Saudi Journal of Ophthalmology (2019) 33, 342–346

Original Article

Biometry characteristics in congenital cataract patients before surgery in a tertiary eye care centre in Nepal

Sabin Sahu *; Paras Panjiyar

Abstract

Purpose: To evaluate the anterior segment biometry characteristics in congenital cataract patients before undergoing surgery in a tertiary eye care centre.
Methods: We retrospectively reviewed the charts of congenital cataract patients aged less than 15 years who had undergone the congenital cataract surgery from Jan-Dec, 2015. 451 eyes of 351 patients were reviewed. The eyes were examined using an autorefract-keratometer, applanation A-scan and parameters like keratometry, axial length, corneal astigmatism were noted.
Results: The mean age at the surgery was 92.4 ± 4.13 months (range 6 months to 15 years). The ratio of boys to girls was 2.34:1. The mean axial length was 21.94 ± 1.94 mm. Girls had shorter axial length than boys (21.53 mm vs 22.11 mm, $p = 0.01$). The axial length in the cataractous eyes in bilateral cases was significantly smaller than that in the unilateral cases (21.46 mm vs 22.55 mm, $p < 0.0001$).The mean keratometry was 44.12 ± 2.6 D. Girls had larger mean keratometry value than boys (44.71 vs 43.88, $p = 0.0032$). Keratometry values were higher in cataractous eyes in bilateral cases than in the unilateral cases (44.61 D vs 43.51 D, $p < 0.0001$). The mean corneal astigmatism was 1.49 ± 1.13 D. The prevalence of the corneal astigmatism of 2.0 D or more was 25.5%. The with-the-rule astigmatism was the most frequent type (62.53%). Girls had higher mean astigmatism than boys ($p = 0.0122$). The mean corneal astigmatism was higher in the cataractous eyes in bilateral cases than in the unilateral cases ($p = 0.0094$).
Conclusions: The axial length, mean keratometry and corneal astigmatism in congenital cataract patients varied with age, gender, and laterality. The data on biometry characteristics of Nepalese pediatric patients provided in the present study are of clinical significance and hence greatly enhance the guidelines for treatment decisions, IOL power calculations and management of congenital cataract patients.

Keywords: Axial length, Biometry, Congenital cataract, Corneal astigmatism, Keratometry

https://doi.org/10.1016/j.sjopt.2019.07.004

Introduction

With the recent advances in the surgical techniques and progresses in pediatric cataract surgery, primary implantation of intraocular lens has been the standard of care for the congenital and childhood cataract.[1] Biometry of the eye is an essential step for calculation of intraocular lens power. The calculation of IOL power in pediatric population is prone to errors due to technical difficulties in measuring biometric parameters in children and use of IOL power calculation formulas designed for adult patients which are based on adult biometry data. In newborns or non-cooperative children the

Received 6 April 2017; received in revised form 21 May 2019; accepted 9 July 2019; available online 17 July 2019.

Sagarmatha Choudhary Eye Hospital, Lahan – 3, Siraha, Nepal

* Corresponding author. Fax: +977 33 560492.
e-mail address: sabinsahu@gmail.com (S. Sahu).

Peer review under responsibility of Saudi Ophthalmological Society, King Saud University

Production and hosting by Elsevier

Access this article online:
www.saudiophthaljournal.com
www.sciencedirect.com

biometric measurements need to be performed under general anesthesia. Autokeratometers are commonly used for the biometric measurements of such children, but they are still not available in most medical centers in the developing countries, where congenital cataract is a leading cause of childhood blindness.[2,3] Keratometric measurements may not be accurate in clinical conditions, such as presence of corneal opacities or posttraumatic deformations. In such situations, error may occur if adult average keratometric values are taken for the IOL power calculations. So for the accurate calculation of IOL power in pediatric eyes, the biometry data from the pediatric eyes are necessary.

Several previous studies have reported the biometry data like axial length, anterior chamber depth and lens thickness in children with clear lens[4,5,6] and in cataractous eyes of Caucasian and African-american children.[7] Similarly the corneal curvature and axial length data in Caucasian children with cataractous eye[8], keratometry in pediatric eyes with cataract[9,10], anterior segment biometry characteristics in Chinese congenital cataract patients[11] have been reported.

We retrospectively evaluated a large series of pediatric eyes with congenital cataract with the objective to report the axial length, keratometry measurements and astigmatism in pediatric cataractous eyes measured with the applanation A-scan and an autorefract-keratometer.

