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Evaluation of Changing Axial Length in Eyes after Paediatric Cataract Surgery.

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ABSTRACT

Background: Evaluation of changing axial length in eyes after paediatric cataract surgery. Aim – To assess the change in axial length of eye after paediatric cataract surgery which will help us to determine the amount of under-correction required in IOL power with increase in age. **Methods:** 32 patients were divided in three age groups; 0-2 years, 2-5 years and 5-10 years. Post cataract surgery, in all the patients axial length measurement, intraocular pressure recording and cycloplegic refraction was done at 6month, 1 year and after 2year of surgery. An unpaired T-test was performed to check the significance of study. **Results:** The change in axial length in first group(0-2 years) was higher at the end of 2 years (1.82mm) than second (1.74mm) and the third group (0.85mm). The mean axial growth of aphakic eye was higher (1.65mm) than the pseudophakic eyes of the same age group. Maximum growth rate (40-56% of the total growth) was observed in the first 6months of surgery in all the three groups. Myopic eyes in group 2 had higher mean axial growth (2.28) than the non-myopic eyes (1.28) of the same study group. Myopic eyes in the other group also had higher growth rate. **Conclusion:** Paediatric eye is a growing system with an eminent myopic shift which necessitates the required adjustment in IOL power to achieve emmetropia at adult age. As the rate of growth in axial length is maximum between 0-2 years of age, the required reduction in IOL power is more in this group to achieve the final status of emmetropia.

Keywords: Paediatric cataract surgery, axial length, intraocular lens(IOL)

INTRODUCTION

Cataract in paediatric age group is one of the significant cause of treatable blindness in our society. According to W.H.O every minute one child goes blind somewhere in the world.[1] Worldwide, an estimated 1.4 million children are blind, of whom approximately 190,000 (14%) are blind owing to bilateral un-operated cataract, complications of surgery, amblyopia due to delayed surgery, or the presence of other associated anomalies.[2]

Paediatric cataract is broadly classified as – Congenital cataract (lens opacities present at birth), infantile cataract (presents within 2years of age) and juvenile cataract (appears in first decade of life). Any visually significant cataract should be removed at the earliest possible opportunity provided that the health of child is not jeopardized.[3] For unilateral cataract, the critical period for surgical intervention is 6weeks, with potential of equal outcomes if surgery was performed at any point during this first 6 weeks of life.[4] For infants with bilateral congenital cataracts Scott et al,[5] proposed that they should undergo cataract surgery before the onset of nystagmus, which in most children occurs after the first 10 weeks of life.

In spite of the inherent risk of surgery and complications like hyphema, fibrinous uveitis, pupil capture, capsular fibrosis, visual axis obstruction, different complications related to cornea, lens and vitreous; implantation of IOL in paediatric patients after cataract removal appears to be at least as safe as implantation in older patients.[6] Primary IOL implantation with posterior capsulorhexis and vitrectomy has been well accepted in children beyond their first birtday but IOL implantation at the time of cataract surgery in children less than 1 year remains controversial.[7-9]

Gordan RA in his study on refractive development of the eye, showed that premature children with birth weight less than 2500g, have the refractive error of -1.3 D to +1.1 D. It is +0.6 to +2.6 D in full-term newborns. This mild hyperopia persists throughout the next 6- to 7- years and then a myopic shift of -2 D occurs from 6 years to adulthood.[10] Because of the anticipated myopic shift, the general consensus is

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to under-correct at the time of surgery, to offset the myopic shift that occurs in these growing eyes but what should be the target refraction and how much under-correction is required for a particular age, to achieve the target emmetropia at adulthood is still a debatable issue. Change in axial length produces the greatest problem in selecting an appropriate power for an IOL in these paediatric patients.

This study was conducted to assess how the axial length of paediatric eye changes over a period of 2years after cataract surgery to give us some guideline regarding calculation of IOL power for achieving target emmetropia.

MATERIALS AND METHODS

A prospective observational case study was conducted at TVP Eye Institute, Vadodara. Total 32 eyes of 18 patients who underwent cataract surgery between2008 and 2009 were included in the study. They were divided into 3 groups according to their age. The first group included patients of less than 2years of age, the second group had patients between 2 to 5years of age and the third group had patients between 5 to 10 years of age.

Eligibility criteria

Inclusion criteria

- Children under 10years of age with unilateral or bilateral cataract were included in this study.

Exclusion criteria

Ocular pathologies like persistent hyperplastic vitreous, retinopathy of prematurity, congenital glaucoma, microphthalmos and traumatic cataract were excluded from the study.

