ORIGINAL ARTICLE

Changes in Central Corneal Thickness and Endothelial Cell Count Following Pediatric Cataract Surgery

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ABSTRACT

Objective: To evaluate the mean changes in Central Corneal Thickness (CCT) and Endothelial Cell Count (ECC) in eyes after pediatric cataract surgery with foldable intraocular lens using scleral tunnel incision micro-surgical technique.

Study Design: Qausi experimental study.

Place and Duration of Study: Department of Pediatric Ophthalmology and Strabismus, Al-Shifa Trust Eye Hospital, Rawalpindi, from May 2011 to March 2012.

Methodology: Fifty-two eyes of 37 children with pediatric cataract were included in the study. Extracapsular Cataract Extraction (ECE) with foldable Intra Ocular Lens (IOL) implantation using sclera tunnel incision was performed in all children. Endothelial Cell Count (ECC) and Central Corneal Thickness (CCT) were recorded before surgery and 1 month, 3 months and 6 months after surgery and the effect of currently practiced surgical technique on ECC and CCT was evaluated.

Results: The mean age at the time of surgery was 8.8 ±2.7 years (range: 4 to 15 years). The postoperative ECC and CCT were significantly different from the pre-operative values. Mean pre-operative ECC was 3175.3 ±218.4 cell/mm^2 and in first postoperative month the mean ECC was 3113.4 ±210.8 cell/mm^2 ($p<0.0001$). In the 3rd and 6th month postoperative means ECC were 3052 ±202.5 cell/mm^2 ($p<0.0001$) and 3015 ±190.6 cell/mm^2 ($p<0.0001$), respectively. The mean cell loss at first postoperative month was 1.95% and at 3rd and 6th postoperative month were 3.9% and 5.05%, respectively. Mean pre-operative CCT was 514 ±49.9 µm and first postoperative mean CCT after 1 month was 524.1 ±25 µm ($p = 0.084$). After the 3rd and 6th months postoperative, mean CCT were 527.3 ±24.6 µm, and 530 ±24.5 µm, respectively. Third and 6thmonths postoperative means were significantly higher than baseline CCT, $p = 0.024$ and 0.007, respectively.

Conclusion: Endothelial cell loss with closed chamber micro-surgical technique using scleral tunnel incision is within acceptable limits and within the range of normal ECC in children.

Key Words: *Pediatric cataract. Endothelial cell count. Central corneal thickness. Scleral tunnel incision.*

INTRODUCTION

Congenital cataract is responsible for about 10% of all visual deprivation in children worldwide.[1] Early surgical intervention and visual rehabilitation is necessary to prevent cataract induced childhood blindness. Corneal endothelium is under the influence of many factors during intraocular surgery. These include surgical technique, site and size of tunnel incision, viscoelastic substance, type of intra ocular lens, duration of surgery, postoperative inflammation and secondary glaucoma.[2-5] Surgical trauma is associated with some morphological changes in corneal endothelium, mainly central corneal thickness and endothelial cell density.[6,7]

Endothelial cell count is approximately 6000 cells/mm^2 during the first month of life which reduces to about 3500 cells/mm^2 at the age of 5 years and 3400 cells/mm^2 at the age of 15 years.[8] Normally, the average rate of endothelial cell loss throughout the life is about 0.6% per year.[9] Reported endothelial cell loss after pediatric cataract surgery varies from 5.1% to as high as 22.68%.[6,10-12] The percentage of endothelial cell loss can be reduced by adopting minimally invasive micro-surgical techniques and modifying the site of incision in the management of pediatric cataract.[13,14] Internationally, the subject is well documented in literature but local study could not be found nationally to ascertain postcataract extraction corneal morphological changes in pediatric age group.

The objective of this study was to evaluate the mean changes in corneal endothelial cell count and central corneal thickness after pediatric cataract surgery with foldable Intra Ocular Lens (IOL) implantation using sclera tunnel incision.

METHODOLOGY

This study was conducted in the Department of Pediatric Ophthalmology and Strabismus, Al-Shifa Trust Eye Hospital, Rawalpindi, from May 2011 to March 2012. Approval was obtained from Ethical Review Committee of Al-Shifa Trust Eye Hospital. In all 52 eyes were

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included in the study. The sample size was based on a 7.2% margin of error and 7.5% endothelial cell loss10 at a 95% confidence interval.

