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CENTRAL CORNEAL THICKNESS VARIATIONS FOLLOWING PHACOEMULSIFICATION: A PRE- AND POST-SURGICAL ANALYSIS

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Abstract

Background: Cataract is the most prevalent cause of blindness worldwide, with cataract-related blindness being especially prevalent in low-income countries. However, performing surgery on a cataract that has advanced to a hypermature and cloudy state is challenging and carries a higher risk of postoperative complications, including corneal edema.

Objective: To determine the mean change in central corneal thickness after phacoemulsification surgery.

Material And Methods: This prospective observational study was conducted at the cataract clinic of Shaheed Mohtarma Benazir Bhutto Medical College Lyari and Sindh Government Lyari General Hospital, Karachi, over a six-month period from October 2018 to March 2019. Patients aged 40 to 80 years with cataracts, and no associated ocular conditions such as uveitis, glaucoma, subluxated lens, or pseudo-exfoliation (PXF) as assessed by slit lamp examination, were included. Both genders were considered. Selected cases were referred to the ward for preoperative assessment and central corneal thickness (CCT) measurement using ultrasound pachymetry, first by the principal investigator and then by a senior ophthalmologist. The final decision regarding phacoemulsification surgery was made by the senior ophthalmologist. CCT was measured again one day post-surgery and recorded on a CCT Assessment Proforma.

Results: Overall 65 patients were studies. In terms of gender, the sample of study consists of 31 males (47.6%), and 35 females (52.4%). On the central corneal thickness comparison before and after surgery, thickness was 538.2$\pm$34.16 before surgery, while after surgery it was found 578.83$\pm$29.11 with significant difference p-value 0.065.

Conclusion: Study revealed that the mean central corneal thickness increased after phacoemulsification surgery. Due to the small sample size and the limited 24-hours follow-up period, these results cannot be considered as finally conclusive and larger-scale studies are needed to confirm the findings.

Key words: Cataract, phacoemulsification surgery, central corneal thickness

INTRODUCTION

Cataracts are the leading cause of blindness worldwide. The prevalence among individuals aged 40 years and older is around 11.8% to 18.8%.[1] Prevalence of cataract is predicted to increase dramatically as the population ages, resulting in a considerable social and economic burden.[2] This condition is painless and progressive, affecting contrast and color perception, while also altering. Cataract significantly affects not only the individual but also their family, community, and nation by causing visual disability.[3] It decreases the quality of life, limits independence, and reduces social interaction refraction, which can ultimately result in complete vision loss.[3] With rising life expectancies, the global number of individuals affected by cataracts is expected to grow, particularly in low-income countries where access to surgery is limited.[4] While cataract surgery is generally regarded as safe, it does carry some risks of complications.[4]

Phacoemulsification and implantation of intra-ocular lens is the surgical method of choice to treat cataract. Phacoemulsification is a type of cataract surgery in which cataractous lens is emulsified with the help of an ultrasonic hand piece and is aspirated from the eye. It is one of the two types of extra capsular cataract extraction (ECCE), the other is done by manual expression. As opposed to manual expression, Phacoemulsification utilizes small corneal incision, i.e $\leq$ 3mm and thus requires minimal or no sutures. This results in reduced postoperative astigmatism. Apart from this, the smaller wound expedites the healing time and there is a lesser risk of postoperative iris prolapse. All these benefits make phaco the more popular choice of cataract surgery.[5] The demand for phacoemulsification has risen with the introduction of premium intraocular lenses (IOLs), like toric and multifocal IOLs, which offer better vision across a wider range of distances compared to standard IOLs.[6] Although, it is essential to conduct thorough and careful preoperative assessments before performing the procedure. However, it has been noted that phacoemulsification cataract surgery leads to various changes in the anterior segment, with the corneal endothelium being the most negatively impacted structure.[6] Complication of phacoemulsification is the significant loss of endothelial cells, along with reductions in corneal thickness and corneal endothelial cell density during cataract surgery, which can lead to extended corneal edema.[7,8] According to a study, the diabetic population experience significantly greater endothelial damage and corneal edema compared to non-diabetic controls.[9] On the other hand according to a study observed that the CCT value gradually decreases and returns to near-normal levels by day 30.[10] Taking above concern regarding complications and controversial literature findings, this study has been done to evaluate the central corneal thickness after phacoemulsification surgery.

