Macular and Retinal Nerve Fiber Layer Thickness Changes in Adolescent Patients after Cataract Surgery

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Abstract

Purpose: *This study analyzed macular thickness (FMT) and retinal nerve fiber layer thickness (RNFL) following phaco-aspiration (PHACO) and small incision cataract surgery (SICS) in adolescent eyes.*

Methods: *Macular thickness and RNFL thickness were measured using optical coherence tomography (OCT) in 52 eyes who underwent PHACO or SICS surgery. OCT measurements were done preoperatively, and on 1st, 14th, 42nd, 84th and 168th postoperative days. Eyes with any other diseases were excluded. Paired sample t-test was used to compare the parameters.*

Results: *The FMT and RNFL thicknesses were found to be higher postoperatively. The SICS group had significantly higher macular thickness (233.06 ± 31.23 µm) than the PHACO group (227.33 ± 28.25 µm) on the 42nd day. The RNFL thickness in SICS was significantly higher than in PHACO and highest on the 84th postoperative day, with mean average value 95.04 ± 16.61 µm and 91.98 ± 18.22 µm respectively.*

Conclusions: *This study shows that cataract surgery increases the macular and RNFL thickness. These increases are significantly higher in the SICS than in PHACO eyes on the 42nd day after surgery, which resolves gradually towards 168th day after surgery. This indicates that phaco aspiration is more preferable surgery then SICS in adolescents with regard to postoperative increase in macular and RNFL thickness.*

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Introduction

There are 1.4 million blind children worldwide, with roughly 3,20,000 of the affected individuals residing in sub-Saharan Africa.[1] The etiology of childhood blindness has got wide regional and socioeconomic variation. Worldwide, about 2,00,000 children are blind from cataract. In addition to that, approximately 20,000 to 40,000 neonates are born each year with congenital cataract.[2] An estimated 1,33,000 children with cataract related blindness live in third world countries.[3] The prevalence of blindness due to cataract may reach more than 30% of cases in the developing world.[4-9]

Studies on childhood blindness showed that 7.4%–15.3% of it is due to childhood cataract.[10] It is a significant amount of avertable disability. Within the disease-control strategy of priority eye diseases by the "VISION 2020" initiative, childhood blindness is an important one.[11] In developing countries such as India, 7.4-15.3% of childhood and adolescence blindness is due to cataract.[12-14] The prevalence of cataract in children has been estimated between 1 and 15/10,000 children.[15,16]

Surgical management is the only treatment of cataract. There are extensive studies on cataract management in children and adults, but few such reports are available in the adolescent group. Since a large number of childhood and developmental cataract patients get their surgical management during their adolescence, studies on cataract surgery during adolescence has got an immense importance. The aim of this study was to analyze the changes in macular and retinal nerve fiber layer thickness after uneventful cataract surgery with posterior chamber intraocular lens (PC-IOL) implantation in adolescent patients.

Cataract surgery may cause macular oedema in some cases, though the exact etiology of macular oedema following cataract surgery is not known. The surgical trauma and subsequent release of prostaglandin may increase the permeability of the perifoveal capillaries, which is suspected to be a factor of post-surgical macular oedema.[17] Macular oedema may severely affect the vision which may decrease the postoperative visual acuity (VA). After the introduction of phaco aspiration, the rate of postoperative macular oedema is found to be lesser than earlier cataract surgeries.[18-20]

Optical coherence tomography (OCT) is an essential diagnostic tool which perfectly analyzes the thickness of the retina. It is used for the diagnosis of the retinal diseases and is considered as the gold standard for diagnosing cystoid macular edema (CME). Optical coherence tomography is an objective, noninvasive, well-tolerated, noncontact method for quantitative measurements of retinal thickness, with good reproducibility and with 10µm resolution.[21]

In India, cataract patients attending a hospital at the age of 10-19 years are not uncommon situations. These patients undergo either SICS or phaco aspiration surgery.