Materials and methods

The retrospective review of the charts of all patients who had undergone the congenital cataract surgery at or before 15 years of age at the pediatric ophthalmology clinic of Sagarmatha Choudhary Eye Hospital, Lahan between January 2015 and December 2015 was done. All the Nepalese congenital cataract cases which were diagnosed before surgery and lacked other ocular abnormalities like corneal diseases, subluxated lens, glaucoma and nystagmus were included. The eyes in which the axial length or keratometry values were not available at the time of cataract surgery were excluded. The axial length was measured with the applanation A-scan technique and keratometry was done using a handheld autorefract-keratometer, Retinomax K-plus 3 at the time of general anesthesia.

The cataractous eyes of unilateral cases and both eyes of bilateral cases were included in the analysis. Data collected include age at the time of surgery, gender, laterality of cataract, axial length, keratometry and corneal astigmatism.

Absolute frequency (n) and relative frequency (%) were used to analyze qualitative variables, and mean and standard deviation (mean ± SD) were used to analyze quantitative variables. The t-test for independent samples was used to analyze the variables of cataractous eyes. A P-value <0.05 was considered statistically significant.

Results

Four hundred and fifty one eyes of 351 patients were reviewed. A unilateral cataract was present in 56.41% (198/351), and the remaining 43.59% (153/351) had bilateral cataract. The mean age at surgery was 92.4 ± 4.13 months (range 6 months to 15 years). The ratio of boys to girls was 2.34:1 (246:105).

The mean axial length was 21.94 ± 1.94 mm (range 16.12–32.58 mm). The mean axial length was higher in the cataractous eyes in boys (22.11 ± 2.02 mm) than that in girls (21.53 ± 1.73 mm) (p = 0.01, 95% CI = 0.14 to 1.02). However, the mean axial length comparisons among the males and females according to age distribution was found to be significant in age group between 11–15 years (p = 0.007, 95% CI = 0.26–1.60) and not in other age groups as shown in Table 1. The axial length in the cataractous eyes in bilateral cases (21.46 ± 2.05 mm) was significantly smaller than in the unilateral cases (22.55 ± 1.63 mm) (p <0.0001, 95% CI = 0.7037 to 1.4763). There was no difference between the mean axial length of right eyes and left eyes (p = 0.9135). The axial length measurements in the cataractous eyes by age group, gender and laterality is provided in Table 1.

The mean keratometry was 44.12 ± 2.6 D (range 38.29–55.66 D). The mean keratometry distribution of all patients is shown in Fig. 1. The cataractous eyes in girls have larger mean keratometry value (44.71 ± 2.38 D) than that in boys (43.88 ± 2.41 D) (p = 0.0032, 95% CI = −1.38 to −0.28). Keratometry values are significantly higher in cataractous eyes in bilateral cases (44.61 ± 2.43 D) than in the unilateral cases (43.51 ± 2.29 D) (p <0.0001, 95% CI = −1.59 to −0.60). Older children have lesser mean keratometry value compared to younger children. Infantile eyes have significantly steeper

Table 1. Axial length measurements in the cataractous eyes of congenital cataract patients by age, sex and laterality of the cataract.

Axial length	< 1 yr	1–5 yr	6–10 yr	11–15 yr	0–15 yr
Gender					
Male	18.5 ± 1.58 (n = 12)	21.56 ± 2 (n = 65)	22.39 ± 1.84 (n = 100)	23.03 ± 1.29 (n = 69)	22.11 ± 2.02 (n = 246)
Female	18.33 ± 1.12 (n = 5)	20.99 ± 1.23 (n = 39)	22 ± 1.78 (n = 40)	22.1 ± 1.56 (n = 21)	21.53 ± 1.73 (n = 105)
P	0.83	0.11	0.25	**0.007**	**0.01**
95% CI	−1.5 to 1.84	−0.13 to 1.27	−0.28 to 1.06	**0.26–1.60**	**0.14–1.02**
Laterality					
UL	19.24 ± 0.28 (n = 2)	21.69 ± 1.28 (n = 54)	22.68 ± 1.82 (n = 81)	23.23 ± 1.14 (n = 61)	22.55 ± 1.63 (n = 198)
BL	18.39 ± 1.51 (n = 15)	21.17 ± 1.8 (n = 50)	21.94 ± 1.76 (n = 59)	22.24 ± 1.53 (n = 29)	21.46 ± 2.05 (n = 153)
P	0.45	0.09	**0.02**	**0.0009**	**0.0001**
95% CI	−1.49 to 3.19	−0.08 to 1.12	**0.13–1.35**	**0.42–1.56**	**0.70–1.48**
Total	18.46 ± 1.46 (n = 17)	21.37 ± 1.8 (n = 104)	22.27 ± 1.82 (n = 140)	22.8 ± 1.41 (n = 90)	21.94 ± 1.95 (n = 351)

