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Original Article

Active silicone oil removal with 23 gauge transconjunctival system; ''Doganay silicone oil extraction system''

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Abstract

Aim: To describe a new and simple silicone oil removal method with 23-gauge (G) transconjunctival vitrectomy system.

Material and Methods: This is a prospective, single center, interventional clinical trial. A hundred thirty-three eyes of 133 patients were enrolled in this study. 1000 centistoke (cSt) silicone oil was removed with our new method. Main outcome measurements were silicone oil removal time, number of sutured 23 G sclerotomy sites, intraoperative and postoperative complications, preoperative and postoperative intraocular pressure (IOP) alterations, and preoperative and postoperative visual acuity changes.

Results: The mean time between pars plana vitrectomy surgery with silicone oil endotamponade and silicone oil removal was 8.5±3.5 months. Mean silicone oil removal time was 141.7±37.7 seconds. 210 of total 293 sclerotomies sites required suture. A statistically significant decrease in postoperative IOP was found only on day 1 ($p<0.05$). Mean preoperative (before silicone oil removal) best correct visual acuity (BCVA) was LogMAR 1.39±0.74 and mean postoperative BCVA at the final visit was LogMAR 1.23±0.88 ($p<0.05$). Mean postoperative follow-up was 7.2±6.2 months. Postoperative transient hypotony occurred in 23 eyes (IOP < 7 mm-Hg), re-vitreous hemorrhage occurred in 5 eyes and retinal re-detachment occurred in 7 (5.3%) eyes.

Conclusion: Removal of 1000 cSt silicone oil with our new method is effective, safe, easy, and fast.

Keywords: Silicone oil removal; transconjunctival vitrectomy; 23-gauge.

INTRODUCTION

For many years, silicone oil has been used as a temporary intraocular tamponade in complex vitreoretinal diseases (1). To prevent long term silicone oil complications such as cataract, keratopathy, and glaucoma, it should be removed from the eye as soon as retinal stabilization occurs (2-5). There are two main approaches to remove silicone oil. Silicone oil removal via anterior approach can be performed in aphakic eyes or during cataract extraction. However, posterior (pars plana) approach is preferred by vitreoretinal surgeons since it allows additional surgery manipulation such as epiretinal membrane peeling, membranectomy, endolaser application, and fluid-air exchange.

Twenty-three gauge (23 G) transconjunctival vitrectomy system was first introduced by Dr. Eckard in 2005 (6). Oshima et al. introduced 27-gauge vitrectomy with an incision size 0.40 mm in 2010 (7). It has some advantages over 20 G systems. However, there are some difficulties, such as silicone oil removal and silicone oil injection with 27 G transconjunctival vitrectomy system. In literature, a few method of silicone oil removal with smaller gauge sclerotomies (23 G and 25 G) were previously described (8-11).

In this study, we report a new and simple 23 G system for active removal of 1000 cSt silicone oil via pars plana and evaluate its efficacy and safeness with potential complications of this method.

MATERIAL and METHODS

This is a prospective, single center, interventional clinical trial. A hundred thirty-three eyes of 133 patients (73 males, 60 females) were enrolled in this study. We certify that all applicable institutional and governmental regulations

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concerning the ethical use of human volunteers were followed during this research. All patients gave informed consent to the study, and the tenets of the Declaration of Helsinki were followed. The ethical approval was obtained from Malatya Ethical Committee (Reference number: 2011/176). All previous posterior segment surgeries and silicone oil removal surgeries were performed using 23 G transconjunctival sutureless vitrectomy system by the same surgeon (S.D). Causes of the pars plana vitrectomy were given in Table 1.

Table 1. Causes of pars plana vitrectomy

Etiology	n= 133 (100%)
Retinal detachment	n= 83 (62.4%)
Diabetic vitrectomy	n=48 (36.1%)
Endophthalmitis	n= 1 (0.75%)
Perforating trauma	n= 1 (0.75%)

n = number of the cases

Patients were scheduled preoperatively and postoperatively for complete ophthalmic examinations, including best correct visual acuity (BCVA, Snellen visual acuity converted to LogMAR chart), slit-lamp examination, and posterior segment examination using binocular indirect ophthalmoscope lenses. Silicone oil removal time, intraoperative and postoperative complications, number of sutured 23 G sclerotomy sites, preoperative and postoperative intraocular pressure changes were evaluated. Before the silicone oil removal procedure, patients' posterior segments were stable. Characteristics of patients having silicone oil (1000cSt) removal with our new system are given in Table 1.

