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REVIEW OF LITERATURE

Choice of IOL power in pediatric cataract

Galal S, MD[1]

The optical correction of pediatric aphakia can be achieved with glasses, contact lenses, epikeratophakia, or intraocular lenses. Each of these methods has associated problems that make them less than ideal, and there is no uniform consensus on their use. Intraocular lenses (IOLs) have become increasingly popular as a way to rehabilitate unilateral and bilateral aphakia in children as they avoid many of the problems of spectacles and contact lenses. An initial concern was the long term safety of these lenses in the pediatric population, but as more experience is gained, this appears to be less of a problem. Buckley et al suggested that pseudophakic infants (younger than 6 months) had actually better visual acuity and less strabismus than aphakic infants being corrected with contact lenses. Other authors found little difference in visual acuity but did report better stereopsis in pseudophakic children. There has been discrepancy as to rates of complications between the two groups[1].

The IOL power to be implanted in childhood should not cause high myopia in adulthood. This can be achieved by anticipating the expected myopic shift and undercorrecting eyes that need IOL implantation. The initial hypermetropia, anisometropia, or both should be acceptable and correctable by spectacles. The globes of normal eyes grow throughout childhood but more so during the first 18 months of life[2].

Predicting axial growth, and the refractive change that accompanies it, is one of the major challenges for long term care following pediatric cataract surgery. This is especially true with wide-spread acceptance of fixed power IOL implantation. Unless the growth of the eye can be accurately predicted, selection of IOL power is a difficult task[3].

As the age of implantation in children decreases the selection of the appropriate intraocular lens power becomes more important. As can be seen in table 2, a significant change in intraocular lens power necessary to achieve emmetropia occurs during the first 5 years of life. Younger children will undergo a larger change in axial length and refraction[1].

Axial elongation and changes in corneal curvature are major factors in influencing refractive changes in the first few years of life. The observed changes in keratometry values and axial length have opposing consequences for the refractive state of the eye. Increasing axial length should lead to a myopic shift and decreasing keratometric values should lead to a hypermetropic shift. Overall, the changes in axial length appeared to outweigh for the progressive corneal flattening with age[4].

Choice of IOL power in pediatric cataract

(A) If the patient is made emmetropic at the time of implantation, a significant myopic shift can be expected into the teenage years. A review of 77 patients who received IOL implantation showed a myopic shift of approximately one-half diopters per 6 months that persisted to age 10 years[1].

Birth	34.3 D
0-1 yr	28.7 D
1-2 yr	26.4 D
2-3 yr	23.0 D
3-4 yr	22.1 D
4-5 yr	20.9 D
5-6 yr	19.5D

Table 1. Shows IOL power at different ages to achieve emmetropia[1].

Correspondence to:
Dr. Sameh Galal, MD
[1]Department of Pediatric Ophthalmology - Research Institute of Ophthalmology, Giza, Egypt
Email: sameh.ophth@gmail.com
Full list of author information is available at the end of the article.

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(B) Using the powers appropriate to adults will avoid the future myopic shift but will produce high levels of hypermetropia during the first few years of life[4].

In either events (A) or (B), the use of spectacle correction is required at some stage in order to maximize visual acuity and minimize the risk of amblyopia.

(C) Choosing partial under correction at the time of surgery will tend to minimize the amount of anisometropia in both the immediate postoperative period and later in life .This is of particular importance in the case of unilateral pseudophakia to avoid problems of spectacle induced aniseikonia. With regard to the ocular growth patterns of the two oculometric variables affecting the IOL power (keratometry and axial length), it's the length that produces the greatest problems in selecting the IOL power[4].

Preoperatively, in the study of Flitcort and associates, axial length and keratometry measurements were made and lens power was calculated according to the SRK ii formula. A correction was then made to this calculated IOL power on the basis of the age of the child at the time of surgery. In the first year of life 6 D was subtracted from the calculated IOL power, from 1 year to 4 years 3 D were subtracted and from 5 to 12 years 1 D was subtracted[4].

Age	Target postoperative refraction (diopters)
<2 yr	+ 4.00
2-4 yr	+3.00
4-6 yr	+2.00
6-8 yr	+1.00
>8 yr	Emmetropia

Table 2: Target post-operative refraction to guard against future myopic shift[1].

Guidelines for IOL power selection in children

Under correction in diopters or percentage from emmetropia			
Age	**Dahan & Drusedau**	**Enyedi et al (Diopters)**	**Filtcroft et al (Diopters)**
≤ 1 year	20 % under correction	–	+6
1-2 years	20 % under correction	+6 to +5	+3
3-4 years	10 % under correction	+4 to +3	+3
5-6 years	10 % under correction	+2 to +1	+1
7-8 years	10 % under correction	Plano	+1

Table 3: Guidelines for IOL power selection in children[5].

Measurement challenges in children

A potential source of error in IOL power selection in infants and children that is likely of greater magnitude in pediatric patients than adults is inaccuracy of axial length and/or keratometry power measurement[6].

1. Challenges in axial length measurement

A-scan ultrasound biometry is the conventional method for measurement of axial length in children. Ultrasound can be performed using applanation or immersion techniques. The applanation technique may introduce a measurement error in recorded axial length (shorter axial length obtained) by the slight indentation of the corneal surface. With the immersion technique care must be taken to ensure to ensure that the ultrasound beam is perpendicular to the retina by ensuring that the retinal spike is displayed as a straight, steeply rising echospike[7].

If the patient is not cooperative, measurements can be obtained under anesthesia but a skilled ultrasound technician should be available[8].

Partial coherence interferometry for axial length measurement has been shown to be very accurate but requires patient cooperation, and thus may not be available option in infants, young children and uncooperative children[9].

