

Long-term prognosis after removal of silicone oil

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PURPOSE. To investigate surgical and functional results six or more months after silicone oil (SiO) removal in patients undergoing pars plana vitrectomy (PPV) and tamponade for various reasons.

METHODS. Retrospective chart review. Inclusion criteria were recurrent retinal detachment with PVR grade C (R-RD), primary PVR grade C longer than 9 hours, recurrent vitreous hemorrhage in PDR (PDR-RVH) with traction RD, giant retinal tears (GRT) with PVR grade C and total RD with vitreous hemorrhage and hypotony in penetrating traumas (PT). Indications for removal of SiO included attached retina and intra-ocular pressure (IOP) more than 10 mmHg after 60 days or IOP more than 30 mmHg despite medication.

RESULTS. Of the 212 patients undergoing PPV and SiO tamponade between 1994-1997, 91 met the inclusion criteria, 8 had incomplete charts so 83 eyes were included in the study. The mean interval between PPV and SiO removal was 163.1 ± 111.0 days and follow-up was 351.5 ± 148.6 days. At the time of SiO removal, 30.6% of phakic eyes had cataract, 14.4% keratopathy and 8.4% IOP more than 30 mmHg. At the last visit after SiO removal, 43.5% had cataract, 12.0% keratopathy, 6.0% IOP > 30 mmHg and 3.6% IOP < 5 mmHg. After SiO removal, 6.0% eyes developed R-RD. There was no significant difference in SiO duration for patients with and without R-RD. VA was more than 5/200 in 16.8% of eyes preoperatively, 79.5% at the time of SiO removal ($p < 0.05$) and 78.3% at the last visit (n.s.) and better than 20/400 in respectively 2.4%, 51.8% ($p < 0.05$) and 53% (n.s.). There was a tendency for VA to improve after SiO removal ($p = 0.011$).

CONCLUSIONS. SiO is an effective tamponade for complex RD, although its possible benefits must always be weighted carefully against the complications and the need for further intervention. The present series compares favorably with the current literature in terms of complication rates. The optimal timing of SiO removal and precise screening and decision-making guidelines before removal are still the main issues and need careful consideration. (Eur J Ophthalmol 2000; 10: 60-5)

KEY WORDS: Pars plana vitrectomy, PDR, Penetrating trauma, PVR, Silicone oil tamponade, Retinal detachment

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INTRODUCTION

Silicone oil (SiO) is a useful tamponade in retinal detachment (RD) although complications, namely cataract, glaucoma and keratopathy among the com-

monest, have led to worries about its prolonged use. Prompt removal of SiO has been recommended (1, 2). The Silicone Oil Study showed that SiO tamponade yields a higher success rate than SF6 (2) tamponade in RD with PVR C3 (3, 4) or higher, while fail-

ing to provide any benefit over C3F8 for the same cases (5).

Further studies showed that after pars plana vitrectomy (PPV) for PVR grade C SiO filled eyes, are more prone than C3F8 filled eyes to develop ocular hypertension and less prone to develop hypotension (6). Visual outcome and complications after removal of SiO have been studied extensively and re-detachment rates range from 20% in PVR grade C cases (7), to 16-25% in PDR cases (8, 9), and 8% and 34% respectively in "uncomplicated" and "complicated" cases (10).

The present paper reports the visual outcomes, complication rates and follow-up data 6 to 30 months after SiO removal in 83 eyes undergoing PPV and SiO tamponade for various surgical indications.

METHODS

We retrospectively analyzed the records of patients undergoing PPV with SiO tamponade and SiO removal at our institution between January 1994 and December 1997, operated on by one surgeon (GL) for the indications reported below. Patients with less than six months' follow-up after SiO removal were excluded.

SiO used in all cases is 2,000 centistokes polydimethylsiloxane (Micromed Inc., Rome, Italy).

The indications for SiO tamponade, listed in Table I, comprised:

- 23 recurrent retinal detachment after vitrectomy with PVR grade C (R-RD);
- 28 primary RD with PVR grade C type 4 and/or 5 extending for more than 9 o'clock;
- 16 proliferative diabetic retinopathy with recurrent vitreous hemorrhage and "macula off" traction retinal detachment (PDR-RVH);
- 10 giant retinal tears with PVR grade C (GRT);
- 6 perforating or penetrating trauma (PT) associated with total RD and vitreous hemorrhage.

Patients in the R-RD group underwent an average of 1.7 operations before SiO tamponade, and all patients in the PDR-RVH group experienced at least two recurrent vitreous hemorrhages before evolving into a "macula-off" traction RD.