Thirty-seven children with pediatric cataract were included in this study. Patients with history of trauma, previous intra ocular surgery, glaucoma, uveitis and with other anterior segment abnormalities such as anterior segment dysgenesis, aniridia and subluxated lenses were excluded from the study. After written informed consent from the parents or guardians, all patients underwent detailed ophthalmic examination including visual acuity, intra ocular pressure, slit lamp examination for the anterior segment and dilated fundus examination. Ocular ultrasound was performed in children with no fundus view to rule out posterior segment pathology. Non-contact specular microscope (SP-2000, Topcon Medical System, Oakland, CA) was used to record ECC and CCT pre-operatively and 1 month, 3 months and 6 months postoperatively. The mean of 3 readings was calculated for ECC and CCT.

Surgery was performed under general anesthesia. After standard aseptic measures, conjunctival peritomy was performed at 12 O'Clock. The scleral tunnel was constructed using crescent knife and entry into the anterior chamber was made with 3.2 keratome. Two corneal side ports were made at 2 and 10 O'Clock with 20-gauge Micro Vitreo Retinal (MVR) blade to introduce automated vitrector-aspirator probe and Anterior Chamber Maintainer (ACM) for irrigation. Hydroxypropyl methylcellulose (HPMC) 2% was injected to maintain anterior chamber and to protect endothelium. Continuous curvilinear anterior capsulorhexis (CCC) achieved with cystotome bent needle and utrata forceps and lens matter was aspirated with vitrectomy probe. Anterior chamber was refilled with HPMC and the acrylic Intra Ocular Lens (IOL) was implanted with the help of injector. Scleral and conjunctiva wound were closed with 10/0 vicryl. HPMC were aspirated from anterior chamber with the help of vitrector probe and corneal side ports were closed with 10/0 vicryl as well. Intracameral 1.0 ml moxifloxacin hydrochloride 0.5% and dexamethasone 0.4 mg were given at the end of the procedure. Topical antibiotic and steroid combination was given post-operatively.

Data was analyzed by using SPSS Version 16. Frequencies and percentages were calculated for all qualitative/categorical variables including gender, eye laterality and endothelial cell loss. Mean value and standard deviation was calculated for all quantitative variables including age, central corneal thickness and endothelial cell count. Percentages of ECL and CCT increase were calculated by difference in pre- and postoperative (I month, 3 months and 6 months) values divided by pre-operative value multiplied by 100. Repeated measure ANOVA was used to compare the mean central corneal thickness and endothelial cell count between preoperative and postoperative at different follow-ups. Pair-wise comparison was done by pair sample t-test at 5% level of significance.

RESULTS

A total of 52 eyes of 37 children were included in this study. Male to female ratio was 1:0.7, 21 (56.8%) children were males and 16 (43.2%) were females. Of 37 children, 22 (59.5%) were unilateral cases and 15 (40.5%) were bilateral cases. The mean age was 8.8 ±2.7 years (ranging from 4 to 15 years).

Table I illustrates the comparison of pre-operative and up to 6 months postoperative Endothelial Cell Count (ECC). The overall mean difference of Endothelial Cell Count (ECC) was seen statistically significant before and upto 6 months after surgery ($p < 0.0001$). Figure 1 shows the postoperative percentage of mean endothelial cell loss on three follow-up visits.

Table II shows the comparison of Central Corneal Thickness (CCT) values before and upto 6 months after surgery. The overall mean difference of central corneal thickness was seen statistically significant before and after surgery, upto 6 months of follow-ups ($p = 0.018$). The mean difference of CCT at 1 month postoperative was insignificant as compared with baseline ($p = 0.084$). The 3rd months and 6th months postoperative means were also significantly higher than baseline CCT mean ($p = 0.024$ and 0.007, respectively). Figure 2 shows the postoperative percentage of mean central corneal thickness increase on three follow-up visits.

