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Comparison of phacoemulsification + IOL implantation and silicone oil removal in one session with performing these operations in two sessions

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ABSTRACT

Silicone oil injection at the end of vitrectomy is common. Cataracts are also common when silicone oil needs to be removed from the eye. The question arises; should we remove the silicone oil first and at least two months later perform cataract and intraocular lens (IOL) implantation surgery? Or do two operations at the same time? The aim of the present study was to compare these two methods. Patients who had previously undergone vitrectomy and silicone oil injection and needed cataract surgery and silicone oil drainage were divided into two groups. In the first group, pars plana silicone oil removal was done first and at least two months later, cataract+IOL surgery was performed. In the second group cataract + IOL surgery and pars plana silicone oil removal was donein one step. In all patients, lens power was determined by IOL Master Device. There was no significant difference between the two groups in terms of age (P = 0.36) and gender (P = 0.88). The refractive error in the first and second groups was -0.75± 0.66 and -1.00± 0.99 diopter respectively, but the difference was not statistically significant (P = 0.44). The mean of uncorrected visual acuity six months after one-step and two-steps surgery was 1.20± 0.08 and 1.13± 0.17 Log MAR respectively, but the difference was not statistically significant (P = 0.18). Also, best corrected visual acuity six months after one-step and two-steps surgery was 0.98± 0.26 and 0.91± 0.28 Log MAR, respectively, which was not statistically significant (P = 0.27). In respect to no statistically significant difference between two groups and lower risk of complications of the one-step approach, including complications of anesthesia, as well as lower cost and fewer visits, we recommend surgeries should be performed in one step.

Keywords: silicone oil removal, Cataract surgery, Ultrasound biometry, Laser interferometry

1. INTRODUCTION

Retinal detachment is considered a very important problem because if left untreated, it will lead to blindness in almost all cases (Satoshi et al., 2018). Treatment of retinal detachment is surgical but success rate remains less than 100% and usually 85% (Ziyaad Nabil Sultan et al., 2020). Proliferative vitreoretinopathy (PVR) is the most common cause of failure of retinal detachment surgery. PVR is characterized by the growth of fibrous membranes within the vitreous cavity and on both sides of the retina, as well as intraretinal fibrosis (Nagasaki et al., 1998; Pastor, 1998). Contraction of these membranes can cause retinal detachment and turn rhegmatogenous retinal detachment into tractional retinal detachment (The Retina Society Terminology Committee, 1983).

Silicone oil for the treatment of complex retinal detachments was first introduced in 1960 (Cibis et al., 1962). In the decade 1980, a number of researchers used silicone oil in patients with PVR (McCuen et al., 1985; Cox et al., 1986). Since then, silicone oil has been used frequently as a tamponade in cases of complex detachment. Also silicone oil is used in cases of diabetic vitrectomy. However, some researchers believe that the benefits of silicone oil are questionable (Yeo et al., 1987), but others have supported the use of silicone oil to stabilize the retina and prevent iris neovascularization (Lucke et al., 1987; de Juan et al., 1986). In addition, silicone oil is associated with significant complications such as cataract, keratopathy, corneal decompensation, glaucoma (Riedel et al., 1990; Farrahi et al., 2014). Silicone oil is usually removed 3 to 6 months after surgery (Jančo et al., 2014; Al-Habboubi, 2018). The presence of silicone oil accelerates the progression of cataract (Borislav, 1993), so cataract surgery and intraocular lens (IOL) implantation is necessary concurrent with silicone oil removal. The question is, should silicone oil be removed first and cataract surgery is performed at least two months later? Or do both at the same time? This study was designed to compare these two methods. The aim of this study was to use the results of this study to decide whether to perform this surgery in one step or two steps.

2. METHOD

Study design

The study was approved by Ahvaz Jundyshapur University of Medical Sciences. This prospective and randomized study was performed in Imam Khomeini Hospital in Ahvaz in 2019-2020. All patients who had cataract after vitrectomy and silicone oil injection that need cataract surgery and silicone drainage were included. Oral informed consent was obtained from all individual participants included in the study. Additional informed consent was obtained from all individual participants for whom identifying information is included in this manuscript. Patients who did not return for follow-up or had other major ocular surgeries with this type of surgery were excluded from the present study. Individuals were randomly divided into two groups based on random block permutation.Patients were divided in two groups at specified intervals with cataract after vitrectomy and injection of silicone oil that needed vitrectomy and drainage of silicone oil.

The first group underwent surgery in two steps, first silicone oil removal surgery and then cataract surgery. The second group underwent cataract surgery and silicone oil removal in one step.