The authors routinely remove SiO provided the following conditions are met:

- Attached retina

- IOP more than 10 mmHg after 60 days or
- IOP more than 30 mmHg despite medication

SiO removal technique

SiO was removed, after pars plana placement of an infusion cannula, by active suction through a second sclerotomy in pars plana, under direct visualization through the operating microscope. After SiO-fluid exchange, all eyes were checked carefully for oil emulsion by means of scleral depression. In a few cases, in order to remove the oil more completely, an intermediate time with fluid-air exchange was allowed so as to remove both the SiO and the emulsion.

Complications

Among SiO associated complications, "significant cataract" was defined as a posterior cortical lens opacity developing after SiO tamponade that significantly impaired fundus examination: "keratopathy" was defined as the development of significant epithelial or stromal edema, opacity or band keratopathy after SiO tamponade, with or without corneal endothelial contact.

Thirty-nine of 83 (46.9%) eyes (15/23 R-RD, 12/28 PVR, 8/16 PDR-RVH, 0/10 GRT, 4/6 PT) underwent trans-pupillary laser treatment after surgery and before SiO removal. In most PVR, R-RD and PT eyes a 360°, equatorial, double-row laser treatment was accomplished.

Statistical analysis used the chi-squared test, Fisher's test, Analysis of Variance (F-test), Student's t-test, Wilcoxon's signed-rank test and McNemar's test; p values less than 0.05 were considered significant.

RESULTS

Ninety-one patients met inclusion criteria but eight (8.7%) had incomplete records. There was no significant difference between patients lost to follow-up and those included in the study as regards age, sex, VA at baseline or diagnosis. Between January 1994 and December 1997, 212 patients with the same indications as those included in the study underwent PPV and SiO tamponade with an overall oil removal rate of 91/212 (42.9%).

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The sample population comprised 83 eyes of 83 patients, average age 59.6 ± 14.2 years at baseline. Diagnosis at presentation and SiO durations are reported in Table I. The mean interval between PPV and SiO removal for the whole sample was 163.1 ± 111.0 days, mean follow-up after SiO removal was 351.5 ± 148.6 days (range 62 - 924 days). Analysis of variance did not show any significant difference for age or SiO duration between the groups reported in Table I.

Complications occurring during the period of SiO retention are reported in Table II and included 19 phakic eyes developing significant cataract, 12 with keratopathy, and 7 eyes with IOP greater than 30 mmHg despite medication. At the last visit after SiO removal 27 had significant cataract, 10 keratopathy,

5 IOP>30, and 5 eyes had IOP < 5 mmHg.

The mean time of SiO retention for eyes that eventually developed significant cataract (regardless of subgroup) was 169.8 ± 83.2 days (n.s. from eyes not developing a cataract) for eyes developing IOP greater than 30 mmHg it was 196.2 ± 151.5 days (regardless of subgroup; n.s.). The mean age of patients developing cataract was 58.7 ± 5.3 years (n.s. from those not developing a cataract).

After SiO removal 5/83 eyes (6.0%) developed R-RD: three had a baseline diagnosis of R-RD, one GRT and one trauma. The time of SiO retention for eyes developing recurrence after oil removal was 135.5 ± 23.6 days. There was no significant difference in duration of SiO between patients with and without R-

TABLE I - DIAGNOSIS AT PRESENTATION, AGE AND SiO DURATION

Diagnosis	Age (years \pm SD)	No.	%	SiO duration (days \pm SD)
R-RD with PVRC	58.3 ± 14.4	23	28	145.0 ± 92.5
PVRC type 4 and 5	62.2 ± 10.9	28	34	160.4 ± 101.1
PDR-RVH	61.5 ± 18.0	16	19	196.1 ± 145.7
GRT	48.5 ± 16.2	10	12	200.0 ± 166.2
Trauma	51.4 ± 9.7	6	7	135.2 ± 101.6
	59.6 ± 14.2	83	100	163.1 ± 111.0

TABLE II - COMPLICATIONS BEFORE AND AT THE LAST VISIT AFTER SiO REMOVAL

Complication	Before SiO removal		After SiO removal	
	No.	%	No.	%
Cataract	19/62	30.6	27/62	43.5
Keratopathy	12/83	14.4	10/83	12.0
IOP > 30 mmHg	7/83	8.4	5/83	6.0
IOP < 5 mmHg	-	-	5/83	6.0

