Assessment of Pathologies Detected on Retinal Imaging Simultaneous With Silicone Removal Surgery

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ABSTRACT

Purpose: To assess pathologies which may be seen during silicone removal and additional surgical procedure in patients who underwent pars plana vitrectomy (PPV) using silicone oil as intraocular tamponade due to rhegmatogenous or tractional retinal detachment.

Material and Method: We retrospectively reviewed patients who underwent silicone oil removal and data regarding age, gender, best-corrected visual acuity, intraocular pressure, lens status, duration of silicone retention in eye, additional pathologies during silicone removal and additional surgical procedures were recorded. All data were extracted from baseline examination and visits after PPV and silicone removal.

Results: The study included 60 eyes of 60 patients (25 women, 35 men). Mean age was 59.6 ±11.6 years (19-83 years). Mean best-corrected visual acuity was 0.091±0.231 before surgery (pre-PPV) whereas 0.049±0.092 before silicone oil removal (post-PPV) and 0.134 ±0.229 after silicone oil removal. Mean intraocular pressure was 14.58±5.24 mmHg before surgery whereas 15.56 ±4.86 mmHg before silicone oil removal and 13.16 ±5.32 mmHg after silicone oil removal. Mean time to silicone oil removal was 4.48 ±4.10 months (2-24). In the same session, epiretinal membrane and internal limiting membrane peeling was performed in 21 patients (35.0%) whereas vitreous clearance in 11 patients (18.3%) after silicone oil removal. As retinal detachment was detected after silicone removal, detachment surgery was performed in 16 patients (26.7%) whereas additional laser photocoagulation in 16 patients (26.7%) in the same session. In final control visit, it was seen that retinal attachment was achieved in 55 of 60 patients (91.7%).

Discussion: An additional pathology was detected in the majority of patients following silicone oil removal. Thus, the retina must be assessed using wide-angle imaging systems during silicone oil removal and required interventions should be performed in the retina same session for cost-effectiveness.

Keywords: Retinal detachment, silicone oil tamponade, silicone oil removal.

INTRODUCTION

Silicone oil use in the treatment of complicated retinal detachment was first reported by Cibis in 1962[1] and it has been used as a safe and effective tamponade in the treatment of complicated retinal detachment so far.[2] In recent years, pars plana vitrectomy (PPV) has been increasingly used with greater success owing to advances in wide-angle imaging systems, introduction of surgical instruments with smaller diameter, anti-vascular endothelial growth factor therapy and increased surgical experience.[3] In addition to silicone oil, air, sulfur hexafluoride (SF6) and perfluoropropane (C_3F_8) gases can be used as intraocular tamponade after vitreoretinal surgery. In the literature, it was shown that silicone oil is effective in achieving retinal attachment in eyes with severe proliferative vitreoretinopathy (PVR) and complicated eyes when compared to other tamponade agents.[4-6] In general, silicone oil is preferred in several conditions including PVR, proliferative diabetic retinopathy (PDR), retinal detachment caused by giant retinal tears and retinal detachment complicated by factors such as ocular trauma etc.[7] Although silicone oil is a safe and effective option to maintain retinal attachment and prevent recurrence, there are many potential silicone oil-related complications. These complications include refractive errors, cataract, silicone emulsification, glaucoma, band keratopathy, corneal endothelium insufficiency, inverse hypopyon in anterior chamber, rubeosis iridis, macular hole, cystoid macular edema and optic atrophy.[8-12] In patients given silicone oil as tamponade, it is recommended to remove

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silicone oil as soon as possible after achievement of retinal stability in order to prevent such complications.[9, 13]

There are different approaches regarding retinal assessment during silicone removal. Some surgeons complete surgical procedure by aspirating silicone oil.[14-16] while others perform anterior segment imaging after completion of silicone oil and detect and treat pathologies present.[17] Several complications including incomplete laser, recurrent detachment, retinal tears in different quadrants and epiretinal membranes are commonly observed during silicone oil removal. Thus, the retinal imaging during silicone oil removal and performing additional surgical procedures, if needed, in the same session seem beneficial regarding patient comfort, early visual recovery and cost-effectiveness.

