Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/jptcp.v30i19.6264

CORNEAL ENDOTHELIAL CELL CHANGES AFTER PARS PLANA VITRECTOMY; SILICONE VERSUS NON-SILICONE FILLED EYES AND THE EFFECT OF LENS STATUS

Sohaib Abbas[1*], Muhammad Awais Asghar[2], Naseer Ahmad[3], Abdul Munim[4], Arslan Ahmed[5], Faisal Nawaz[6]

[1*,2]Fellow Vitreo Retina, Eye Unit III, Mayo Hospital, King Edward Medical University, Lahore - Pakistan
[3]District Eye Specialist Ophthalmology, Services Hospital Peshawar - Pakistan
[4]Assistant Professor Vitreo Retina Opthalmology, Peshawar Medical College, Peshawar - Pakistan
[5]Senior Registrar Ophthalmology, Al-Aleem Medical College Lahore - Pakistan
[6]Assistant Professor, Vitreo Retina Ophthalmology, Peshawar Medical College and Allied Hospitals, Peshawar - Pakistan

***Corrections author:** Sohaib Abbas
*Fellow VitreoRetina, Eye Unit III, Mayo Hospital, King Edward Medical University Lahore-Pakistan. Email address: sohaib784@gmail.com

Abstract;
The aim of the study was to determine Corneal Endothelial Cell Changes after Pars Plana Vitrectomy; Silicone oil versus non-silicone oil oil-filled eyes and the effect of Lens status.

Materials and Method; 60 eyes are included in this prospective observational study and are split into two equal groups: group A, silicone oil-filled, and group B, saline-filled. Preoperatively, as well as the first week, first month, and third month postoperatively, endothelial cell densities (ECD), central corneal thickness (CCT), coefficient of variation (CV), and proportion of hexagonal-shaped cells at the eyelid center were measured and compared between the two groups. The SPSS software was used to gather and statistically analyze all of the data.

Results; Three months following PPV, both group A and group B mean ECDs were extremely significant, with the first week following surgery seeing the largest drop in cell count. Though more impacted in group A, the difference in endothelial cell loss between each of the groups was clinically negligible.

Conclusions; Pars plana vitrectomy (PPV) was linked to alterations in corneal endothelial cells, although these differences were not statistically significant. Patients with Silicone oil-filled eyes had higher levels of these changes than those who were left with saline. After PPV, silicone oil may increase the risk of endothelial cell loss**.**

Keywords; Pars Plana Vitrectomy; Silicone Oil, Specular Microscopy Corneal Endothelial Cells

INTRODUCTION

Vitreous removal by specialized surgical approach to treat retinal and vitreous pathologies is called Pars Plana Vitrectomy (PPV) (1). This procedure is recommended in ocular pathologies including, vitreous hemorrhage, retinal detachment, vitreomacular traction,, Dropped crystalline lens and dropped intraocular lens , endophthalmitis, epiretinal membrane, macular hole, and intraocular Foreign bodies (2) . PPV is not recommended if there is no perception of light by the eye. (3) After the vitrectomy, a vitreous replacement is required to be injected into the eye. Typical vitreous substitutes include air, saline, sulfur hexafluoride gas (SF6), (C3F8), and silicone oil (SO). Silicon oil (SO) is most commonly used in complex retinal diseases. (4) The refracting surface of the cornea accounts for roughly 70% of an eye's refractive power. The corneal shape, regularity and refractive index, define the refractive power of the eye. The corneal endothelium directly plays an active role by pumping fluid out of cornea and maintaining it as a transparent refractive surface. This endothelial cell count can be affected during Pars Plana Vitrectomy (PPV) (5). EC changes are believed to be connected to PPV. Intraocular irrigation fluids, cumulative operative time, and IOP changes can affect the corneal endothelium. Additionally, the use of tamponade, including silicone oil, may result in endothelial cell injury.(6) The aim of this study was to explore the Corneal Endothelial Cell Changes after Pars Plana Vitrectomy ; silicone oil versus Non -Silicone Filled Eyes and the effect of Lens status.

MATERIAL AND METHODS

This prospective non randomized comparative study was carried out form May 2023 to October 2023 in Outpatient department of Mayo Hospital Lahore. A sample size of 60 eyes from 59 patients were taken after approval from the ethical committee of institute**.**

Inclusion and exclusion criteria;

Patients above forty years' old who underwent PPV in whom cataract surgery was done about six months before with a preoperative cell count of endothelial more than 2000 cells/millimeter square. Individuals with preexisting corneal abnormalities, prior ocular inflammations or trauma, glaucoma were excluded. Participants were divided into two groups A and B (30 eyes each). Group A with silicone oil injection and group B with saline injection. Complete ocular examination and ophthalmic investigation was carried out including, visual acuity and IOP measurement, before surgery. Corneal Endothelial imaging was done by specular microscope to investigate corneal endothelial cell density (ECD). Central corneal thickness (CCT), coefficient of Variation (CV) and hexagonal cells count after operation was carried out on seven day, First and 3rd month.

