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Myopic shift, refractive, and visual outcomes after 5 years of infantile cataract surgery: Our experience and review of literature

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Abstract:

PURPOSE: After infantile cataract surgery, axial elongation, induces a myopic shift that cannot be fully compensated by corneal flattening and the rate is unpredictable owing to the non-linear growth of the eye. The current prospective study assesses the myopic shift and visual outcomes in children undergoing cataract surgery in infancy over a follow-up period of 5 years.

MATERIALS AND METHODS: A prospective study conducted at a tertiary eye care center to evaluate the five-year myopic shift, refractive and visual outcomes in infants, who underwent surgery for congenital cataract in infancy. The visual acuity, myopic shift and biometric changes are compared between the aphakia and pseudophakia group.

RESULTS: The mean best-corrected visual acuity (BCVA) recorded in logMAR at 5 years for aphakia group was 0.92±0.44 and for pseudophakia group was 0.66±0.42. (pvalue: 0.002102). The myopic shift was noted to be -5.9+/-5.16 in the aphakia group whereas it was -9.01+/- 3.11 in the pseudophakia group (*P* value= 0.002101) at 5 years after surgery for infantile cataract.

CONCLUSION: IOL implantation in eyes of infants undergoing cataract surgery is feasible in eyes that strictly satisfy the pre-operative inclusion criteria and the visual outcomes in these eyes are better compared to aphakia group at 5 years follow up. Eyes with primary IOL implantation had a higher myopic shift compared to ones without primary IOL implantation. Eyes undergoing primary IOL implantation, need higher under correction compared to the current available formulae.

Keywords:

Aphakia, infantile cataract, myopic shift, pseudophakia, refractive error, visual acuity

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Introduction

With the advent of newer surgical techniques, improvement of intraocular lens (IOL) materials, and a better understanding of the process of emmetropization, the threshold age for IOL implantation in children has become progressively lower and is controversial, especially for children under 2 years of age. Lensectomy followed by contact lens correction of the resulting aphakia is still one of the standard procedures in the management of infantile cataracts in the developed world.

After infantile cataract surgery, axial elongation induces a myopic shift that cannot be fully compensated by corneal flattening and the rate is unpredictable owing to the nonlinear growth of the eye.[1,2] To address the myopic shift after cataract surgery in children, various authors have suggested using IOL powers that initially induce postoperative hyperopia, the degree of which depends on the child's age.[3-7] The degree of myopic shift in a child's pseudophakic eye is predominantly influenced by axial growth, the location of the corrective lens (whether in the capsular bag, on the cornea, or in the spectacle plane),

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and the power of the lens, with higher-powered lenses yielding a greater myopic shift per millimeter of growth.[8] The infant aphakia treatment study (IATS) investigates visual outcomes in infants receiving primary IOL implantation versus remaining aphakia with contact lens correction after cataract surgery in unilateral cataracts. Extrapolating the results of IATS to the Indian scenario, visual rehabilitation in aphakic infants with contact lenses poses an economic burden and poor compliance leading to an increase in avoidable blindness due to amblyopia. The current prospective study assesses the refractive outcomes, visual outcomes, and myopic shift in children undergoing cataract surgery in infancy over a follow-up period of 5 years after the cataract surgery.

Materials and Methods

A prospective study was conducted at a tertiary eye care center to evaluate the 5-year myopic shift, visual and refractive outcomes in infants, who underwent surgery for congenital cataracts between June 2016 and June 2017. The 5-year data were collected between June 2021 and June 2022. The study adhered to the tenets of the Declaration of Helsinki, approved by the Institutional Review Board (LEC-BHR-R-07-23-1077), and written informed consent was obtained from the parents.

The study design, the baseline patient demographic details, the preoperative evaluation techniques, surgical techniques, factors influencing IOL implantation, choice of IOL, postoperative eye care regime, patching and optical correction regimens, and postoperative evaluation methods have been reported previously along with visual and refractive outcomes and complications at 1 year after infantile cataract surgery.[9] Eyes that satisfied the preoperative criteria of an axial length ≥16.5 mm and a horizontal corneal diameter ≥10.5 mm, in the absence of anterior segment dysgenesis and glaucoma, were implanted with an IOL in the bag (AcrySof SA60AT, Alcon Laboratories, Inc, Fort Worth, Tx USA).[10] The IOL power was calculated using the Sanders–Retzalff–Kraff II/T formula with Enyedi's guidelines for under-correction.[5,6] All children were followed up at 1 week, 1 month, 3 months, 6 months, 9 months, and yearly thereafter.

