A Two-Port Inexpensive and Effective Method for Silicone Oil Removal

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ABSTRACT: **Background:** There are several ways to remove silicone oil (SO) from the vitreous cavity.

Objectives: To describe a simple, safe and inexpensive method of 2-port SO removal.

Method: Medical charts of 33 patients who underwent SO removal combined with cataract extraction were retrospectively reviewed, from a cohort of 119 patients who had silicone oil removal. The primary outcome was the rate of re-detachment, secondary outcomes included visual acuity (VA) and intraoperative and postoperative complications.

Results: Mean follow-up time was 27.6 months (0.25–147 ± 33.1), and mean tamponade duration prior to SO removal was 16.77 months (4–51.5 ± 14.6). The re-detachment rate was 3% (one patient). Postoperatively, seven patients (20%) had epiretinal membrane (ERM), eight patients had posterior capsule opacification (24%), and proliferative vitreoretinopathy (PVR) was diagnosed in two patients (6%). Compared to the mean VA (logarithm of the minimum angle of resolution [LogMAR]) at the preoperative examination, the mean VA (LogMAR) improved significantly at the last visit when including all ranges of VA (n=32, LogMAR 1.52 vs. 1.05 $P = 0.0002$ [Student's *t*-test] and $P = 0.001$ [Wilcoxon test]).

Conclusions: The technique described is fast and simple, keeping the posterior capsule intact in pseudophakic patients, which is advantageous in the event of future re-detachment necessitating SO reinjection. Rates of re-detachment and postoperative ERM and PVR were low. Furthermore, our method does not require the use of a surgical microscope with posterior segment viewing systems, or opening a full disposable vitrectomy set, thus drastically reducing the procedure's cost.

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KEY WORDS: retinal detachment, silicone oil (SO), two-port silicone oil removal

Silicone oil (SO) tamponade is used for complex retinal detachment (RD) procedures such as proliferative vitreoretinopathy (PVR), diabetic tractional retinal detachment (TRD), traumatic RDs, RD with giant tear, chronic serous RD, and failed primary procedure [1-4]. SO is also applicable in cases where postoperative positioning is a challenge (i.e., children or patients unable to maintain optimal position due to physical or mental disability), or a postoperative necessity for air travel. These complex RDs have a significant risk of re-detachment with a reported rate of 13–34% [5,6]; however, if the SO remains for too long it could lead to complications such as keratopathy, cataract, glaucoma, PVR formation, optic neuropathy, or subretinal migration of oil droplets [7-10].

There are several techniques described for SO removal divided into anterior segment approaches and posterior segment approaches. Some of the techniques include active vacuum aspiration and others are passive. Removal of SO in aphakic eyes is performed by aspirating the SO via the anterior chamber (AC) after performing a corneoscleral tunnel [11]. Another anterior segment approach involves the removal of SO via a posterior capsulorrhexis in pseudophakic patients or as part of a combined cataract with SO removal surgery [12-14]. The pars plana methods of removing SO uses three trocars (20G, 23G, or 25G), opening a full disposable vitrectomy set, using a posterior segment viewing system, and at times leaving an air bubble at the end of the procedure [15-18]. To the best of our knowledge, there is only one published study describing a 2-port technique for SO removal by using a non-conventional inexpensive method [19]. The aim of our study was to describe our method of active 2-port pars plana SO removal as compared to other methods.

PATIENTS AND METHODS

All data for this retrospective study were collected and analyzed in accordance with the policies and procedures of the institutional review board of Meir Medical Center and the tenets set forth in the Declaration of Helsinki.

The medical charts of 119 patients who underwent SO removal by a single surgeon (AR) at Meir Medical Center between 1 January 2005 and 30 November 2016 were analyzed. We present the data of 33 patients who underwent SO removal combined with cataract surgery to have a homogenous cohort for visual acuity (VA) comparison. The other 86 patients underwent only a SO removal procedure. We included patients who did not have clinically visible epiretinal membrane (ERM), PVR, or retinal detachment preoperatively and who underwent the exact surgical technique described. Exclusion criteria were patients who underwent a SO removal by another method, patients under the age of 18 years, and pseudophakic patients.