In this study, it was aimed to assess additional pathologies which may be seen during silicone removal, complication frequency and additional surgeries performed in patients underwent PPV using silicone oil as intraocular tamponade due to rhegmatogenous or tractional retinal detachment.

MATERIALS AND METHODS

This cross-sectional study was approved by Ethics Committee on Medical Research of Balıkesir University, (approval#201/102-14.04.2021). In the study, we retrospectively reviewed files of the patients who underwent PPV due to rhegmatogenous or tractional retinal detachment using silicone oil as intraocular tamponade at Ophthalmology Clinic of Balikesir University, Medicine School between May, 2019 and January, 2021. The patients with incomplete data, those without follow-up ≥3 months after silicone oil removal and those underwent PPV with any diagnosis other than tractional/rhegmatogenous retinal detachment were excluded. In all patients included, demographic characteristics, vitrectomy indication, best-corrected visual acuity (BCVA) as measured by Snellen charts (decimal) and intraocular pressure (IOP) values as measured by Goldmann applanation tonometry) were recorded. In addition, data lens status, duration of silicone retention in eye, additional surgical procedures performed during silicone removal and retinal status were also recorded. In final control visit, anterior segment and posterior segment findings were recorded. If retinal illumination could not be achieved, B-mode sonography findings were recorded. All these assessments were extracted from data obtained from baseline visit (before PPV) and control visits before and after silicone removal.

Surgical technique:

In all patients, pupil dilatation was achieved using tropicamide 5% (Tropamid, Bilim İlaç., Turkey), cyclopentolate hydrochloride 1% (Sikloplejin, Bilim İlaç., Turkey) and phenylephrine hydrochloride 2.5% (Alcon, USA) 3 times by 5-minutes intervals in alternate manner. In all patients, surgery was performed using a 3-way, 23 G system by same surgeon (E.K) under subtenon, retrobulbar or general anesthesia by same surgeon. Silicone oil removal was performed after phacoemulsification plus intraocular lens implantation in patients undergoing combined cataract surgery. Sclerotomy was achieved using 23 G paracentesis glade and combined trocar at superonasal, superotemporal and inferotemporal quadrants; thereafter, an infusion containing BSS was inserted to inferotemporal quadrant and uneventful passage of trocar into vitreous was confirmed. After starting fluid infusion, silicone oil was removed using silicone oil removal module of vitrectomy device (Eva, DORC, Netherlands). After completion of silicone oil removal, whole posterior pole and periphery of retina were screened using EIBOS 2 wide-angle imaging system. Surgery was completed using fluid tamponade in 47 of 60 eyes while air in 5 eyes, C_3F_8 gas in 2 and SF_6 gas in 6 eyes. Thereafter, one 7.0 Vicryl suture was placed scleral access sites and impermeability was tested. At postoperative period, all patients were given a standard regimen including moxifloxacin 0.5% (Vigamox, Alcon, USA) and dexamethasone 0.1% (Maxidex, Alcon, USA) for one month.

Statistical analysis

Data were analyzed using SPSS version 23.0. Paired samples t test was used to analyzed visual acuity and IOP values. Spearman's and Pearson's paired correlation tests were used to assess relationship between parameters. A p value <0.05 was considered as statistically significant.

FINDINGS

We extracted data from 77 eyes of 77 patients who met inclusion criteria and underwent silicone oil removal. Two patients were excluded, as vitrectomy indication was endophthalmitis in one patient and choroid-retina pigment epithelium graft in the other patient. In addition, 14 patients were excluded due to incomplete follow-up data. Final analysis included 60 eyes from 60 patients (25 women, 35 men). Mean age was 59.6±11.6 years (19-83). Of 60 patients, PPV indication was rhegmatogenous retinal detachment with PVR degree≥C2 in 36 patients (69%) while tractional retinal detachment secondary to PDR in 24 patients (40%). Mean BCVA was 0.091±0.231 before surgery (pre-PPV) and 0.049±0.092 before silicone oil removal (post-PPV). Mean IOP was 14.58±5.24 mmHg before surgery and 15.56 ±4.86 mmHg before silicone oil removal (Table 1). Figure 1 and 2 presents mean BCVA and IOP values before surgery, before silicone oil removal and at final visit after silicone oil removal. Mean time to silicone oil removal was 4.48 ±4.10 months.[2-24] Of 60