Intervention

Silicone oil drainage surgery was performed at least 3 months after vitrectomy and silicone oil injection and complete retinal adhesion was observed. Lens power was determined by IOL Master (Carl Zeiss Meditec AG, Germany). After explaining the surgical method to patients, including the duration of the operation, anesthesia was performed in two ways, local or general based on the request of the patient, except in cases that general anesthesia was high risk, in which case local or topical anesthesia was used inevitably. In the first group, cataract surgery and silicone oil drainage were performed in two separate steps.

In the first group, for drainage of silicone oil after conjunctival incision, sclerotomy was performed in the inferotemporalquadrant area 3.5 mm from the limbus, and 23-gaugetrocar was placed in it and infusion cannula was placed in trocar. Then peritomy and sclerotomy was performed at a distance of 3.5 mm from the limbus in the supranasal or supra temporal quadrant and silicone oil was removed. After ensuring complete drainage of the silicone oil, the infusion cannula was removed and the sclerotomies and peritomies were repaired with absorbable suture vicryl 8.0. At least 2 months after this operation, cataract surgery was performed by temporal corneal incision, capsulorhexis, hydrodissection, phacoemulsification inside the capsular bag, removal of the lens cortex and placement of a foldable lens in the capsular bag.

In the second group conjunctival incision sclerotomy were made in the inferotemporal quadrant at a distance of 3 mm from the limbus and the infusion cannula was placed in it, then cataract surgery was performed in the same way as the first group. After cataract surgery, the corneal incision was closed with a non-absorbable nylon 10-0 or stromal hydration, and a peritomy and sclerotomy were performed at a distance of 3 mm from the limbus in the supranasal or supra temporal quadrants, through which silicone oil was removed. Sclerotomies and peritomies were repaired with Vicryl 8.0 absorbable suture. Primary posterior

capsulorhexis and trans limbal silicone oil removal wasn't done for any patient. In both groups, in case of posterior capsule opacity, posterior capsulectomy was performed with YAG Laser.

Medical treatment was performed after surgery with betamethasone drops and antibiotic drops. Periodic dilatation visits were performed on the first day, the third day, the first week, the first month, the third month and the sixth month after surgery. Additional visits were made if necessary. At each visit, examinations included: patient's vision, uncorrected visual acuity, and best-corrected visual acuity, with the help of E Chart, anterior segment examination, Goldman tonometry, and fundus examination. Refraction was also performed 3 and 6 months after surgery.

Statistical analysis

For quantitative variables, mean was used to describe the data center and standard deviation (or quadratic amplitude) was used to describe the data scatter. In qualitative variables, frequency and percentage were used to describe the data. Independent t-test (or Mann-Whitney), Chi-square test (or Fisher's exact test) and Pearson correlation coefficient (or Spearman) were used for univariate data analysis. For multivariate data analysis, the generalized linear mixed model or GEE model was used. Normalization of data was performed using Kolmogorov-Smirnov test and Q-Q diagram. Significance level was considered 0.05%. All tests were performed using SPSS software version 22.

3. RESULTS

172 eyes of 172 patients diagnosed with cataract after vitrectomy and silicone oil injection that required cataract surgery and silicone oil drainage were enrolled. Statistical analysis of the data showed that the mean age of patients with one-step and two-steps surgery was 58.05± 9.10 and 55.92 ± 9.56 years, respectively (Table 1). The minimum and maximum age of patients was 31 and 73 years.

Table 1 Frequency of surgical groups by age

Surgical groups	**Age (year)**		**Mean (SD)**	**P value**
	Man	Woman		
	Mean (SD)	Mean (SD)		
One step	57.28(8.63)	59.56(9.03)	58.05(9.10)	0.36
Two-steps	55.12(10.06)	57.20(9.33)	55.92(9.56)	

SD; Standard deviation

60% of patients in the present study were female and in general 54.37% of them underwent one-step and 45.63% two-steps surgery. However, the statistical test did not show a significant relationship between sex and surgical groups (Table 2). The mean preoperative vision of patients with one-step and two-steps surgery groups was 1.31 ±0.47 and 1.30 ±0.55 Log MAR, respectively (Table 3).

