**INTRODUCTION**

Cataract is the leading cause of preventable blindness worldwide and also in the paediatric population.\(^1\,^2\) Paediatric cataract is responsible for 10% of childhood visual loss world over while incidence of paediatric cataract among the children attending eye outpatient clinics in Pakistan is 11.69%.\(^3\,^4\) Although blindness from cataracts is less common in children compared with adults; the impact is severe in terms of vision years lost.\(^5\) Surgery is the mainstay of treatment and one of the most cost-effective healthcare interventions.\(^6\) However complications like glaucoma can lead to lifelong decreased vision even after an uneventful surgery. These patients should be monitored as glaucoma suspects for rest of their lives.\(^7\,^8\)

Aphakic glaucoma has been reported in up to 32% of eyes after paediatric cataract surgery, however, diagnosis of glaucoma in most of these studies is based on intra-ocular pressure measurements alone.\(^9\,^10\) Although intra-ocular pressure (IOP) is an important factor in the diagnosis, management and follow-up of glaucoma patients and measuring IOP using the Goldmann Applanation Tonometry has been considered the gold standard, central corneal thickness (CCT) should also be considered while interpreting its readings. Goldmann Applanation tonometry overestimates IOP by 5 mmHg for every 70 \(\mu\)m increase in corneal thickness.\(^10\,^11\) So higher incidence of aphakic glaucoma reported in studies, based on IOP measurements alone without considering the effect of CCT, might be an overestimation.\(^12\)

The central corneal thickness can clinically be measured by various techniques. The mean CCT reported in normal healthy children is 549 ± 46 \(\mu\)m.\(^13\) Studies have reported the CCT values upto 574 ± 54 \(\mu\)m in paediatric cataract patients which is higher as compared to normal individuals.\(^14\) As most of these studies were based on postoperative measurement of CCT, consensus is lacking whether this increase in thickness is present pre-operatively or develops postoperative due to endothelial cell damage from intraoperative manipulation or solutions.\(^15\,^17\)

The study addressed CCT evaluation in paediatric cataract patients pre-operatively, which automatically removed the bias of any intra-operative manipulation. This study was conducted to identify an association between paediatric cataract and central corneal thickness.

**METHODOLOGY**

This case control study was conducted at the Paediatric Ophthalmology Clinic of Al-Shifa Trust Eye Hospital, Rawalpindi, from November 2009 to May 2010. An
approval from Hospital ethical committee was taken for this study. Sample size was calculated using WHO sample size calculator was 116 with 58 subjects in each group considering level of significance: 5%, power of test: 80%, population SD: 54, test value of population mean CCT=549 ± 46 µm and anticipated population mean CCT=574 ± 54 µm. Sampling technique was consecutive purposive sampling. Subjects from both genders with age less than 12 years were inducted from paediatric outpatient department after an informed written consent from parents. Subjects with history of ocular trauma, other anterior or posterior segment disorders, inflammations, conditions known to be associated with increased or decreased CCT were excluded. Demographic profile of all participants was noted including age, gender and address followed by a detailed examination. The study population was divided into three groups according to age in years. Group 1 comprised age < 5 years. Group 2 comprised age 5 - 9 years. Group 3 comprised age ≥ 10 years.

The child or his / her attendants (depending upon the age) were explained about the procedure. Topical anaesthesia was instilled before touching the probe with the corneal surface. The tip of the probe was cleaned with the sanitizer. The foot switch was pressed and the pachymeter produced small beeps indicating it was ready to take the reading. Patients under the age of 4 years were examined under sedation (chloral hydrate syrup) with hand held slit lamp while patients older than 4 years were examined with Takagi slit lamp biomicroscope. CCT was measured in a lying down position using a handheld probe of ultasonic pachymeter (model Pac Scan 300). The probe was kept perpendicular to the surface of the cornea for accuracy of the measurement. The probe was gently placed in the mid pupillary axis of the cornea in the undilated eye. A long beep indicated that the measurement had been taken. The mean of three measurements from the central cornea were recorded in microns. All the findings were noted on a specially designed proforma attached.

Data was analyzed by Statistical Package for Social Sciences (SPSS) version 17. Mean and standard deviation were calculated for numerical variables like age and CCT. Independent sample t-test was used for comparing mean CCT values between the two groups while difference in mean CCT between various age groups was compared using ANOVA. Significance was set at p-value < 0.05.

RESULTS

The age range of cases was from 1 month to 12 years (mean = 5.036 ± 3.81 years) while the age range of controls was from 2 months to 12 years (mean = 4.972 ± 3.61 years) with no statistically significant difference between the mean ages (p=0.926). Because of the variation of age in the study population, visual acuity could not be assessed statistically as it was recorded by different techniques (OKN drum, Cardiff cards and Snellens chart) in various patients according to their ages. The CCT of the whole study population including cases and controls ranged from 443 microns to 666 microns with a mean of 551.32 ± 35.238 microns. The mean CCT of cases was 566.83 ± 37.646 microns. There was no significant difference in CCT between male and female cases (p=0.456) and also between cases in various age groups (p=0.065). The mean CCT of controls was 535.81 ± 24.466 microns. There was no significant difference in the mean CCT of male and female controls (p=0.805) and also between controls of the various age groups (p=0.205).

Difference between the CCT of cases and controls was highly significant (p < 0.001).