The following data were collected: age at the time of SO removal, gender, involved eye, VA prior to the retinal detachment (RD) surgery, VA before SO removal surgery, the last VA recorded, cause of RD, whether the macula was on or off, lens status, presence of PVR, type of SO injected, and type of anesthesia during SO removal surgery. Also recorded were type of intraocular lens (IOL) implanted, posterior capsule status, intraoperative complications (posterior capsular tear, sulcus implanted IOL), postoperative complications (ERM), posterior capsule opacification (PCO), PVR, presence of SO in AC, fibrinoid reaction in the AC, diplopia, lens particle remnants, and zonulolysis, re-detachment rate, and follow-up time since SO removal surgery.

The presence of SO in the vitreous cavity changes IOL measurements [20] removal of the silicone oil can be combined with phacoemulsification and intraocular lens (IOL. In this study, preoperative IOL calculations in all patients were conducted by IOLMaster (Carl Zeiss Meditec, Jena, Germany) prior to RD surgery, except for one patient who had vitreous hemorrhage due to proliferative diabetic retinopathy and in this case the axial length was measured by A-scan ultrasonography.

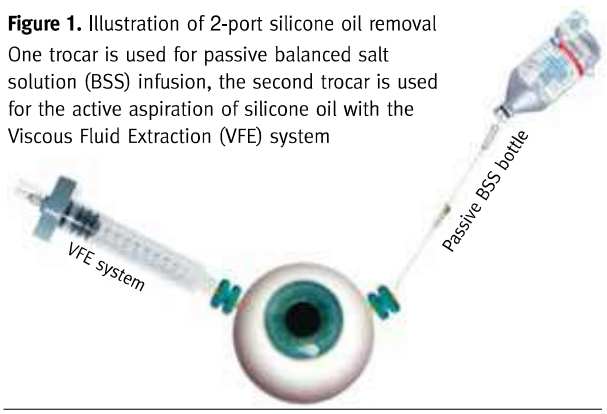
VA was recorded in Snellen units and was converted to logarithm of the minimum angle of resolution (logMAR) for statistical analyses. Primary outcome was the rate of re-detachment, and secondary outcomes were VA, intraoperative and postoperative complications, and postoperative presence of ERM or PVR.

SURGICAL TECHNIQUE

All surgeries were performed at Meir Medical Center, Kfar Saba, Israel, by a single surgeon (AR) using the Constellation System (Constellation, Alcon, USA) and were performed with either retrobulbar anesthesia (with lidocaine 2%) or under general anesthesia in un-cooperative patients.

A standard phacoemulsification surgery was performed with implantation of posterior chamber IOL (either in the bag or in the sulcus), the corneal incisions were closed by hydration, and a temporary 10-0 suture was placed at the principal phaco incision to maintain the anterior chamber during trocar insertion and vitrectomy. Two 25G trocars were inserted approximately 3.5 mm from the limbus, one inferotemporally and one superotemporally. Following this procedure, a passive infusion cannula connected to a balanced salt solution (BSS) bottle was inserted into the inferotemporal trocar, while the SO was aspirated through the second trocar using the active pump of the viscous fluid extraction (VFE) system of the constellation. The BSS was the further aspirated for another 4 to 5 full 10 cc syringe cycles to wash out any remaining oil bubbles [Figure 1]. The vitreous cavity was left with BSS at the end of surgery. The trocars were removed as well as the temporary corneal suture. A depot steroid was injected sub-conjunctivally and the eye was bandaged with antibiotic ointment. Postoperatively, patients received topical antibiotic ofloxacin 0.3% (Oflox; Allergan, Westport, Ireland) and steroid drops prednisolone acetate 1% (Pred Forte; Allergan, Westport, Ireland) 5 times daily for 1 week, and subsequently only steroid drops 3 times daily for a further 2 weeks.