Table 2 Percentage of frequency of surgical groups by sex

Surgical groups	**Sex**		**Total (%)**	**P value**
	Man	Woman		
	N (%)	N (%)		
One step	38 (55%)	56 (54,37%)	94(54,65%)	
Two-steps	31(45%)	47 (45,63%)	78 (45,35%)	0.88
Total (%)	69 (40%)	103(60%)	172 (100%)	

Table 3 Independent t-test of one-step and two-steps group for preoperative vision according to LogMAR

Surgical groups		**Number**	**Mean**	**SD**	**95% Confidence Interval of the Difference**		**Standard Error Mean**	**P value**
					Lower	Upper		
	One step	94	1.31	0.47	HM	1.4	0.28	
VA	Two-steps	78	1.30	0.55	HM	1.4	0.36	0.75

SD; Standard deviation;

Independent t-test showed that although the results of two-steps surgical refraction seems better than one-step, there was no significant relationship between surgical groups and refraction six months after surgery (Table 4).

Table 4 Independent t-test for diopter spherical equivalent six months after surgery

Surgical groups		Number	Mean	Standard Deviation	95% Confidence Interval of the Difference		Standard Error Mean	P value
					Lower	Upper		
Refaction	Onestep	94	-1.00	0.99	-2.25	1.25	0.18	
	Two step	78	-0.75	0.66	-1.75	0.50	0.24	0.44

Statistical tests did not show a significant relationship in terms of uncorrected visual acuity (UCVA) and best corrected visual acuity (BCVA) between one-step and two-steps groups (Table 5).

Table 5 Independent t-test of one-step and two-steps groups for UCVA and BCVA according to LogMAR on different times after surgery

Surgical groups			N	Mean	SD	95% Confidence Interval of the Difference		Std. Error Mean	P value
						Lower	Upper		
UCVA	first day	One step	94	1,24	0,10	1,3	1	0.02	
		Two-steps	78	1,22	0,11	1,3	1	0.03	0.29
	one week	One step	94	1,24	0,09	1,3	1	0.02	
		Two-steps	78	1,22	0,11	1,3	0.95	0.03	0.35
	one month	One step	94	1,21	0,08	1,25	0.95	0.01	
		Two-steps	78	1,20	0,10	1,23	0,95	0.02	0.50
	three months	One step	94	1,20	0,08	1,22	0,91	0.02	
		Two-steps	78	1,16	0,11	1,23	0,88	0.03	0.16
	six months	One step	94	1,20	0,08	1,22	0,89	0.02	
		Two-steps	78	1,13	0,17	1,17	0,85	0.04	0.18
BCVA	first day	One step	94	1,03	0,25	1,3	0,9	0.06	
		Two-steps	78	1,02	0,27	1,25	0,9	0.07	0.35
	one week	One step	94	1,02	0,24	1,25	0,85	0.06	
		Two-steps	78	1,00	0,26	1,20	0,85	0.07	0.56
	one month	One step	94	1,02	0,24	1,20	0,80	0.06	
		Two-steps	78	0,96	0,31	1,13	0.75	0.08	0.71
	three months	One step	94	1,01	0,26	1,18	0,78	0,06	
		Two-steps	78	0,91	0,29	1,05	0,71	0,08	0.38
	six months	One step	94	0,98	0,26	1,15	0,75	0,06	
		Two-steps	78	0,91	0,28	1,04	0,70	0,07	0.27

N; number, SD; Standard deviation, Std; standard, UCVA; uncorrected visual acuity, BCVA; best corrected visual acuity.

However, postoperative UCVA and BCVA improved in both the one-step and two-steps groups over time with a gentle slope. The changes in UCVA and BCVA of one-step and two-steps patients at the time of postoperative follow-up, one week, one month, three months and six months are shown in figure 1. The results of the analysis showed a total of 20 complications including, 11 drug-controlled IOP rise, 7 PCO and 2 RD.