At 5-year follow-up, all children were evaluated comprehensively for vision, refractive error, and biometric characteristics of the eye. The aphakia/pseudophakia status in unilateral or bilateral eyes was documented in all patients before assessing the child. Children who underwent secondary IOL implantation, second surgery for complications of visual axis opacification, and eyes that developed complications such as glaucoma, and retinal detachment were excluded from the analysis in the current study. Visual acuity was assessed using age-appropriate methods considering the cooperation and competency of the child. The various charts used were the Snellen chart, Kay Pictures, HOTV charts, Tumbling E (COMPlog Version 1.3.25.0, Kemp House, 160 City Road, London, EC1V 2NX), and Teller Acuity cards (TAC, Stereo Optical Chicago, Illinois, USA). The visual acuity documented by these methods was converted to logarithmic value of minimum angle of resolution (logMAR) equivalent for analysis.

The refractive status of the eye was documented by performing retinoscopy by a trained optometrist. Any myopic shift present was documented in all patients. All children operated for bilateral cataracts were rehabilitated with spectacles, and children with unilateral aphakia were offered contact lenses. In cases of noncompliance with contact lenses, spectacles were given for constant wear. Patching therapy was continued in the presence of amblyopia. Axial length (Tomey AL-100, Germany), corneal thickness (Tomey SP-100, Germany), keratometry (Nidek HandyReF-K, Japan), and corneal diameter (Castroviejo Calipers) were documented when feasible. The refractive and visual outcomes in each group of aphakia and pseudophakia are evaluated and compared between the groups and to the previously reported studies in the literature.

Statistical analysis was performed using Microsoft Excel and STATA V.14.2 (StataCorp). A linear mixed-effects model using maximum likelihood estimation with random intercepts at the subject level was used in the data analysis to account for the correlation between fellow eyes of the same subject. The comparisons between postoperative visits or groups (aphakia vs psudophakia) were evaluated by mixed-effects regression analysis using marginal linear predictions. $P < 0.05$ was considered statistically significant. For multiple comparisons, a Bonferroni correction was made.

Results

The initial recruit of 173 eyes belonging to 97 patients were prospectively evaluated for visual and refractive outcomes. Fifty subjects (51.6%) were female and 76 (78.4%) had bilateral cataracts. The 1-year results of this cohort are reported by the authors previously.[9] Of 97 patients who were operated, 94 (96.9%), 91 (93.8%), 65 (67.0%), and 79 (81.4%) followed up at 1 week, 1 month, 6 months, and 1 year, respectively. The mean age at surgery was 23.7 weeks (median: 18.7 weeks and interquartile range [IQR]: 11–33.9 weeks). At 5 years, 118 eyes of the 66 (68%) patients were evaluated (out of 97). Of the 118 eyes, eyes that developed secondary glaucoma 25 (20 medically managed, 5 needed surgical intervention), eyes that underwent a second surgery, secondary IOL implantation 14 (12%) eyes, membranectomy 7 (6%), and vitreoretinal surgery 1 (0.8%) were excluded from the analysis in the current study. Seventy (65%) eyes with aphakia and 22 (23%) eyes with pseudophakia were analyzed for refractive and visual outcomes in the current study. The mean age at follow-up was 5.65 (± 0.4) years.

The mean best-corrected visual acuity recorded in logMAR at 5 years for aphakia eyes was 0.92 ± 0.44 and for eyes with pseudophakia was 0.66 ± 0.42 (P = 0.002102). The refractive status of the eye at 5 years was measured in a total of 92 eyes (aphakia: 70 and pseudophakia: 22). The refractive status of the eye documented as mean spherical equivalent in the aphakia group was +12.36 ± 6.96 and for pseudophakia eyes was −3.67 ± 3.13. The refractive status change noted from postoperative week 1–1 year and the current 5-year follow-up is depicted in Figure 1.

The myopic shift was noted to be −5.9 ± 5.16 D in the aphakia group, whereas it was −9.01 ± 3.11 D in the pseudophakia group (P = 0.002101) at 5 years. The two groups were divided into two subgroups each based on the age at which the surgery was performed, and the comparison is shown in Table 1. The myopic shift noted in the 1st year after surgery in the aphakia group was −3.41 ± 2.34 D and between 1 and 5-year was −2.10 ± 3.49 D (P < 0.00001). The myopic shift in the 1st year in the pseudophakia group was −4.55 ± 2.13 D, while the myopic shift between 1 year and 5 years was −4.56 ± 2.55 D (P < 0.00001).

