A COMPARATIVE STUDY OF INCREASE IN CENTRAL CORNEAL THICKNESS FOLLOWING CONGENITAL CATARACT SURGERY IN CHILDREN

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ABSTRACT

BACKGROUND

The incidence rate of paediatric cataracts is high in developing countries like India¹; about 7.4 - 15.3 % of childhood blindness is due to congenital cataract. Although cataract extraction is performed at early ages in these children to prevent stimulus deprivation amblyopia, other complications such as secondary glaucoma,² continue to threaten their long term visual outcome. It was observed that after congenital cataract extraction, the increase in central corneal thickness (CCT) leads to overestimation of Intraocular Pressure (IOP) by Goldman Applanation Tonometry (GAT); and hence overdiagnosis of glaucoma in operated children resulting in unnecessary use of antiglaucoma medications.

Aims and Objectives-

- 1) To determine the central corneal thickness in children following surgery for congenital cataract in primary/secondary pseudophakia and aphakia and compare with age-matched normal children.
- 2) To see the variation in central corneal thickness (CCT) following primary/secondary Posterior Chamber Intraocular Lens (PCIOL) implantation for congenital cataract.

MATERIALS AND METHODS

This is a descriptive comparative study conducted among children under 12 years of age who underwent surgery for congenital cataract, who attended the Outpatient Department (OPD) as well as wards of Department of Ophthalmology and/or Institute of Paediatrics at Government Rajaji Hospital, Madurai. The duration of study was 10 months. Subjects, who fulfilled all eligibility criteria, and none of the exclusion criteria, were only recruited in this study after obtaining written informed consent from their parents/guardian. Out of 170 eyes included in this study, 27 were aphakic, 74 were pseudophakic eyes (46 with primary intraocular lens implantation and 28 with secondary intraocular lens implantation) and 69 unoperated eyes in these subjects were taken as controls as preliminary CCT values were unavailable for the aphakic/pseudophakic eyes. A detailed evaluation of the anterior and posterior segment (dilated fundus examination) was done. Visual acuity was recorded in cooperative children. After explaining both the procedures; IOP & CCT measurement; topical anaesthetic drops (0.5% proparacaine) were instilled into the conjunctival sac. Intraocular pressure was recorded with GAT and in uncooperative children with Perkin's handheld Applanation tonometer. After 5 minutes, child is reassured and asked to fix at a distant target. CCT was measured using ultrasonic pachymeter by placing the tip of the probe gently on the centre of cornea. An average of 5 readings is taken. Uncooperative children were examined under oral sedatives. After IOP and CCT measurement, these were compared to the IOP and CCT readings of their corresponding age-matched healthy children.

RESULTS

The age distribution of cases and controls varied from 4 - 12 years. There was no significant difference in age between the study group and control group. Among the 85 children (170 eyes) studied, 52 were male and 33 were female. In the study group, total number of aphakic eyes was 27 and pseudophakic eyes 74. Among them, 46 had IOL implanted at the time of lens extraction (primary pseudophakia) while in 28 cases IOL was implanted on a later date (secondary pseudophakia). The CCT in aphakia group ranged from 540 - 620 μ m, mean value being 597 μ m. Maximum number of eyes had CCT in the range of 580 - 620 μ m. The CCT in pseudophakic group ranged from 480 - 600 μ m, mean value in primary pseudophakia being 514 μ m and for secondary pseudophakia it was 552 μ m. The IOP values in the study group ranged between 12 - 32 mm of Hg, the mean value is 22.88 mm of Hg. Among the 19 aphakic eyes studied, IOP varied from 12 - 32 mm of Hg, mean value being 24 mm of Hg. The IOP measurements in pseudophakic group ranged from 14 - 26 mm of Hg, mean reading being 20 mm of Hg. Corrected IOP values were determined in each study group as per Dresdner CCT - IOP correction table. For aphakics it was 22 mm of Hg, primary pseudophakics 20 mm of Hg and secondary pseudophakics 20 mm of Hg. There was a significant difference in CCT between the study group and control group. There was a significant positive correlation ($r = 0.525$) between CCT and IOP in the study group.