Figure 1. Illustration of 2-port silicone oil removal
One trocar is used for passive balanced salt solution (BSS) infusion, the second trocar is used for the active aspiration of silicone oil with the Viscous Fluid Extraction (VFE) system



STATISTICAL ANALYSIS

Data are presented as: mean, range, and standard deviation for continuous variables and as numbers and percentage for nominal data. Because sample size is small all analyses were tested with non-parametric tests. Wilcoxon test was used for comparison of pre-SO removal and last visit to the physician and Friedman test was used for VA comparison between the 3 time points. A P value < 0.05 was considered statistically significant. Statistical analyses were performed using IBM Statistical Package for the Social Sciences statistics software, version 23 (SPSS, IBM Corp, Armonk, NY, USA).

RESULTS

This retrospective study comprised 33 eyes of 33 patients who underwent the precise 2-port procedure. Baseline characteristics are shown in Table 1. Mean age of patients at time

Table 1. Baseline characteristics (n=33)

Mean patient age (years, range ± SD)	56.94 (25–85 ± 14.5)
Ratio of male:female	21:12
Buckle presence	n=11
Cause of retinal detachment	
Breaks/ holes	n=20
TRD	n=8
Trauma	n=2
Presence of PVR	n=1
Giant tear	n=1
Macular hole	n=1
VH due to PDR	n=1
Mean tamponade duration (months, range ± SD)	16.77 (4–51.5 ± 14.6)
Pre-silicone oil removal presence of ERM	n=0

ERM = epiretinal membrane, PDR = proliferative diabetic retinopathy, PVR = proliferative vitreoretinopathy, SD = standard deviation, TRD = tractional retinal detachment, VH = vitreous hemorrhage

of surgery was 56.94 ± 14.5 years (range 25–85); 21 patients were male; and 11 patients (33%) had previously undergone buckle surgery in addition to vitrectomy. The cause of retinal detachment (due to which SO was injected), was because of breaks or holes (n=20), one patient had a giant tear, eight had TRD of which one had also PVR, two had traumatic RD, one had a macular detachment associated with a macular hole, and one had multiple recurrent vitreous hemorrhages. Fundus examination prior to SO removal found mild peripheral PVR in five patients. Mean SO tamponade duration was 16.77 months (4–51.5 ± 14.6). Ophthalmological examination before SO removal surgery did not reveal the presence of ERM or any macular pathology in any subjects. The surgeons choice for an implant was mainly the hydrophilic SeelensAF IOL (Hanita, Israel) implanted in 23 patients while the other 10 patients had various different implants. The surgery time for SO removal was about 15–20 minutes less than the standard 3-port method. With our technique the surgery cost was US$298 compared to the standard procedure that costs US$513.

The mean follow-up time after SO removal was 27.6 months (0.25–147 ± 33.1) [Table 2]. The re-detachment rate was 3% occurring only in one relatively young patient who presented with PVR 9 months after SO was removed. Intraoperative complications included one case of posterior capsular tear and a total of five cases where the IOL was implanted in the sulcus due to weak capsule or zonules. In terms of postoperative complications, seven patients (20%) had ERM, PCO was observed in eight patients (24%), and PVR was noted in two patients (6%). The vast majority of the patients had postoperative day 1 hypotony; however, none of them had hypotony at 1–2 weeks of follow-up. Two patients had a residual SO bubble in the AC, two had postoperative fibrinoid reaction, one previously underwent buckle surgery presented diplopia, and one had residual lens cortex in the AC. None of the patients had postoperative endophthalmitis.