Statistical analysis: SPSS 13.0 for Windows XP (SPSS Sciences, Chicago, IL) is used for statistical analysis. The differences between preoperative-postoperative IOP levels and preoperative-postoperative final BCVA values were compared by Wilcoxon Signed-Rank Test. All data were reported as means ± standard deviation. The p value of <0.05 is considered to be statistically significant.

Surgical Method

In our method, pupil is dilated before surgery with tropicamide, epinephrine, and cyclopentolate drops. All procedures were performed by the same surgeon (S.D.) under peribulbar anesthesia. The surgical procedure is based on a 23 gauge transconjunctival vitrectomy system using the two step technique with trocar-cannula system including valve. After placement of the 23-G infusion trocar inferotemporally in the pars plana area (Figure 1A), the second transconjunctival sclerotomy is performed at the exact opposite of the first transconjunctival sclerotomy (Figure 1B), if only silicone oil removal is planned. Third transconjunctival sclerotomy is performed on superotemporally position if additional vitreoretinal manipulation, such as membranectomy, fluid-air exchange, epiretinal membrane peeling and endolaser treatment, is required.

Our new silicone oil removal system consists of two parts. The first part is a special 10 ml syringe including special silicone oil removal cannula (Figure 1C, Figure 2A). This cannula is made from polyvinyl chloride and has a node inside to prevent extrusion of the trocar during silicone oil removal (Figure 2B). The second part is a simple aspiration line which is connected to vitrectomy machine's aspiration line (Figure 2C).

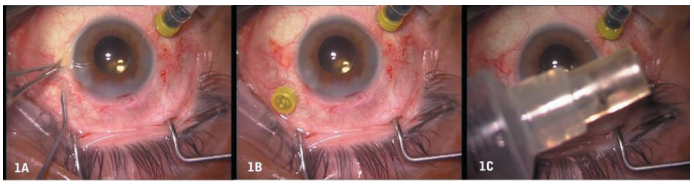

Figure 1a. Placement of the 23-G trocar inferotemporally in the pars plana area for infusion, **Figure 1b.** Transconjunctival sclerotomy is performed at the exact opposite of the first transconjunctival sclerotomy and the second trocar is placed
Figure 1c. Special 10 ml syringe including special silicone oil removal cannula

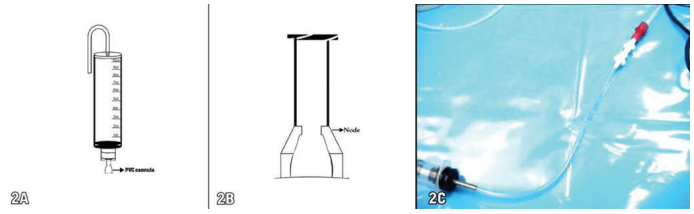

Figure 2a. Illustration of a special 10 ml syringe including special silicone oil removal PVC cannula, **Figure 2b.** Illustration of silicone removal PVC cannula. It has node inside of the cannula to prevent trocar extrusion during silicone oil removal
Figure 2c. Aspiration line which is connected to vitrectomy machine's aspiration line

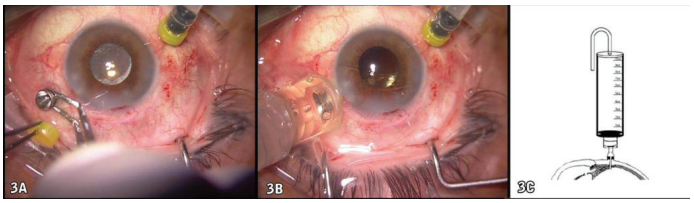

Figure 3a. Removal of the trocar's valve, **Figure 3b.** Silicone oil removal system's cannula covers the 23 G trocar, **Figure 3c.** Illustration of the placement of the new silicon extraction system to remove silicone oil from the eye

The vitrectomy machine, with the cutter switched off, provides the suction for silicone oil removal. The level of the infusion bottle is increased to 85 cm. After removal of the trocar valve (Figure 3A), the cannula placed over the conjunctival surface also whole of cover the 23 G trocar which is placed at exact opposite of the infusion trocar side (Figure 3B, Figure 3C). In this system, silicone oil is removed by suction at pre-set value of 250 mmHg (Figure 4A). In our technique, the key point is not losing the suction during active removal of the silicone oil. As soon as the posterior surface of the silicone oil bubble becomes visible as a meniscus (sunset sign) (Figure 4B) suction level should be decreased down to 50 mmHg. Sunset sign is the sure sign that you removed all silicone oil by looking for the last bubble. Toward the end of the

