Original Article

A Comparison of Functional Endothelial Changes between Phacoemulsification with PCIOL and Manual Small Incision Cataract Surgery with PCIOL

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ABSTRACT

Intraocular surgery e.g., cataract surgery with PCIOL implantation is one of the leading causes of corneal endothelial injury and change in the functionality of the cornea. This observational study was conducted in the Department of Ophthalmology of Combined Military Hospital (CMH), Dhaka Cantonment, Dhaka, Bangladesh, between January and July of 2016, to assess and compare functional changes in cornea (i.e., endothelial thickness) after phacoemulsification with posterior chamber intraocular lens (PCIOL) implantation and manual small incision cataract surgery (MSICS) with PCIOL implantation. A total of 80 patients of age-related cataract were randomly selected based on inclusion and exclusion criteria. All patients underwent complete ophthalmic evaluation pre- and post-operatively (at day 1, after 1 week and 3 months) specifically for observation of the endothelial changes in cornea. Specular microscopy was done to assess corneal endothelial change. The mean central corneal thickness was increased at day 1 (564.71±22.45µ vs. 555.10±40.57µ), after 1 week (539.43±22.16µ vs. 535.08±38.87µ) and 3 months (523.49±21.29µ vs. 520.05±33.68µ) after phacoemulsification and MSICS from their preoperative value (508.72±23.96µ vs. 503.62±32.06µ) respectively. However, the differences were not statistically significant between two groups (P>0.05). The mean percentage of central corneal thickness change at day1, after 1 week and after 3 months following cataract surgery were found 11.01±6.30% and 10.22±26.54% at day 1, 6.04±7.52% and 6.25±21.24% after 1 week, 2.90±11.14% and 3.26±5.05% after 3 months in phacoemulsification and MSICS cases respectively. However, no statistically significant difference was observed in percentage of central corneal thickness change of both groups (P>0.05). To summarize, an increased central corneal thickness was observed after phacoemulsification and SICS from their preoperative values.

Keywords: *Central corneal thickness, phacoemulsification, small incision cataract surgery*

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INTRODUCTION

The cornea is the transparent, avascular front part of the eye, refracts light and accounting for approximately two-thirds of the eye's total optical power.[1] It has five layers – outer epithelium, Bowman's layer, stroma, Descemet's membrane and innermost endothelial layer.[2] Corneal Endothelium is a simple squamous or low cuboidal monolayer, approximately 5ìm thick and consists of 5,00,000 of mitochondria-rich cells.[2] These cells are responsible for regulating fluid and solute transport between the aqueous and corneal stromal compartments and maintenance of corneal optical transparency via active Na/K ATPase pump.[2,3] The cells of the endothelium do not regenerate. Instead, they stretch to compensate for dead cells which reduces the overall cell density of the endothelium; however, it affects fluid regulation. If the endothelium can no longer maintain a proper fluid balance, stromal swelling ensues from excess fluids and subsequent loss of transparency occurs in cornea.[3]

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Intraocular surgeries are one of the leading causes of endothelial injury and cataract surgeries

comprise of 80% eye surgeries.[4] Phacoemulsification is considered the gold-standard procedure for cataract.[5] However, manual small incision cataract surgery (MSICS) has appeared as a popular procedure of choice in the surgical treatment of cataracts as it is less expensive and is as effective as phacoemulsification.[5] Both techniques are advantageous for being suture less procedure and required small incision.[6] However, in both surgeries, the invasive trauma leads to endothelial cell injury. Endothelial injury may occur during surgery due to several factors, such as corneal distortion, ricocheting of nuclear fragments, intraocular lens (IOL) contact and release of free radicals.[7,8] The traumatized endothelium continues to loosen cells and endothelial dysfunction may develop gradually years after the surgery. After surgical trauma, the endothelium shows practically no proliferative activity, and the damaged area is covered by means of cell migration.[8,9] Moderate damage to corneal endothelium during the surgery can cause a transient increase in corneal thickness.[9] Evidence showed that the central corneal thickness (CCT), as an indicator of the physiological (functional) condition of the corneal endothelium, is generally used in diagnoses like keratoconus, Fuchs' dystrophy, and glaucoma.[10]

Several studies done in different countries reported no significant difference in percentage of endothelial cell loss and increased corneal thickness among the manual small incision cataract surgery (MSICS) and phacoemulsification surgery.[4-6,9,11] However, in our country, no such reports are available. Therefore, the present study aims to assess and compare functional changes (central endothelial thickness) in cornea after phacoemulsification with posterior chamber intraocular lens (PCIOL) implantation and manual small incision cataract surgery (MSICS) with PCIOL implantation.