Table 2. Intraoperative and postoperative characteristics (n=33)

Follow-up duration (months, range ± SD)	27.6 (0.25–147 ± 33.1)
Re-detachment rate	n=1 (3%)
Intraoperative complications	
Posterior capsular tear	n=1 (3%)
Sulcus implanted IOL	n=5 (15%)
Postoperative complications	
PCO	n=8 (24%)
ERM	n=7 (21%)
PVR	n=2 (6%)
SO in anterior chamber	n=2 (6%)
TASS/ Fibrinoid reaction	n=2 (6%)
Diplopia	n=1 (3%)
Lens particle in anterior chamber	n=1 (3%)
Zonular weakness	n=3 (9%)
Endophthalmitis	n=0

ERM = epiretinal membrane, IOL = intraocular lens, PCO = posterior capsular opacification, PVR = proliferative vitreoretinopathy, SD = standard deviation, SO = silicone oil, TASS = toxic anterior segment syndrome

The mean VA (LogMAR) was significantly improved at the last recorded visit compared to the preoperative examination when including all VA ranges [Table 3] (n=32, LogMAR 1.52 vs. 1.05, $P = 0.0002$ using Student's t-test and $P = 0.001$ using the Wilcoxon test). When excluding low vision such as counting finger or hand movement, VA [Table 3] also improved, (n=21, LogMAR 1.18 vs. 0.74 $P = 0.001$ using Student's t-test and $P = 0.002$ using the Wilcoxon test).

DISCUSSION

We present a simple, inexpensive, and effective method of SO removal combined with cataract surgery, compared with well-known methods in the literature. Several studies [11-14] have described removal of SO through the anterior segment, thus risking keratopathy, endothelial corneal damage, or glaucoma. Performing posterior capsulectomy during SO removal surgery, when combined with cataract surgery [12-14] is less beneficial in case of a future re-detachment necessitating re-injection of SO, thus increasing the risk of SO seepage into the anterior chamber. The presence of SO in the vitreous cavity may increase the rate of cataract formation as well as increasing the technical difficulty of the surgery itself, as cataract surgery in eyes filled with SO pushing the crystalline lens forward, is challenging and complicated [7,9,21]. Cataract cases presented in public hospitals in Israel are more complicated than at private practice [22]. These difficulties could be avoided by performing a combined vitrectomy and cataract surgery at the RD presentation [23].

In this study, following a combined SO removal and cataract surgery, VA was significantly improved (n=32, LogMAR 1.52 vs. 1.05, $P = 0.0002$ using Student's t-test and $P = 0.001$ using the Wilcoxon test). This effect can be attributed both to the cataract removal and the normalization of the refractive index of the vitreous cavity after SO removal. Our method of SO removal combined with cataract surgery adds only 10 minutes to a standard cataract surgery, and keeps the posterior capsule intact preventing future complications if SO re-injection is needed. In our experience, at some point,

Table 3. Comparison of visual acuity between preoperative and last recorded examination

	Mean	N	SD	Paired t-test	Wilcoxon test
VA (LogMAR) pre-SO removal (all cases)	1.52	32	0.61	$P = 0.0002$	$P = 0.001$
VA (LogMAR) at last visit (all cases)	1.05	32	0.75	–	–
VA (LogMAR) pre-SO removal (excluding CF and HM cases)	1.18	21	0.38	$P = 0.001$	$P = 0.002$
VA (LogMAR) at last visit (excluding CF and HM cases)	0.74	21	0.49	–	–

CF = counting finger, HM = hand motion, SD = standard deviation, VA = visual acuity

nearly every pseudophakic patient will have to undergo YAG capsulotomy; however, we prefer to wait for at least 3 months after SO removal to verify that the retina is attached, before performing YAG capsulotomy.

Two-port way SO removal techniques are sparsely reported. Ju et al. [19] compared two modified methods for active removal of SO using two 23G transconjunctival trocars; however, instead of using the standard VFE pack they connected the fluid-air exchange tube to a 1 ml syringe with the plunger removed. In our study, we used two 25G trocars and aspirated the SO with the standard VFE pack, which might be a safer method.

Other methods [15-18,24] using 3-port way pars plana vitrectomy with posterior viewing system are clearly more time consuming and costly. The importance of performing optical coherence tomography (OCT) preoperatively is well known and is used to identify any macular pathology (such as ERM, cystoid macular edema and ellipsoid zone disruption), which could be treated during the surgery [25]. The advantage of using a posterior viewing system is better assessment of the retina and on spot treatment of ERM, PVR, or new breaks; however, we believe that with careful preoperative observation and selecting the right patients (as done in this study), our method may provide a sufficient solution. This method offers shorter times and lower costs in patients needing only SO removal without preoperative evidence of further posterior segment surgery, such as ERM removal.