In phaco aspiration surgery, the surgeon requires to use vacuum similar to aspiration and irrigation of SICS procedure. During phaco aspiration procedure, intraocular fluid dynamics remains maintained with computerized control mechanism.

This study examined the change of the macular and retinal

nerve fiber layer thickness with OCT after uneventful cataract surgery. It was an attempt to compare the efficacy of phaco aspiration in adolescent patients undergoing cataract surgery with that of manual SICS in the same age group in terms of macular and RNFL thickness. Through this study, we can find some new insight into the status of macular and RNFL thickness after cataract surgery in adolescent age group of patients.

Materials and Methods

This study was conducted in Regional Institute of Ophthalmology, Gauhati Medical College and Hospital, Guwahati. An informed consent was signed by each participant undergoing surgery.

In this prospective randomized study, 52 eyes with cataract of 52 patients were analyzed, 33 being male and 19 female, both in the age group of 10-19 years. Previous intraocular surgery, ocular trauma, other ocular diseases and any intraoperative or postoperative complication were excluded from the study.

The patients taken for this study underwent a comprehensive eye check up prior to surgery. In all patients, preoperative visual acuity and intraocular pressure was recorded. Optical biometry of both eyes was done by IOL master. Patients suffering only from cataract without any associated ocular or systemic diseases were taken for this study.

All selected cases underwent either SICS or PHACO procedure by a single surgeon with sufficient experience in cataract surgery. Cataract surgeries were performed under peribulbar anaesthesia, using a standard technique. In PHACO cases, after the limbal incision, a capsulorhexis was made with forceps under Amvisc Plus (sodium hyaluronate). After good hydroprocedures, the lens matter was aspirated with a phaco probe and a PC-IOL was implanted 'in the bag' in all cases. The viscoelastic material was carefully washed out from the anterior chamber and from behind the PC-IOL using the 'two-compartment technique' of Tetz and Holzer. In SICS cases, after a fornix bases conjunctival flap, a 2.8 mm sclerel tunnel with frown incision was made. Capsulorohexis was made with forceps and after good hydro procedures, the core of the lens was delivered with visco delivery procedure. The remaining lens matter and cortex was aspirated with an irrigation aspiration cannula. One PC-IOL was implanted 'in the bag'. Viscoelastic material was carefully washed out. In both PHACO and SICS group, the implanted PC-IOL was a hydrophobic acrylic lens (Alcon, AcrySof IQ). The preoperative medications and the postoperative treatment were same in all patients.

All the patients who underwent surgery were examined the next day on slit-lamp. Visual acuity was assessed appropriately and recorded. The retinal thickness in the foveal areas was measured on the preoperative day, and on 1st, 14th, 42nd, 84th and 168th postoperative days by one trained and experienced optometrist. Stratus 3000 OCT (Carl Zeiss Meditec, Inc.) was used for measuring the thickness of retinal nerve fiber layer and the macula. Pupils were dilated for OCT examination in all cases with 0.8% tropicamide and 5% phenylephrine eye drops.

Statistical analysis was performed using SPSS v 15 (SPSS Inc, Chicago, IL, USA). Paired sample t-test was used to compare the FMT and RNFL parameters.

This study was approved by the Ethics Committee of Gauhati Medical College, Guwahati. All procedures of this study conformed to the standards set by the Declaration of Helsinki in its latest revision.

Results

Our study included 52 eyes of 52 patients, 32 underwent SICS and 20 patients underwent phaco aspiration procedure. A higher value of foveal thickness was observed in the SICS group than PHACO group during follow up. The highest and significant (p =0.001) difference in macular thickness between the two groups was found on the 42nd day postoperatively, PHACO 227.33 ± 28.25 μm and SICS 233.06 ± 31.23 μm. The foveal thickness resolved to near normal in both the groups, with still a significant (p =0.005) difference during the final follow up on the 168th day, with a value of 205.18 ± 28.66 μm in SICS and 192.71 ± 23.27 μm in phaco aspiration (Figure 1) (Table 1).