procedure, suction is stopped by lifting the foot off the pedal. Remaining small silicone oil droplet is removed with the negative pressure of the tubing system to prevent the eye collapse. Fluid egress from the eye does not mean that all silicone oil was removed. To be sure whether all silicone oil is removed or not, 23 G trocar without valve should be turn four direction whether fluid egress from the eye or not. The surgeons may rarely encounter vacuum lose during silicone oil removal in our technique. In this case, the surgeon should wait for a few second for silicone oil bubble appear, stabilize and take a position again, and then the same procedure should be continued. After removal of silicone oil, the bottle level is decreased to 60 cm, and retinal status is examined with 23 G light probe, if necessary additional procedures can be performed. Trocars are removed (Figure 4C) and the transconjunctival sclerotomy sites are controlled for leakage and bleb formation. If needed, single transconjunctival 7/0 vicrily sutures were placed for transconjunctival sclerotomy. Finally, subconjunctival antibiotic and steroid mixture are injected into the inferior fornix.

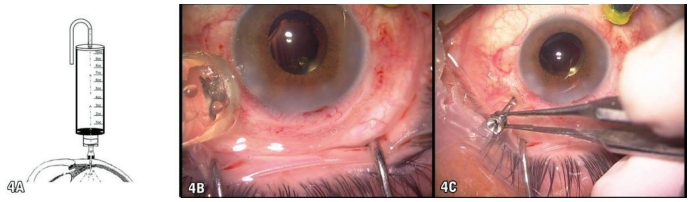

Figure 4a. Illustration of the silicone oil removal procedure, **Figure 4b.** Posterior surface of the silicone oil bubble becomes visible as a meniscus (sun set sign), **Figure 4c.** Removal of the trocars

RESULTS

The mean age of 133 patients (73 male and 60 female) was 56.03±14.55 years (Table 2). The mean time between pars plana vitrectomy with silicone oil endotamponade and silicone oil removal was 8.5±3.5 months.

Table 2. Demographic features of the patients	
Gender (male/female)	**73/60**
Eyes (right/left)	79/54
Mean patient age (years) (min- max)	56.03±14.55 / 10-80
Min: minimum, Max: Maximum	

Mean preoperative (before silicone oil removal) BCVA was Log MAR 1.39±0.74 and mean postoperative BCVA at the final visit was Log MAR 1.23±0.88 (p=0.006).

The mean silicone oil removal time was 141.7±37.7 seconds. No intraoperative complications were reported. The silicone oil was completely removed from all eyes; no clinically significant residual silicone oil in the vitreous cavity or anterior chamber was seen in any eye on the follow-up examination. Totally, two hundred ninety-three 23 G sclerotomies were performed for the patients. However, transconjunctival single 7/0 vicrily suture placement was necessary for 210 sclerotomies. The patients were followed for a mean period of 7.2±6.2.64 months. Retina remained attached in all eyes at the end of the follow-up period.

Mean preoperative (before silicone oil removal) IOP was 14.9±5.3 mmHg, and mean postoperative IOPs at day 1, week 1, month 1, month 3, month 6, month 9, and last visit were 14.9±5.3, 11.5±5.2, 14.4±6.4, 14.2±5.5, 14.4±4.9, 14.6±3.8, 15.5±6, and 14.3±5.1 mmHg, respectively. A statistical significant was found only between the preoperative-postoperative day 1 IOP values (p=0.005). There was no a statistical significant between preoperative IOP values and another visits. Postoperative hypotony was seen in 23 eyes on postoperative day 1 (IOP < 7 mmHg) but all resolved spontaneously within 1 week.

In follow up period; retinal re-detachment occurred in 7 (5.3%) eyes and re-vitreous hemorrhage was observed in 5 (3.7%) eyes (Table 3).

Table 3. Clinical characteristics of patients	
Mean duration of silicone oil removal (sec)	141.7±37.7
Number of sclerotomy/ need suture for sclerotomy	293/210
Best corrected visual acuity (Log MAR)	
Before silicone oil removal	1.39±0.74
After silicone oil removal (final BCVA)	1.23±0.88
Postoperative complications	
Re-detachment	7
Re-vitreous hemorrhage	5
Hypotony	23
Mean time between PPV and SIOR (months)	8.5±3.5
Mean follow-up (moths)	7.2±6.2
Mean IOP (mmHg)	
Preoperative	14.9±5.3
postoperative 1st day IOP	11.5±5.2*
postoperative 1st week IOP	14.4±6.4
postoperative 1st month IOP	14.2±5.5
postoperative 3th month IOP	14.4±4.9
postoperative 6th month IOP	14.6±3.8
postoperative 9th month IOP	15.5±6
postoperative final visit IOP	14.3±5.1
Sec: second, BCVA: best corrected visual acuity, PPV: pars plana vitrectomy, SIOR: silicone oil removal, IOP: intraocular pressure, *p<0.005	

DISCUSSION

The sizes of the sclerotomies' have been decreasing parallel to the advancement of technology in vitreoretinal surgery area. Firstly, Fuji and colleagues introduced 25 G transconjunctival sutureless vitrectomy system in 2002 (12). It was followed by the introduction of a 23-gauge system by Eckardt in 2005. Decreasing of the sclerotomy sizes have brought about the necessity of easily, safety and rapidly removing intraocular endotamponades such as silicone oil from these small sclerotomies.