The horizontal corneal diameter, axial length, and keratometry average (K Avg) comparing the aphakia and pseudophakia groups are shown in Table 2. Out of 118 eyes of 66 patients, corneal diameter was measured for 79 eyes (aphakia: 68 and pseudophakia: 11) at 5-year follow-up. The mean corneal diameter for 79 eyes was 10.88 ± 1.31 mm with a 0.29 confidence level of 95%. The mean change of corneal diameter from preoperative measurements to 5 years in both aphakia and pseudophakia groups is shown in Table 1. The difference between preoperative corneal

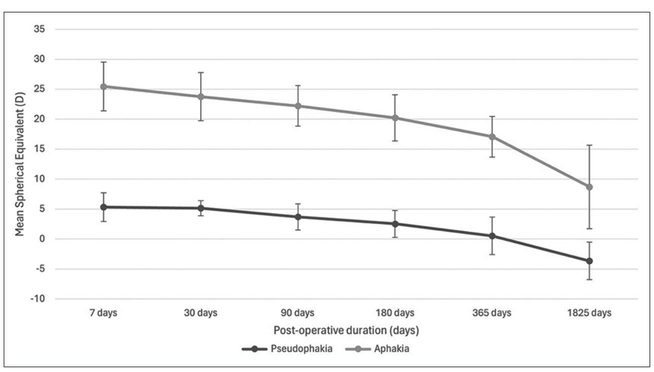

Figure 1: Trend of myopic shift through the course of follow-up of 5 years in both aphakia and pseudophakia group

diameters in the aphakia and pseudophakia groups was significant (P < 0.0001), but at 5 years, they are comparable and not significant (P = 0.02441). The final measurements of the corneal diameter of the two groups at 5 years was 10.77 ± 1.34 mm in the aphakia group which had significantly changed from the preoperative period (P < 0.00001), while in the pseudophakia group, 11.61 ± 0.80 mm of corneal diameter was noted at 5 years, and the change from the preoperative period was insignificant (P = 0.004331).

Central corneal thickness (CCT) measurement was available for 84 eyes (aphakes: 61 and pseudophakes: 23) at the 5-year follow-up. The mean CCT for 84 eyes was 554.22 ± 75.98 microns with a 16.48 confidence level of 95%. In 61 aphakia eyes, the mean preoperative CCT was reported to increase to over 5 years which was statistically significant (P < 0.00001). In 23 pseudophakia eyes, the mean preoperative CCT was reported to decrease to 536 ± 47.94 microns over 5 years which was statistically significant (P = 0.001675). The preoperative and 5-year CCT in the aphakia and pseudophakia are shown in Table 1. The final measurements of CCT of the two groups at 5 years were 647.67 ± 68.98 microns in the aphakia group and 536 ± 47.94 microns in the pseudophakia group. This difference is significant (P = 0.000182).

Axial length measurements were available for 77 eyes (aphakia group: 62 and pseudophakia group: 27). The mean axial length for 77 eyes was 21.47 ± 2.18 mm with a 0.49 confidence level of 95%. In 62 aphakia eyes, the mean preoperative axial length was 16.77 ± 1.99 mm and is reported to significantly increase to 21.20 ± 2.19 mm over 5 years ($P \leq 0.00001$). In 27 pseudophakia eyes, the mean preoperative axial length was 19.25 ± 1.21 mm, increasing to 22.60 ± 1.81 mm over 5 years, which was statistically significant ($P \leq 0.00001$). The difference between preoperative axial length in the aphakia and pseudophakia groups was significant ($P \leq 0.0001$). The final measurements of axial length of the two groups at 5 years were 21.20 ± 2.19 mm in the aphakia group and 22.60 ± 1.81 mm in the pseudophakia group. The difference between the groups was insignificant at 5 years (P = 0.012458). The correlation of change in axial length to myopic shift was neither significant in the aphakia group (P = 0.1041) nor in the pseudophakia group (P = 0.2713).

K Avg was available for 75 eyes (aphakia group: 61 and pseudophakia group: 14) at the 5-year follow-up. The mean K Avg for 75 eyes was 45.90 ± 2.96 D at a 0.68 confidence level of 95%. In 61 aphakia eyes, the mean preoperative K Avg was 46.22 ± 2.10 D, which was reported to change to 46.19 ± 3.12 D over 5 years ($P \leq 0.00001$). In 14 pseudophakia eyes, the mean preoperative K Avg was 44.78 ± 1.89

D, which was reported to change to 44.64 ± 1.76 D over 5 years (*P* = 0.197269). The difference between preoperative K Avg in the aphakia and pseudophakia groups (*P* = 0.02) which was statistically insignificant remained insignificant at the final measurements of K Avg of the two groups at 5 years (*P* = 0.038935).