Standard deviation (SD). Bold data are statistically significant at P < 0.05.

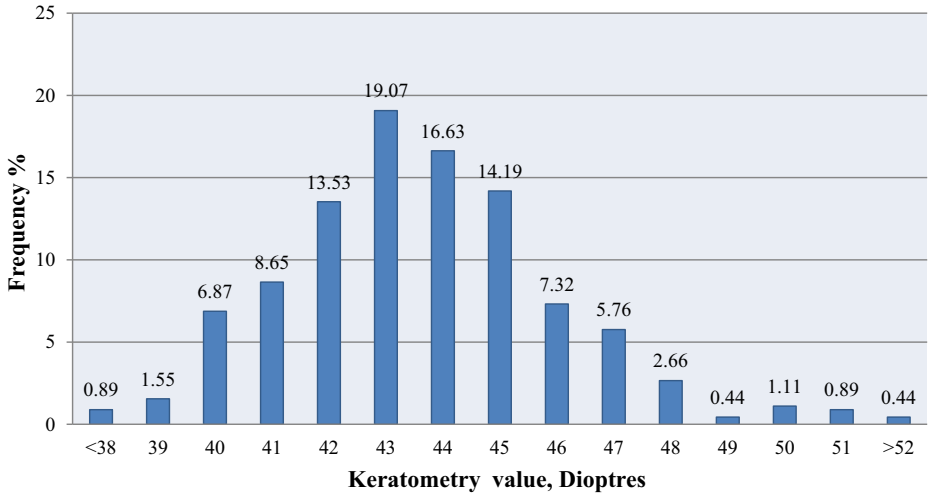

Fig. 1. Distribution of mean keratometry in 1 D step in the entire sample of congenital cataract patients.

Table 2. Mean keratometry measurements in the cataractous eyes of congenital cataract patients according to age, gender and laterality of the cataract.

Keratometry	<1 yr	1–5 yr	6–10 yr	11–15 yr	0–15 yr
Gender					
Male	46.04 ± 3.4 (n = 12)	44.21 ± 2.58 (n = 65)	43.69 ± 2.06 (n = 100)	43.38 ± 2.22 (n = 69)	43.88 ± 2.41 (n = 246)
Female	45.69 ± 0.48 (n = 5)	44.78 ± 2.02 (n = 39)	45.02 ± 2.75 (n = 40)	43.79 ± 2.21 (n = 21)	44.71 ± 2.38 (n = 105)
P	0.83	0.24	0.0022	0.46	**0.0032**
95% CI	−2.97 to 3.67	−1.52 to 0.39	−2.17 to −0.49	−1.51 to 0.69	**−1.38 to −0.28**
Laterality					
UL	50.90 ± 6.72 (n = 2)	44.00 ± 2.41 (n = 54)	43.32 ± 2.13 (n = 81)	43.09 ± 1.73 (n = 61)	43.51 ± 2.29 (n = 198)
BL	44.49 ± 2.02 (n = 15)	44.79 ± 2.4 (n = 50)	44.48 ± 2.72 (n = 59)	44.62 ± 2.04 (n = 29)	44.60 ± 2.43 (n = 153)
P	**0.0053**	0.097	**0.005**	**0.0004**	**0.0001**
95% CI	**2.22 to 10.59**	−1.73 to 0.15	**−1.97 to −0.35**	**−2.35 to −0.71**	**−1.60 to −0.60**
Total	45.96 ± 2.98 (n = 17)	44.40 ± 2.42 (n = 104)	44.08 ± 1.82 (n = 140)	43.48 ± 1.41 (n = 90)	44.12 ± 1.95 (n = 351)

Standard deviation (SD). Bold data are statistically significant at P < 0.05.

keratometry compared to other age-group (p <0.0001, 95% CI = 1.56 to 3.39). The keratometry measurements in the cataractous eyes by age group, gender and laterality is provided in Table 2.