DISCUSSION

Aphakic glaucoma in paediatric patients grabbed the attention of Ophthalmologists as a high percentage of paediatric cataract cases were reported to develop glaucoma after surgery.18 CCT has been recognized as an important factor to affect the IOP measurements by Goldmann Applanation Tonometer.10 Search of literature revealed only one study conducted to detect the mean CCT of normal Pakistani population. That study was also conducted on a limited scale in a hospital based population and considered only adult age group.19 Mean CCT of normal controls in this study was 535.81 ± 24.46 microns. This value is comparable with the CCT of 531.08 microns in normal adult Pakistani population. Aghaian et al. compared mean CCT of various Asian sub-populations and reported a mean CCT of 542.9 microns. The authors concluded that CCT vary among Asian sub-populations: Caucasians, Chinese, Hispanics, and Filipinos have comparable CCT measurements, whereas the corneas of African Americans are significantly thinner (521.0 microns).20 Similarly, Dai suggested differences in CCT among different ethnic groups in the paediatric population, with African-Americans having thinner corneas than Caucasians and Hispanics. In their study, mean CCT in each ethnic group was African-Americans, 523 ± 40 microns; Caucasians, 563 ± 36 microns; and Hispanics, 568 ± 44 microns.21 Considering the results of all these studies, the mean CCT values of present normal paediatric patients are comparable with the African-Americans, a fact similar to the adult population.19,20 The difference between the CCT values of cases and controls was highly significant in this study (p < 0.001). Most of the studies have evaluated CCT values of eyes with congenital cataract after cataract surgery and have reported a significantly high CCT of aphakic and pseudophakic eyes. These studies suggest intra or...
postoperative endothelial cell damage as the cause of increased corneal thickness in eyes with prior paediatric cataract surgery. Simon et al. and Amino et al. reported intraoperative manipulation or solutions as the causative factor for corneal endothelial cell dysfunction. Nilforushan et al. revealed that corneal endothelial cell characteristics are not significantly different in eyes with prior congenital cataract surgery and control eyes implying other causative factors for the increased CCT in eyes with prior paediatric cataract surgery. Certain growth abnormalities in the cornea of aphakic eyes may also account for this difference. Cataract extraction in childhood is also reported to affect the growth of globe. Embryologic investigations have shown that corneal shape and growth is induced by the crystalline lens. Lens extraction in childhood can alter the normal corneal growth resulting in a thicker cornea.

Results of the current study partially compare with the results of Muir et al. who reported a mean CCT of $574 \pm 54$ microns in 46 eyes with cataracts which was more than that of controls ($562 \pm 38$ microns, $p = .001$). However, after excluding from the cataract group, those eyes with aniridia, Down syndrome, Marfan syndrome, or glaucoma surgery, they found that mean CCT ($564 \pm 34$ microns $[n = 36]$) was not significantly greater than that of controls ($p = .07$). So they concluded that in the absence of factors known to affect CCT (Down syndrome, Marfan syndrome, and aniridia), CCT is similar in eyes with paediatric cataracts and normal controls. The sample size in the study by Muir et al. was less than the current study while after excluding the 10 cases of Marfan syndrome, Down syndrome, glaucoma and aniridia the sample was further reduced. This might have lead to unrepresentative sample of eyes with congenital cataract. All such factors were excluded in the current study and mean CCT values were found significantly greater than the controls.

In a recently published study by Lupinacci et al. patients with congenital cataracts and aphakia were divided into four groups i.e. unilateral cataract, bilateral cataract, unilateral aphakia and bilateral aphakia. The mean CCT of the control group was not significantly different from the normal ($p = .747$) and cataractous eyes of group 1 ($p = .252$), however, the mean CCTs of both eyes of group 2 (with bilateral cataracts) were significantly higher than the control group ($p < .001$). These results also point towards some association between increased CCT and paediatric cataracts which need to be explored further in future studies.

The current study has several strengths and limitations. To the best of our knowledge, this is the first study that has addressed the association between pre-operative CCT and congenital cataracts in Pakistani population. The study was conducted in a tertiary care eye centre where patients from different cities of Pakistan utilize the services. So the study population had representation from various cities of Pakistan. The method used for determining CCT in the current study was ultrasonic contact pachymetry which is the current standard for CCT measurement. Other modalities including non-contact pachymeters such as scanning slit topography (i.e. Orbscan) and camera pachymeter (i.e. Pentacam) require patient co-operation.

Regarding limitations, the study was conducted in a hospital based setting and was prone to selection bias. The controls were also selected from the patients presenting to the hospital. Although it was made sure to exclude the patients suffering from any disease that can affect CCT but subjects with refractive errors were included as controls. Future studies should also exclude patients with refractive errors to remove any bias related to correlation of refractive errors and CCT. The mean CCT values of eyes with different types of congenital cataracts were not compared separately. Moreover, no previous studies on local population were available; so the results had to be compared with other populations.

**CONCLUSION**

Eyes with congenital cataracts have greater CCT values as compared to normal paediatric population. This factor must be kept in mind while interpreting IOP in such patients. However, further studies on local paediatric population with a larger sample size incorporating more advanced technologies are strongly suggested to compare these results. This will lead to a better understanding of the relationship between CCT and congenital cataracts.

**REFERENCES**