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Changes in Central Corneal Thickness After Phacoemulsification Surgery

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Author`s Contribution

[1,3]Substantial contributions to the conception or design of the work; or the acquisition, Active participation in active methodology, [2,5,6]analysis, or interpretation of data for the work, [4]Drafting the work or revising it critically for important intellectual content

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ABSTRACT

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

Methodology: This quasi experimental study was carried out at Liaquat University Eye Hospital, Hyderabad from June 2019 to May 2020. All the patients with age from 40 to 80 years having cataract with no associated ocular diseases like uveitis, glaucoma, subluxated lens, pseudo-exfoliation (PXF), as assessed on slit lamp examination, either gender, were included. Selected cases were referred to ward for preoperative assessment and CCT measurement on Ultrasound Pachymetry by Principal investigator and finally by a senior Ophthalmologist. The Phaco surgery, for all cases, was performed by the same Ophthalmic surgeon. CCT was measured again one day after Phaco; and noted on a CCT Assessment Proforma. Each participant's ophthalmic examination would include: Best corrected visual acuity, cataract assessment (Slit lamp biomicroscopy) and CCT measurement by ultrasound pachymetry.

Results: On central corneal thickness comparison before and after surgery, thickness was 539.08+33.35 before surgery, while after surgery it was found 583.37+30.55 with significant difference p-value 0.01. No significant difference was found before and after surgery in both age groups P-value 0.24 and 0.87 respectively. No significant difference was found in central corneal thickness between both genders before and after surgery p-value 0.05 and 0.72 respectively.

Conclusion: We concluded that the mean central corneal thickness increased after phacoemulsification surgery.

Keywords: Cataract, phacoemulsification surgery, central corneal thickness.

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Introduction

Cataracts are the leading cause of blindness worldwide and can be treated with phacoemulsification surgery. However, corneal endothelial damage following this procedure remains a significant concern in contemporary cataract surgery. Cataract is the most common treatable cause of impaired vision globally.[1,2] Its removal is among the most frequently performed surgeries in ophthalmology and ranks as the second most cost-effective medical procedure after vaccination. The major goal of current cataract surgery is to improve uncorrected visual acuity, assuring a rapid recovery from the operation without many complications.[1] It is the foremost cause of blindness globally, particularly prevalent in low-income countries. There are 39 million people reported to be blind worldwide,[3,4] with age-related cataracts accounting for 51% of these cases, affecting approximately 20 million individuals.[3] Symptoms can include faded colors, blurred vision, halos around lights, difficulty with bright lights, and difficulty in seeing during night. These issues can lead to problems with driving, reading, or recognizing faces. Additionally, poor vision from cataracts can increase the risk of falls and

depression. A wide range of risk factors for age-related cataract (ARC) include advanced age, ultraviolet B exposure, cigarette smoking, consumption of alcohol, the hormone estrogen, steroid hormones, anti-oxidants, hypertension, type 2 diabetes, and body mass index.[5] By 2020, cataracts and under corrected refractive errors will account for 50% of all global blindness and 75% of all global moderate to severe visual impairment (MSVI).[5,6] The prevalence of total blindness due to cataracts and under corrected refractive errors varies significantly by region, and this issue has not been adequately addressed in any part of the world, including high-income nations.[7]

Several surgical options are available to aid patients in recovering from the condition. Phacoemulsification is a widely used method for cataract surgery.[8] It has become popular because it involves a smaller incision, shorter recovery time, less induced astigmatism, faster visual rehabilitation, and fewer surgical complications compared to traditional surgeries.[8] However, performing surgery on a hypermature, cloudy cataract (a white cataract) is challenging and can lead to postoperative complications like posterior capsule rupture or corneal edema.[9,10] Phacoemulsification and implantation of intra-ocular lens is the surgical method of choice to treat cataract. In this 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 Extracapsular 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 phacoemulsification the more popular choice of cataract surgery.[11]

However, Phacoemulsification using ultrasound energy is known to result in corneal endothelial cell loss.[12] Additionally, it can induce inflammation, which may subsequently cause macular edema.[12] Due to the edema, thickness of cornea is increased. Increased thickness can result in corneal decompensating and visual loss.[13] On literature search, it has been observed that the number of studies on this topic is very limited specifically at local level, and mostly recommended further research.[5]