Method

The pre-operative evaluation included pedigree analysis, relevant systemic examination, TORCH titre evaluation whenever indicated, detailed ocular examination including recording of intraocular pressure, corneal diameter and axial length (DTH ultrasound biometer), corneal curvature (Autokeratometer – Nidek KM) measurement.

All the surgeries were performed by the same surgeon, under general anaesthesia. Cataract extraction was performed by phacoemulsification technique. The important steps included frown shaped scleral incision, preparation of a sclero-corneal tunnel, anterior continuous curvilinear capsulorhexis, hydrodissection, aspiration of lens matter, intraocular lens implantation and posterior continuous curvilinear capsulorhexis with anterior vitrectomy. All the ports were closed using 10-0 monofilament nylon suture.

Single piece acrylic foldable intraocular lens or polymethyl methacrylate intraocular lens was implanted in all but five eyes where corneal diameter was less than 11.00mm. In bilateral cataract both eyes were operated at the difference of 1month, except in 1case where the cataract was not visually significant in the eye which got operated after a year. Standard post-operative protocol was followed and rise of intraocular pressure was managed with pressure lowering agents (Timolol and Dorzolamide eye drops). Suture removal was done after 3months of surgery.

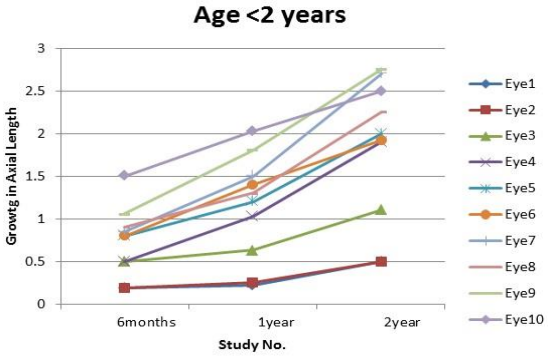
All the patients were examined on the 1st postoperative day and subsequently at 1month, 3months, 6months, 1year, 2year and then till the last follow-up. On every follow-up axial length measurement, intraocular pressure recording and cycloplegic refraction was done. Appropriate visual rehabilitation in the form of spectacles, patching were prescribed. Cases with visual axis obscuration were managed by surgical membranectomy (via pars plana) and vitrectomy and YAG capsulotomy.

RESULTS

In this study 32 eyes were categorized and assessed in 3 groups. The 1st group had patients who got operated before 2years of age, in the 2nd between 2-5years of age and the 3rd between 5-10years of age.

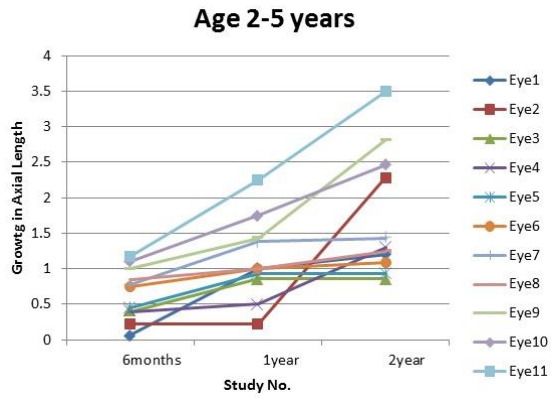
In the first group [Figure 1], the mean axial length increased from 19.82mm to 21.63mm in the period of 2years. The mean growth of axial length was 0.72(SD, 0.40) mm, 1.37(SD, 0.61)mm and 1.82 (SD, 0.83)mm respectively after 6months, 1year and 2 year of surgery. 5 out of 10 eyes were aphakic and their final mean axial growth after 2years of surgery was 1.65mm which was higher than the mean growth of pseudophakic eyes of this age group which was 1.1mm.

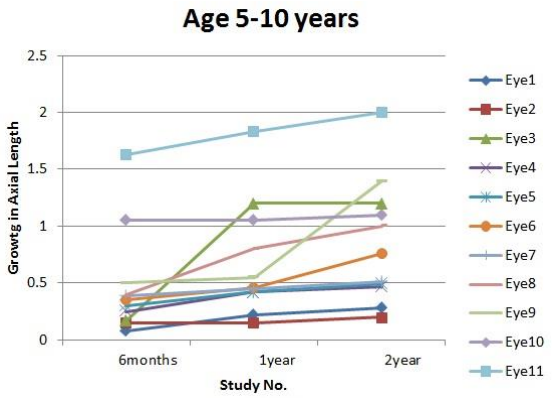
In group 2 [Figure 2], the mean axial length increased from 23.06 to 24.80mm in the period of 2years. The mean growth axial length in mm was 0.65 (SD, 0.36) mm, 1.12(SD, 0.56)mm and 1.74 (SD, 0.88)mm respectively after 6months, 1year and 2 years of surgery. 3 out of 11 eyes showed higher mean axial growth (2.93mm) than the mean axial growth of rest of the eyes(1.29mm). These 3 eyes with higher growth rate were myopic with higher axial length from the beginning of study.

