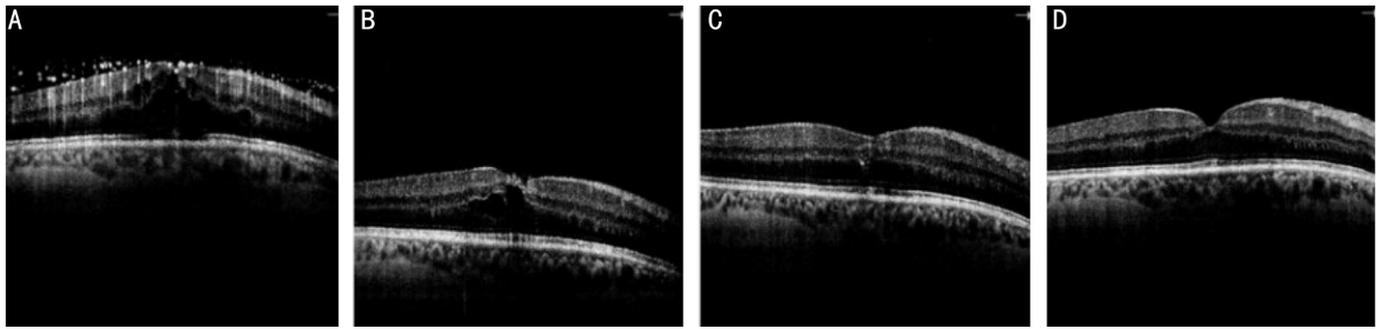


Figure 1 OCT images of a patient with cystoid macular edema shows spontaneous resolution after silicone oil removal A: OCT demonstrates the cystoid macular edema under silicone oil one week before silicone oil removal; B: OCT at 1wk after silicone oil removal shows a decreased macular edema; C: OCT at 1mo after silicone oil removal shows totally resolved macular edema; D: OCT shows sustained resolution of macular edema at 3mo after silicone oil removal.

patients. The PVR grading was done according to the Retina Society classification [17]. Four patients were graded as C2, sixteen patients as C3, and 4 patients as D1. All of the patients were pseudophakic and cataract surgery was performed at least one year before pars plana vitrectomy. All cases were primary repair. Patients having diabetes, past history of uveitis, glaucoma, age-related macular edema, and patients had previous ocular surgery except uneventful cataract surgery were excluded. Full ophthalmic examinations were performed before SO removal and 1wk, 1mo and 3mo postoperatively. Ophthalmic examination was included measurement of best corrected visual acuity (BCVA), intraocular pressure, evaluation of anterior segment by slit-lamp, dilated fundus examination with indirect ophthalmoscopy and contact lens biomicroscopy. Retinal structure was evaluated with OCT (Optovue, Inc., Fremont, CA, USA) using the "retinal map" and "single line" scan parameters. BCVA was measured using Snellen chart and was converted to logarithm of the minimal angle resolution. OCT images were evaluated by two doctors (Karahan E and Zengin MO). Cystoid macular edema (CME) was defined as retinal thickening with loss of foveal depression with intraretinal cystoid spaces. Subretinal fluid was defined as subretinal fluid involving the macula. This study was adhered to the Declaration of Helsinki. Informed consent was obtained from each participant. The institutional board for ethics approved the study (Sifa University, Izmir). SPSS, statistical software, version 11.6 (SPSS, Inc., Chicago, IL, USA) was used for statistical analysis. Mann-Whitney U test was used to compare silicon duration time in eyes with and without macular changes. The Wilcoxon test was used to detect differences for repeated measurements.

RESULTS

Mean age of patients was 57.4 ± 9.7 y (range 42-74y). Of the 24 eyes enrolled initially, 2 eyes with PVR grade D1 were excluded from the study because of retinal redetachment after SO removal. The remaining 22 patients completed at least 3mo follow-up after SO removal, mean follow-up time was

