·Clinical Research·

Effect of silicone oil removal on central corneal thickness

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Abstract

• AIM: To evaluate the effect of silicone oil removal(SOR) on central corneal thickness (CCT) in aphakic and pseudophakic eyes prospectively.

• METHODS: Patients who underwent SOR surgery between June 2005- August 2007 were included in this study. Silicon oil was actively removed behind the posterior capsule through the pars plana sclerotomy site (posterior approach) in pseudophakic eyes and through the pupil and the corneal tunnel incision (anterior approach) in aphakic eyes with the 18-gauge cannula. CCT was assessed with Orbscan II corneal topography system preoperatively and at one month and three months postoperatively. A total of 34 eyes of 34 patients (26 males, 8 females) comprised the study group. Mean age was (55.6± 12.3) years (Range: 25-80 years). Twenty-six eyes (76.5%) were pseudophakic and 8 (23.5%) aphakic. Mean time between silicone oil injection and removal was (15.1± 13.6) months (Range: 5-54 months). At baseline, CCT was 576.4± 46.0μm in pseudophakic eyes and 611.6± 36.2μm in aphakic eyes.

• RESULTS: At the first postoperative month CCT was (573.3± 40.1)μm and (630.9± 72.9)μm in pseudophakic and aphakic eyes respectively. At the third postoperative month, CCT was (582.7± 49.5)μm and (614.5± 82.4)μm in pseudophakic and aphakic eyes respectively. There was no statistically significant difference in CCT measurements one month and 3 months after SOR when compared to preoperative values in both aphakic and pseudophakic eyes (P>0.05).

• CONCLUSION: Active SOR either by anterior or posterior approach did not affect the CCT.

• KEYWORDS: Aphakia; central corneal thickness; silicone oil; pseudophakia

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INTRODUCTION

Silicone oil has been widely used as an internal tamponade for complicated retinal detachment surgery since it was first introduced in 1962. It is common practice to remove silicone oil after a period of time to reduce its well-known complications such as glaucoma, cataract and keratopathy [1-3]. Various surgical techniques have been described for silicone oil removal (SOR). Anterior or posterior approach is generally selected according to the lens status of the patient. Anterior approach is performed through an anterior chamber paracentesis in aphakic patients with an open posterior capsule [4-6], whereas posterior approach involves a pars plana sclerotomy that enables SOR from behind the posterior capsule [3,6,7]. In the anterior approach there is contact between silicone oil and corneal endothelium. Numerous reports [8-12] proposed some adverse effects of silicone oil on the cornea. Central corneal thickness (CCT) measurement is an indirect way of evaluating corneal endothelial function since corneal thickening may indicate endothelial decompensation. In this study, we studied the effect of two different techniques of SOR on CCT prospectively with Orbscan corneal topography.

MATERIALS AND METHODS

Subjects Patients who underwent SOR surgery between June 2005 and August 2007 were included in the study. Baseline ocular examination prior to SOR included Snellen visual acuity, slit-lamp biomicroscopy, Orbscan corneal topography, intraocular pressure (IOP) measurement, binocular indirect ophthalmoscopy and contact lens fundus examination. Eyes with silicone oil in the anterior chamber, eyes requiring additional surgery (*e.g.*, cataract extraction, glaucoma surgery, penetrating keratoplasty, removal of epiretinal membranes, endophotocoagulation, intravitreal gas injection) at the time of SOR or within three months postoperatively were excluded. Patients who had their initial silicone oil surgery elsewhere were also excluded. A total of 34 eyes of 34 patients (26 males, 8 females) comprised the study group. Mean age was (55.6±12.3) years (range: 25-80 years). Twenty-six eyes (76.5%) were pseudophakic and 8 (23.5%) aphakic. The mean time between silicone oil injection and removal was (15.1±13.6) months (range: 5-54 months). Indications for initial silicone oil surgery were

rhegmatogenous retinal detachment with proliferative vitreoretinopathy (PVR) in 29 eyes (85.3%), foreign body removal and concurrent rhegmatogenous retinal detachment in 3 eyes (8.8%), retinal detachment with giant retinal tear in one eye (2.9%) and severe trauma in one eye (2.9%). Twenty-four eyes (70.6%) had silicone oil injection as a primary procedure, and 10 eyes (29.4%) had a history of at least one retinal detachment surgery prior to silicone oil surgery. As a whole, the study group had undergone a mean of 1.4±0.7 (Range: 1-3) vitreoretinal surgeries. Prior to SOR, retina was fully attached except one eye. This eye had a chronic, stable inferior retinal detachment and emulsified silicone oil at the time of SOR.