Silicone oil is routinely removed from the eye after retinal stabilities. Many ingenious techniques have been described to remove intraocular silicone oil. In aphakic eyes, silicone oil can be removed as actively or passively

via anterior approach using corneal incision or during cataract surgery through posterior capsulorhexis (13-17). However; these techniques have some disadvantages, such as not permitting examination of the retina, additional surgery manipulation, and endolaser application. For these reasons, pars plana approach is preferred by vitreoretinal surgeons.

Transconjunctival sutureless vitrectomy systems have some advantages such as cosmetically better wound construction, early healing, saving time, and eliminating conjunctival peritomy. Kapran and Acar introduced a passive approach for removal of 1000 cSt with 25 G transconjunctival sutureless vitrectomy system (10). They also reported a more efficient method of active removal of 1000 and 5000 cSt silicone oil with two specially designed 25 G cannule (9). Romano et al reported 23 G transconjunctival technique for active removal of Densiron-68 through a short 23-G cannula (18). In another study, Song et al also reported a new approach for active removal of 5000 cSt silicone oil through 23 G cannula (8). In this study, we described a new method of active removal of 1000 cSt silicone oil.

Kapran and Acar reported that, with the 25 G microcannular sytem, passive removal of 1000 cSt silicone oil was achieved in a mean period of 7.3 minutes (10). They also reported their technique as a sutureless technique for active removal of silicone oil through specially designed 25 G microcannulas (9). In this report, mean removal times for 1000 and, 5000 cSt silicone oil were 3.3, and 10.3 minutes, respectively. In the report of Patwardhan et al., mean silicone removal time is 6.9 minutes for the passive removal of silicone oil (1000 cSt) through 23 G transconjunctival sutureless sclerotomies, and 6.1 minutes for the active aspiration of silicone oil (1000 cSt) through 20 G traditional sclerotomies (11). Recently, Song et al., reported a new approach for active removal of 5000 cSt silicone oil via pars plana through a regular 23 G instrument cannula. In their technique, the mean silicone oil removal time was 6.8 minutes (8). Mean silicone removal time was 141.7 second for current method. The advantage of the method is obvious. Firstly, it is considerably shorter duration than other approaches (8-11). Secondly; the removal of the silicone oil procedure is very simple and easy. Thirdly, the 23 G transconjunctiaval sutureless system cause much less surgical trauma. Also, this method can be performed for phakic, aphakic, or pseudophakic eyes.

In patients who underwent combined phacoemulsification with silicone oil removal with our new technique, no any intraoperative and postoperative complication was observed. We have created transconjuncjtival sclerotomy opening after the phacoemulsification procedure. However, some authors suggest placement of trocars before the phacoemulsification to avoid hypotony (19,20). But, here no any difficulty was encountered during the surgeries.

A fibrous opacification of the posterior capsule of lens is common after silicone oil tamponade. The presence of fibrous opacification on the posterior capsule is a good indication for posterior capsulotomy. We routinely performed posterior capsulotomy with 23 G ocutom where phacoemusification and silicone removal combined surgeries undergone at the end of the surgery.

Patwardhan et al. reported that 3 of 20 cases (15%) needed single transconjunctival suture for sclerotomy sites during 23 G transconjunctival sutureless passive silicone oil removal (11). In our study, 210 of 293 (71.7%) sclerotomies sites required single transconjunctival suture. To prevent postoperative hypotony, we prefer to put a single transconjunctival suture on sclerotomy in the case of leakage after removal of the trocars.

In our study postoperative transient hypotony occurred in twenty-three eyes (IOP < 7 mmHg), but all of them resolved spontaneously within 1 week. The mechanism by which silicone oil removal produces transient hypotony is not fully understood. Underlying pathologic changes of the eyes or surgical procedures may play a role in the development of transient hypotony by reducing fluid production, creating excess fluid outflow or combination of both (21).

CONCLUSION

In conclusion, 1000 cSt silicone oil removal with our new silicone oil extraction system is a new technique. This method is fast, effective, safe, and easy. We recommend this technique for routine removal of 1000 cSt silicone oil.

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