Table 1: *The best-corrected visual acuity and intraocular pressure of patients during follow-up period.*

	Preoperative (V1)	**Before silicone oil uptake (after PPV)** (V2)	**Final visit after silicone oil uptake** (V3)	**V1** vs **V2**	**V2** vs **V3**	**V1** vs **V3**
Best-corrected visual acuity	0.091 ± 0.231 CF 5m 20/250	0.049 ± 0.092 CF 3m 20/400	0.134 ± 0.229 0,13 20/160	0.178	0.002*	0.282
Intraocular pressure (mmHg)	14.58 ± 5.24	15.56 ± 4.86	13.16 ± 5.32	0.223	0.004*	0.109

PPV: Pars plana vitrectomy, CF: Counting fingers

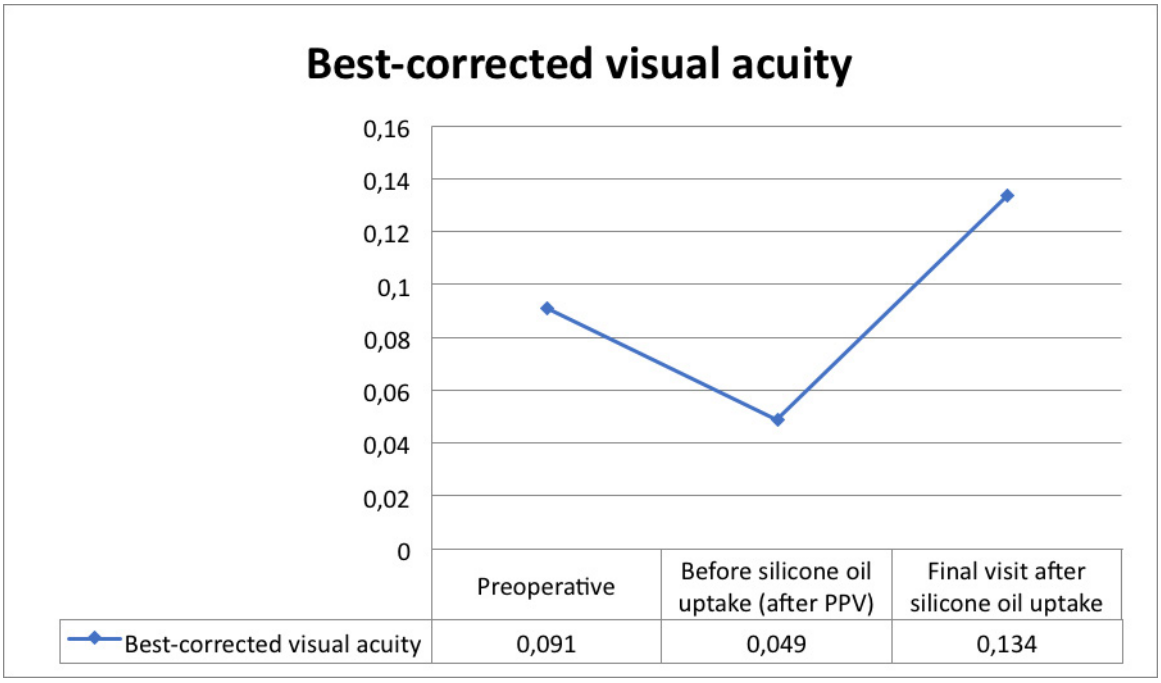

Figure 1: *The best-corrected visual acuity of patients during follow-up period.*