MATERIAL AND METHODS

A prospective observational study was conducted at the Cataract clinic of Shaheed Mohtarma Benazir Bhutto Medical College Lyari and Sindh Government Lyari General Hospital, Karachi, over a six-month period from October 2018 to March 2019. The non-probability consecutive sampling technique was used. Patients of both genders, aged 40 to 80 years, who provided informed consent and had cataracts without associated ocular diseases such as uveitis, glaucoma, subluxated lens, or pseudo-exfoliation (PXF), as assessed by slit lamp examination, were included. Patients with a history of traumatic cataract, identified through both history and slit lamp examination, were excluded. Additionally, those with cataracts associated with ocular conditions such as uveitis, glaucoma, subluxated lens, or pseudo-exfoliation (PXF), as diagnosed by slit lamp examination, were also not included. The study also excluded individuals with hard cataracts graded 4-5, as assessed by slit lamp examination. Selected cases were referred to the ward for preoperative assessment and central corneal thickness (CCT) measurement using ultrasound pachymetry, first by the principal investigator and then by a senior ophthalmologist. The decision to proceed with phacoemulsification surgery was made by the senior ophthalmologist. All phacoemulsification procedures were performed by the same ophthalmic surgeon. CCT was measured again one day after surgery and recorded on a CCT Assessment Proforma. Each participant's ophthalmic

examination included best corrected visual acuity (BCVA), cataract assessment using slit lamp biomicroscopy, and CCT measurement by ultrasound pachymetry. Changes in central corneal thickness were evaluated by comparing mean measurements at enrollment and 24 hours postoperatively using a pachymeter. Data were analyzed with SPSS Version 19, and a t-test was applied, with a p-value <0.05 considered significant.

RESULTS

In this study overall, 65 patients were studied. The overall sample of the study consists of 34 males (52.4%) and 31 females (47.6%). Regarding the affected eye, 37 patients (57.1%) have an issue in the right eye, while 27 patients (42.9%) have it in the left eye, totaling 59 patients with available eye data. Socioeconomic status (SES) is categorized into three groups: 40 patients (61.5%) fall into the 'Poor' category, 17 patients (26.2%) are classified as 'Middle,' and 8 patients (12.3%) are in the 'Upper' category. The mean age of the patients is 54.0 years with a standard deviation of 7.67 years.

Table. 1

On the comparison of central corneal thickness measurements, between before and after surgery for 65 patients, the mean central corneal thickness was 539.38 µm with a standard deviation of 34.81 µm and a mean standard error (SE) of 4.31 µm was before surgery. After surgery, the mean central corneal thickness increased to 578.83 µm, with a standard deviation of 29.11 µm and a mean SE of 3.6111 µm. The change in mean central corneal thickness was higher after surgery compared to mean central corneal thickness before surgery, while statistically insignificant, with a p-value of 0.065. **Table 2**.

TABLE:1. Patient's distribution according demographic information n=65

Variables		Frequency	Percent
Gender	**Male**	35	52.4
	Female	31	47.6
	Total	65	100.0
Site of eye	**Right**	37	57.1
	Left	27	42.9
	Total	59	100.0
SES	**Poor**	40	61.5
	Middle	17	26.2
	Upper	8	12.3
Mean age		54.0±7.67 years	

TABLE:2. Comparison of pre and post mean Central corneal thickness n=65

Variables		**N**	**Mean**	**Std. Deviation**	**Mean SE**	**p-value**
Central corneal thickness	Before surgery	65	539.38	34.81	4.31	0.065
	After surgery	65	578.83	29.11	3.6111	

