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CORNEAL CHANGES IN EYES WITH SILICONE OIL TAMPONADE: A COMPARATIVE PRE- AND POST-OPERATIVE ASSESSMENT

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Abstract

objective: This study aimed to evaluate and compare pre- and post-operative corneal changes in eyes treated with silicone oil tamponade. **Methodology:** A comparative cross-sectional study was conducted at Al-Shifa Trust Eye Hospital in Rawalpindi, Punjab, Pakistan, enrolling subjects using a non-probability consecutive sampling technique undergoing silicone oil tamponade. Detailed ocular examination of the anterior and posterior segments was performed with slit lamp biomicroscopy. Corneal parameters, including principal corneal curvature K1, K2, its average KAVG, central corneal thickness (CCT), and anterior chamber depth (ACD), were measured with IOL Master 700 pre- and post-operatively. Data were entered and analyzed using DATATAB online web-based software. **Results:** A total of 50 subjects participated, including 34 (68%) males and 16 (32%) females, with a mean age of 48.10 ± 18.55, ranging from 10 to 80 years. The mean pre- and post-operative values for K1, K2, KAVG, CCT, and ACD were 42.93 ± 1.91, 44.67 ± 1.80, 43.87 ± 1.63, 529.14 ± 37.02, and 3.79 ± 1.02, and 42.71 ± 1.82, 44.74 ± 2.01, 43.81 ± 1.77, 531.74 ± 38.18, and 3.99 ± 1.00, respectively. Comparing pre- and post-operative corneal parameters after one-month follow-up, no significant changes were observed. However, a statistically significant increase in ACD was observed ($p < 0.002$). **Conclusion:** No significant changes in corneal parameters occurred in eyes with silicone oil tamponade, while an increase in anterior chamber depth was observed.

Keywords: Anterior Chamber Depth (ACD), Central Corneal Thickness (CCT), IOL Master, K-Readings

INTRODUCTION

Silicone oils (SO) are liquid materials that can be used to fill the inside of the eye (intraocular tamponade) during complex surgeries for the retina, the light-sensitive layer

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at the back of the eye. They are classified as class IIb medical devices within the European Union, which means they are implantable, surgical invasive devices that can stay in the eye for more than 30 days(1). SO have a higher refractive index (1.405) than the natural fluids in the eye, such as the vitreous and aqueous humour(2). This means that SO change the way light bends when it enters the eye, and affect the eye's vision(3)**.** SO have a long history of use and are still very important for treating difficult retinal diseases (4). However, they can also cause serious complications, which are not fully explained by current scientific knowledge(5). One of these complications is SO-associated keratopathy, which is a condition where the cornea, the clear front part of the eye, becomes damaged and cloudy after SO tamponade (6). This can lead to loss of vision and the need for a corneal transplant(7).The cornea is responsible for about 70% of the eye's ability to focus light. This depends on the cornea's shape, smoothness, clarity, and refractive index, which can all be affected by surgery. Some studies have also shown that SO can change the mechanical properties of the cornea(8). SO keratopathy can affect up to 30% of eyes after 6 months of SO tamponade(9), and it may be more common in eyes without a natural lens (aphakic eyes) (10). It is possible that SO causes corneal damage by blocking the nutrition of the corneal cells (CECs) from the aqueous humour, especially when SO moves into the front part of the eye (anterior chamber) and touches the CECs(2,11,12)

This study explores the subtle effects of silicone oil tamponade on the cornea, the clear front part of the eye. It compares the outcomes before and after the surgery in a comprehensive way. It examines how the silicone oil tamponade interacts with the corneal parameters, such as the main curvature of the cornea, the thickness of the central cornea, and the depth of the space between the cornea and the lens (anterior chamber). It tries to find out if this eye treatment causes any changes in these parameters.

METHODOLOGY

This research employed a comparative cross-sectional study design conducted at Al-Shifa Trust Eye Hospital in Rawalpindi, Punjab, Pakistan. Subjects with age ranged from 10 to 80years undergoing silicone oil tamponade were enrolled using a non-probability consecutive sampling technique. Subjects with congenital eyeball and scleral anomalies associated with retinal disease with SO indication were excluded from the study.

The study included a comprehensive ocular examination of the anterior and posterior segments through slit lamp Biomicroscopy. Corneal parameters, namely principal corneal curvature (K1, K2), average KAVG, central corneal thickness (CCT), and anterior chamber depth (ACD), were measured using the IOL Master 700 instrument. Subjects were seated comfortably in front of IOL Master with three readings were taken pre and post-operatively and average were taken. Data collected included pre-operative measurements taken before silicone oil tamponade and post-operative measurements recorded after the procedure. A one-month follow-up period was observed to assess changes in corneal parameters post-operatively.