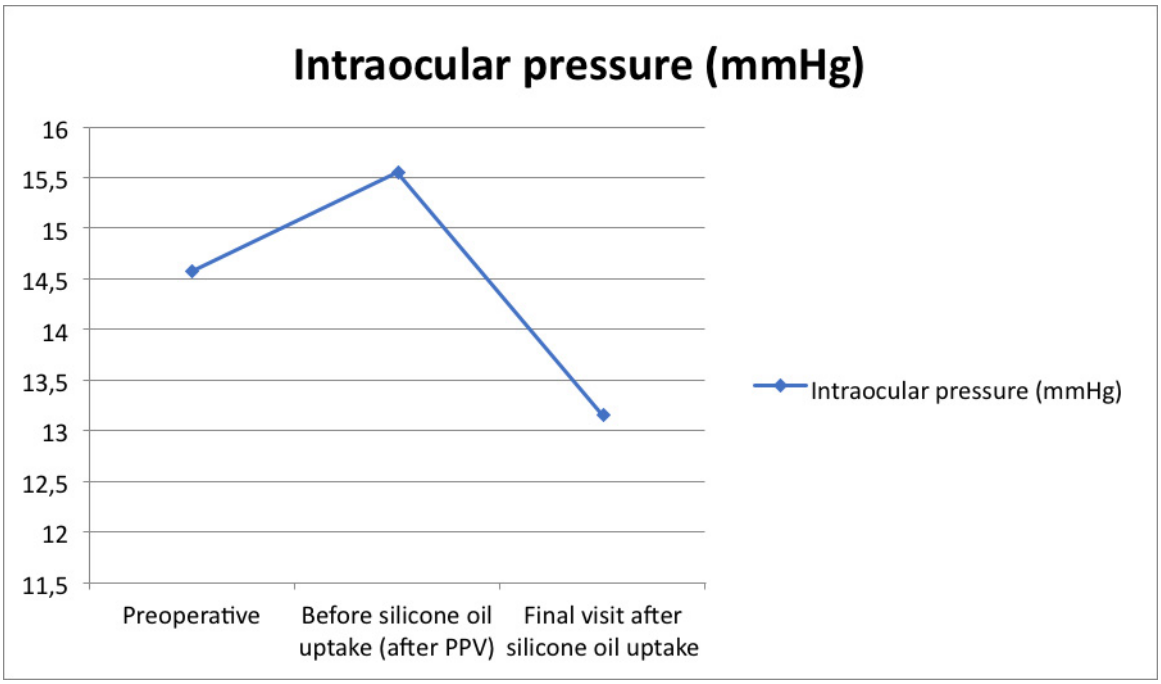

Figure 2: *The intraocular pressure of patients during follow-up period*

patients scheduled to silicone oil removal, 34 were phakic (56.6%) while 24 were pseudophakic (40.1%) and 2 (3.3%) were aphakic. In the same session, epiretinal membrane and internal limiting membrane peeling was performed in 21 patients (35.0%) whereas vitreous clearance in 11 patients (18.3%) in addition to silicone oil removal. As retinal detachment was detected after silicone removal, detachment surgery was performed in 16 patients (26.7%) whereas additional laser photocoagulation in 16 patients (26.7%) in the same session. In addition to silicone oil removal, phacoemulsification and IOL implantation were performed in 10 (29.4%) of 34 phakic patients in the same session. Scleral fixation and intraocular lens implantation was performed in one aphakic patient. In final control visit after silicone oil removal, mean BCVA was 0.134±0.229 while mean IOP was 13.16±5.32 mmHg. Based on data from final control visit, it was seen that retinal attachment was achieved in 55 (91.7%) of 60 patient while there was recurrent detachment in 4 patients (6.7%), phthisis bulbi in 3 patients (5.0%), optic atrophy in 2 patients (3.3%), intravitreal hemorrhage in one patient (1.7%), hyphema in one patient (1.7%), corneal epithelial staining in one patient (1.7%), macular folds in one patient (1..7%) and corneal endothelial insufficiency in one patient (1.7%). All complications in final control visit were detected after silicone oil removal. In 3 patients, vitrectomy was performed to achieve retinal attachment in 3 patients with recurrent detachment; in these patients, retina was found to be stable in final control visit. Three patients with phthisis bulbi were treated medically. In 2 patients with optic atrophy, BCVA was maintained at level of hand movement in control visits. In one patient with intravitreal hemorrhage and in another patient with hyphema, spontaneous recovery was noted with medical therapy. Partial recovery was achieved with anterior chamber lavage and medical therapy in the patient with corneal epithelial staining. Additional vitreoretinal surgery was performed in the patient with macular fold and eye was left with C_3F_8 20%; it was found that BCVA was 0.1 and that macular folds were recovered in final control visit. In one patient with corneal endothelial insufficiency, retinal attachment and graft transparency was achieved by penetrating keratoplasty plus PPV using transient Eckardt keratoprosthesis. Silicone oil tamponade was repeated during silicone oil removal in 3 patients and silicone oil removal was uneventfully performed after 3.2±0.8 months in average.