METHODS

This observational study was conducted in Department of Ophthalmology of Combined Military Hospital (CMH), Dhaka Cantonment, Dhaka, Bangladesh, between January and July of 2016. After taking written informed consent, a total of 80 cataract patients with age ranging from 40 to 70 years were selected. They were randomly allocated into two groups. One group consists of 40 cataract patients who underwent phacoemulsification with PCIOL implantation, while the other group consists of 40 cataract patients who underwent manual small incision cataract surgery (MSICS) with PCIOL implantation. Patients with pre-operative astigmatism more than ±1.00 D and post-operative more than ±1.5 D with K1-K2 in keratometric reading, intra-operative use of sutures, corneal diseases like any pre-existing scar, any interstitial keratitis, peripheral corneal degeneration, dry eye, limited visual potential after cataract surgery like amblyopia, maculopathy, glaucoma, diabetic retinopathy, previous retinal detachment surgery, optic atrophy were excluded from the study. Detailed history and physical examination of each patient was performed and recorded. The anterior segment was examined by torch and slit lamp biomicroscope to evaluate lids, conjunctiva, cornea, anterior chamber, pupil, iris, lens and anterior vitreous (where possible). Visual acuity and extra- ocular muscle balance were tested. The posterior segment was examined by direct and indirect ophthalmoscope. Retinal and macular functions were tested by projection of rays in different quadrants, two-points discrimination, Maddox rod and colour perceptions test. Intra-ocular pressure was measured by applanation tonometer and sac patency test was done to exclude the possible source of infection. All patients were examined preoperatively and post operatively at day 1, after 1 week and after 3 months for evaluation of corneal endothelial change. Keratometric cylinder was measured by using an Autorefractometer (Nidek AR-1, Tokyo, Japan) and Autokeratometer (Grand Seiko; GR-3100K, Shigiya Machinery Works Ltd, Japan) to find out the K1 and K2 reading for flat and steep meridian. Astigmatism was calculated from keratometric data using vector analysis. A specular microscopy was done to analyze corneal endothelial cell count, central corneal thickness and hexagonal cells. Uncorrected and Best corrected visual acuity for all patients were measured in all examination visits. Subjective refraction was done for all patients with Snellen chart, trial frame and trial lens. Most of the operation was done under local anesthesia and few with topical anesthesia. Standard operative procedure was followed in the phacoemulsification and posterior chamber IOL implantation and manual small incision cataract surgery and posterior chamber IOL implantation.

All the data were compiled, sorted properly, and analyzed statistically using Statistical Package for

Social Science (SPSS) version 20.0. Chi-square test, unpaired and paired Student's 't' tests were performed to compare between the groups. P value <0.05 was considered as significant. Ethical clearance was obtained from the Institutional Review Board (IRB) of Combined Military Hospital, Dhaka Cantonment, Dhaka, Bangladesh.

RESULTS

Most of the patients belonged to the age group of e"50 years. The mean age was 52±9.1 years in phacoemulsification group and 55±8.9 years in manual small incision cataract surgery (SICS) group. Men (62.50%; 70%) had a higher incidence rate than women (37.5%; 30%) in both groups. Male female ratio was 1:1.7 in Phacoemulsification group and 1:2.3 in SICS group. Statistically no significant (P>0.05) difference was observed in age and sex between the groups (Table-I). Table-II showed that mean central corneal thickness was increased at day 1 (564.71±22.45µ vs. 555.10±40.57µ), after 1 week (539.43±22.16µ vs. 535.08±38.87µ) and 3 months (523.49±21.29µ vs. 520.05±33.68µ) after phacoemulsification and MSICS from their preoperative value (508.72±23.96µ vs. 503.62±32.06µ) respectively. However, the differences were not statistically significant (P>0.05) between the groups. Table-III showed that mean central corneal thickness changes at day 1, and 1 week and 3 months after surgery respectively. In this study, central corneal thickness was significantly (P<0.001) increased at day 1 and after 1 week than that of preoperative value in both phacoemulsification and MSICS. Table-IV showed that the mean percentage of central corneal thickness changed at day1, after 1 week and after 3 months following cataract surgery. Mean central corneal thickness was found 11.01±6.30% and 10.22±26.54% at day 1, 6.04±7.52% and 6.25±21.24% after 1 week, 2.90±11.14% and 3.26±5.05% after 3 months in phacoemulsification and MSICS cases respectively. However, no statistically significant difference was observed in percentage of central corneal thickness change of both groups (P>0.05).

Table-I: Distribution of study subjects according to age and gender (N=80)

	Phacoemulsification (n=40)	MSICS (n=40)	P value
Age (Years)			
<50	17 (42.5%)	13 (32.5%)	0.356^{NS}
e"50	23 (57.5%)	27 (67.5%)	
Mean±SD	52± 9.1	55± 8.9	
Sex			
Male	25 (62.50%)	28 (70%)	0.478^{NS}
Female	15 (37.50%)	12 (30 %)	
Ratio	1:1.7	1:2.3	

Data were expressed as frequency, percentage and Mean±SD. Chi-Square test was performed to compare between the groups. NS=not significant.