The mean corneal astigmatism was 1.49 ± 1.13 dioptres (D) (range 0.05–7.56 D). The overall distribution of corneal astigmatism is shown in Fig. 2. Girls have higher mean astigmatism (1.73 ± 1.28 D) than boys (1.40 ± 1.05 D) (p = 0.0122, 95% CI = −0.59 to −0.07). The mean corneal astigmatism are higher in the cataractous eyes in bilateral cases (1.63 ± 1.18) than in the unilateral cases (1.32 ± 1.04) (p = 0.0094, 95% CI = −0.54 to 0.08). The prevalence of the corneal astigmatism of 1.0 D or more was 59.21%, 2.0 D or more was 25.5% and 3.0 D or more was 11.09%. The astigmatism was predominantly with-the-rule type (62.53%) in all age groups (Fig. 3).

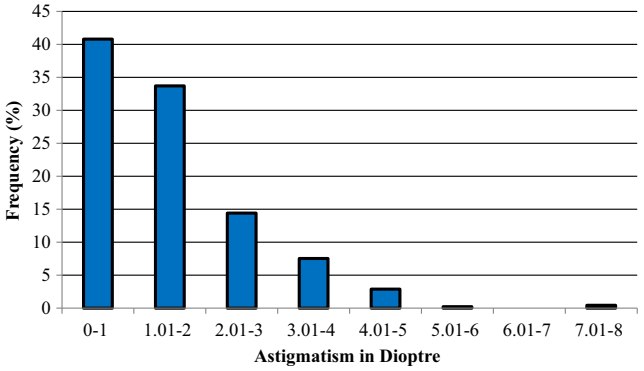

Fig. 2. Distribution of the corneal astigmatism in 1 D step in the entire sample of congenital cataract patients.

Discussions

Biometry of the eye is a crucial step for the IOL power calculation. The pediatric IOL power calculations however are based on formulas which are designed for adult eyes and are formulated based on adult biometry data. The biometry data based on the pediatric eyes are hence essential to design IOL power calculation formulas specifically for the pediatric population. The biometry characteristics and prevalence of preoperative corneal astigmatism are essential for proper planning and management of congenital cataracts. The studies with large cohort of congenital cataract patients are however less, perhaps due to low incidence of congenital cataract, lack of proper equipments, difficulty in

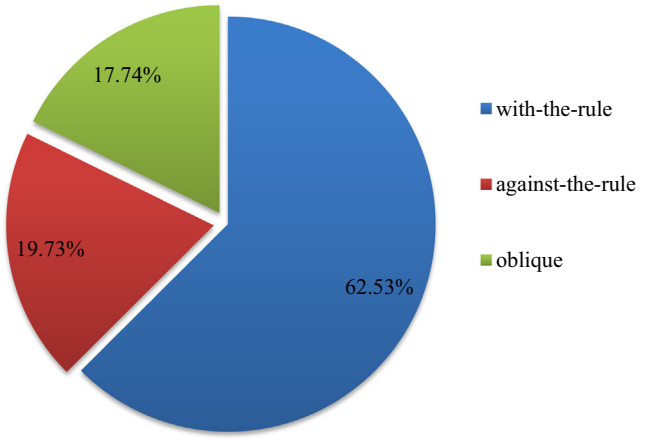

Fig. 3. Types of corneal astigmatism in the entire sample of congenital cataract patients.

examinations or lack of awareness of importance of such data. In this study, we report the biometry characteristics of the large cohort of congenital cataract patients in Nepal.

Previous studies have reported the axial length and corneal curvature data in cataractous eyes of Caucasian and African-american children[7], axial length, anterior chamber depth (ACD) and lens thickness (LT) in noncataractous pediatric eyes.[4,5,6] It has been reported that the growth of the eye is influenced by visual experience and visual deprivation leads to elongation of eye.[12,13] In this study we used applanation A–scan to determine the axial length values in pediatric cataractous eyes. We found that the eyes with bilateral cataract had significantly smaller axial length than those with unilateral cataract (Table 1, 21.53 vs 22.11, p = 0.0001), similar to reports by Trivedi and Wilson[7], Rasooly et al.[13] and Lorenz et al.[14] Sex-linked differences in axial length was found similar to that reported in literature[4,15], the girls having shorter axial length than boys (Table 1, 21.53 mm vs 22.11 mm, p = 0.01). The axial length at age less than 1 year was significantly different from all other age categories (Table 1). We could not adequately determine the rate of axial growth or the age at which axial length growth stabilizes since this was not a longitudinal study.