DISCUSSION

In this study, we assessed clinical conditions observed during surgery and additional interventions in patients undergoing silicone oil removal. Among patients reviewed, it was found that at least one additional intervention was required in 56.7%. Thus, we recommend to visualize retina during silicone oil removal and to perform additional intervention, if needed, in the same session. Additional pathologies are frequently seen due to complications developed at vitreoretinal interface during time period where silicone oil retained in the eye, lens opacity and recurrent detachment secondary to proliferative membranes. Thus, all silicone removal procedures should be considered as a new vitrectomy and it is important to be prepared regarding both cost-effectiveness and timely intervention to these additional pathologies.

There are different views regarding silicone oil removal after PPV. Some authors recommend to remove silicone oil as soon as possible owing to potential complications[2, 9, 12, 18-20] while others recommend silicone oil removal only if severe anterior segment complications develop.[11] Some authors recommend silicone oil removal after 8-12 weeks while others recommend to remove after 6-22 weeks.[2,9] According to Silicone Oil Workshop, the most reliable time is 6 months for silicone oil removal.[20] In agreement with literature, mean time to silicone oil removal was 4.48±4.10 months in our patients. Silicone oil removal was considered based on PPV indication, silicone oil-related complications and retinal attachment status. Time to silicone oil removal was shorter in patients with silicone oil-related complications while it was delayed as soon as possible in patients with unstable retina and ongoing proliferative process. No correlation was detected between time to silicone oil removal and recurrent detachment (p=0.806).

In our study, the finding of significant increase in BCVA after silicone oil was in agreement with literature (0.049 before silicone oil removal vs. 0.134 at final visit; p=0.002). In larger series, marked improvement was detected in BCVA after silicone oil removal in patients with ambulatory vision at preoperative period and before silicone oil removal.[9, 20] There may be reduction in BCVA due to both optic alteration and mechanical barrier effect resulting from silicone oil.[21] In addition, BCVA may be decreased due to complications related to silicone oil. In particular, corneal epithelial or stroma edema resulting from IOP elevation can lead decreased BCVA. It is also thought that silicone oil can lead retinal toxicity which is recovered after removal of silicone oil.[22] We think that significant improvement was achieved in BCVA due to fact that cataract surgery and ERM peeling were performed in 16.7% and 35% of the patients during silicone oil removal. In our study, BCVA was found to be ≥0.05 in 24 patients (40%) at final control visit. In a study including patients underwent vitrectomy for giant retinal tear, Talep et al. found that BCVA was 20/400 or better in 75.5% of patients after silicone oil removal.[23] Similarly, in a study on patients underwent surgery for retinal detachment, Gonzalez et al.

found BCVA ≥20/400 in 84.9% of patients.[24] In our patient group, the lower rate might be due to reviewing data from more complicated patients in a tertiary clinic and that fact that restoration was performed in seriously damaged retina resulting from PDR-related tractional retinal detachment in a significant proportion of patients.