Among the 33 eyes in the current study, re-detachment occurred only in one relatively young patient who presented with PVR and re-detachment 9 months after SO was removed, making it unlikely to be related to the SO removal technique. Re-detachment rates were reported to be 13–34% [5-7] compared to the current study (albeit with a small sample size). We found a very low rate of re-detachment over a relatively long follow-up time, especially considering the indications and complexities of the previous surgeries.

The relatively long tamponade time with SO in this study, was due to both the limited availability of operating room time and many patient's reluctance to undergo further surgery to remove the SO.

STRENGTHS

The strengths of this study are a relatively long follow-up time after SO removal, with no loss to follow-up of patients, and the use of a single technique in all cases.

LIMITATIONS

The study was a retrospective analysis and some information was missing in the medical charts; hence, the limited data concerning VA, as well as a relatively limited number of patients, giving less power to the statistical analysis. VA was not best corrected acuity, but rather measured with patient's own glasses or corrected with pinhole. Presence or absence of posterior vitreous detachment was not mentioned in the patient's preoperative examination. Also, the absence of ERM prior to SO removal as concluded by slit lamp exam was not confirmed with OCT imaging therefore possibly underestimating its true prevalence.

CONCLUSIONS

Our method of SO removal combined with cataract surgery is fast, inexpensive, and safe. It keeps the posterior capsule intact, but necessitates careful patient preoperative examination and selection.

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Capsule

Taking preventive measures for cancer

Recent technological advances have made it possible to detect, in healthy individuals, premalignant blood cells that are likely to progress to hematologic cancer. These advances in early detection have fueled interest in "cancer interception," the idea that drugs designed to treat advanced cancer might also be useful for cancer prevention. **Uckelmann** and colleagues provided support for this concept in a study of mice genetically predisposed to develop acute myeloid leukemia. Early administration of an epigenetic therapy that had previously been shown to have anticancer activity in advanced leukemia models was able to eliminate preleukemia cells and extend survival of the mice.

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Eitan Israeli

Capsule

Presurgical immune checkpoint blockade

Checkpoint blockade immunotherapy using antibodies that inhibit the programmed cell death 1 (PD-1) or cytotoxic T lymphocyte-associated protein 4 (CTLA-4) pathways has resulted in unprecedented clinical outcomes for certain cancers such as melanoma. **Topalian** and co-authors reviewed advances in neoadjuvant (presurgical) immunotherapy as an important next step for enhancing the response of early-stage tumors to immune checkpoint blockade. They highlight the mechanistic rationale for neoadjuvant immunotherapy and recent neoadjuvant clinical trials based on anti–PD-1 or anti–PD-1 ligand 1 (anti–PD-L1) therapy. Pathological assessment criteria that may provide early on-treatment biomarkers to predict patient response are also discussed.

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Eitan Israeli

Capsule

MAIT cells and tumor immunity

Mucosal-associated invariant T (MAIT) cells are immune cells that recognize host microbial metabolites presented by major histocompatibility complex class I-related protein 1 (MR1). During bacterial infection, activation of MAIT cells leads to the elimination of the infected cells. However, the role of MAIT cells in other disease states is less clear. For example, MAIT cells have been reported to be present in human tumors, but the physiological relevance has not been explored. **Yan** et al. studied two different experimental mouse tumor models and found that MAIT cells promoted lung metastasis by quashing natural killer cell activity. The researchers could block this effect and reduce metastasis by using inhibitory antibodies against MR1. Targeting the MAIT cell–MR1 axis may represent an emerging strategy for cancer immunotherapy.

Cancer Discov 2020; 10: 124

Eitan Israeli

"An ounce of action is worth a ton of theory"

Ralph Waldo Emerson (1803-1882), American essayist, lecturer and poet, and champion of individualism