Prediction error after pediatric cataract surgery with intraocular lens implantation: Contact versus immersion A-scan biometry

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PURPOSE: To evaluate the accuracy of pediatric intraocular lens (IOL) calculations performed using contact and immersion A-scan biometry.

SETTING: Storm Eye Institute, Charleston, South Carolina, USA.

DESIGN: Evaluation of diagnostic test or technology.

METHODS: Data from a prospective study of pediatric eyes that had in-the-bag implantation of an AcrySof SN60WF IOL and had refraction results available from 14 days to 3 months postoperatively were retrospectively analyzed. The contact and immersion A-scan biometry techniques were performed in each eye and compared.

RESULTS: The mean age at surgery of the 22 patients (22 eyes) was 4.8 years ± 4.1 (SD). The mean prediction error was +0.4 ± 0.7 diopter (D) in the contact group and −0.4 ± 0.8 D in the immersion group ($P < .001$) and the mean absolute prediction error, 0.7 ± 0.4 D and 0.7 ± 0.6 D, respectively ($P = .694$). The absolute prediction error was less than 0.5 D in 5 eyes (23%) using the contact technique and 11 eyes (50%) using the immersion technique. The mean postoperative spherical equivalent was +2.9 ± 2.5 D, which was significantly different from the mean predicted refraction for contact A-scan (3.3 ± 2.8 D; $P = .010$) but not immersion A-scan (2.5 ± 2.5 D; $P = .065$).

CONCLUSIONS: There was a significant difference in prediction error between postoperative refractive results obtained with contact biometry and immersion A-scan biometry in children. Based on the results, the immersion A-scan technique is recommended for pediatric IOL power calculation.

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Intraocular lens (IOL) implantation in the eyes of children has become a common practice during pediatric cataract surgery.[1] However, accurate determination of IOL power in these eyes remains a challenge. Refractive surprises after pediatric cataract surgery are common.[2–11] Although a myopic shift in refraction that occurs with eye growth can result in a late refractive error, early refractive errors can be attributed to inaccuracy in IOL power calculation and are a preventable cause of postoperative refractive error. Any early refractive surprise makes early amblyopia management difficult and partly influences long-term refractive shift.

Errors in measurement of the axial length (AL) of the globe are the most significant errors in IOL power calculation. They can account for an error of 2.5 diopters (D)/mm in IOL power, increasing to 3.75 D/mm, or even higher, in short eyes. The ultrasound AL of the eye is commonly measured using contact or immersion techniques. In the contact method, the probe touches the cornea. This can result in corneal compression and a shorter AL. Immersion A-scan eliminates corneal compression but requires more training and experience to perform properly. Immersion A-scan has been shown to give better results than contact biometry in adults.[12–15] However, in pediatric cataract surgery, the contact biometry remains a common technique for measuring the AL of the globe, especially when the measurements are taken in the operating room with the patient under general anesthesia.[16]

In a retrospective review of pediatric eyes by Ben-Zion et al.,[17] AL measurements were taken using contact A-scan in the first 138 eyes and using the immersion technique in the subsequent 65 eyes. The authors compared absolute prediction errors in IOL power calculation and found no difference between the 2 techniques. However, the study did not directly compare the AL measurements obtained using immersion biometry and contact biometry in the same eyes. To our knowledge, no study has compared the prediction error when the AL was measured by both the contact technique and the immersion technique in children. Our study compared the prediction error between the 2 techniques in children having cataract surgery; the AL was measured with both techniques in all eyes.

PATIENTS AND METHODS

This study complied with the U.S. Health Insurance Portability and Accountability Act. Institutional Review Board approval was obtained from the Medical University of South Carolina. In cases of bilateral cataract, only 1 eye was selected to prevent a correlation effect in statistical analysis.

Details of the methods used were published in a prospective trial comparing AL measurements by the contact technique and the immersion technique in 50 eyes.[16] In the current study, eyes that had primary in-the-bag implantation of an AcrySof SN60WF IOL (Alcon Laboratories, Inc.) and had refractive data available within 14 days to 3 months postoperatively were retrospectively analyzed. The same surgeon (M.E.W.) performed all the surgeries, and an experienced pediatric ophthalmologist performed all refractions manually with a retinoscope.

Data collected included the patient's age at the time of surgery, the AL measured using the contact technique and the immersion technique, the IOL power required to achieve emmetropia with both techniques (using the Holladay 1 formula and manufacturer's A-constant of 118.7), the predicted refraction with both techniques with the implanted IOL power, the duration of follow-up, and the postoperative refraction. The refraction closest to 4 weeks after surgery was used in the calculations of prediction error. The spherical equivalent (SE) of the residual refractive error was recorded in diopters. For each surgery, the prediction error was calculated as the difference between the predicted postoperative refraction and the actual postoperative refraction. The prediction error between contact A-scan and immersion A-scan AL measurements was then compared. Statistical analysis was performed using the paired *t* test.

RESULTS

Twenty-two eyes of 22 patients (12 boys; 55%) were analyzed. The mean age at the time of AL measurement and cataract surgery was 4.8 years ± 4.1 (SD) (median 3.6 years; range 0.1 to 15.4 years). Ten patients (45%) were white, 9 (41%) were African-American, and 3 (14%) were in other ethnic categories.

Table 1 shows the results obtained by both techniques. Keratometry (K) readings measured with an automated keratometer were used in both groups (mean K1, 43.0 ± 1.9 D; mean K2, 44.8 ± 2.1 D). The mean time of the postoperative refraction measurement was 36 ± 18 days (median 31 days; range 15 to 88 days). The absolute prediction error was less than 0.5 D in 5 eyes (23%) using the contact technique and 11 eyes (50%) using the immersion technique (Table 2 and Figure 1). Figure 2 shows a histogram of the prediction error with measurements by contact and immersion biometry. Sixteen eyes (73%) had a positive prediction error using contact A-scan data, while a similar number of eyes had a negative prediction error using immersion data. The mean postoperative SE was +2.9 ±2.5 D. This value was significantly

Table 1. Comparison of contact and immersion techniques.

Parameter	Technique		*P* Value
	Contact	Immersion	
Axial length (mm)			<.001
Mean ± SD	22.2 ± 2.6	22.5 ± 2.5	
Median	22.1	22.4	
Range	16.7 to 27.6	16.8 to 27.6	
IOL power for emmetropia (D)			<.001
Mean ± SD	25.8 ± 8. 8	24.6 ± 8.5	
Median	26.4	25.2	
Range	6.8 to 47.0	6.8 to 46.4	
Prediction error (D)			<.001
Mean ± SD	0.4 ± 0.7	−0.4 ± 0.8	
Median	0.6	−0.3	
Range	−1.1 to 1.3	−2.9 to 0.9	
Absolute prediction error (D)			.694
Mean ± SD	0.7 ± 0.4	0.7 ± 0.6	
Median	0.6	0.5	
Range	0.06 to 1.30	0.03 to 2.90	

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