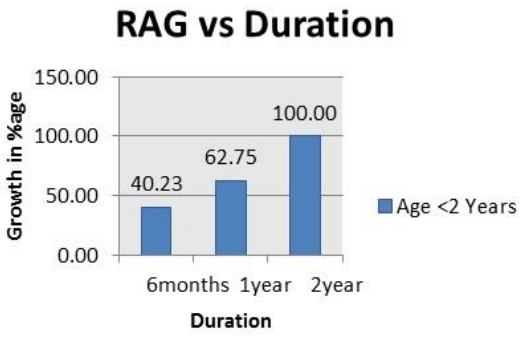


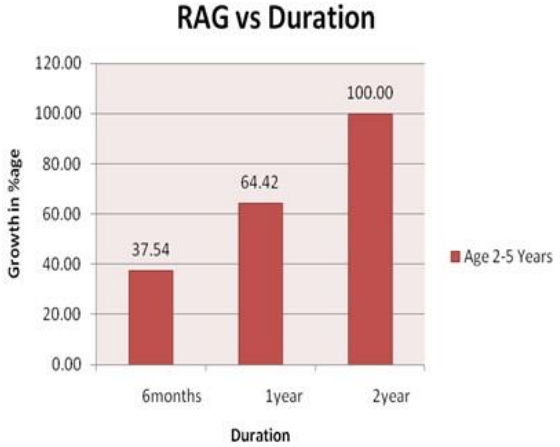
The 3rdgroup [Figure 3] with patients between 5-10years of age, the mean axial length increased from 22.75mm to 23.60mm. The mean growth of axial

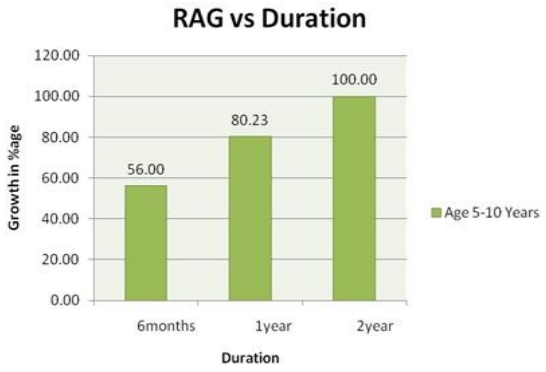
length in mm was 0.47 (SD, 0.46)mm, 0.63 (SD, 0.49)mm and 0.85(SD, 0.54)mm respectively after 6months, 1year and 2 years of surgery.











DISCUSSION

The final refractive status of a pseudophakic paediatric patient depends on 3 factors –

1) Growth in axial length of eye.
2) Change in corneal curvature - During first year of life, the horizontal diameter of cornea increases from 11.0mm to 12.0mm and its flattening decreases the keratometric reading from 51.2dioptre at birth to 45.2dioptre at 6months of age.
3) IOL related factor – Power of the IOL (more refractive change per millimeter of growth when a higher power of IOL is implanted) and its position in eye (accounted for by the A-constant used in the SRK-T formula, or equivalent IOL-dependent factors for other formulas).[11,12]

Among these three, growth in axial length is the most important factor. Prediction of axial growth is important in choosing the IOL power and planning for future changes in refraction.[13] Corneal curvature changes very rapidly during the first few month of life but remains constant throughout most of the childhood and in adulthood. For operation even as early as 4weeks, using pre-operative keratometry reading is likely to contribute an underestimation of appropriate power for later life of only 2 dioptre or so. After 12weeks very little inaccuracy would be expected to be contributed from keratometry owing to stabilisation of corneal curvature. In contrast, the expected axial length change is expected to produce very large myopic shift during childhood. Over the period from 4weeks to 10years of age a change in axial length of 5.41mm would be expected resulting in a myopic shift in excess of 10D.[13]

Larsen in his study on sagittal growth of the eye suggested 3 phases of eye growth.[14]

1) A rapid postnatal phase with an increase in length of 3.7 – 3.8mm in the first year and a half of life.
2) Slower infantile phase lasting to the age of 5years with an increase in length of 1.1 – 1.2mm.
3) Slow juvenile phase up to the age of 13years, with an increase of 1.3 – 1.4mm.