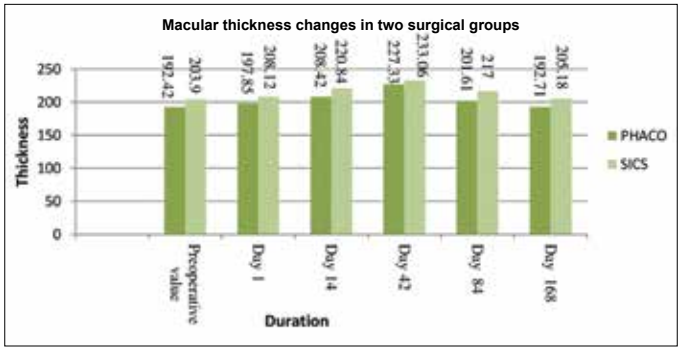

Figure 1: *Comparison of macular thickness in SICS group and PHACO group*

Table 1: Comparison of changes in macular thickness between SICS group and PHACO group

Time after surgery	Phaco aspiration (Mean ± SD)	SICS (Mean ± SD)	p-value
Preoperative value	192.42 ± 25.56	203.90 ± 32.45	0.05
Day 1	197.85 ± 27.66	208.12 ± 31.63	0.006
Day 14	208.42 ± 27.56	220.84 ± 29.30	0.003
Day 42	227.33 ± 28.25	233.06 ± 31.23	0.001
Day 84	201.61 ± 27.13	217 ± 30.65	0.002
Day 168	192.71 ± 23.27	205.18 ± 28.66	0.005

Note: Data presented as mean ± standard deviation

Retinal nerve fiber layer analysis showed an increase in its thickness in both SICS and PHACO group till 84th day in comparison to the preoperative value, with maximum increase on the 42nd postoperative day in both the groups. The thickness resolved towards the final follow up on 168th day, with a mean thickness of 90.52 ± 15.71 μm in SICS and 89.25 ± 16.97 μm in PHACO group (Figure 2) (Table2).

There were significant differences in the changes of retinal nerve fiber layer thickness between SICS and PHACO group in all the postoperative follow up days. The highest and

significant (p=0.005) difference was observed on the 84th day, SICS 95.04 ± 16.61 μm and PHACO 91.98 ± 18.22 μm (Figure 2) (Table2).

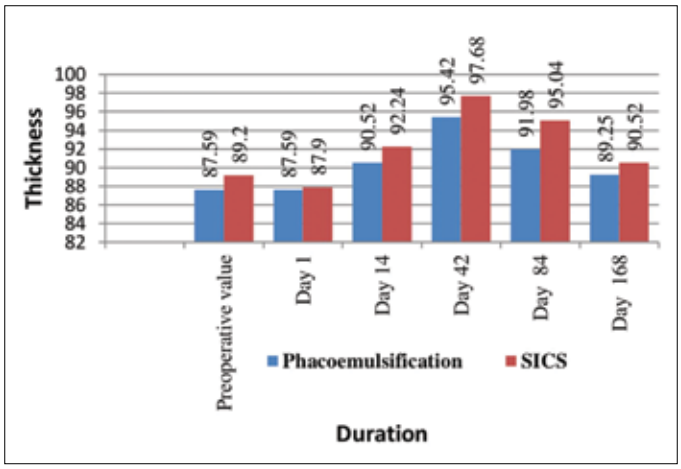

Figure 2: *Comparative retinal nerve fiber layer thickness measurement in SICS group and PHACO group*

Table 2: Retinal nerve fiber layer thickness in SICS and PHACO group. (Thickness in μm)

Time after surgery	phaco aspiration (Mean ± SD)	SICS (Mean ± SD)	P-value
Preoperative value	87.59 ± 15.78	89.20 ± 15.51	0.05
Day 1	87.59 ± 12.98	87.90 ± 13.60	0.08
Day 14	90.52 ± 18.23	92.24 ± 17.12	0.003
Day 42	95.42 ± 18.53	97.68 ± 16.83	0.001
Day 84	91.98 ± 18.22	95.04 ± 16.61	0.005
Day 168	89.25 ± 16.97	90.52 ± 15.71	0.003