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The collected data were entered into the DATATAB online web-based software for analysis, including descriptive statistics for continuous variables and Wilcoxon rank statistical tests to determine the significance of changes after checking data distribution with shapiro wilk test with significance level were kept (<0.05%). Ethical considerations were paramount, with informed consent obtained from participants and approval from the institutional ethics committee as per tent of Helsinki declaration.

RESULTS

Table 1: Demographic Characteristics of Patients Undergoing Silicone Oil Tamponade: Gender and Age Distribution

		Gender		
		Male	**Female**	**Combined**
	Frequency	34	16	50
	%	68%	32%	100%
Age	Mean	47.47	49.44	48.1
	Std. Deviation	17.71	20.77	18.55
	Minimum	10	10	10
	Maximum	78	80	80

Table 1 presents demographic characteristics of 50 patients undergoing silicone oil tamponade, with 68% being male and 32% female. The age distribution reveals a mean age of 48.1 years, ranging from 10 to 80 years, with a standard deviation of 18.55 years. This indicates a relatively equal gender distribution, though slightly more males, and a varied age range among the patients receiving silicone oil tamponade, demonstrating the diversity within the study cohort.

Table 2: Distribution of Silicone Oil-Filled Eyes: Left and Right Eye Frequency Percentage in Pre- and Post-Operative Assessment

Silicone oil filled eye	Frequency	%
Left eye	26	52%
Right eye	24	48%
Total	50	100%

Table 2 displays the distribution of silicone oil-filled eyes in a cohort of 50 patients undergoing pre- and post-operative assessments. Among these eyes, 52% are left eyes, and 48% are right eyes. The total count of silicone oil-filled eyes sums up to 50, representing 100% of the cases. This information provides an overview of the distribution of silicone oil placement between the left and right eyes in the context of the assessed surgical procedures.

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Table 3: Preoperative Anterior Chamber Depth (Pre-ACD), Central Corneal Thickness (Pre-CCT), Keratometry Readings (Pre-K1 and Pre-K2), and Average Keratometry (Pre-K Avg): Descriptive Statistics and 95% Confidence Intervals

	Pre-ACD	Pre-CCT	Pre-K1	Pre-K2	Pre-K Avg
Minimum	1.5	444	35	41	38.75
Maximum	6.27	612	47	48.5	47.75
95% Confidence interval of Mean	3.51; 4.07	518.88; 539.4	42.4; 43.46	44.17; 45.16	43.41; 44.32
Mean ± Std.	3.79 ± 1.02	529.14 ± 37.02	42.93 ± 1.91	44.67 ± 1.8	43.87 ± 1.63

Table 3 presents descriptive statistics and 95% confidence intervals for various preoperative ocular parameters. The Preoperative Anterior Chamber Depth (Pre-ACD) ranges from 1.5 to 6.27, with a mean of 3.79. Central Corneal Thickness (Pre-CCT) spans from 444 to 612, with a mean of 529.14. Keratometry Readings for the steepest (Pre-K1) and flattest (Pre-K2) meridians range from 35 to 47 and 41 to 48.5, respectively, with mean values of 42.93 and 44.67. The Average Keratometry (Pre-K Avg) varies from 38.75 to 47.75, with a mean of 43.87. The 95% confidence intervals provide a range for each mean estimate, offering insights into the precision of the measurements within the studied population.

Table 4: Postoperative Anterior Chamber Depth (Post-ACD), Central Corneal Thickness (Post-CCT), Keratometry Readings (Post-K1 and Post-K2), and Average Keratometry (Post-K Avg): Descriptive Statistics and 95% Confidence Intervals

	Post-ACD	Post-CCT	Post-K1	Post-K2	Post-K Avg
Minimum	1.5	450	37.5	40.75	40.25
Maximum	6.12	618	47	49	49.5
95% Confidence interval of Mean	3.71; 4.26	521.16; 542.32	42.2; 43.21	44.18; 45.3	43.31; 44.3
Mean ± Std.	3.99 ± 1	531.74 ± 38.18	42.71 ± 1.82	44.74 ± 2.01	43.81 ± 1.77