TABLE III - VISUAL ACUITY PRE-OPERATIVELY, AT THE TIME OF SiO REMOVAL AND SIX MONTHS AFTER REMOVAL. There were significant differences for both post-operative figures. VA with and without SiO are not significantly different

Visual acuity (VA)	> 5/200	%	p	> 20/400	%	p
Pre-op	26/83	31.3		2/83	2.4	
At the time of SiO removal	66/83	79.5	<0.05	43/83	51.8	< 0.01
6 months after SiO removal	65/83	78.3	< 0.05	44/83	53.0	<0.01

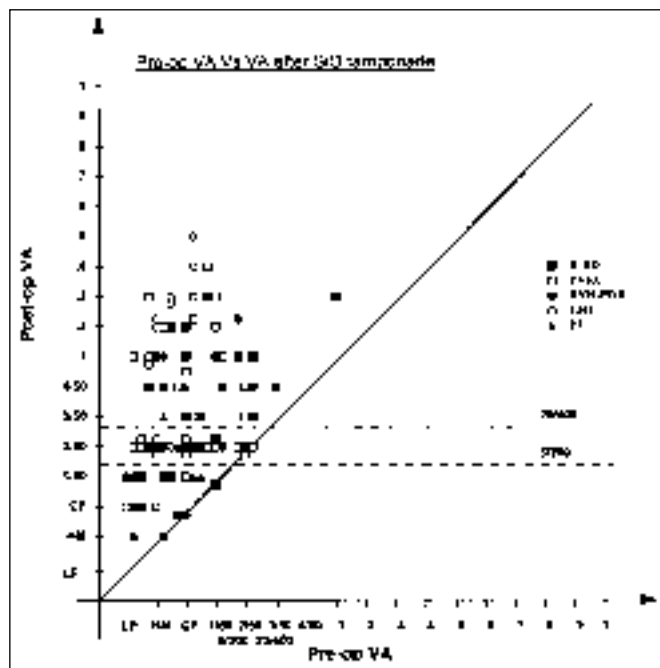


Fig. 1 - Pre-operative and post-operative VA (i.e. best-corrected VA with SiO in the vitreous chamber) in a two-dimension scattergram.

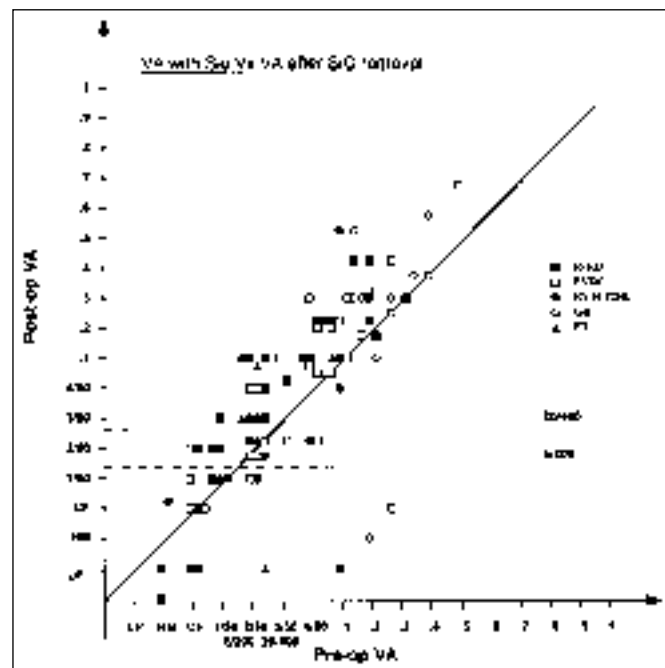


Fig. 2 - VA before and after SiO removal in a two-dimension scattergram. Wilcoxon's signed-rank test gave a significant trend in VA improvement ($W = -553.0$; $p = 0.011$).

RD. Two of the five eyes developing R-RD had the SiO removed because of IOP > 30 mmHg (versus 3 of the remaining 76; $p = 0.07$; n.s.). One of the five eyes with R-RD after SiO removal underwent transpupillary completion of laser treatment before removal (versus 4/44 who did not undergo laser treatment; $P=0.4$; n.s.).

Visual acuity (VA) outcomes are reported in Table III and in Figures 1 and 2. There was a significant trend ($p = 0.011$) towards VA improvement after SiO removal (Fig. 2). Of the 7/83 eyes in which SiO was removed because of IOP > 30 mmHg (Tab. II), two achieved VA better than 5/200 compared to 57 eyes of the remaining 76; $p = 0.03$) and one better than 20/400 (compared to 37 of the remaining 76; n.s.).