Dr. Sameh Galal, MD

[1]Department of Pediatric Ophthalmology - Research Institute of Ophthalmology, Giza, Egypt

Email: sameh.ophth@gmail.com

Full list of author information is available at the end of the article.

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2. Challenges in keratometry

Poor cooperation and improper fixation are major challenges in K. readings assessment in infants and children. Keratometry can be done in uncooperative infants and children intraoperatively in a supine position under general anesthesia by the use of hand held keratometer (e.g. Nidek KM 500 handheld keratometer[10].

According to the study of Maya Eibschitz et al, the mean K readings in different age groups are [10]:

- Infant eye ; 51.2 D
- 1 year old ; 45.2 D
- 2 years old ; 44.9 D
- 3 years old ; 44.1 D

Errors in calculating IOL power may arise in several ways:

1. Instrumentation error

The steeper corneas of infants may result in inaccuracy although the overall effect is likely to be small in calculation of IOL power[11].

2. Surgical error

Intraocular positioning of the IOL will affect the prediction error, with sulcus fixation producing a relative myopic shift from the estimated refraction. In the study of Tromans, 4 out of 52 IOLs had hybrid capsular bag /sulcus fixation and three of these eyes had a more myopic refractive error than was estimated[12].

3. Formula error

It has been shown that the 3rd generation theoretical formulas are more accurate for short eyes .This is attributed to their improved prediction of post-operative anterior chamber depth (ACD). However, the mean ACD in infant eyes is less than adult eyes[13] and this may contribute to inaccuracy of IOL power calculation using current formulas. One strategy for improving prediction accuracy is to measure postoperative ACD and back calculate to modify the IOL formula as suggested by Holladay[14].

In a recent study Inatomi showed that the SRK/T formula was more accurate than empirical formulas in calculating IOL power in short eyes and they found increasing prediction error for shorter eyes in their series[15].

4. Effect of IOL implantation on ocular growth

The changes in axial length during childhood following implantation of intraocular lenses as noted in different studies of pediatric pseudophakia, create difficulties regarding the choice of the power of the appropriate intraocular lens[5] .The myopic shifts in pseudophakic eyes are expected to be greater than those observed in normal eyes even if axial growth followed the normal pattern. This increased myopic shift occurs because in the developing phakic eyes, progressive flattening of the crystalline lens reduces the refractive consequences of the axial elongation[2].

Author details

Dr. Sameh G, MD[1], FRCS

Department of Pediatric Ophthalmology
Research Institute of Ophthalmology

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References

1. Chang DF. Siepser slipknot for McCannel iris-suture fixation of subluxated intraocular lenses. J Cataract Refract Surg 2004; 30:1170–1176.
2. Gibson A, Boulton MG, Watson MP et al. The first cut is the deepest: basic surgical training in ophthalmology. Eye 2005; 19(12):1264-1270.
3. Kumar DA, Agarwal A, Jacob S, et al. Sutureless scleral-fixated posterior chamber intraocular lens. J Cataract Refract Surg. 2011;37(11):2089-2090.
4. Scharioth GB, Prasad S, Georgalas I et al. Intermediate results of sutureless intrascleral posterior chamber intraocular lens fixation. J Cataract Refract Surg 2010; 36:254–259.
5. Dick HB, Augustin AJ. Lens implant selection with absence of capsular support. Curr Opin Ophthalmol 2001;12:47-57.
6. Odenthal MT, Sminia ML, Prick LJ et al. Long-term follow-up of the corneal endothelium after Artisan lens implantation for unilateral traumatic and unilateral congenital cataract in children: two case series. Cornea 2006; 25:1173–1177
7. Zeh WG, Price FW Jr. Iris fixation of posterior chamber intraocular lenses. J Cataract Refract Surg. 2000;26(7):1028–1034.
8. Chipont EM, Garcia-Hermosa P, Alio JL. Reversal of myopic anisometropic amblyopia with phakic

Correspondence to:
Dr. Sameh Galal, MD
[1]Department of Pediatric Ophthalmology - Research Institute of Ophthalmology, Giza, Egypt
Email: sameh.ophth@gmail.com
Full list of author information is available at the end of the article.

intraocular lens implantation. J Refract Surg 2001;17:460-2.
9. Lifshitz T, Levy J, Klemperer I. Artisan aphakic intraocular lens in children with subluxated crystalline lenses. J Cataract Refract Surg 2004;30:1977-81.
10. Saxena R, van Minderhout HM, Luyten GP. Anterior chamber iris-fixated phakic intraocular lens for anisometropic amblyopia. J Cataract Refract Surg 2003;29:835-8.
11. Ophtec BV. Artisan and Artiflex training manual, Ch1.10, Artisan IOLs for other indications 2007.
12. De Silva SR, Arun K, Anandan M et al. Iris-claw intraocular lenses to correct aphakia in the absence of capsule support. J Cataract Refract Surg 2011; 37:1667–1672.
13. Bahn CF, Glassman RM, MacCallum DK et al. Postnatal development of corneal endothelium. Invest Ophthalmol Vis Sci 1986; 27:44–51.
14. Muller A, Doughty MJ. Assessments of corneal endothelial cell density in growing children and its relationship to horizontal corneal diameter. Optom Vis Sci 2002; 79:762–770.
15. Nucci P, Brancato R, Mets MB et al. Normal endothelial cell density range in childhood. Arch Ophthalmol 1990; 108:247–248.

Dr. Sameh Galal, MD

[1]Department of Pediatric Ophthalmology - Research Institute of Ophthalmology, Giza, Egypt

Email: sameh.ophth@gmail.com

Full list of author information is available at the end of the article.