However, this study was aimed to determine the mean change of central corneal thickness (CCT) after uneventful Phacoemulsification surgery in average adult population

Methodology

A quasi-experimental study was conducted at the Department of Ophthalmology, Liaquat University Eye Hospital, Hyderabad, from June 2019 to May 2020, using a non-probability consecutive sampling technique. The study included patients aged 40 to 80 years, of both genders, who provided informed consent. Eligible participants were those diagnosed with cataract but without associated ocular conditions such as uveitis, glaucoma, subluxated lens, or pseudo-exfoliation (PXF), as assessed via slit-lamp examination, and who were scheduled for uncomplicated cataract surgery.

Exclusion criteria included patients with traumatic cataracts (based on history and slit-lamp examination), Grade 4-5 cataracts (as assessed on slit-lamp), surgical complications such as posterior capsular rupture, and patients with corneal opacities.

Upon obtaining informed consent, patients were counseled regarding the study's aims and objectives and assured that their information would remain confidential and be used solely for research purposes. All selected participants underwent preoperative assessment, which included central corneal thickness (CCT) measurement using ultrasound pachymetry. This was initially conducted by the principal investigator and confirmed by a senior ophthalmologist. The final decision to proceed with phacoemulsification surgery was made by the senior ophthalmologist. All surgeries were performed by the same ophthalmic surgeon.

CCT was measured again one day after surgery and recorded on a CCT assessment form. Each participant's ophthalmic examination included best-corrected visual acuity (BCVA), cataract assessment using slit-lamp biomicroscopy, and CCT measurement via ultrasound pachymetry.

Data were analyzed using SPSS Version 19. Mean and standard deviation (SD) were computed for age and CCT before and after surgery. Frequency and percentage were calculated for categorical variables such as gender and the eye involved. Effect modifiers were controlled through stratification by age, gender, and eye involved. After stratification, the t-test was applied, with a p-value of <0.05 considered statistically significant.

Results

In this study mean age of the patients was 54.0±9.10 years, with range of minimum 35 years and maximum 69 years. Female gender was in majority 55.4% as compare to male 44.6%. Right eye was more evolve in Cataract 57.1%, while left eye infected patients were found 42.9%. Table I

Table I: Patient's distribution according to gender and site. (n=56)

Variables		N	%
Gender	Male	25	44.6
	Female	31	55.4
Site of eye	Right	32	57.1
	Left	24	42.9
Age (mean±SD)		54.0+9.10 years	

On central corneal thickness comparison before and after surgery, thickness was 539.08±33.35 µm before surgery, while after surgery it was found 583.37±30.55 µm with significant difference p-value 0.001. Table II

Table II: Comparison of central corneal thickness before and after surgery. (n=56)

Central corneal thickness	Mean	SD	P-value
Before surgery	539.08 µm	35.35 µm	**0.001**
After surgery	583.37 µm	30.55 µm	
Mean difference	-44.28 µm	31.81 µm	

According to central corneal thickness comparison before and after surgery between age groups no significant difference was found before and after surgery in both age groups P-value 0.087 respectively. No significant difference was found in central corneal thickness between both genders before and after surgery p-value 0.25 respectively. Additionally, central corneal thickness was found almost equal in both side eyes before and after surgery p-vale 0.91. Table III

Table III: Central corneal thickness comparison according to age, gender and site. (n=56)

Variables		Mean change = Post - pre	P-value
Age groups	40-60 years	43.9±24.1 µm	**0.08**
	61-80 years	56.4±22.4 µm	
Gender	Male	50.0±26.7 µm	**0.25**
	Female	42.5±21.0 µm	
Site	Right	46.78±24.0 µm	**0.91**
	Left	46.0±24.8 µm	