CONCLUSION

Children who have undergone lens extraction for congenital cataract are found to have a clinically significant increase in central corneal thickness which can in turn provide overestimated intraocular pressure readings by GAT. Aphakic eyes have a thicker

cornea when compared to their pseudophakia counterpart. Measuring central corneal thickness and necessary intraocular pressure corrections should be made mandatory before prescribing anti-glaucoma medications in children who are highly susceptible to their serious side effects.

KEYWORDS

Congenital Cataract, Corneal Thickness, Aphakia.

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BACKGROUND

The incidence rate of paediatric cataracts is high in developing countries like India; about 7.4 - 15.3% of childhood blindness is due to congenital cataract. Although cataract extraction is performed at early ages in these children to prevent stimulus deprivation amblyopia, other complications such as secondary glaucoma, continue to threaten their long term visual outcome. It was observed that after congenital cataract extraction, the increase in central corneal thickness (CCT) leads to overestimation of Intraocular Pressure (IOP) readings by Goldman Applanation Tonometry (GAT); and hence overdiagnosis of glaucoma in operated children resulting in unnecessary use of antiglaucoma medications.

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This is a descriptive comparative study conducted among children under 12 years of age who underwent surgery for congenital cataract, who attended the Outpatient Department (OPD) as well as wards of Department of Ophthalmology and or Institute of Paediatrics at Government Rajaji Hospital, Madurai, after obtaining written informed consent from their parents/guardian. The duration of study was 10 months. Those with previous history of ocular trauma, inflammatory ocular conditions, history of glaucoma drainage device surgery, any other associated congenital ocular anomalies, central corneal opacity or scar, history of refractive surgeries or penetrating keratoplasty and those with history of contact lens use, were excluded from this study.

The sample size was determined by our statistician using the formula $n = (Z_{\alpha/2} + Z_{\beta})^2 \cdot \sigma^2 / d^2$, where ' $Z_{\alpha/2}$ ' - the critical value of the normal distribution at ' $\alpha/2$ ' is 1.96, ' Z_{β} ' - the

critical value of the normal distribution at ' β ' is 0.84, ' σ^2 ' - the population variance is 806 and ' d ' - the difference we would detect is 21. Henceforth, the sample size required for each group is 27 for confidence level 95%, power 80%, hypothesised difference is 10 and population 150 (very rare case). Out of 170 eyes included in this study, 27 were aphakic, 74 were pseudophakic eyes (46 with primary Intraocular lens implantation and 28 with secondary Intraocular lens implantation) and 69 unoperated eyes in these subjects were taken as controls as preliminary CCT values was unavailable for the aphakic / pseudophakic eyes.

A detailed evaluation of the anterior and posterior segment (dilated fundus examination) was done. Visual acuity was recorded in cooperative children. After explaining both the procedures - IOP & CCT measurement, topical anaesthetic drops (0.5% proparacaine) instilled into the conjunctival sac. Intraocular pressure was recorded with GAT and in uncooperative children with Perkin's hand held Applanation tonometer. After 5 minutes, child is reassured and asked to fix at a distant target. CCT was measured using ultrasonic pachymeter by placing the tip of the probe gently on the centre of cornea. An average of 5 readings was taken. Uncooperative children were examined under oral sedatives (chloral hydrate syrup 25 mg/kg in 3 divided doses). After IOP and CCT measurement, these were compared to the IOP and CCT readings of their corresponding age-matched healthy children.

The information collected regarding all the cases were recorded in a Master Chart. Data analysis was done with the help of computer using Statistical Package for Social Sciences (SPSS) software developed by IBM corporation. Using this software- range, frequencies, percentages, means, standard deviations, 't' value and 'p' values were calculated. Pearson correlation, Student's 't' test was used to test the significance of difference between quantitative variables. A 'p' value of less than 0.05 is taken to denote significant relation.