In our study, the pseudophakic eyes had the similar nonlinear pattern of growth as reported in literature. Group one with eyes under 2years of age had higher growth rate than group two and three. The mean

axial growth of group one was 1.82 whereas for group three it was 0.85. It shows that eyes under 2years of age grow faster than those of higher age group.

In a similar study on 38 eyes of paediatric cataract surgery patient with a follow up period of 6 years, Plager et al concluded that the mean rate of myopic shift decreased throughout childhood, and the range of shift among individuals narrowed as patient age increased.[15]

Crouch et al in their prospective study on 42 pseudophakicpaediatric eyes between age of 12 and 18 months with mean follow up period of 5.45 years,found that the greatest rate of refractive growth or change occurred between 1 and 3 years of age. After age 3 years, the rate of refractive growth followed a more linear trend.[16]

In our study the mean axial growth for patients less than 2 year of age, after a follow-up period of 2years was 1.82mm (range – 0.50 – 2.75). It is slightly lesser than that reported in other studies for similar age group.

In the study published by Flitcroftet al,[17] the congenital cataract patients, over a follow up period of 140 weeks, had an increase of 3.41 mm in axial length. There was, however, a wide variation in the observed growth rates (range 0.41–8.01 mm). They had definite evidence that the surgery at younger age is associated with greatest degree of postoperative growth in axial length.

Vasavada et al,[18] had a large study group of 152 paediatric eyes, 73 eyes of less than 1 year of age operated for cataract, 24 had bilateral aphakia and 49 pseudophakia after sugery, with mean follow- up period of 58.96 +/- 2.02 months. They reported an axial length increase of 4.59mm in patients operated before 1 year of age and with IOL implantation. They had similar rate of axial length growth in normal fellow eye in unilateral pseudophakic eyes and to the normal population in bilateral pseudophakic eyes. They had a very large group of patient under study with a longer follow up period in comparison to our study.

It has been suggested that having an IOL in place may retard axial elongation, resulting in less myopic shift than if no IOL were used. Animal studies have demonstrated this phenomenon, which is more pronounced when surgery is performed at younger ages.[15] Lambert and co-authors found that an IOL placed in neonatal monkeys decreased axial elongation and consequent myopic shift compared to the elongation and shift in the aphakic eye.[19]

In our study all the aphakic eyes but one showed greater mean growth than the pseudophakic eyes. We could not compare the operated aphakic eye with the normal or pseudophakic eye of the same patient as most of the patients had bilateral cataract. Both the eyes got operated at the difference of one month.

McClatchey et al pooled the data from 7 centers to accumulate 100 eyes of 83 pseudophakic patients with surgery between 3 months and 10 years of age and a minimum follow-up of 3 years. When compared to the aphakic population, the pseudophakic eyes showed a slightly lower rate of refractive growth.[20]

Superstein and associates also came to the similar conclusion that pseudophakic eyes show less myopic shift than aphakic eyes.[21]

In our study in all the 3 study groups the maximum growth rate was observed in the first 6months of surgery [Figure 4, 5 and 6). Considering the total amount of growth in 2years as 100%, near about 40-56% of the growth observed in the first 6months of follow-up.

This result was comparable to that published by Flitcroft[17] where the axial growth in eyes operated on for congenital cataracts, with implantation of posterior chamber IOLs, followed closely the pattern observed for normal eyes with the majority of axial elongation taking place in the first 3–6 months life and a gradually reducing rate of growth over the next 2 years.

In our study, myopic eyes in group 2 had higher mean axial growth (2.28) than the non-myopic eyes (1.28) of the same study group. Myopic eyes in the other group also had higher growth rate. This could be due to higher growth observed in myopic eyes or due to genetic predisposition.[22]

CONCLUSION

Paediatric eye is a growing system with corresponding change in refractive status. There is an eminent myopic shift occurs in most the growing eyes which necessitates the required adjustment in IOL power to achieve emmetropia at adult age. The amount of this myopic shift varies from one age group to another. The rate of growth is higher in eyes that got operated in less than 2years of age group than those who got operated later. So, the amount of under-correction or the required adjustment in IOL power would be variable. Our study results show maximum growth rate in paediatric eyes operated under 2 years of age. The rate of growth decreases with the exceeding age. Eyes operated between 5-10 years of age would have lesser increase in mean axial growth than those between 2-5years of age. The required reduction in the calculated power of IOL, to offset the myopic change will be higher in patients less than 2 year of age. Operating paediatric cataract in myopic eyes need special consideration as they have higher axial growth.

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