Graefe's Archive for Clinical and Experimental Ophthalmology (2022) 260:2779–2780
https://doi.org/10.1007/s00417-022-05783-7

EDITORIAL (BY INVITATION)

# Optimization of intraocular lens selection for pediatric cataract surgery

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Received: 18 July 2022 / Revised: 18 July 2022 / Accepted: 19 July 2022 / Published online: 25 July 2022

The stakes of cataract surgery are higher in children then in adults for several reasons. Younger children are still in the visual development period, so that refractive errors and visual deprivation can affect visual acuity for life. Management of postoperative complications such as posterior capsular opacification or a need for lens exchange typically require general anesthesia in children. The potential benefits of surgery are also greater, because children have more potential years of life to enjoy improved vision.

Among the many challenges associated with pediatric cataract surgery is selection of an intraocular lens which optimizes the postoperative refraction. Reitblat and colleagues recently compared the accuracy of 6 formulas, including the Kane formula, for predicting the postoperative refraction by retinoscopy in 62 children age 6 months to 17 years [1]. They found that the standard deviation of the prediction error was lowest with the Barrett Universal II formula (1.34 D), and highest with the Haigis formula (1.50 D), with results closer to the low end of the range for the Kane formula (1.38 D) (their Table 2).

Pediatric cataract surgery involves several unique aspects. For instance, because of the myopic shift associated with development in younger children, surgeons may consider a slightly more hyperopic target. Infants with cataracts are often left aphakic, with secondary intraocular lens placement in several years' time. Secondary lens placement was not addressed by the current study, nor did the study include children with trauma, lenticonus, or persistent fetal vasculature [1].

Younger children may not cooperate with in-office measurements of axial length by optical biometry, and therefore require intraoperative biometry by ultrasound, with lens selection in the operating room. The study biometry was performed optically in 8 patients (12.9%) and by immersion ultrasonography in the remainder [1]. The authors do not specify that they separately optimized the lens constants for each biometry group, but this should have been done because different keratometers were used, and because ultrasound is reflected from the internal limiting membrane, while optical methods measure up to the photoreceptor layer, and are expected to yield axial lengths from 0.0873 to 0.20 mm greater [2, 3].

Pediatric cataract surgery in younger patients who would not tolerate in-office YAG capsulotomy is often performed with planned posterior capsulotomy and anterior vitrectomy, which may affect the refraction. Most surgeons would not perform a posterior capsulotomy in older children. The authors agree that in children, there is a "routine practice of performing posterior capsulotomy and anterior vitrectomy," but do not mention if this was done in any or all of their cases, and whether this technique affected the refraction [1].

One of the limitations of the study is the small sample size ($n = 62$). When one breaks the study into subgroups (SA60AT vs. MA60AC, ultrasonography vs. optical biometry, posterior capsulotomy performed vs. not), the sizes of each subgroup might have been quite small. The range of postoperative refractions was − 2.625 to + 5.125 D. One or two outliers might have had a profound effect, without yielding generalizable associations.

The authors performed a clear corneal incision in all patients, but do not indicate if they sutured the incision in any patients [1]. Many surgeons prefer a scleral tunnel

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technique in children, who might be expected to rub the eye, and cannot tolerate clear corneal suture removal at the slit lamp.

Two of the formulas used, the Kane formula and the Barrett Universal II formula, are closed and proprietary. Reitblat and colleagues used one method for optimizing the intraocular lens constant for these 2 closed formulas, and another method for the 4 open formulas. Using different optimization methods for different types of formulas could introduce a bias. The most straightforward method of optimizing the constants would have been to iteratively vary the lens constant until the mean error was zero. In fact, the heteroscedastic statistical methods used in the study require a mean error of zero. However, this particular iterative method was not used for either group. Due to nonlinearities, the mean prediction errors (not provided in their Table 3) might have varied slightly from zero.

One of the most important takeaways from the paper by Reitblat is that postoperative refraction in children tends to be slightly more myopic than is predicted using nominal lens constants based on adults. This average myopic error ranged from – 0.12 D for the SRK/T formula to – 0.48 D for the Kane formula (their Table 5). This myopic error should be considered when planning pediatric cataract surgery.

Several aspects of the paper raise larger issues in ophthalmology. For instance, two of the formulas used were closed and proprietary. Scholarship does not advance over decades or centuries because geniuses build secret black boxes which, for a profit or personal gain, others are permitted to access. Rather, a field advances from the cumulative and often incremental efforts of a distributed community, operating in an open and transparent environment. How can the inherent logic of an algorithm be tested when the specifics are secret? How can anyone improve upon a closed system? Any new efforts have to start from scratch. How can the algorithm outlast its developer? How can anyone even know that the implementation of this algorithm is uncorrupted and stable over time? The ophthalmic profession should seek to promote open-source algorithms.

In addition, standard approaches based on mean absolute error regard an error of – 1 D myopia and + 1 D hyperopia as equivalent, but a hyperopic error will have a more negative impact on quality of life. Moreover, surgeons are often judged based on their worst case. Standard approaches regard 10 patients having an error of – 0.1 D as equivalent to one patient having an error of + 1 D hyperopia. However, the patient with a more extreme error would likely be much less happy. Therefore, approaches that assess expected quality of life, rather than mean error, could be devised.

## Declarations

**Conflict of interest** The authors declare no competing interests.

## References

1. Reitblat O, Khalili S, Ali A, Mireskandari K, Vega Y, Tuuminen R, Elbaz U, Sella R (2022) Evaluation of IOL power calculation with the Kane formula for pediatric cataract surgery. Graefes Arch Clin Exp Ophthalmol (in press)
2. Cooke DL, Waldron R, Savini G, Riaz KM, Taroni L, Murphy DA, Guaraldi F (2022) Immersion ultrasound biometry vs optical biometry. J Cataract Refract Surg 48(7):819–825
3. Nakhli FR (2014) Comparison of optical biometry and applanation ultrasound measurements of the axial length of the eye. Saudi J Ophthalmol 28(4):287–291