RESULTS

The age distribution of cases and controls varied from 4 - 12 years, majority being in the range between 6 - 8 years of age. There was no significant difference in age between the study group and control group. Among the 85 children (170 eyes) studied, 52 were male and 33 were female. In the study group, total number of aphakic eyes was 27 and pseudophakic eyes 74. Among the pseudophakic eyes, 46 had IOL implanted at the time of lens extraction (primary pseudophakia) while in 28 cases IOL was implanted on a later date (secondary pseudophakia). The age at which lensectomy was done in study group varied from 1 - 5 years, most of them being in the range of 2 - 3 years.

The central corneal thickness in aphakia group ranged from 540 - 620 μm , mean value being 597 μm . Maximum number of eyes had CCT in the range of 580 - 620 μm . The CCT in pseudophakic group ranged from 480 - 600 μm , mean

value in primary pseudophakia being 514 μm and for secondary pseudophakia it was 552 μm . Number of eyes in the study and control group belonging to various ranges of CCT (Table 1) was plotted; CCT was found to be higher in secondary pseudophakia when compared to their primary pseudophakia (Figure 1).

The IOP values in the study group ranged between 12 – 32 mm of Hg, the mean IOP being 23 mm of Hg. Maximum number of eyes in study group had IOP in the range of 22 – 27 mm of Hg. Among the 19 aphakic eyes studied, IOP varied from 12 – 32 mm of Hg, mean value being 24 mm of Hg. The IOP measurements in pseudophakic group ranged from 14 – 26 mm of Hg, mean reading being 20 mm of Hg. Corrected IOP values were determined in each study group as per Dresdner CCT - IOP correction table. For aphakics it was 22 mm of Hg, primary pseudophakics 20 mm of Hg and secondary pseudophakics 20 mm of Hg.

Figure 1. The Colour Variation shows the Distribution of Cases based on CCT Values in Children: Maximum No Children in Control is in the CCT range of 480 – 499 μm not seen in Aphakia and Increased CCT seen in Aphakia in the CCT range of 580-619 μm not seen in Control Group

CCT (μm)	Number of Eyes			
	Control	Primary pseudophakia	Secondary pseudophakia	Aphakia
460 - 479	5			
480 - 499	50	2		
500 - 519	8	27	2	
520 - 539	6	17	11	
540 - 559			3	1
560 - 579			3	1
580 - 599			9	12
600 - 619				13

Table 1. The Distribution of CCT Among Subjects in our study Showing the Increased CCT Among Aphakia whereas CCT is low in Controls

The mean CCT was greater in study group than in control group. There was a significant difference in CCT between the study group and control group ('p' value < 0.001). There was no significant relation between sex and CCT, age and CCT in study group. But a significant negative correlation was noted between age and CCT in control group ('p' value < 0.001). As the age increases, CCT is found to decrease in normal healthy controls. There was a significant positive correlation ($r = 0.525$) between CCT and IOP in the study group ("p" value < 0.001).

PARAMETERS	MEAN	SD	"P" VALUE
Control vs. Aphakia	492.967	15.092	< 0.001 Significant
	596.500	16.262	
Control vs. Primary Pseudophakia	492.967	15.092	< 0.001 Significant
	514.833	11.429	
Control vs. Secondary Pseudophakia	492.967	15.092	< 0.001 Significant
	551.500	28.383	
Primary Pseudophakia vs. Aphakia	514.833	11.429	< 0.001 Significant
	596.500	16.262	
Secondary Pseudophakia vs. Aphakia	551.500	28.383	< 0.001 Significant
	596.500	16.262	

Table 2. Table Showing Outcome of Statistical Analysis of Different Groups in Support of our Inferences

A similar correlation was found between the same variables in control group too ("p" value < 0.001). The difference in mean CCT values between aphakic eyes and primary pseudophakic eyes was more when compared to the difference between aphakic eyes and secondary pseudophakic eyes (Table 2). A significant difference was noted between CCT and IOP in both study group and control group with a "p" value of less than 0.001.

DISCUSSION

The critical time period for developing amblyopia begins approximately at around 4 months of age.³ Segregation of ocular dominance and sensitivity of binocular correlation begins at 4 months of age. Hence, this is considered as the critical time period for visual development.