7.6 ± 3.7 mo (range 3 to 15). Mean RRD time was 20.9 ± 7.3 d (range 15 to 35d) before pars plana vitrectomy. All of the 22 patients maintained anatomical success of complete retinal attachment. None of the patients had anterior PVR and any retinectomy procedure did not performed during pars plana vitrectomy. Cryotherapy was not used preoperatively or intraoperatively. Laser photocoagulation was applied around the retinal tears and 360 degrees to peripheral retina. Mean duration of SO tamponade was 3.6 ± 1.0 mo (range 3-7mo). All study eyes revealed macular detachment before pars plana vitrectomy. Mean intraocular pressure was 15.2 ± 6.5 mm Hg before SO removal (range 8-32 mm Hg). Antiglaucoma medications were used in 9 eyes (40.9%), and 3 eyes (13.6%) revealed intraocular pressure >21 mm Hg, despite antiglaucoma medications. None of the antiglaucoma medication was prostaglandin analogs that could have resulted in inflammation-associated CME. After SO removal, intraocular pressure was maintained under 21 mm Hg in all eyes. Macular epiretinal membrane was not observed in any eye during silicone oil tamponade. CME was detected in 3 eyes (13.6%) before SO removal. Reduction of CME, defined as the resolution of intraretinal cystoid changes with appearance of foveal depression, was achieved in all 3 eyes after SO removal. None of the patients had peeling of internal limiting membrane (ILM) during SO removal or after SO. CME did not recur in any eye during the follow-up period after resolution (Figures 1-3). Submacular fluid was represented in 1 eye (4.5%) before SO removal. This eye achieved complete resolution of submacular fluid at the last follow-up visit (Figure 4).

Mean duration of SO tamponade was 3.5 ± 0.7 mo (range 3-6mo) in eyes without macular changes, and it was 4.0 ± 2.0 mo (range 3-7mo) in eyes with macular changes. This difference was not statistically significant ($P=0.457$). Mean RRD time before pars plana vitrectomy was 21.3 ± 7.8 d (range 15 to 35d) in eyes without macular changes, 23.7 ± 6.2 d (range 15 to 30d) in eyes with macular changes. This difference was not significant ($P=0.208$).

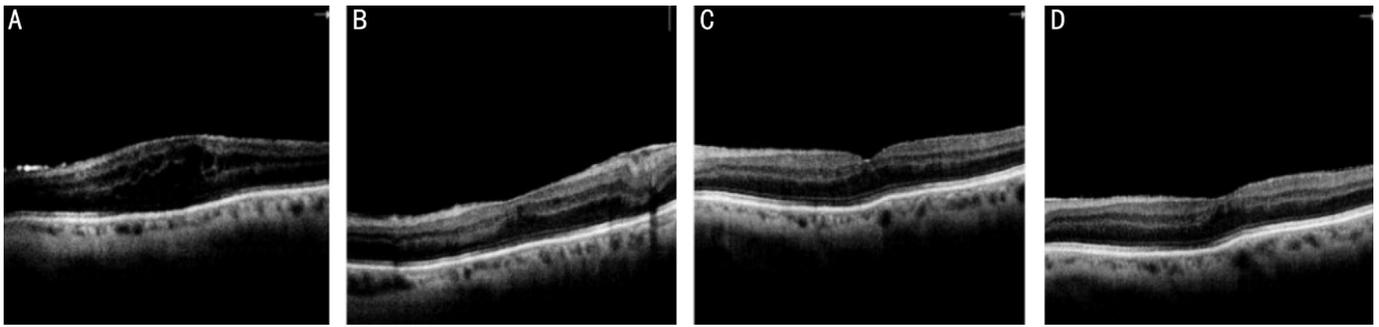


Figure 2 Resolution of cystoid macular edema after silicone oil removal A: OCT image demonstrating the cystoids macular edema under silicone oil 1wk before silicone oil removal; B: OCT at 1wk after silicone oil removal shows decreased macular edema with small intraretinal cystoid spaces; C: OCT at 1mo after silicone oil removal shows totally resolved macular edema; D: OCT shows sustained resolvment of macular edema at 3mo after silicone oil removal.

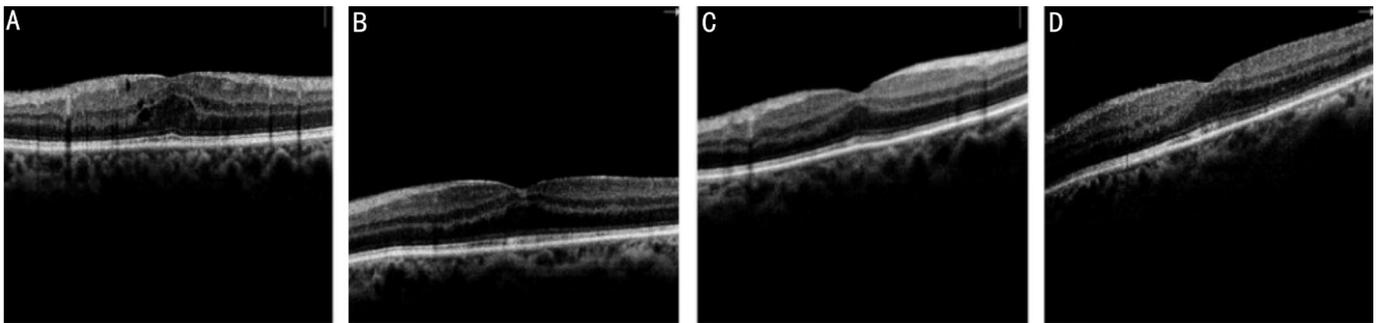


Figure 3 Resolution of cystoid macular edema after silicone oil removal A: OCT image demonstrates the cystoid macular edema under silicone oil at 1wk before silicone oil removal; B: OCT at 1wk after silicone oil removal shows a decreased macular edema; C: OCT at 1mo after silicone oil removal shows totally resolved macular edema; D: OCT shows sustained resolvment of macular edema at 3mo after silicone oil removal.