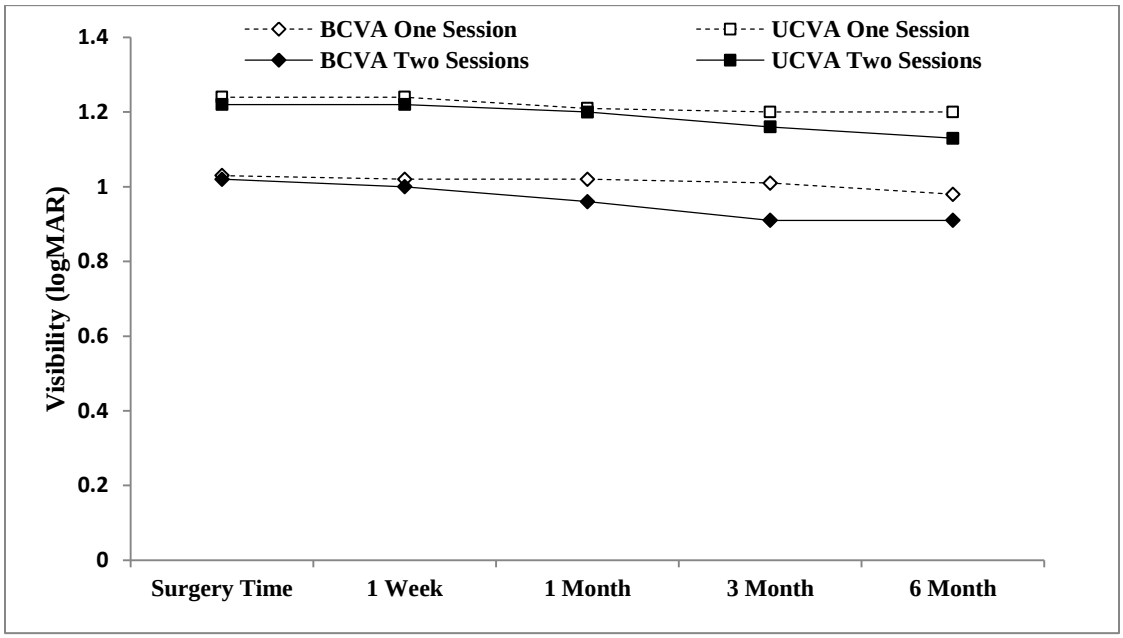

Figure 1 UCVA and BCVA changes up to 6 months after surgery according to log MAR.
BCVA; best corrected visual acuity, UCVA; uncorrected visual acuity.

4. DISCUSSION

Silicone oil injections at the end of vitrectomy are common. One of the important factors after cataract surgery is the postoperative refraction rate. The present study showed that although two-steps surgery resulted in better refraction result, but this wasn't statistically significant. It seems that the accuracy of the IOL master in estimating the power of the IOL in spite of silicone oil in vitreous cavity has caused this result. In the Madanagopalan et al. (2019) study refraction in one-step group was significantly better than two-steps group. This could be due to the use of ultrasonography in their study to estimate the strength of the IOL, whereas in the present study IOL-master was used to estimate the power of the IOL.

Habibabadi et al. (2005) studied the refractive results of silicone oil removal, cataract surgery and IOL implantation in 12 patients. In their study, IOL power was calculated using laser interferometry and refraction (spherical equivalent) 12 weeks after surgery was -0.30 ±0.91 D, which is comparable to our result. El Baha et al. (2003) used intraoperative biometry for calculating IOL power after removing silicone oil in 12 cases of cataract in silicone-filled eye. After surgery, the mean spherical equivalent of refractive error was 0.77 ±0.34 D that is comparable to our result. Patwardhan et al. (2009) study which was performed with the aim of calculating the power of IOL with the help of retinoscopy during simultaneous cataract surgery and removal of silicone oil, Ianchulev's formula was used as R×2.01449. Refractive error (spherical equivalent) three months after surgery in their study was 0.45±0.63 D, that is comparable to our result.

In a retrospective study of patients who underwent simultaneous silicone oil removal, phacoemulsification and IOL implantation, a group using biometric ultrasound and a group using laser interferometer (IOLMaster) to estimate IOL power were compared. Postoperative spherical equivalent defects were examined. The mean spherical equivalent in the group that underwent biometric ultrasound was -1.34 D and in the group that underwent laser interferometry was -0.51 D (Kevin K Suk et al., 2013). UCVA and BCVA are two other factors that were examined in this study. According to figure 1, the levels of UCVA and BCVA have improved over time after surgery. Although the results of two-steps surgery in both factors were better than one-step, the independent t-test did not show a significant relationship between these two factors and the type of surgery.

A study was conducted by Krepler et al. (2003) to evaluate the visual results of a one-step and two-step surgical approach. The difference between the two groups was not statistically significant in terms of vision improvement which was similar to the present study. According to the results, it can be said that if silicone oil can cause some errors in the calculation of power IOL using IOL master, it is negligible. Also, the prevalence of side effects should be evaluated with too more patients.

Limitation

This study isn't double-blind.

5. CONCLUSION

Despite the slightly better result of refraction in two-steps surgery, due to the insignificance of statistical tests, lower risk for complications of the one-step operation including complications of anesthesia, as well as lower cost and less need for visits, we recommend doing cataract surgery and silicone oil removal in one step.

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Conflict of Interest

The authors declare that there are no conflicts of interests.

Ethics

The study was approved by the medical ethics committee of Ahvaz Jundyshapur University of Medical Sciences (ethical approval number is IR.AJUMS.REC.1398.130).

Data and materials availability

All data associated with this study are present in the paper.

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