Keratometry values have been previously reported in noncataractous pediatric eyes[16,17] as well as in cataractous pediatric eyes.[8,9,10,11] Trivedi and Wilson[8] investigated keratometry in 299 pediatric eyes with cataracts of white and African Americans and reported that the average keratometry value was 45.39 D, with steeper keratometry in girls than in boys and in unilateral cases than in bilateral cases. Gordon and Donzis[18] reported the average keratometry value of full-term infants as 45.2 D. Shrestha and Shrestha[10] in a study of keratomeric readings in 80 bilateral congenital cataracts from Nepal have reported mean keratometry value of 44.8 D in operated eyes and 44.7 D in fellow eyes. Another keratometry study in Thai children from newborn to the age of ten found that the keratometry reading was consistent in all age groups in the range of 43–44 D.[19] In the present study, the mean keratometry value was 44.12 D. We found that infants have a steeper keratometry than older children and girls have steeper keratometry compared to boys, which is consistent with the previous findings.[8,17,18] In additions, our study show significantly steeper mean keratometry readings in bilateral congenital cataract cases than those of cataractous eyes in unilateral involvement (p <0.0001) which contradicts previous findings.[8] The difference in age composition or different ethnicities may cause these discrepancies.

In the present study, the mean corneal astigmatism in congenital cataract patients was 1.49 D. More than one fourth of the cases (25.5%) had astigmatism of 2 D or more indicating the high prevalence of corneal astigmatism in the congenital cataract patients. Previous studies have shown the prevalence of corneal astigmatism of 2 D or more to be 65.7% in Japanese congenital cataract patients[20] and 39.25% in Chinese congenital cataract patients.[11] Most of the patients had with-the-rule astigmatism similar to other studies.[11,20] We also found that the mean corneal astigmatism was higher in the bilateral congenital cataract cases than the affected eyes of the unilateral congenital cataract cases which is probably due to abnormal development of the eyes.[21]

This is the first study on the biometry characteristics and prevalence of corneal astigmatism in congenital cataract patients in Nepal. The knowledge of anterior segment biometry characteristics as well as corneal astigmatism measured before surgery can thus improve the management guidelines of congenital cataracts.

There were some limitations to this study. We used the applanation A-scan ultrasound biometry for the axial length measurements in this study. Applanation ultrasound remains a commonly used method worldwide, especially in developing countries like Nepal due to familiarity with the technique and cost. The acquisition of both ultrasonography data as well as keratometry data in paediatric patients is difficult because of the technical difficulties and the need for general anesthesia in newborns and uncooperative children. However, applanation ultrasound biometry has been reported to have comparative accuracy and equal or better results with optical biometry in previous comparative studies.[22–24] Also, compared to immersion A-scan biometry with non-contact to cornea, we used applanation A-scan biometry, which requires the ultrasound probe to be placed in contact with the corneal surface. The compression of cornea is unavoidable in applanation biometry making the axial length measurement more variable compared to other non-contact biometries.[25]

Conclusion

The axial length, mean keratometry and corneal astigmatism in congenital cataract patients varied with age, gender, and laterality. The data on biometry characteristics of Nepalese pediatric patients provided in the present study are of clinical significance and hence greatly enhance the guidelines for treatment decisions, IOL power calculations and management of congenital cataract patients.

Conflict of interest

The authors declared that there is no conflict of interest.

References

1. Wilson Jr ME, Bartholomew LR, Trivedi RH. Pediatric cataract surgery and intraocular lens implantation: practice styles and preferences of the 2001 ASCRS and AAPOS memberships. *J Cataract Refract Surg* 2003;**29**(9):1811–20.