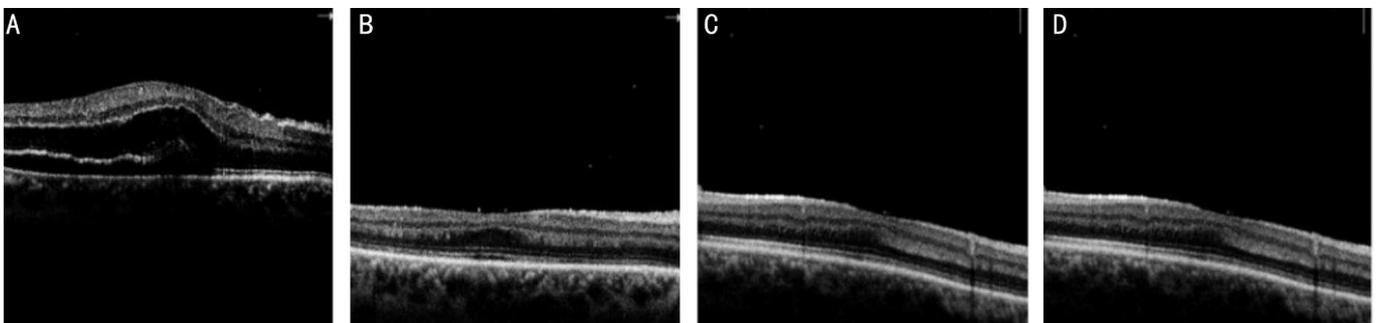


Figure 4 OCT images of a patient with fluid accumulation in subretinal and subretinal pigment epithelium A: OCT images demonstrating the subretinal fluid and fluid under retinal pigment epithelium under silicone oil at 1wk before silicone oil removal; B: OCT at 1wk after silicone oil demonstrates resolvment of subretinal and subretinal pigment epithelium fluid; C: OCT at 1mo after silicone oil demonstrates sustained resolvment of subretinal and subretinal pigment epithelium fluid; D: OCT at 3mo after silicone oil demonstrates sustained resolvment of subretinal and subretinal pigment epithelium fluid.

Mean baseline central foveal thickness (CFT) was $214.2 \pm 18.0 \mu\text{m}$ (range 185-245 μm) in eyes without macular changes. After SO removal, the mean CFT values at 1wk, and 1 and 3mo $210.7 \pm 12.4 \mu\text{m}$, $210.2 \pm 9.6 \mu\text{m}$, and $208.7 \pm 6.2 \mu\text{m}$, respectively, none of which showed significant differences from the baseline ($P=0.096$, 0.203 and 0.152 , respectively). In the eyes with CME and subretinal fluid, mean CFT was 374.2 ± 54.5 preoperatively, reduction in CFT were maintained during the follow-up period and mean CFT was 194.5 ± 18.1 at the 3mo visit which was significantly thinner than preoperative CFT ($P=0.014$). Mean BCVA was 1.15 ± 0.65 (range, hand movement to 0.2)

before SO removal in eyes without macular changes. After SO removal, the mean BCVA values at 1wk and 1 and 3mo, and 0.82 ± 0.23 , 0.76 ± 0.21 , and 0.70 ± 0.19 , all of which were significantly better than baseline ($P=0.030$, 0.017 , 0.006 respectively). In the eyes with macular CME and subretinal fluid the mean BCVA was significantly improved at 3mo after SO removal compared with baseline ($P=0.037$).

DISCUSSION

Despite its many reported complications, SO has become widely used in cases of retinal detachment due to PVR, giant retinal tears and other complicated retinal detachment procedures^[11,14,18,19].

Since the early use of SO for retinal surgery, there have been concerns about its potential retinal toxicity^[20,21]. It has been reported that SO damages the retinal tissue by mechanical stress of floating SO bubbles or biochemical toxic reactions^[22-24].