Discussion

At age 5 years, there was significantly better vision noted in the pseudophakia group compared to the aphakia group. Our results are in contrast with the results from the IATS group which showed no significant difference between the median visual acuity of operated eyes in children who underwent primary IOL implantation and those left aphakia.[11] Birch *et al*.[12] found no significant difference in visual acuity at age 4 between eyes left aphakic and treated with contact lenses (*n* = 5) and eyes after primary IOL implantation (*n* = 4) following unilateral congenital cataract surgery. However, the mean visual acuity recorded in logMAR at 5 years for aphakia eyes in our study was 0.92 ± 0.44, similar to aphakia eyes in the IATS group, while the mean visual acuity in eyes with pseudophakia was 0.66 ± 0.42, better than the pseudophakia group in the IATS group. Birch *et al*. reported that a mean logMAR visual acuity was better in the operated eyes in their series at age 4 years (both groups, logMAR 0.44) than the operated eyes in the IATS (both, logMAR 0.90, *P* = 0.54). Autrata *et al.* also reported better logMAR visual acuities at age 5 years in the treated eyes of children following unilateral cataract surgery optically corrected with contact lenses (*n* = 23) or IOL implantation (*n* = 18) (contact lens: 0.58 (20/76), IOL: 0.43 (20/54).[13] The mean visual acuity in pseudophake eyes in our cohort was worse compared to Birch *et al*. and Autrata *et al*.[12,13] There are a couple of possible reasons why visual acuities are different in our study compared to other groups. First, we did not randomize our patients to aphakia and pseudophakia groups, instead chose those eyes for IOL implantation, that satisfy the biometry criteria of horizontal corneal diameter ≥10 mm and axial length ≥16.5 mm in the absence of glaucoma and anterior segment dysgenesis. With the strict inclusion criteria of eyes for IOL implantation, these eyes would have developed better than the eyes that were left aphakic. This also possibly explains the visual acuity being better in pseudophakia eyes. Second, we have a mix of both bilateral and unilateral cataracts, and all our patients in both groups were rehabilitated with spectacles, instead of contact lenses owing to poor compliance to contact lenses and constraints of affordability, and our results cannot be reasonably compared to the previous studies which majorly included unilateral cataracts.

The axial length at 5 years was similar in both groups of aphakia and pseudophakia, while the rate of growth of the eye was higher in aphakia eyes compared to pseudophakia eyes. Although this parameter cannot be compared to the reports by IATS groups, the baseline mean axial length in eyes with aphakia in our cohort was smaller compared to the eyes that underwent

Table 1: Total myopic shift at 5 years

	Age at surgery (months)		*P*
	<6	>6	
Aphakia	−6.67±4.10	−3.46±7.43	0.012527
Pseudophakia	−12.01±2.72	−7.51±2.32	0.000434
P	0.000392	0.011275	

The Bonferroni correction was made, and *P*<0.0125, that is, 0.05/04, was considered statistically significant

Table 2: Postoperative and 5-year horizontal corneal diameter, central corneal thickness, axial length and keratometry

Variable (mean±SD)	Aphakia	Pseudophakia	*P*
Horizontal corneal diameter (mm) (*n*=79)			
Preoperative	9.50±0.80	11.06±0.50	<0.0001
5 year	10.77±1.34	11.61±0.80	0.02441
P	<0.00001	0.004331	
CCT (μ) (*n*=84)			
Preoperative	552.9±72.0	546±55.9	0.63
5 year	647.67±68.98	536±47.94	0.000182
P	<0.00001	0.001675	
Axial length (mm) (*n*=77)			
Preoperative	16.77±1.99	19.25±1.21	<0.0001
5 year	21.20±2.19	22.60±1.81	0.012458
P	<0.00001	<0.00001	
Keratometry average (diopter) (*n*=75)			
Preoperative	46.22±2.10	44.78±1.89	0.02
5 year	46.19±3.12	44.64±1.76	0.038935
P	<0.03241	0.197269	

