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AN ARTICLE REVIEW : IOL POWER CALCULATION IN CHILDREN

KEY WORDS: Amblyopia, Biometry, Intraocular lens (IOL), Pediatric cataract

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ABSTRACT

The major provocation these days in pediatric cataract surgery is not the approach of surgery or intraocular lens (IOL) used but important factor is postoperative refraction. Amblyopia takes place due to post surgery refractive error which demolish the welfare acquire by near perfect and timely surgery. The parts of IOL power calculation formulae have an effect on post surgery refractive error should not be misjudge. This review article is bringing up to date on major IOL power computation formulas helpful in pediatric cataract.

INTRODUCTION:

The major stimulus these days in childhood cataract surgery is not the approach of surgery or intraocular lens used but post operative refraction is key factor.[1] The placement of an IOL in children and infants undergoing cataract surgery is gaining wilder acceptance. With improved surgical equipment and technique the acceptable age for IOL implantation is becoming progressively younger.

Refractive Goal:

I] Should a myopic shift be anticipated and if so,
II] How much and at what age?
III] What target refraction should be sought immediately following the implantation?

A. Normal eye development and myopic shift

Most ocular growth occurs in the first few years of life and this has significant optical implications. As a child eye develops, the refractive changes are largely due to growth in axial length (AL). More than half of this growth in AL occurs before one year of age and most axial elongation occurs during the first two years of life. The change in mean keratometric power occurs almost completely within the first six month of life, with only minor changes after that. As the AL increases from an average of 16.8 mm at birth to 23.6 mm in adulthood, the corneal curvature will decrease from an average power of 51.2D to 43.5D. the lens power decreases by more than 10D during the first year of life , then drops only 3-4 D from the age of two until the lens power stabilizes at ten years of age. In aphakic and pseudophakic eyes, the lens power is static and if AL grows normally, decreasing hyperopia or increasing myopia would be expected to result. Axial growth after cataract surgery can be attributed to normal eye growth as well as other factors, including age at surgery, visual input, the presence or absence of an IOL, laterality, genetic factors and intraocular AL difference.

Weakleyet al noted that the rate of refractive growth was correlated with visual acuity outcome. [2] Vanathi et al noted a mean myopic shift of 7.35D in twelve children (mean age 6.7 years) post monocular cataract surgery followed for a mean of 7.8 years. [3] Measurements of the AL in the pseudophakic eye and the un operated fellow eye have shown no significant difference in AL change over time between the pseudophakic and its fellow eye. These findings suggest that most pseodophakic eyes grow normally and thus a significant shift after IOL implantation is to be expected in these young patients. Better understanding of the factors influencing pediatric eye growth will assist in IOL power calculation and the prediction of refractive changes after IOL implantation.

B. Postoperative refractive goal in older children

There is no consensus in literature on the ideal postoperative refraction in infants and children after IOL implantation. Although few surgeons targeted emmetropia or even mild myopia after surgery at all ages, most aimed for hyperopia until 5 years of age when the consensus shifted to emmetropia . Enyedi et al recommended a post operative refractive goal of +6 for a one year old, +5 for a two year old, +4 for a three year old, +3 for a four year old, +2 for a five year old, +1 for a six year old, plano for a seven year old and -1 to -2 for an eight year old and older.[4]

C. Postoperative refractive goal in infants

For children less than two years old, implantation of IOL is still controversial and most still prefers to leave an infant aphakia after cataract surgery and to use contact lenses or glasses for optical correction.

Measurement of Axial Length

In addition to the uncertainties of growth after IOL implantation, the measurements of AL and keratometry in children can be less accurate than for adults. Office measurement of AL and keratometry can be difficult in young children and infants. It can be done under sedation or general anesthesia. Ultrasound can be performed using applanation or immersion techniques. Using the immersion technique, the ultrasound probe does not come in to direct contact with the cornea, but instead uses a coupling fluid between the cornea and probe preventing corneal indentation. When the probe is aligned with the optical axis of the eye and the ultrasound beam is perpendicular to the retina, the retinal spike is displayed as a straight, steeply rising echospike. When the probe is not properly aligned with the optical axis of the eye, ultrasound beam is not perpendicular to the retinal surface and retinal spike is displayed as a jagged, slow rising echospike. Partial coherence interferometry (PCI) has been used in co operative children with reliability and accuracy. PCI requires patient co operation and thus may not be a viable option in infants and young children. This technique relies on a laser Doppler to measure the echo delay and intensity of infrared light reflected back from tissue interfaces.

Intraocular Lens Power Calculation

Once the decision has been made to implant an IOL and the desired postoperative refractive goal is determined. Several

formulas can be used to predict the IOL power needed to achieve the desired refractive goal. To date, formulas for IOL lens power calculation have been largely derived from studies in adults. SRK : Sanders- Retzlaff- Kraff formula, SRK II, SRK/T formula, Hoffer, Gills, Thompson- Maumenee formula, Donzis Kastle formula, Gordon, Holladay, Holladay 2 formula, Hoffer Q.

Intraocular Lens Power Calculation in Pediatric Patients

Because all IOL power calculation formulas were derived from considerations regarding the adult eye ,it is yet unclear whether they can be applied in children with the same degree of confidence, especially with short AL and high keratometry values and a target refraction that may be significantly different from plano.

Recent work by Mezer et al suggest that none of the current prediction formulas, including Hoffer Q, Holladay, SRK/T,SRK and SRK II provide adequate outcomes in patients between two and seventeen years of age.[5] Only the mean error for all patients was reported. Differences as a function of AL and keratometry values were defined. The average differences ranged between 1.06 – 0.79 D up to 1.79 – 1.47 D. Andreo et al stated that there was little difference between SRK II, SRK/T, Holladay and Hoffer Q formulas in short, medium and long eyes in providing adequate predicted refraction.[6][7] The mean error was between 1.23 to 1.33 D in long eyes, 0.98 to 1.03 D in medium eyes and 1.41 to 1.8 D in short eyes.

Neely et al showed that the SRK II, SRK T and Holladay I formulas had no significant difference in lens power predictability in children. [8] However, there was increased variability in post operative refractive outcome in patients younger than two years of age with all formulas. The Holladay II formula incorporates measured anterior chamber depth , lens thickness and corneal diameter and is purportedly helpful in adults requiring at least 30D of power for emmetropia.

CONCLUSION:

Refractive growth after IOL implantation in infants and children can not be predicted accurately and current IOL formulas vary in their predictive outcomes. If the target refraction goal is ametropia, amblyopia treatment will be easier but may result in myopia later in life. If the target refraction goal is hyperopia, amblyopia treatment may be more difficult but emmetropia later in life is more likely. Although placement of an IOL in children has gained acceptance and placement of an IOL in infant is gaining favor. With the trend towards implanting IOLs in infant with shorter AL, there will likely be a greater need to understand the accuracy and the differences between prediction formulas at lower extremes of AL and keratometry values. Using current formulas and refining the A constant and surgeon factor may reduce post operative refractive error, but unlike adults, most Pediatric Ophthalmologist only perform a few , if any IOL implants in infants and children with a wide range of AL and K values rendering adjustment of A constants and surgeon factors problematic. Any modern IOL formula can be used on children but more errors should be expected. Use immersion A scan instead of contact and repeat K readings to make sure they are reproducible. As for multifocal IOLs in children, given the need for highly accurate biometry, astigmatism control and no refractive growth, caution should be used in considering the use of multifocal IOL s in infants and Salchildren.

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