Methods All surgeries were performed under retrobulbar anesthesia. In pseudophakic eyes posterior approach was preferred whereas anterior approach was elected in aphakic eyes.

In pseudophakic eyes, an anterior chamber maintainer (ACM) connected to balanced salt solution (BSS) was placed through a 6-o'clock paracentesis. A pars plana sclerotomy was created at the 12 o'clock position, 3.5mm away from the limbus. A 18-gauge cannula (B-CAT2, Bıçakcılar, Istanbul, Turkey) was trimmed to 8mm and a beveled-up tip was made (Figure 1). A 10mL syringe was connected to the cannula. The cannula was inserted through the sclerotomy into the silicone oil bubble and silicone oil was aspirated manually by exerting steady suction by the syringe piston.

In aphakic eyes, the ACM was placed through the 6 o'clock paracentesis. A self-sealing corneal tunnel incision was created at the upper quadrant. A 18-gauge cannula was prepared as described above. Silicone oil was aspirated manually through the pupillary area in a similar fashion via corneal tunnel incision. Corneal incisions were closed with stromal hydration only. Subconjunctival antibiotic and steroid were given at the end of surgery. Topical antibiotics were given for two weeks, cycloplegics and corticosteroids were administered for six weeks with gradual tapering of the steroid.

Postoperative clinical examinations were performed on the first postoperative day, one month and three months after the surgery. CCT was assessed with Orbscan II corneal topography system (Bausch & Lomb, Rochester, NY) preoperatively, one month and three months. Indication for silicone oil surgery and silicone oil related complications were recorded. Intraoperative and early postoperative complications were also noted. The eyes were followed up for three months following SOR.

Statistical Analysis SPSS 11.0 software (SPSS, Inc, Chicago, IL) was used with Wilcoxon's signed rank test for statistical evaluation. $P<0.05$ was regarded as statistically significant.

Table 1 MeanCCT in pseudophakic and aphakic eyes after SOR

[mean±SD(range), μm]

Period	Pseudophakic	Aphakic
Baseline	576.4±46.0 (495-691)	611.6±36.2 (577-679)
At 1 month	573.3±40.1 (514-688)[a]	630.9±72.9 (478-715)[a]
At 3 months	582.7±49.5 (493-697)[a]	614.5±82.4 (423-675)[a]

[a] $P>0.05$ *vs* baseline (Wilcoxon signed rank test)
Wilcoxon signed rank test was used to analyze differences in CCT within groups. Comparisons are made in respect to baseline CCT measurements.

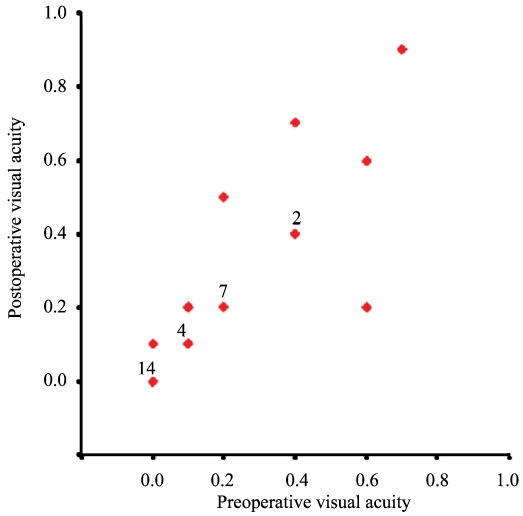

Figure 1 Preoperative and postoperative visual acuities at 3 months after SOR.