Note: Data presented as mean ± standard deviation

Discussion

Optical coherence tomography is a diagnostic tool, which gives a high resolution cross-sectional image of the retina and choroid in the living structure (in vivo). This non invasive device is used to find out macular thickness in case of undefined poor visual outcome after cataract surgery. OCT helps in quantitative measurement of macular thickness following intra ocular surgeries.

In OCT, the eye is illuminated with a near-infrared light. Since it is a noncontact method, it is well tolerated by the patients. Dilation of the pupil helps it to be performed, which is not absolutely necessary. Reproducibility of this method is very good, and its accuracy is around 10μm.[22]

The present study investigated changes in macular thickness following cataract surgery in adolescents. The adolescent cataract surgery differs from senile cataract surgery in many ways. There may be associated amblyopia and the sclera is less rigid. Moreover, the axial length and refractive status of the eye may keep on changing in these patients. There are chances of more postoperative inflammation and post operative capsular opacity (PCO) after cataract surgery in adolescent patients. Hence, visual results of adolescent cataract surgery are less spectacular than senile cataract surgery.

Blindness with pediatric cataract presents a vast problem to developing countries with human morbidity, economic loss and social burden. Managing cataract in pediatric and adolescent group remains a test, where treatment is difficult, often tiresome, and always requires a group effort. To guarantee the best long term result for cataract blind children and adolescents, suitable surgical techniques need to be defined and adopted.[23]

In developing countries a large number of pediatric cataract patients undergo cataract surgery during their adolescence. Numerous research works have been done on the management of pediatric as well as adult cataract. But, few research articles have been published till date on cataract surgery in adolescents. No articles have been published on macular thickness and retinal nerve fiber layer thickness analysis after cataract surgery in adolescents. To the best of our knowledge, this was the first study to analyze these aspects of cataract surgery during adolescence. We found increase in the foveal and retinal nerve fiber layer thickness on 1st, 14th, 42nd and 84th days postoperatively, after uncomplicated cataract surgery.

Analysis of PHACO and SICS procedure on senile cataract showed that the macular thickness was higher in SICS group.[24] The authors showed significant difference in macular thickness between PHACO and SICS group on 3rd day, 7th day, 3rd month and 6 months follow up.[24] The results of our study were similar to that analysis, though their study was on senile cataract and ours was on adolescent patients. We found significant difference in macular thickness between the two groups from 1st postoperative day to 168th postoperative day, the highest difference being on the 42nd postoperative day. On all the follow up days, the macular thickness in the SICS group was higher than the PHACO group.

In one study, the RNFL average thickness measured by OCT showed an increase after cataract surgery.[25] In our study, we found that there was increase in the retinal nerve fiber layer thickness on the 14th, 42nd, 84th postoperative day, with a maximum increase on the 42nd day. We found a significant difference in the RNFL thickness between the two surgical techniques, SICS and PHACO. The retinal nerve fiber layer thickness was always higher in SICS group than the PHACO group postoperatively. The highest difference in the thickness was observed on the 84th day postoperatively.

Conclusions

Cataract surgery on adolescent patients affects the macular and retinal nerve fiber layer thickness. The effective thickness varies from the 1st postoperative day till 168th day following surgery, with the highest thickness being on 42nd day post operatively.

Post-surgical increases in macular and RNFL thicknesses are significantly higher in small incision cataract surgery in comparison to phaco aspiration procedure in adolescent patients, indicating PHACO to be a better choice. Further study including more number of patients with a longer follow up will bring more informative results.

Need of proper imaging instruments to analyze retinal structures and thickness through a completely opaque and hazy media is the limitation of this study. Innovation of such an instrument will be more helpful in such situations.

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