The normal anatomy of visual cortex is altered easily if sensory input is abnormal. Other areas of cerebral cortex also depend on this sensory input and stimulation, so as to form proper anatomical circuits essential for normal adult visual function. Most common clinical condition for stimulus deprivation amblyopia is congenital cataract⁴ or early acquired cataract. This fact underscores the significance of providing children with congenital cataract a timely intervention and equally important post-operative visual rehabilitation and follow-up. So removal of cataracts and clearing the obstruction to the visual axis at an earlier age should be done inevitably with adequate care given at the time of follow-up.

Since the children who have undergone cataract removal are highly susceptible to the risk of developing secondary glaucomas, a close monitoring of IOP and CCT changes should be done. This can be helpful in the management of this unique category of patients. There was a statistically significant increase in central corneal thickness in all eyes operated for congenital cataract. A longitudinal study conducted by Zena Lim and Kelly et al⁵ showed this increase in CCT was noticed in eyes without any evidence of glaucoma. They also found that mean CCT was even higher in eyes with aphakic or pseudophakic glaucoma.

A small case-control study on the endothelial characteristics in children who have undergone congenital cataract extraction did not show any significant changes in endothelial cell characteristics when compared to the age and sex-matched healthy control eyes, though there was a reduction in endothelial cell count.⁶ This finding is in contrast

to the study done by Ramasubramanian et al⁷ who had the viewpoint that surgical trauma at the time of cataract extraction can cause endothelial cell dysfunction and resultant increase in CCT. Another school of thought for risk of developing glaucoma being more in aphakic group rather than in primary pseudophakia group is due to the exposure of the maturing angle structures and maturing cornea to harmful side effects of vitreous components.⁸ This access to trabecular meshwork and cornea is less if artificial lens is implanted at the same time as that of cataractous lens extraction. So, increased CCT in aphakia and pseudophakia eyes following congenital cataract extraction and its effect on IOP measurement should be borne in mind before making a diagnosis of glaucoma and prescribing anti-glaucoma medications in children.

CONCLUSION

Children who have undergone lens extraction for congenital cataract are found to have a clinically significant increase in central corneal thickness which can in turn provide overestimated intraocular pressure readings by GAT. Aphakic eyes have a thicker cornea when compared to their pseudophakia counterpart showing primary lens implantation can be a protective factor against this increase. Measuring central corneal thickness and necessary intraocular pressure corrections should be made mandatory before prescribing anti-glaucoma medications in children who are highly susceptible to their serious side effects.

REFERENCES

- [1] Khokhar SK, Pillay G, Agarwal E, et al. Innovations in pediatric cataract surgery. *Indian J Ophthalmol* 2017;65(3):210-6.
- [2] Simsek T, Mutluay AH, Elgin U, et al. Glaucoma and increased central corneal thickness in aphakic and pseudophakic patients after congenital cataract surgery. *Br J Ophthalmol* 2006;90(9):1103-6.
- [3] Daw NW. Critical periods and amblyopia. *Arch Ophthalmol* 1998;116(4):502-5.
- [4] Simsek T, Mutluay AH, Elgin U, et al. Glaucoma and increased central corneal thickness in aphakic and pseudophakic patients after congenital cataract surgery. *Br J Ophthalmology* 2006;90(9).
- [5] Lim Z, Muir KW, Duncan L, et al. Acquired central corneal thickness increase following removal of childhood cataracts. *Am J Ophthalmol* 2011;151(3):434-41.
- [6] Nilforushan N, Falavarjani KG, Razeghinejad MR, et al. Cataract surgery for congenital cataract: endothelial cell characteristics, corneal thickness, and impact on intraocular pressure. *J AAPOS* 2007;11(2):159-61.
- [7] Ramasubramanian A, Mantagos I, Vanderveen DK. Corneal endothelial cell characteristics after pediatric cataract surgery. *J Pediatr Ophthalmol Strabismus* 2013;50(4):251-4.
- [8] Faramarzi A, Feizi S, Maghsoodlou A. Factors influencing intraocular pressure, corneal thickness and corneal biomechanics after congenital cataract surgery. *Br J Ophthalmol* 2017.