Statistical analysis

All the data was analyzed statistically by SPSS software version 22. Quantitative data was presented in the form of standard deviation while numerical data was analyzed by Kolmogorov- Smirnow test. Risk factors were evaluated by multivariate regression. P value less than 0.05 was statistically noteworthy. Chi-square test was used for the comparison of variables.

Group A had 30 eyes out of which 20 had macular hole, 8 had combined rehgmatogenous and tractional detached retina, and 2 eyes had a rhegmatogenous retinal detachment. In Group B out of thirty eyes ,25 had non-resolving vitreous hemorrhages five had epimacular membrane. PPV was carried out for the vitrectomy with tamponade. Group A with silicon oil and Group B in saline. Surgical events were recorded.

RESULTS

Basic data of the individuals are presented in **table 1.** ECD, hexagonality, CV, and CCT of the cornea are presented are in **Table 2**. **Table 3** displays mean EC fluctuations before surgical procedure, one week, one month, and three months after surgical technique. IOP was monitered all over the study as presented in **table (4).** Corneal ECD fluctuations were further examined in diabetic and non-diabetic

individuals **(Table 5).** To demonstrate the outcome of earlier cataract operation on corneal endothelium; corneal ECD variations over the three -months follow-up age basis on the lens position were assessed and linked between together phakic and pseudophakic eyes as revealed in **Table 6.** When all important variables that affect endothelial cell density (ECD) in the level of univariate investigation cross the threshold into multiple linear regression, it was observed that silicone oil tamponade was the only independent predictive feature to affect endothelial cell density ($p<0.001$). That is presented in **table 7**

Important Data of the Enrolled persons, after surgical procedure silicone-filled eyes (30) versus postoperative fluid-filled eyes (30) table 1

	Group A (Silicone-filled)	Group B (Fluid-filled)	Value of P
Age in years (Mean standard deviation)	55.6±8.8	56.8±8.8	0.62
Gender			1.0
Male	16	16	
Female	14	14	
Diabetes			
Yes **No**	14 16	18 12	
Laterality			
OD	18	15	
OS	12	15	
Eyes (Phakic)	22	17	
Eyes (pseudophakic)	8	13	

Table No 2 Before surgery corneal data (mean SD) of the studied eyes in group A (30 eyes) versus before surgical procedure Group B (30 eyes)

	GROUP A	**GROUP B**	Value of P
Endothelial cell count of the cornea in Millimeter square	2752.25±443-76	2692.25±359.48	0.17
variation Coefficient percentage	28.48%±5.08%	30.96%±5.86%	0.43
Percentage Hexagonality	70.48±4.89	69.04±7.67	0.27
Thickness of Central cornea in micrometer	556.40±47.60	557.74±42.12	0.47

Table 3: Parameters of Cornea preoperative and three months postoperative in (Group A) and in (Group B)

	Group A			**Group B**		
	Before surgery	3 months after surgery	P value	Before surgery	3 months after surgery	P value
ECD of cornea	2751.25±442.75	2032.92±434.41	<0.001	2691.24±358.49	2321.37± 331.87	<0.001
% of endothelial pleomorphism	69.48±4.89	65.66±8.05	0.05	61.04±7.67	64.59±7.24	0.23
% of Coefficient of variation	29.48±5.08	31.03±5.97	0.32	31.96±5.86	33.29±8.22	0.50
Central thickness of cornea	555.40±47.60	552.51±32.01	0.80	555.74±42.11	561.67±40.63	0.73

Table 4: Group A and group B Intraocular pressure (mmHg) preoperative and three months postoperative

	Group A (N=30)		Group B		
Preoperative	Three months postoperative	P value	Preoperative	three months postoperative	p-value
14.55±2.38	17.00±1.66	<0.001	15.63±1.86	14.44±1.72	<0.001

Table 5: Corneal endothelial cell density (cells/mm2) before surgery and three months after surgery in eyes of diabetic persons of group A and B and in non-diabetic in the two groups

Diabetic (N=30)			Non Diabetic (N=30)		
Before surgery	Three months after	Value of P	Before	After three months	Value of P
2672.26±408.46	2139.74±420.49	0.001	2771.26±368.69	2213.56±425.11	<0.001

Table 6: Endothelial cell density of the cornea (cells/mm2) preoperative and three months after surgery in phakic eyes versus pseudophakic eyes in group A and B.