The Bonferroni correction was made, and *P*<0.003125, that is, 0.05/16, was considered statistically significant. SD=Standard deviation, CCT=Central corneal thickness primary IOL implantation. In the IATS cohort, the eyes were randomized for the IOL and aphakia groups, and the mean axial length was similar in both groups before cataract surgery.[14] Vasavada *et al*. showed that the rate of axial growth in children operated at in infancy was significantly higher than in those from 1 to 3 years and from 3 to 10 years. In children operated in infancy, the temporal profile of the rate of axial growth was higher in the first 2 years after surgery.[15]

The myopic change seen in children's eyes following cataract surgery has been documented to follow a logarithmic pattern.[16,17] Our study's observations on the myopic shift align with prior research, showing a higher rate of myopic shift within the initial 1–1.5 years postsurgery, followed by a gradual continuation thereafter.[18] This trend remains consistent for both aphakia and pseudophakia eyes. Contributing factors to this myopic shift include an increase in axial length and effective lens power due to eye elongation.[18] Corneal flattening, which typically compensates for the myopic shift through axial elongation, proves insufficient as its rate is slower compared to eye growth. The rate of corneal flattening showed no significant difference in either group after 5 years.

McClatchey *et al*., in a retrospective study, found that the myopic shift in infants under 6 months with IOL implantation was influenced by factors such as laterality and best-corrected logMAR visual acuity, but not by age at surgery, initial refraction, surgeon, axial length, length of follow-up, or gender.[19] They also noted a slightly slower rate of refractive growth in pseudophakic eyes compared to aphakic eyes, indicating that the presence of an IOL affects eye growth to some extent. Despite this, pseudophakic eyes showed a greater mean myopic shift than aphakic eyes, attributed to the optical effects of the IOL in a developing eye. Both types of eyes experienced slower refractive growth between 3 and 6 months postcataract surgery, with pseudophakic eyes exhibiting a greater mean myopic shift. This phenomenon is optical, as the presence of an IOL amplifies the myopic shift, especially with higher IOL powers.[19] Other studies similarly found no correlation between age at surgery and the rate of myopic shift.[18,20]

Formulae for IOL power selection are available for children >1 year of age, scarcity persists regarding IOL prediction for children <1 year of age. Very few studies have evaluated myopic shift in very young infants (<6 months of age) after IOL implantation to better target immediate postoperative refractions and to minimize later anisometropia. In the current study, the myopic shift was noted to be −5.9 ± 5.16 in the aphakia group, whereas it was −9.01 ± 3.11 in the pseudophakia (P = 0.002101) at 5 years. McClatchey *et al*. reported a 6.68 D shift after 8 years of follow-up in a large series of pseudophakia eyes undergoing surgery from 3 to 6 months of age.[19] Lambert *et al.* reported a 5.49 D mean myopic shift over an average of only 13 ± 6 months postoperatively in 11 pseudophakic eyes of infants operated at a mean of 10 ± 6.6 weeks.[21] Ashworth *et al.* reported a mean myopic shift of 6.26 ± 2.91 D in the first 12 months following IOL implantation before 10 weeks of age, while those undergoing surgery after 10 weeks but before 1 year had a myopic shift of only 2.33 ± 1.99 D during this same period. Ashworth *et al*. also noted a significantly greater myopic shift in shorter eyes.[22] Earlier the cataract extraction surgery and IOL implantation, the higher power of the IOL power, the larger the myopic shift.[23] These results are consistent with Lambert *et al*.[8,21] Our results being consistent in the myopic shift in aphakes and pseudophakes in the literature, we recommend higher under-correction in children operated at age <6 months of age. The current study is limited by follow-up attrition at 5 years, the mix of unilateral and bilateral cases, and the nonrandomization of cases to the aphakia and pseudophakia group.

Conclusion

IOL implantation in the eyes of infants undergoing cataract surgery is feasible in the eyes that strictly satisfy the preoperative inclusion criteria, and the visual outcomes in these eyes are better compared to those left aphakia at the 5-year follow-up. The myopic shift in pseudophakes is more compared to aphakes at 5 years; however, the rate of axial growth in aphakia group was more compared to the pseudophakia group with no significant change in corneal flattening. The presence of IOL influences the myopic shift in pseudophakes. The higher the power of implanted IOL, the greater the myopic shift. We recommend to at least under-correct by +8 to +9 D for children undergoing surgery at age <6 months of age.

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Data availability statement
The datasets generated during and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

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Conflicts of interest

The authors declare that there are no conflicts of interests of this paper.