Table-II: Mean central corneal thickness of the study subjects at different follow-up (N=80)

Follow-up	Phacoemulsification (n=40)	MSICS (n=40)	P value
Pre-operative (in µ)	508.72±23.96	503.62±32.06	0.995^{NS}
Post-operative (in µ)			
At day 1	564.71±22.45	555.10±40.57	0.848^{NS}
After 1 week	539.43±22.16	535.08±38.87	0.998^{NS}
After 3 months	523.49±21.29	520.05±33.68	1.000^{NS}

Data were expressed as Mean±SD. Unpaired student's t test was performed to compare between the groups. NS= not significant.

Table-III: Mean central corneal thickness change after surgery at different follow-up (N=80)

Follow-up	Phacoemulsification (n=40)		MSICS (n=40)	
	Corneal thickness (in μ)	P value	Corneal thickness (in μ)	P value
At day 1	55.99±1.51	<0.001^{S}	51.48±8.51	<0.001^{S}
After 1 week	30.71±1.80	<0.001^{S}	31.46±6.81	<0.001^{S}
After 3 months	14.77±2.67	0.367^{NS}	16.43±1.62	0.233^{NS}

Data were expressed as Mean±SD. Paired student's t test was performed to compare pre and postoperative values of each group. NS= not significant, S= significant.

Table-IV: Mean percentage of central corneal thickness change at different follow-up (N=80)

Follow-up	Phacoemulsification (n=40) (%)	MSICS (n=40) (%)	P value
At day 1	11.01±6.30	10.22±26.54	1.000^{NS}
After 1 week	6.04±7.52	6.25±21.24	0.825^{NS}
After 3 months	2.90±11.14	3.26±5.05	1.000^{NS}

Data were expressed as Mean±SD. Unpaired student's t test was performed to compare between the groups. NS= not significant.

DISCUSSION

In the present study, the majority of the study subjects belongs to age group of e"50 years. Mean±SD age was 52± 9.1 years in Phacoemulsification group and 55± 8.9 years in manual small incision cataract surgery (SICS) group. Men (62.50%; 70%) had a higher incidence rate than women (37.5%; 30%) and male female ratio was 1:1.7 in Phacoemulsification group and 1:2.3 in SICS group. Participants were matched by age and gender. Almost similar findings were observed by various researchers of different countries.[11,12]

Our study showed that the mean central corneal thickness was found to increase at day 1, after 1 week and 3 months in both phacoemulsification and MSICS patients from their preoperative values respectively. However, statistically no significant (P>0.05) difference was observed in mean central corneal thickness of both groups. In this study, central corneal thickness was significantly (P<0.001) increased more at day1 and after 1 week than preoperative value in both phacoemulsification and MSICS. Mean central corneal thickness was increased 11.01±6.30% at day-1, 6.04±7.52% at 1st week, and 2.90±11.14% at 3 months after Phacoemulsification and increased 10.22±26.54% at day-1, 6.25±21.24% at 1st week, 3.26±5.05% at 3 months after SICS. There is no significant difference in percentage of change in central corneal thickness between the groups with respect to increase in central corneal thickness postoperatively. Present study demonstrated that the central corneal thickness shows a decreasing trend over 1 week and 3 months; however, it remains higher than that of its preoperative value. Several other studies found similar results with significant increase in central corneal thickness over 1 week and 1 month after surgery.[12-16] A study by Goldenberg et al. also showed similar results with significant increase in CCT post manual small incision cataract surgery when compared to preoperative values on first post-operative week and first month post-operatively. However, the study also showed a return to normal values by the end of third month.[14] Two other studies showed a return of the CCT to normal thickness one month postoperatively after phacoemulsification.[15,16] Mathew et al. showed an increasing trend in CCT after SICS for the first two weeks followed by a decrease in the thickness.[17] Similar study was done in the same hospital setting to compare the morphological changes between those two procedures which revealed that a decreased endothelial cell count was observed after cataract surgery in both

phacoemulsification and MSICS procedures from their preoperative values respectively. However, the difference was not significant between those two procedures.[18]

CONCLUSION

To summarize, a significant change was observed in the functionality of the corneal endothelium i.e., central corneal thickness after both phacoemulsification with PCIOL and MSICS with PCIOL. It is evident by a decreased endothelial cell count and increased central corneal thickness after Phacoemulsification and SICS from preoperative value. Though corneal thickness increased initially after surgery, but it almost decreased to its pre-operative value after surgery. However, a large-scale study can be conducted to make the findings of the study generalizable to the reference population.

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