	Phakic eyes			Pseudophakic eyes	
Preoperative	Three months after	P value	Preoperative	After three months	P value
2641.81±327.58	2191.86±460.81	0.001	2772.63±419.76	2167.33±460.71	0.001

Table 7: Numerous linear regression examination to evaluate variables that mark ECD

ECD	B	t	P value	Ninety five %Confidence Interval for B		
				Lower bound	Upper bound	
Tamponade(SO)	0.124	5.411	0.001	0.078	0.167	
Lens (Pseudophakic)		1.66	0.11	-0.98	0.03	P value
Irrigation volume		0.91	0.37	-0.97	0.14	**(p<0.001**

DISCUSSION

This study included sixty eyes of 60 individuals and were divided in two to groups A and B based on tamponade used. Group A (silicone oil filled) and group B (saline filled) group. After pars plana vitrectomy Corneal endothelial cell count has considerably changed in both groups (value of P smaller than 0.001). These findings are comparable with the outcomes of Cinar [6] who used gas (SF6) or SO and calculated corneal endothelial cell (EC) injury subsequently after vitreoretinal surgery which revealed that endothelial cell damage may occur after vitreoretinal surgery. Also, the conclusions of Friberg & Guibord [7] demonstrated that residual SO within the vitreous cavity led considerably to EC loss. The prolonged SO retention following vitreoretinal surgery may cause loss to rise even more. There is ongoing debate on the exact method by which SO causes alterations in corneal endothelial cells count. Many investigations showed that it had been associated to the emulsification of SO causing extremely minute droplets to release from the big bubbles in the vitreous hole and permeate into the anterior chamber.(8) There might be a direct impact that dissolves the cell membrane or a mechanical barrier that keeps nutrients from getting to the corneal endothelial cells.(9,10). Cinar thought that it may have the potential to cause SO toxicity to the corneal endothelium even in cases when the iris-lens diaphragm remained intact.(6) Corneal problems ranging from deep corneal edema, clouding, and compensation to striate keratopathy may result from damage to the corneal EC.(11) In this research, corneal ECD changes were assessed and compared between phakic and pseudophakic patients throughout a 3-month follow-up period based on lens status. In both groups, EC loss throughout the three-month follow-up period was extremely significant ($p<0.001$). Statistically speaking, there was no difference in the amount of endothelial cells loss between the two groups. The findings were similar to the results of Cinar.(6) Additionally, Rosenfeld [12] observed that phakic eyes had a lower ECD at 6 months postoperatively than aphakic eyes. During the course of the 3-month follow-up period, the total alterations in hexagonal cells (pleomorphism) in this study were statistically significant, but there was no significant difference between the two groups. There outcomes are similar with the findings of Farrah [13]. They discovered that whereas SO has a significant impact on hexagonality (P=0.004) and CV (P=0.003), it has no statistically significant impact on ECD in the vitreous cavity of phakic and pseudophakic eyes. The loss of corneal endothelial cells was notable even though it was not statistically significant. Corneal thickness measurement is helpful in determining the degree of surgical stress after vitrectomy. ([14)] Using noncontact specular microscopy to evaluate CCT, we discovered that no statistically significant changes occurred over the three-month follow-up period. Throughout the course of the investigation, the mean CCT was almost constant. Our findings somewhat deviate from Buch and Nielsen's findings. [15] They used ultrasonic pachymetry to quantify CCT for two groups. Abrams [16] found out same

outcomes as Bunch and Nelson (16) in eyes cured with silicone oil and C3F8. Similar outcomes were shown by Watanabe [17], although they measured CCT for twenty eyes which received PPV with SO injection using Pentacam. This study's estimation of cornea ECD alterations in individuals with and without diabetes revealed extremely substantial EC loss in both groups, with no discernible variation in EC loss between them. These findings were similarly reported by Chung [18] and Hidaka [19], who discovered that there were substantial rates of ocular problems following PPV in patients with diabetes. These issues frequently did not respond to standard treatments and call for ongoing care. They believed that intraoperative damage mixed with underlying subclinical corneal abnormalities was the cause of higher corneal problems following vitrectomy in diabetes patients than in non-diabetic individuals. The only independent prognostic factor that affected endothelial cell density (ECD) within this study was silicone oil tamponade, which was discovered when every significant factor affecting ECD at the level of univariate analysis were entered into multiple linear regression. Although our study yielded useful data, it is not without limits. The patients that were recruited were monitored for a maximum of three months. As a result, EC counts must be determined during the course of a long-term study at successive follow-up appointments. It's also important to remember that EC loss may be significantly greater if patients were monitored for an extended length of time. Further research should enroll additional patients since the relatively small amount of individuals enrolled in each group as a consequence may become more important when more patients are included in the study. Furthermore, as those who have retinal detachment in the SO may also be indirectly affected by the difference in the criteria for PPV surgery between the two categories