DISCUSSION

Although the use of SiO is still a matter of controversy, there are a number of situations including necrotizing retinitis (11) PDR-RVH (12), GRT (13), total RD in perforating trauma with hypotony and vitreous hemorrhage (14) and, to a lesser extent, R-RD with PVR

grade C (1), where most authors agree (15). In these cases the chemical and physical properties of SiO offer an advantage over gas tamponades, allowing faster postoperative rehabilitation, less need for prone positioning and a better view of the fundus in case of late postoperative bleeding. Whether these benefits outweigh the well-known risks and disadvantages of SiO tamponade (16, 17) is a matter of speculation.

The purpose of the present paper is to report the long-term follow-up of eyes undergoing SiO removal after PPV in a broader range of complicated cases, including those not meeting the Silicone Oil Study inclusion criteria (2).

The age of the study population did not differ significantly among groups, though GRT patients tended to be younger. There was also no significant difference between the groups in terms of timing of SiO removal (Tab. I), which agrees with the Silicone Oil Study Report No. 6, where the average oil retention period was 181 days (7), considerably shorter than in some other studies (1, 8).

Complications arising during SiO retention (Tab. II) included 19/62 eyes developing significant cataract progressing to 27 at the latest available visit, 2/83

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keratopathy, 7/83 IOP greater than 30 mmHg and 3/83 IOP less than 5 mmHg. Although the population and study design are different from the Silicone Oil Study, definitions of cataract and IOP limit values overlap and the incidence of both hypotony and increased IOP match fairly closely, but the incidence of keratopathy is lower in our series. A partial explanation might be the different definition of keratopathy, which in the Silicone Oil Study included any sign of edema or localized opacity of the cornea. The lower glaucoma and keratopathy rates than in other studies (1, 8) might be explained on the basis of the significantly shorter duration of SiO retention while the lower rate of eyes below 5 mmHg after SiO removal might reflect a selection bias introduced by indications to SiO removal too (IOP before removal > 10 mmHg; see Methods).

Despite the removal of SiO, the rate of progression to significant cataract increased (Tab. II), in accordance with other reports (17), and the prevalence of glaucoma and keratopathy remained basically unchanged.

Silicone oil removal rates in our series are close to those reported in the literature (18), since we elected to remove oil in 91/212 (43.3%) eyes. Five eyes developed marked hypotony after SiO removal.

Retinal re-detachment after SiO removal occurred in 5/83 (6.0%) eyes, independently of the duration of tamponade and the pre-operative diagnosis, with a slightly higher prevalence of R-RD eyes. This figure compares favorably with most current reports (7-10). Although not statistically significant, eyes in which SiO was removed because of IOP > 30 mmHg were more prone to develop R-RD.

Trans-pupillary argon laser treatment was done in 39/83 (46.9%) eyes, and was associated with a lower percentage of re-detachment (1/39 versus 4/44: n.s.) after SiO removal. This treatment was delivered in order to complete intra-operative photocoagulation whenever the surgeon deemed it necessary to achieve more secure retinal adhesion around retinal holes or

tears or to complete panretinal photocoagulation in PDR eyes. We clearly cannot infer that laser treatment *per se* has any protective or beneficial property, since all eyes undergoing oil removal had been previously judged "sufficiently treated" before removal; it is nonetheless our impression that the adequate treatment of all breaks and tears is of paramount importance (10), since after SiO removal the dynamics of fluids within the vitreous chamber radically change and leakage underneath the retina becomes easier (19).

Comparison of VA before and after SiO removal shows a significant improvement ($w = 2.553$; $p = 0.011$) (Fig. 2) though dividing patients into 5/200 and 20/400 groups was not significant (Tab. III). Patients in whom SiO was removed because of IOP > 30 mmHg had a worse prognosis than the rest of our sample population, with only 2/7 over 5/200 and 1/7 over 20/200.

Once again it is not easy to compare these results with previous studies and obviously these patients undergoing SiO removal represent a subgroup with a significant bias for better outcome than eyes retaining oil. Nonetheless, postoperatively 65/83 eyes retained vision better than 5/200 and 44/83 better than 20/400, indicating overall good visual rehabilitation.

SiO is an effective tamponade for complex RD cases of PDR, GRT, trauma and complex R-RD with PVR. The possible benefits must always be weighted carefully against the complications and need for future removal. The present paper would like to stimulate discussion on points that might make a difference in terms of long-term prognosis, such as optimal timing of SiO removal and precise screening and decision-making guidelines before removal.

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