Kiss *et al*^[16] investigated the macular changes after SO removal in patients with complicated retinal detachment with PVR. The macula was clinically normal in only 12.8% of patients. Macular problems were retina pigment epithelium irregularities in 23.1%, macular pucker in 20.5%, cystoids macular edema in 18% and subretinal fibrosis in 25.6% of patients. In our study, we found three patients with CME. None of these 3 patients had associated epiretinal membrane. One patient had subretinal fluid accumulation with retinal pigment epithelium detachment. CME, and subretinal fluid were spontaneously resolved after SO removal without any additional macular surgery such as ILM peeling. The duration of SO in patients which developed macular changes and patients without macular changes were not different. A recent study was also documented analysis of macular microstructure before and after SO removal *via* spectral domain (SD) OCT. In this study, SD-OCT demonstrated macular tomographic findings of epiretinal membrane in 26.1%, CME in 19.6%, undulated inner retina in 17.4% and submacular fluid in 8.7% of the patients. Mean duration of SO tamponade was significantly longer in eyes with macular changes. Six eyes of 9 eyes which developed CME had also epiretinal membrane in this study, and 7 eyes of 9 eyes with CME underwent ILM peeling combined with SO removal. They underlined that marked reduction of CME was achieved in 8 of 9 eyes, one eye was failed to achieve recovery of CME despite ILM peeling. But, as the authors stated the primary disease entities were heterogeneous in their study, such as proliferative diabetic retinopathy, RRD and macular hole. They also underlined that, macular changes might be caused by changes related to underlying diseases rather than the toxicity of SO^[25].

In present study, the only primary disease was RRD in all cases. Duration of SO tamponade was not a significant factor for development of macular changes. None of our patients with macular changes had associated epiretinal membrane formation. We did not combined any macular surgery with SO removal. One month postoperatively all 4 patients with macular changes had normal macula with foveal depression. This improvement was sustained at 3mo postoperative examination. Absence of epiretinal membrane in a group of patient with PVR was a surprising result. Twenty of 22 eyes had PVR C3 or C2, probable reason for absence of epiretinal membrane might be the mild grades of PVR in our study group. Also, the small sample may be the cause of 0% incidence of epiretinal membrane. We believe that, presence of epiretinal membrane is inevitable in a larger sample group

with PVR. Duration of SO tamponade in our study was relatively shorter compared with previous studies^[16,25], we believe that this might be another reason for absence of epiretinal membrane formation.

The effect of SO on macular microstructure is still unclear, it has been reported that some growth factors could be concentrated into a smaller volume between SO and retina^[26,27]. Asaria *et al*^[28] performed a laboratory analysis of intraocular fluid and vitreous specimens obtained from patients undergoing removal of SO, revision vitrectomy or primary vitrectomy for macular hole, PVR or retinal detachment. They found that the median levels of fibroblast growth factor, IL-6 and protein in the retro-oil fluid were raised compared to all of the vitreous and vitreous cavity fluid samples. Theoretically, these factors may contribute to process of CME and retro-oil perisilicone proliferation and subsequent fibrocellular membrane formation.

RRD has shown to be a disease that retinal microstructure in even attached parts of the retina is abnormal. A previous study showed that retinal structure especially photoreceptor and photoreceptor outer segment is started to demonstrate some changes in ophthalmoscopically normal-appearing, still-attached part of the retina in RRD^[29]. Visual loss after successful RRD surgery is still a serious problem regardless of chosen endotamponade. Retinal folds, macular holes, pigmentary migration, foveal thinning on OCT are some changes that may result after successful RRD surgery^[30,31]. In addition, photoreceptor nonintegrity or atrophy as indicated by disruption of an inner segment and outer segment junction is another problem after successful RRD surgery^[32,33]. Previously demonstrated adverse effects of SO on macular microstructure may cause additional visual loss after successful RRD surgery. Our study also showed that SO cause macular disturbance which resolve spontaneously after SO removal. Course of these changes in years after SO removal is still unknown. The negative effect of SO on macular microstructure should be considered in all individual cases.

This study has some limitations: the sample was too small and study was not comparative. Comparison of SO and other tamponades with respect to macular changes could be more beneficial. In addition, follow-up period was too short. The studies with longer follow-up periods could give more information about the effect of SO on retinal microstructure.

In conclusion, CME and subretinal fluid accumulation was a complication of SO tamponade regardless of duration of SO tamponade. Decreased visual acuity in eyes filled with SO could be caused by macular complications due to SO. To the best of our knowledge, this is the first study demonstrate the spontaneous resolution of macular changes after SO removal. We believe that, our study does not reveal enough findings for recommendation of early SO removal. Prospective studies

with larger study groups will be needed to elucidate the incidence and course of macular changes occur with SO tamponade.

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