

Effect of Pars Plana Vitrectomy on Central Corneal Thickness and Its Influence on Intraocular Pressure

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ABSTRACT

Purpose: To determine the effect of Pars Plana Vitrectomy on the central corneal thickness (CCT) and its influence on intraocular pressure (IOP).

Study Design: Interventional case series.

Place and Duration of Study: This research was conducted at Ibrahim Eye Hospital, Karachi, Pakistan, from October 2022 to March 2023.

Methods: Forty-one patients of either sex presenting with posterior segment disease and planned for Pars Plana vitrectomy (PPV) were selected after written informed consent. Pre and post-operative comparison of CCT and IOP was done using paired t-test. Follow-up of readings was done by repeated measures ANOVA test. BCVA measurements were based on the Snellen chart and were converted to the logarithm of the minimum angle of resolution (logMAR) scale for statistical analysis.

Results: CCT and IOP of the affected eyes were increased considerably in the first post-operative week (CCT = 591 ± 1.5 , IOP = 28 ± 1.5) and decreased significantly in the 3rd month (CCT = 527 ± 1.34 , IOP = 13 ± 2.5). The change was insignificant at 6th month follow-up. BCVA was improved in first week (626 ± 1.34) and remained same throughout the follow-up period. Maximum change in CCT (Δ CCT) was found in age < 15 years and in aphakic eyes (119 ± 0.09).

Conclusion: Pars Plana vitrectomy causes significant change in CCT which can influence IOP. This change should be kept in mind to prevent false diagnosis of glaucoma in the early post-operative period of PPV. Young patients and Aphakic eyes are more prone to the corneal changes.

Key Words: Pars Plana vitrectomy, Central Corneal Thickness, Intraocular Pressure, Retina, Vitreous.

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INTRODUCTION

Pars Plana Vitrectomy (PPV) is among the common surgical procedures executed for various vitreoretinal diseases.¹ Vitreous functions as a shock absorber and maintains globe integrity. Hence, vitrectomy would

induce corneal remodeling and variations in central corneal thickness (CCT).^{2,3} Few studies have reported variations in corneal thickness after vitrectomy and other ocular surgeries.^{4,5}

Another change associated with vitreoretinal surgeries is increased intraocular pressure (IOP).⁶ Silicon oil is commonly used as tamponade after PPV, it can also contribute to rise in IOP. A secondary increase in IOP following PPV with silicone oil administration is well reported in considerable number of patients.^{7,8} It is also evident from literature that IOP may be affected by change in the CCT.^{9,10} This can cause errors in readings of IOP and may lead to false

diagnosis of secondary glaucoma.^{11,12} Doughty and Zaman reported that a 10% change in CCT may cause 3.4mmHg change in IOP.¹³

This research was designed to assess the outcome of PPV in terms of CCT and its influence on IOP. This would help in making decision regarding which patients need referral to the glaucoma specialist.

METHODS

This Prospective follow-up study was carried out at Ibrahim Eye Hospital, Karachi for 6 months duration starting from October 2022 till March 2023 after taking approval from Institutional Review Board (IRB no: REC/IPIO/2023/066). The study strictly followed guidelines specified by the declaration of Helsinki. Patients of either gender undergoing PPV for posterior segment diseases were selected for research after taking written informed consent. The sample size was acquired by online sample size calculator <https://www.calculator.net/sample-size-calculator.html>. (confidence interval: 95%, Margin of errors: 5, Population proportion: 50%, population size: 45 cases). Patients with prior history of Glaucoma or on previous anti-glaucoma medications and patients undergoing anterior segment surgeries were excluded from study.

Demographic information and baseline findings related to patients such as age, sex, area of residency, lens status and final diagnosis of patients were noted on a self-designed proforma. Preoperative ocular examinations were done including CCT, IOP BCVA. All the surgeries (PPV) were performed by trained eye surgeons. After PPV, postoperative examination was conducted at first week. CCT was acquired through ultrasound pachymetry (Sonomed Pacscan 300P for B scan and A scan) under topical anesthesia. Mean CCT was taken after 6 readings with a standard deviation within readings < 5 microns. Any variations in readings with large standard deviations in asymmetrical corneas were omitted from study. IOP was determined by the Goldman Applanation Tonometer (GAT, Haag Straight AT900 tonometer) after topical anesthesia. BCVA was calculated by Snellen's chart. Follow up readings were done at 3rd and 6th month. Change in CCT (Δ CCT) was calculated at different time intervals throughout the study period.

Statistical analysis was done using SPSS version 23. Descriptive data is presented as Mean \pm SD (or median and interquartile range). P-value was taken

significant at < 0.05. Normality was detected using Shapiro-Wilk test. Pre and post-operative comparison of CCT and IOP was done using paired t-test. Follow-up was done by repeated measures ANOVA. BCVA measurements were based on the Snellen chart and were converted to logarithm of the minimum angle of resolution (logMAR) scale for statistical analysis.

RESULTS

Forty-one patients were included in the study. Two patients lost to follow up, therefore, 39 qualified for analysis. These patients were in the age range of 12 – 70 years and suffering from various vitreoretinal diseases. Mean age of patients was 55.12 ± 1.2 years. There were 27 (69.23%) males and 30.76% females. Maximum cases undergoing PPV had Advanced diabetic eye disease (31.71%) followed by vitreous hemorrhage (21.95%). Other indications were retinal detachment, endophthalmitis and nucleus drop/complicated cataract surgery. Majority of the patients were aphakic (51.28%), 28.2% were pseudophakic and only 20.51% were phakic. There were 33 (84.61%) patients who were resident of Karachi. Only eyes of 3 patients were affected on both sides.