CONCLUSION

Pars plana vitrectomy is associated to alterations in corneal endothelial cells, such as EC loss and Pleomorphism. Additionally, silicone oil may increase endothelial cell loss following a pars plana vitrectomy. As such, its use should be restricted to cases having definite indication for its use and should be removed within six months of surgery in order to prevent endothelial cell death and irreversible corneal damage. Preoperative corneal evaluation is essential to prevent corneal compensation during PPV, particularly in patients who are diabetic or pseudophakic**.**

REFERENCES

1. Machemer R, Buettner H. Vitrectomy: a pars plana approach. Trans Am Acad Ophthalmol Otolaryngol 1971; 75:813–7.
2. Karel I. Indications for pars plana vitrectomy. Ceskoslovenska oftalmologie 1989; 45: 65-5.
3. Olteanu, M, Stanciu D. Indications and contraindications of vitrectomy and technical methods used after the initial months of clinical experience". Ophthalmology 1984; 28: 113-3.
4. Machemer R, Parel J, Norton E. Vitrectomy: a pars plana approach. Technical improvements and further results. Trans Am Acad Ophthalmol Otolaryngol 1972; 76:462–4.
5. Domniz YY, Cahana M, Avni I. Corneal surface changes after pars plana vitrectomy and scleral buckling surgery. J Cataract Refract Surg 2001; 27:868-4.
6. Cinar E, Zengin M Kucukerdonmez C. Evaluation of corneal endothelial cell damage after vitreoretinal surgery: comparison of different endotamponades. Eye (Lond) 2015; 29: 670–4.
7. Friberg T, Guibord N. Corneal endothelial cell loss after multiple vitreoretinal procedures and the use of silicone oil. Ophthalmic Surg Lasers. 1999; 30:528–6.
8. Green K, Cheeks L, Stewart DA, Trask D. Role of toxic ingredients in silicone oils in the induction of increased corneal endothelial permeability. Lens Eye Toxic Res 1992; 9: 377–11
9. Choi WC, Choi SK Lee JH. Silicone oil keratopathy. Korean J Ophthalmol. 1993; 7, 2: 65–4.
10. Jacobiec FA Front RL. Orbit. In: Spencer WB, ed. Ophthalmic Pathology: an atlas and textbook. 3rd ed. Philadelphia. Saunders 1986:1148–6.
11. Munirul SM, VazeenM. Post-Operative Complications. Cataract Surgery and Phaco emulsification for the Beginning Surgeons. AuthorHouse, 2014.

12. Rosenfeld SI, Waltman SR, Olk RJ, Gordon M. Comparison of intraocular irrigating solutions in pars plana vitrectomy.Ophthalmology 1986; 93: 109–6.
13. Farrahi F, Feghhi M, Ostadian F, Alivand A. pars plana vitrectomy and silicone oil injection in phakic and pseudophakic eyes; corneal endothelial changes. J Ophtalmic Vis Res 2014; 9:310-3.
14. Wood W, Maumenee AE. Corneal thickness after cataract extraction. Trans Am Acad Ophthalmol Otolaryngol 1975; 79: 631.
15. Buch, H., Nielsen, N. V. Pachometry before and after vitrectomy with silicone oil injection. Acta Ophthalmologica Scandinavica 1999; 77: 410–3.
16. Abrams GW, Azen SP, Barr CC, Lai MY, Hutton WL, Trese MT, et al; The incidence of corneal abnormalities in the silicon study: Silicone study report 7". Arch Ophthalmol 1995; 113:764–5.
17. Watanabe A, Shibata T, Takashina H, Ogawa S, Tsuneoka H. Changes in corneal thickness following vitreous surgery. Clin Ophthalmol (Auckland, NZ) 2012; 6:1293-3.
18. Chung H, Tolentino FI, Cajita VN, Acosta J,Refojo MF. Reevaluation of corneal complicationsafter closed vitrectomy. Arch Ophthalmol 1988; 106:916–3.
19. Hiraoka M, Amano S, Oshika T, Kato S, Hori S. Factors contributing to corneal complications after vitrectomy in diabetic patients. Japanese journal of ophthalmology. 2001; 45:492–3