2. Bowman RJ. How should blindness in children be managed? *Eye* 2005;**19**(10):1037–43.
3. Gilbert C, Foster A. Childhood blindness in the context of VISION 2020–the right to sight. *Bull World Health Organ* 2001;**79**(3):227–32.
4. Larsen JS. The sagittal growth of the eye. IV. Ultrasonic measurement of the axial length of the eye from birth to puberty. *Acta Ophthalmol* 1971;**49**(6):873–86.
5. Zadnik K, Manny RE, Yu JA, et al. Ocular component data in schoolchildren as a function of age and gender. *Optom Vis Sci* 2003;**80**(3):226–36.
6. Larsen JS. The sagittal growth of the eye. 1. Ultrasonic measurement of the depth of the anterior chamber from birth to puberty. *Acta Ophthalmol* 1971;**49**(2):239–62.
7. Trivedi Rupal H, Edward Wilson M. Biometry data from caucasian and african-american cataractous pediatric eyes. *Invest. Ophthalmol. Visual Science* 2007;**48**:4671–8.
8. Capozzi Paolo, Morini Chiara, Piga Simone, Cuttini Marina, Vadalà Pasquale. Corneal curvature and axial length values in children with congenital/infantile cataract in the first 42 months of life. *Invest Ophthalmol Visual Sci* 2008;**49**:4774–8.
9. Trivedi RH, Wilson ME. Keratometry in pediatric eyes with cataract. *Arch Ophthalmol* 2008;**126**(1):3842.
10. Shrestha UD, Shrestha MK. Keratometry in eyes with bilateral pediatric cataract at tertiary eye care center in Nepal: a preliminary report. *Nepal Med Coll J* 2009;**11**(3):2034, Sep.
11. Lin D, Chen J, Liu Z, et al. Prevalence of corneal astigmatism and anterior segmental biometry characteristics before surgery in Chinese congenital cataract patients. *Sci Rep.* 2016;**6**:22092.
12. Von Noorden GK, Lewis RA. Ocular axial length in unilateral congenital cataracts and blepharoptosis. *Invest Ophthalmol Vis Sci* 1987;**28**(4):750–2.
13. Rasooly R, BenEzra D. Congenital and traumatic cataract: the effect on ocular axial length. *Arch Ophthalmol.* 1988;**106**(8):1066–8.
14. Lorenz B, Worle J, Friedl N, Hasenfratz G. Ocular growth in infant aphakia: bilateral versus unilateral congenital cataracts. *Ophthalmic Paediatr Genet.* 1993;**14**(4):177–88.
15. Isenberg SJ, Neumann D, Cheong PY, Ling YL, McCall LC, Ziffer AJ. Growth of the internal and external eye in term and preterm infants. *Ophthalmology* 1995;**102**(5):827–30.
16. Friling R, Weinberger D, Kremer I, Avisar R, Sirota L, Snir M. Keratometry measurements in preterm and full term newborn infants. *Br J Ophthalmol* 2004;**88**(1):8–10.
17. Asbell PA, Chiang B, Somers ME, Morgan KS. Keratometry in children. *CLAO J* 1990;**16**(2):99–102.
18. Gordon RA, Donzis PB. Refractive development of the human eye. *Arch Ophthalmol* 1985;**103**:785–9.
19. Ubolsing S, Charoensri A. Keratometry in Thai children from newborn to the age of ten: a retrospective study. *J Med Assoc Thai* 2006 (Suppl); 89: S196-9.
20. Watanabe T, Matsuki N, Yaginuma S. Nagamoto T. Corneal astigmatism in children with congenital cataract. *Nippon Ganka Gakkai Zasshi.* 2014;**118**:98–103.
21. Bouzas AG. Anterior polar congenital cataract and corneal astigmatism. *J Pediatr Ophthalmol Strabismus* 1992;**29**:210–2.
22. Rončević MB, Bušić M, Čima I, Elabjer BK, Bosnar D, Miletić D. Comparison of optical low-coherence reflectometry and applanation ultrasound biometry on intraocular lens power calculation. *Graefe's Archive Clin Experiment Ophthalmol* 2011;**249**(1):69–75, Jan 1.
23. Raymond S, Favilla I, Santamaria L. Comparing ultrasound biometry with partial coherence interferometry for intraocular lens power calculations: a randomized study. *Invest Ophthalmol Vis Sci* 2009 Jun 1;**50**(6):2547–52.
24. Nakhli FR. Comparison of optical biometry and applanation ultrasound measurements of the axial length of the eye. *Saudi J Ophthalmol* 2014 Oct 1;**28**(4):287–91.
25. Yang QH, Chen B, Peng GH, Li ZH, Huang YF. Accuracy of axial length measurements from immersion B-scan ultrasonography in highly myopic eyes. *Int J Ophthalmol* 2014;**7**(3):441–5.