Discussion

Cataract ranks among the most prevalent reasons for blindness, and Phacoemulsification offers improved visual results. However, there was indicated that macular edema may develop following cataract surgery.[14,15] In this study, the mean age of the patients was 54.0 ± 9.10 years, ranging from a minimum of 35 years to a maximum of 69 years. The majority of patients were female, accounting for 55.4%, compared to 44.6% male. Similarly, Salvi SM et al[16] reported a mean age of 58.30 ± 10.04) years, with 58.0% being women. Conversely, Memon MN et al[17] found a similar gender distribution, with a male-to-female ratio of 1:0.7, and 56.8% of children being males and 43.2% females. Among 37 children, 59.5% had unilateral cataracts and 40.5% had bilateral cataracts, with a mean age of 8.8 ± 2.7 years (ranging from 4 to 15 years). In our study, the right eye was more affected by cataracts in 57.1% of cases, while 42.9% had left eye involvement; no cases of bilateral involvement were found. This difference may be due to the fact that the study by Memon MN et al. focused on children, who may have congenital bilateral infections. In this study, no significant effect of age, gender, or eye side on central corneal thickness before and after surgery was observed.

In this study, the mean central corneal thickness (CCT) was compared before and after surgery, revealing a thickness of 539.08±33.35 µm before surgery, which increased to 583.37±30.55 µm after surgery, with a significant difference indicated by a p-value of 0.01. Similarly, in a national study by Salvi SM et al[16] comparable findings were observed, where the mean CCT notably increased after clear corneal cataract surgery, returning to normal baseline values in the majority of eyes within 1 week and approaching near-normal values by 1-month post-surgery. Additionally, Aribaba OT et al[3] reported similar results, indicating an increase in mean baseline CCT from 520.6 ± 20.3 µm to 597.9 ± 30.4 µm 24 hours after cataract surgery, followed by a relative reduction in mean CCT to 555.2 ± 24.7 µm and 525.1 ± 19.7 µm at 2 weeks and 12 weeks, respectively. In a related study, Kim et al[18] observed notably thicker corneas in treated eyes (600 µm) compared to the control group (569 µm), with no significant change observed in endothelial cell density (ECD). Similarly, Memon MN et al[17] reported that central corneal thickness increases following pediatric cataract surgery due to endothelial damage during and after the procedure. They observed a 1.95% increase in mean CCT from pre-operative measurements to 1-month post-surgery, followed by increases of 2.5% at 3 months and 3.1% at 6 months post-surgery. Kongsap P et al[9] conducted a comparative study and they reported that

following surgery, central corneal thickness (CCT) rose in both groups. Initially, the thickness was higher in the Phacoemulsification group (p=0.008) and by one-month post-surgery, the thickness had returned to preoperative levels in both groups.

In the comparison of this study Kumar R et al[19] reported that there was no statistically significant difference in the preoperative mean endothelial cell count and central corneal thickness between the phacoemulsification and SICS groups. However, a statistically significant difference was found in the postoperative mean ECC ($P < 0.01$) and mean CCT ($P < 0.001$) on day 1 and in the 3rd week between the phacoemulsification and SICS groups.[19] However García Gómez de Segura M et al[20] observed that the macular thickness increases up to 6 months following uncomplicated cataract surgery in both diabetic patients without diabetic retinopathy and non-diabetic individuals, with no significant difference observed between the two groups. There have been thickness variations detected when compared to previous studies, which could be due to changes in the criteria for selecting study samples and the types of devices used to measure corneal thickness, and this study has various limitations, like sample is relatively small, which could restrict the findings' applicability to a larger population. No alternative technique was compared, and certain possible risk variables were not investigated, which could have provided useful insights into the association between those factors and changes in central corneal thickness following cataract surgery. However, the further large scale comprehensive studies are suggested to improve the statistical power and reliability of the findings, thus allowing for more definitive conclusions to be achieved.

Conclusion

Study revealed that the mean central corneal thickness increased after phacoemulsification surgery. Corneal endothelial damage is a major problem in modern cataract surgery. Furthermore, no effects of age or gender on central corneal thickness before and after surgery were discovered. More research is needed to identify techniques for limiting corneal endothelial damage after surgery. Larger, more diversified sample sizes research should be done to validate these findings and look into other potential risk factors

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