As similar to BCVA, a significant reduction was observed in IOP after silicone oil removal. This is due to increased anterior chamber drainage after silicone oil removal and IOP reduction may occur due to elimination of pupillary block. In addition, it is known that cataract surgery also leads to somewhat reduction in IOP.[25] The cataract surgery was performed in 16.7% of the patients during silicone oil removal, which might be contributed to IOP reduction. During silicone oil removal, IOP elevation may be in higher extent due to pupillary block in aphakic eyes. Thus, it is recommended to perform iridectomy in the same session if silicone oil tamponade is planned. In our study, there was only two aphakic patients (3.3%), all of which underwent inferior iridectomy. We think that no pupillary block and resultant IOP elevation occurred in these patients. In our study, 1000 cSt silicone oil was used in all patients. In fact, low molecular weight silicone oils can be emulsified more intensely; thus, they can block drainage by leaking anterior chamber. We think that risk for emulsification-related glaucoma was lower due to shorter time to silicone removal. In our study, IOP was found to be within normal range before and after silicone oil removal; however, it should be kept in mind that silicone oil-related IOP may persist after removal.[9] No additional surgery was required for glaucoma in our patients. In our study, following silicone oil removal, air, SF_6 and C_3F_8 gas were used as tamponade in 13 of 60 patients; no additional problem was observed in IOP in these patients.

Recurrent detachment is considered as most important complication following silicone oil removal in vitrectomized eyes. In our study, retinal detachment was observed in 26.7% of the patients at perioperative examination following silicone oil removal and required intervention was performed during silicone oil removal. Retina was reattached during silicone oil removal. Overall, it was found that retinal attachment was achieved in 55 (91.7%) of 60 patients during follow-up after silicone oil removal. In patients with severe disease, recurrent detachment following silicone oil removal is not low. In the literature, retinal detachment rate has been reported as 0-32% in several studies. In a study by Silicone Workgroup, recurrent detachment rate was found to be 20% following silicone oil removal in eyes with PVR≥C3.[20] In a study by Jonas et al., PPV plus silicone tamponade was performed in 185 patients with PVR and 40 patients with PDR and recurrent detachment was observed in 25.3% of patients.[26] Previous failure of PPV, insufficient vitreous clearance, lack of scleral buckling, early vitreous hemorrhage and retinal membrane formation have been reported as the risk factors for recurrent detachment following silicone oil removal.[27] In their study, Franks et al. reported similar recurrent detachment rate and suggested that this is due to proliferative membrane formation under silicone oil. Although these membranes do not lead to subretinal fluid formation owing to silicone oil, retinal detachment can be seen at early period after silicone oil removal.[9] Zilis et al. reported that these proliferations develop at retinal surface in eyes filled with silicone oil and should be overlooked during routine examination. Thus, there is risk for detachment even during silicone oil removal. The removal of preretinal tractions during silicone oil removal will reduce risk for recurrent detachment. Thus, during silicone oil removal, retinal imaging must be performed and membranes, if present, should be removed and detachment at hyper-acute period should be treated rapidly. In our study, in all patients, first PPV was performed in our clinic; thus, no assessment was performed regarding history of PPV failure. No early vitreous hemorrhage was observed in our study. During PPV, scleral buckling surgery was performed in 12 patients. No correlation was detected between scleral buckling and recurrent detachment. During silicone oil removal, vitreous clearance was performed in all patients found to have insufficient vitreous clearance; in addition, membran removal was performed in all patients with membrane formation over retina. Following silicone oil removal, acute retinal detachment development is fluid passage beneath retinal tear by tamponade effect of silicone at original tear site. As it can be seen in our results, recurrent detachment will occur immediately after silicone oil removal and can be detected in the same session. In a study, Bozan et al. reported that it was reported that recurrent detachment was detected in 46 (38.3%) of 183 and that detachment was detected in 38 (82.6%) of 46 eyes within 3 months.[28] In our study, recurrent detachment rate was decreased to 8.3% at the end of follow-up when detachment detected during surgery were treated and additional surgical interventions were performed.

This study has some limitations including retrospective design. The indication for silicone oil removal was unclear in patients underwent silicone removal. Again, data was lacking whether silicone oil removal was performed due to achievement of complete retinal attachment or silicone oil-related complications. Moreover, there is insufficient data regarding giant retinal tears (rate, localization and extent of tear etc.), an important risk factor for recurrent detachment.

In conclusion, it is likely to observe a new pathology at all points from anterior segment to peripheral retina following silicone oil removal. Thus, silicone oil removal procedure

should not be considered as an aspiration alone and one should be ready as he/she will perform a vitreoretinal surgery. Further multicenter studies are needed to draw definitive conclusions in this issue.

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