DISCUSSION

The thickness of the cornea significantly affects IOP measurements. When corneal thickness is greater than normal, more force is required to indent the cornea, resulting in higher IOP values. Conversely, a thinner cornea yields lower IOP readings. It is crucial to understand how variations in

central corneal thickness can impact IOP measurements.[11,12] Previous studies have shown that central corneal thickness generally returns to normal levels in most eyes after an initial increase observed one week post-cataract surgery.[13] This study included 65 patients with a mean age of 54.0±7.67 years, with males making up the majority (55.4%) compared to females (44.6%). In alignment with this study, et al[14] reported that only 12 individuals (6.0%) were under fifty years old, while 141 patients (70.5%) were aged between 50 and 69 years, with the majority being male (118 patients, 59.0%). Similarly, Salvi SM et al[15] reported a mean age of 58.30±10.04 years among participants, with females making up the majority (58.0%). Memon MN et al[16] also observed a similar gender distribution, with a male-to-female ratio of 1:0.7; of 37 children, 21 (56.8%) were males, and 16 (43.2%) were females. Of these, 22 (59.5%) were unilateral cases, and 15 (40.5%) were bilateral cases. Additionally, Bamdad S et al[7] reported on 92 eyes from 85 patients, with 43 females and 42 males, and an average age of 62.1±12.2 years. The differences in mean age and gender across the studies may be attributed to variations in sample selection criteria and sample sizes. Furthermore, in this study, no significant effect of age, gender, or the affected eye's side was found on central corneal thickness before and after surgery.

In our study found thzt the mean central corneal thickness comparison before and after surgery, thickness was 538.2±34.16 before surgery, while after surgery it was found 586.5±29.89 with significant difference p-value 0.01. On other hand in the national study of Salvi SM et al[82] was also found comparable findings and reported that overall average CCT significantly rises after uneventful clear corneal cataract surgery, returning to normal baseline levels in most operated eyes within 1 week, and approaching near-normal baseline values by 1 month. In a recent study of Aribaba OT et al[83] reported comparable results as; the mean baseline CCT increases from 520.6±20.3 μm to 597.9±30.4 μm, a rise of 76.9 μm, within 24 hours after cataract surgery. This is followed by a gradual decrease in mean CCT to 555.2±24.7 μm at 2 weeks and 525.1±19.7 μm at 12 weeks. Memon MN et al.16 observed an increase in central corneal thickness following pediatric cataract surgery, attributed to endothelial damage occurring during and after the procedure. The study noted a 1.95% rise in mean CCT from pre-operative measurements to 1 month post-surgery, a 2.5% increase at 3 months, and a 3.1% increase at 6 months post-surgery. In aligns to this series a comprehensive systemic review, which analyzed 3,060 records, found significant correlations between the corneal edema and the loss of endothelial cell during phacoemulsification surgery and identified factors like age of the patient, mechanical stress and the grade of cataract as key contributors to loss of the endothelial cell.[17] However the Kim et al also reported significantly thicker corneas in treated eyes (600 μm) compared to the control group (569 μm), although they did not find any significant changes in endothelial cell density (ECD).[18]

According to the observations of a review, the corneal edema after cataract surgery is an undesirable yet largely preventable complication.[19] By conducting a thorough preoperative assessment, taking appropriate intraoperative precautions, and providing diligent postoperative care, this issue can often be avoided. This approach not only helps in preventing patient dissatisfaction but also mitigates potential medicolegal concerns for the operating surgeon.[19] in the study by Kausar A et al[20] observed and recommended that the patients with peripheral corneal degenerations and dense nuclear cataracts experience significantly higher rates of postoperative corneal edema. Employing the phaco-chop technique and minimizing the duration of phacoemulsification can reduce postoperative corneal edema, which in turn enhances patient satisfaction during the immediate postoperative period.[20] Although this study observed an increase in corneal edema following phacoemulsification surgery, the findings cannot be considered definitive due to certain significant limitations, like the relatively small sample size and the fact that patients were only monitored for 24 hours post-surgery, whereas other studies have noted that edema may resolve after several days or months. Like Kongsap P et al[21] reported that on the first day after surgery, corneal thickness was higher in the phaco group, with an increase of 138 μm compared to a 73 μm increase in the MSICS group p=<0.05. However, by 1 month postoperatively, the thickness had returned to preoperative levels. Given these limitations, further large-scale studies with comprehensive follow-up are recommended to conclusively establish these findings.

CONCLUSION

Based on study observations, the phacoemulsification surgery leads to an increase in mean central corneal thickness. Despite advancements in surgical techniques, preventing and addressing corneal endothelial damage remains a key concern. Furthermore, the study observed no significant impact of age or gender on central corneal thickness measurements before and after the surgery. However, due to the small sample size and the limited 24-hours follow-up period, these results cannot be considered as finally conclusive and larger-scale studies are needed to confirm the findings.

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