References

1. Sorkin JA, Lambert SR. Longitudinal changes in axial length in pseudophakic children. J Cataract Refract Surg 1997;23 Suppl 1:624-8.
2. Gordon RA, Donzis PB. Refractive development of the human eye. Arch Ophthalmol 1985;103:785-9.
3. Dahan E, Drusedau MU. Choice of lens and dioptric power in pediatric pseudophakia. J Cataract Refract Surg 1997;23 Suppl 1:618-23.
4. Enyedi LB, Peterseim MW, Freedman SF, Buckley EG. Refractive changes after pediatric intraocular lens implantation. Am J Ophthalmol 1998;126:772-81.
5. Kekunnaya R, Gupta A, Sachdeva V, Rao HL, Vaddavalli PK, Om Prakash V. Accuracy of intraocular lens power calculation formulae in children less than two years. Am J Ophthalmol 2012;154:13-9.e2.
6. Sachdeva V, Katukuri S, Kekunnaya R, Fernandes M, Ali MH. Validation of guidelines for undercorrection of intraocular lens power in children. Am J Ophthalmol 2017;174:17-22.
7. McClatchey SK. Choosing IOL power in pediatric cataract surgery. Int Ophthalmol Clin 2010;50:115-23.
8. Lambert SR, Cotsonis G, DuBois L, Wilson ME, Plager DA, Buckley EG, *et al.* Comparison of the rate of refractive growth in aphakic eyes versus pseudophakic eyes in the infant aphakia treatment study. J Cataract Refract Surg 2016;42:1768-73.
9. Chattannavar G, Badakere A, Mohamed A, Kekunnaya R. Visual outcomes and complications in infantile cataract surgery: A real – World scenario. BMJ Open Ophthalmol 2022;7:e000744.
10. Chougule P, Kekunnaya R. Intraocular lens implantation in infants and toddlers in 2020. Expert Rev Ophthalmol 2020;15:275-84.
11. Infant Aphakia Treatment Study Group, Lambert SR, Lynn MJ, Hartmann EE, DuBois L, Drews-Botsch C, *et al.* Comparison of contact lens and intraocular lens correction of monocular aphakia during infancy: A randomized clinical trial of HOTV optotype acuity at age 4.5 years and clinical findings at age 5 years. JAMA Ophthalmol 2014;132:676-82.
12. Birch EE, Cheng C, Stager DR Jr., Felius J. Visual acuity development after the implantation of unilateral intraocular lenses in infants and young children. J AAPOS 2005;9:527-32.
13. Autrata R, Rehurek J, Vodicková K. Visual results after primary intraocular lens implantation or contact lens correction for aphakia in the first year of age. Ophthalmologica 2005;219:72-9.
14. Wilson ME, Trivedi RH, Weakley DR Jr., Cotsonis GA, Lambert SR, Infant Aphakia Treatment Study Group. Globe axial length growth at age 5 years in the infant aphakia treatment study. Ophthalmology 2017;124:730-3.
15. Vasavada AR, Raj SM, Nihalani B. Rate of axial growth after congenital cataract surgery. Am J Ophthalmol 2004;138:915-24.
16. McClatchey SK, Parks MM. Myopic shift after cataract removal in childhood. J Pediatr Ophthalmol Strabismus 1997;34:88-95.
17. Nyström A, Lundqvist K, Sjöstrand J. Longitudinal change in aphakic refraction after early surgery for congenital cataract. J AAPOS 2010;14:522-6.
18. Weakley DR Jr., Lynn MJ, Dubois L, Cotsonis G, Wilson ME, Buckley EG, *et al.* Myopic shift 5 years after intraocular lens implantation in the infant aphakia treatment study. Ophthalmology 2017;124:822-7.
19. McClatchey SK, Dahan E, Maselli E, Gimbel HV, Wilson ME, Lambert SR, *et al*. A comparison of the rate of refractive growth in pediatric aphakic and pseudophakic eyes. Ophthalmology 2000;107:118-22.
20. Whitmer S, Xu A, McClatchey S. Reanalysis of refractive growth in pediatric pseudophakia and aphakia. J AAPOS 2013;17:153-7.
21. Lambert SR, Buckley EG, Plager DA, Medow NB, Wilson ME. Unilateral intraocular lens implantation during the first six months of life. J AAPOS 1999;3:344-9.
22. Ashworth JL, Maino AP, Biswas S, Lloyd IC. Refractive outcomes after primary intraocular lens implantation in infants. Br J Ophthalmol 2007;91:596-9.
23. Valeina S, Heede S, Erts R, Sepetiene S, Skaistkalne E, Radecka L, *et al*. Factors influencing myopic shift in children after intraocular lens implantation. Eur J Ophthalmol 2020;30:933-40.