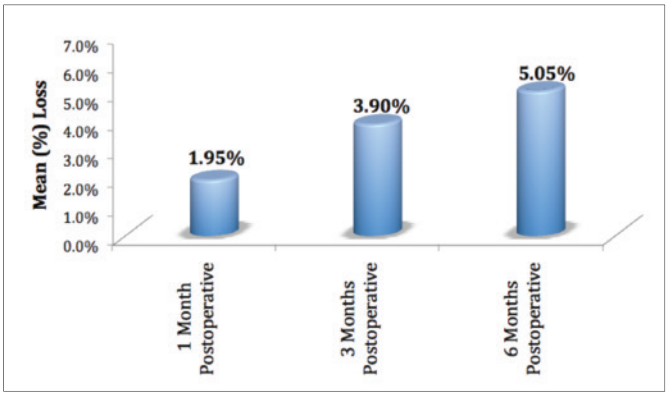

Figure 1: Mean postoperative endothelial cell loss in 52 eyes.

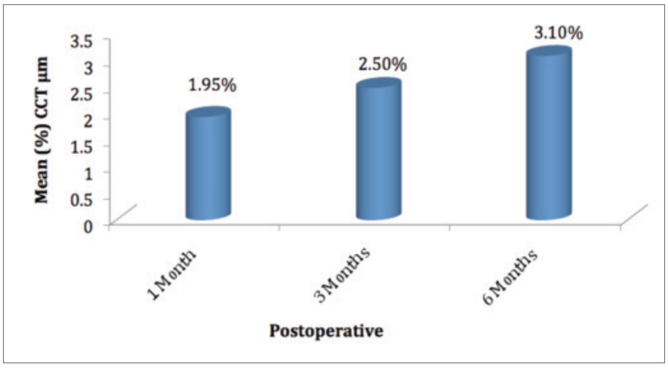

Figure 2: Mean central corneal thickness increase (µm) in 52 eyes.

Table I: Comparison of endothelial cell count (cell/mm²) in 52 eyes (before and after surgery).

Visits	ECC cell/mm²		Repeated measure ANOVA	Paired comparison
	Mean ±SD (range)	ECL Cell/mm²	p-value	p-values* (95% CI)
Pre-operative	3175.3 ±218.4 (2764 - 3600)	-	< 0.0001	-
1 month postoperative	3113.4 ±210.8 (2745 - 3579)	62		Baseline vs. 1 month < 0.0001 (45.5 - 78.3)
3 months postoperative	3052 ±202.5 (2732 - 3467)	123		Baseline vs. 3 months < 0.0001 (92.5 - 154)
6 months postoperative	3015 ±190.6 (2713 - 3453)	160		Baseline vs. 6 months < 0.0001 (122 - 197.7)

*ECC = Endothelial Cell Count; ECL=Endothelial Cell Loss; *By Paired t-test.*

Table II: Comparison of central corneal thickness (μm) in 52 eyes (before and after surgery).

Visits	CCT μm		Repeated measure ANOVA	Paired comparison
	Mean ±SD (range)	CCT increase	p-value	p-values* (95% CI)
Pre-operative	514 ±49.9 (210 - 560)		0.018	-
1 month postoperative	524.1 ±25 (472 - 562)	10μm		Baseline vs. 1 month 0.084 (-21.6 to 1.4)
3 months postoperative	527.3 ±24.6 (475 - 565)	13μm		Baseline vs. 3 months 0.024 (-24.9 to -1.8)
6 months postoperative	530 ±24.5 (480 - 568)	16μm		Baseline vs. 6 months 0.007 (-27.6 to -4.6)

*CCT = Central Corneal Thickness; *By Paired t-test.*

DISCUSSION

Corneal endothelium is a single layer of cells, lines the inner surface of cornea. These cells are devoid of mitotic activity. Endothelium cell loss, secondary to surgical trauma, is compensated by changes in size and shape of corneal endothelium and increase in central corneal thickness.[15] The operated eyes continue to lose endothelial cells for several years after cataract surgery at a high rate of about 2.5% per year.[9]

This study results suggest that the postoperative endothelial cell density and central corneal thickness are different from the pre-operative values. The ECL in present study was 3.95% at 3 months and 5.05% at 6 months after surgery. The percentage of ECL after pediatric cataract surgery has reduced as compared to the data reported during last few decades.[6,10,16] It is mainly because of the better understanding of the complexity of pediatric eye and advances in microsurgical techniques. A cross-sectional study by Hiles and coworkers in 1979 reported that IOL implantation, using corneal incision, was associated with a 33.3% ECL compared to control group; and the rate of cell loss for irrigation-aspiration and phacoemulsification cataract extraction were not statistically different.[16] However, in their study, pre-operative ECD was not recorded and postoperative values compared with un-operated fellow eyes of children with unilateral cataract. Urban and colleagues observed mean ECL of about 10.94% after 1 month, 17.85% after 6 months and 22.68% after 12 months of Extra Capsular Cataract Extraction (ECCE) with polymethacrylate (PMA) IOL implanted through corneal incision.[6] This significantly high rate of cell loss in their study is probably due to different site of incision and different surgical technique from recently used closed chamber technique.