Table 1 shows pre and postoperative comparison of study parameters; BCVA, CCT and IOP. CCT of affected eyes was increased significantly ($591 \pm 1.5^*$) when compared to its reading in preoperative period (526 ± 1.4). Similarly, IOP in affected eyes was also raised ($28 \pm 1.5^*$) as compared to its preoperative reading (14 ± 2.35). BCVA of affected eyes improved significantly ($626 \pm 1.34^*$) as compared to preoperative reading (660 ± 2.91) (Table 1). At 6th month follow-up, CCT of affected eyes showed non-significant decrease (526 ± 1.08) as compared to its reading in 3rd month after PPV (527 ± 1.34) but when the reading was compared with preoperative reading (526 ± 1.4), it was almost near to its preoperative value. There was no significant change in IOP (13 ± 1.3) and BCVA (624 ± 1.02) of patients at 6th month in comparison to its reading in 3rd month (Table 1).

On comparison among different age groups, maximum change in CCT (Δ CCT) was found in age < 15 years (119 ± 0.09). The Δ CCT was more in aphakic eyes (119 ± 0.08) as compared to pseudophakic (44 ± 0.06) and phakic eyes (11 ± 0.01).

Table 1: Comparison of affected eyes before and after Pars Plana Vitrectomy(N=39).

| Parameter (Mean ± S.D) | Preoperative | Postoperative 1 st week | Postoperative 3 rd Month | Postoperative 6 th Month | P-value |
|------------------------|--------------|------------------------------------|-------------------------------------|-------------------------------------|---------|
| BCVA | 660 ± 2.91 | 626 ± 1.34* | 624 ± 1.23 | 624 ± 1.02 | 0.004 |
| IOP (mmHg) | 14 ± 2.35 | 28 ± 1.5* | 13 ± 2.5* | 13 ± 1.3 | 0.002 |
| CCT(microns) | 526 ± 1.4 | 591 ± 1.5* | 527 ± 1.34* | 526 ± 1.08 | 0.001 |

BCVA (Best corrected visual acuity); IOP (intraocular pressure); CCT (Central Corneal thickness); S.D (Standard Deviation), *P < 0.05

Table 2: Comparison of change in CCT ((ΔCCT) at various age groups.

| Age Ranges Years | Preoperative CCT (Microns) | Postoperative CCT(Microns) | Change in CCT(ΔCCT) |
|------------------|----------------------------|----------------------------|---------------------|
| < 15 | 510 ± 1.23 | 629 ± 1.14 | 119 ± 0.09 |
| 16 – 30 | 522 ± 2.35 | 599 ± 2.17 | 77 ± 0.18 |
| 31 – 45 | 525 ± 1.45 | 595 ± 1.09 | 70 ± 0.36 |
| 46 – 60 | 537 ± 1.29 | 586 ± 2.45 | 49 ± 1.29 |
| >60 | 538 ± 1.07 | 549 ± 1.04 | 11 ± 0.03 |

DISCUSSION

This study showed that CCT of the affected eyes undergoing Pars Plana vitrectomy increased significantly in the first week after the procedure. Along with CCT, IOP of the affected eyes also increased in the same period. Both the CCT and IOP decreased to its preoperative value in 3rd follow-up month but remained same in 6th month.

Measuring CCT is an important parameter in determining IOP by GAT.^{12,14} An elevated IOP after PPV can be due to numerous causes including change in CCT.¹⁵ A quickly triggered, inflammatory (TNF- α mediated), IOP-independent process occurring due to acute injury or surgical procedure is also identified.^{16,17} Increase in CCT after surgery indicates increased stromal thickness due to stress-induced keratocyte stimulation or alterations in the endothelial density.^{18,19} It is also hypothesized that variations in corneal curvature or axial length after surgery may also induce modifications in corneal thickness.¹⁹

According to Gawas L et al, out of 127 eyes of 120 patients, mean CCT in the affected eye was significantly greater than the unaffected contralateral control eye (p < 0.0001). The major drawback of this study was that preoperative measurements of affected eyes were not conducted and postoperative findings in affected eyes were compared with contralateral normal eyes only.⁴

In disagreement to this, Seymenoglu et al, found no alteration in CCT following 23-G vitrectomy.¹⁹

Similarly, Mukhtar et al, stated that minor variations in CCT, 6months after PPV or buckle surgery.²⁰ Another study conducted in China reported no significant difference in CCT after PPV.²¹ However, in this study the included cases were only of primary rhegmatogenous retinal detachment.

In our study, maximum change in CCT was observed in patients lesser than 15 years of age. Lisikaga was also reported maximum change in CCT in patients < 25 years with highest changes observed in patients < 12 years.⁴

In our study, maximum CCT changes were observed in aphakic patients, which was also in accordance with the previous research.⁴

Limitations of this study are shorter follow up duration, small sample size and multiple surgeons who performed PPV.

CONCLUSION

PPV causes significant change in CCT of eyes, which can influence IOP. Correction in IOP reading is advised according to change in CCT so that false diagnosis of glaucoma can be avoided. Younger age patients and patients with aphakia are more at risk of corneal changes after vitrectomy.

Conflict of Interest: Authors declared no conflict of interest.

Ethical Approval: The study was approved by the Institutional review board/Ethical review board (REC/IPIO/2023/66).

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