RESULTS

No statistically significant change in CCT was found after SOR both in aphakic and pseudophakic eyes ($P>0.05$, Table 1). Although in aphakic eyes CCT was higher (630.9±72.9μm, range: 478-715μm) than baseline values (611.6±36.2μm, range: 577-679μm); this was not statistically significant($P=0.161$). Before SOR, visual acuity varied from light perception to 0.7. Visual acuity improved in 4 eyes (11.8%), did not change in 29 eyes (85.3%), and deteriorated in one eye (2.9%) three months after the surgery. Figure 1 shows the preoperative and postoperative third month visual acuity values. No eyes had clinically demonstrable corneal decompansation or corneal edema at the time of SOR. IOP was elevated prior to SOR in 10 eyes (28.6%). IOP returned to normal in only two of these 10 eyes after the removal. No complication such as corneal decompensation or hypotony occurred during the study period. Retina redetached in one pseudophakic eye one week after SOR. This patient had total glaucomatous optic atrophy and VA was hand motion before SOR. Therefore, no further retinal surgery was attempted. Following SOR, hyphaema occurred in 3 eyes (8.6%) due to transient hypotony; and mild to moderate vitreous haemorrhage occurred in one eye (2.9%). The haemorrhage cleared in all eyes spontaneously without requiring further surgical intervention.

DISCUSSION

Silicone oil keratopathy, which has a spectrum of corneal changes such as band keratopathy, corneal edema, bullous

keratopathy, corneal vascularization and opacification, is a well-known complication in silicone oil-filled eyes. Sternberg *et al* [8] investigated the influence of silicone oil on the animal cornea. The anterior chamber of 14 rabbits and 7 cats was filled with silicone oil. Within six days, wide-field specular microscopy showed a 40% reduction in endothelial density in the area of the silicone oil bubble in both groups. Progressive stromal thinning along with development of a retrocorneal membrane occurred in the rabbit cornea. In contrast, persistent stromal edema, peripheral vascularization, irregular plaques on the endothelium and eventual epithelial ulceration and corneal thinning occurred in cat eyes.

Aphakia is an important risk factor for developing silicone oil keratopathy. Federman *et al* [9] reported the complications associated with silicone oil in 150 eyes and found that all 20 eyes with band keratopathy were aphakic at the time of silicone oil injection. Pang *et al* [10] underlined that presence of an intact lens or posterior capsule correlated well with the absence of irreversible silicone keratopathy.

Using the transcorneal route is a short-cut for SOR in aphakic eyes as it avoids pars plana sclerotomy related complications such as new peripheral retinal breaks, vitreous hemorrhage, choroidal hemorrhage and subretinal infusion. On the other hand, with this technique, there is some contact between corneal endothelium and silicone oil during SOR and such contact may lead to corneal decompensation [4,5]. Thus in aphakic eyes, anterior approach may further compromise the cornea although contact duration of silicone oil and corneal endothelium is short.

The CCT measurement is an indirect but easy way to assess the corneal health. It is well-kown that both silicone oil in the eye and silicone removal affect corneal thickness. An animal study detected progressive stromal thinning [8] while endothelial loss and progressive corneal edema may reflect itself as corneal thickening. Although specular microscopy may give more information about the endothelium, our main intention in this study was to investigate CCT changes after SOR. According to our results, CCT was not affected in pseudophakic eyes after SOR. We observed some increase in CCT in aphakic eyes, however there was no statistical significance. To our best knowledge, no previous study has investigated CCT changes in eyes undergoing SOR. However, there are several papers investigating the corneal status in combined cataract surgery and SOR. Cacciatori *et al* [11] evaluated the influence of combined clear corneal phacoemulsification and silicone oil removal via anterior approach on corneal endothelium. They performed specular microscopy before and 6 weeks after the surgery. They found that average endothelial cell loss was 6.7% and concluded that anterior approach even with combined phacoemulsification and intraocular lens implantation was safe for corneal endothelium. Boscia *et al* [12] evaluated the corneal damage by combined clear corneal phacoemulsification and passive SOR. They compared their results with the patients who underwent phacoemulsification surgery only. At six months postoperatively CCTs were similar with the preoperative values and there was no statistically significant difference between the groups. Although endothelial cell loss in the central region was relatively higher in eyes that underwent SOR, the difference was not significant. Their technique of SOR was somewhat different from our method. They inserted a curved cannula through the phaco incision and posterior capsulorhexis. The stream of fluid floated the silicone oil out through the pupil and corneal incision. In contrast, we placed an ACM and aspirated silicone oil manually with a cannula, decreasing the possibility of endothelial trauma from free floating silicone oil.

In conclusion, the results of our study reflect that SOR had no significant effect on the corneal thickness in pseudophakic eyes. In aphakic eyes, central corneal thickness was slightly increased but this was not statistically significant. Removing silicone oil by anterior approach through a corneal incision actively did not compromise the corneal thickness.

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