Table 4 outlines descriptive statistics and 95% confidence intervals for postoperative ocular parameters, including Postoperative Anterior Chamber Depth (Post-ACD), Central Corneal Thickness (Post-CCT), Keratometry Readings for the steepest (Post-K1) and flattest (Post-K2) meridians, and Average Keratometry (Post-K Avg). Post-ACD ranges from 1.5 to 6.12, with a mean of 3.99. Post-CCT ranges from 450 to 618, with a mean of 531.74. Post-K1 and Post-K2 range from 37.5 to 47 and 40.75 to 49, with mean values of 42.71 and 44.74, respectively. Post-K Avg varies from 40.25 to 49.5, with a mean of 43.81. The 95% confidence intervals provide a range for each mean estimate, offering insights into the precision of the measurements within the studied population postoperatively.

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Table 5: Comparison of Pre- and Post-Operative Measurements Using Wilcoxon Rank Test: Descriptive Statistics and p Values

Variable (N=50)	Pre-operative		Post-operative		p value
	Mean ± SD	Median	Mean ± SD	Median	
K1	42.93 ± 1.91	43	42.71 ± 1.82	42.75	<0.144
K2	44.67 ± 1.8	44.75	44.74 ± 2.01	44.75	<0.682
KAVG	43.87 ± 1.63	44.25	43.81 ± 1.77	44	<0.786
CCT	529.14 ± 37.02	530.5	531.74 ± 38.18	532.5	<0.177
ACD	3.79 ± 1.02	3.51	3.99 ± 1.00	4	<0.002
DS(Diopter sphere) Note: The p values indicate the level of significance in the comparison between pre-operative and post-operative measurements for each variable (K1, K2, KAVG, CCT, ACD, DS).					

Table 5 provides a comparison of pre- and post-operative measurements using the Wilcoxon Rank Test for various ocular variables in a sample of 50 individuals. The pre-operative and post-operative means and medians, along with standard deviations, are presented for Keratometry Readings (K1, K2, and KAVG), Central Corneal Thickness (CCT), Anterior Chamber Depth (ACD), and Diopter Sphere (DS). The p values associated with each variable indicate the level of significance in the comparison between pre-operative and post-operative measurements, highlighting the statistical significance of observed changes. Notably, significant differences are observed in ACD ($p < 0.002$), indicating a noteworthy alteration in this parameter following the surgical procedure. The other variables, including K1, K2, KAVG, CCT, and DS, do not show statistically significant differences between pre- and post-operative measurements.

DISCUSSION

This study examines the changes in the cornea, the clear front part of the eye, before and after the surgery with silicone oil tamponade, a liquid material that fills the inside of the eye. It reveals the immediate effects and adds new information to the existing knowledge in this area. The results show that the corneal curvature (K1, K2, and KAVG) and thickness (CCT) do not change much after the surgery, which is similar to what (13) and(14) found. This means that the cornea keeps its shape and thickness well after the eye surgery. These consistent findings suggest that silicone oil tamponade does not have immediate negative effects on the corneal surface or thickness.

However, the results also show that the depth of the space between the cornea and the lens (ACD) increases significantly after the surgery ($p < 0.002$), which is an interesting finding. This outcome agrees with what (15) found, showing that the silicone oil may affect the balance of the fluid in the front part of the eye. This change in ACD, though important, needs more research to understand how it happens. The physical properties of silicone oil, such as how it floats and bends light, may affect how the fluid moves in the eye, which is also what (15) suggested. Understanding these processes is important for explaining the complex relationship between silicone oil tamponade and the fluid in the front part of the eye.

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While our study gives reassuring insights into the short-term stability of the cornea, it is still important to monitor the eye over time. The lack of immediate changes in corneal curvature and thickness within one month after the surgery is similar to what(13) observed, supporting the idea that silicone oil does not cause sudden damage to these aspects of the corneal structure. However, long-term effects and possible cumulative impacts need longer follow-up studies, as other studies (16) suggested, to fully evaluate the safety of silicone oil tamponade on corneal health.

The complex relationship between silicone oil tamponade and corneal dynamics shows the need for a careful and comprehensive approach to patient care. Clinicians should be aware of the potential changes in ACD while also considering the overall stability observed in other corneal parameters. Future research should investigate more deeply the underlying mechanisms and long-term outcomes, contributing to a better understanding of the eye changes associated with silicone oil tamponade.

CONCLUSION

Silicon Oil does not cause significant changes in corneal parameters in short term while long term effect need further studies. However Anterior Chamber Depth changes in short term and need prompt attention in short and long term along with posterior segment.

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