This data is comparable with the work done by Basti and coworkers.They found the mean ECL of about 5.28% 24 - 36 weeks after ECCE and capsular bag IOL implantation through scleral tunnel incision.[10] The present study showed comparable ECL of 5.05%, 24 weeks after surgery. Another recently reported prospective study by Vasavada and coworkers reported ECL of 5.1% at 3 months after ECCE with single piece Acrylic IOL injected through clear corneal 3.2 mm incision.[11] Here, the ECL was 3.90%, 3 months after cataract surgery with single piece acrylic IOL injected through scleral tunnel incision. The difference in ECL 3 months after cataract surgery between two studies could be attributed to different incision sites used in both studies.

Baltrame and coauthors compared the endothelial damage induced by different cataract incision sites, i.e. 3.5 mm Clear Corneal Incision (CCI) with silicon IOL; 5.5 mm sutured CCI with PMMA IOL and 5.5 mm scleral tunnel incision with PMMA IOL. They concluded that scleral tunnel incision has less postoperative endothelial damage than 2 other CCI groups and induces less direct and indirect trauma because of posterior placement of incision.[2] Another study also compared the effect of clear corneal and sclera tunnel incisions on ECC after cataract surgery and concluded that scleral incision was associated with lower postoperative endothelial damage than CCI (6.4% vs. 8.4%).[17] But both the studies were conducted in the adult age group.

Nucci *et al*. studied the normal endothelial cell loss in children. They showed that the normal decrease in cell density is 13% between 5 and 7 years of age and an additional drop of 12% by the age of 10 years.[8] The maximum mean endothelial cell loss in the current study was 5.05%, which is within the normal range.

In the present study, the maximum ECL was found during first 3 months after surgery (3.9%) and then the rate of cell loss reduced after that. There was further reduction of only 1.1% (3.9% - 5.05%) from 3 months to 6 months postoperatively. Price and coworkers observed that the most cell loss occurs within the first month after surgery.[18]

The central corneal thickness increases after pediatric cataract surgery due to endothelial damage during and after surgery. There was 1.95% increase in mean CCT from pre-operative reading to 1 month after surgery, 2.5% at 3 months and 3.1% at 6 months after surgery. Kim and coworkers found significantly thicker corneas in treated eyes (600 µm) as compared to the control group (569 µm), whereas they did not find any significant change in ECD.[19] Vasavada and coworkers observed 2.8% increase in the mean CCT from pre-operative period (519.5 µm) to 3 months (531.9 µm) after surgery, in eyes underwent posterior capsulotomy and anterior vitrectomy along with IOL implantation; whereas in eyes with intact posterior capsule, there was 2.3% decrease in mean CCT from pre-operative period (535.8 µm) to 3 months (521.6 µm) after surgery.[11] Nilforushan and coworkers concluded that congenital cataract surgery does not affect corneal transparency but increases the CCT as compared to age and sex matched control group.[7] They also presented hypothesis that the corneal shape and growth is related to the growth of the crystalline lens. Lens extraction in early infancy can affect the normal corneal growth resulting in thicker corneas. However, further studies are needed to test this hypothesis. Thus, the authors believe that surgical trauma is an important factor responsible for the postoperative changes in CCT and ECL. It is a well known fact that the corneas of young children must stay clear for longer period of time and it is important to practice great care during cataract surgery to lessen endothelial cell loss.

This study has the limitation of short follow-up. Further studies with larger sample size and long-term follow-up are required to evaluate the long-term effects of cataract surgery on pediatric cornea.

CONCLUSION

Endothelial cell loss with closed chamber micro-surgical technique, using scleral tunnel incision, is within acceptable limits and within the range of normal ECC in children.

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