Original Article

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Lens Thickness and Associated Factors among Age-Related Cataracts Patients in Chattogram, Bangladesh

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ABSTRACT

Background: *Lens Thickness (LT) is one of the important parameters in ocular biometry. The observation of LT among cataract patients is of great importance from clinical and pathophysiological perspectives. The study aimed to investigate the relationship between the LT and lens density changes concerning age, types and densities of age-related cataracts in a sample of the Bangladeshi population.*

Materials and methods: *It is a prospective observational case control study. A total of 2066 (n = 2066) participants were included in the study from an Eye Hospital in Chattogram, Bangladesh. All participants underwent standard vision testing. LT was evaluated using the immersion technique with A-scan ultrasound. The types and density of cataracts were identified with a slit-lamp attached to a video camera. Cataract was classified morphologically into cortical, nuclear, and posterior sub-capsular types. Nuclear cataract was observed under oblique illumination, and retro-illumination was used to assess cortical and posterior sub-capsular cataracts. The density of the lens nucleus was graded as Emery and Little classification.*

Results: *Ages of the study population ranged from 40-95 years, with a mean age of 62.76 ± 9.43 years. Of the participants, 937 (45.4%) were males and 1129 (54.6%) were females. The mean LT was 4.15±0.86mm. The LT was greater in older (≥60 years) patients than in the younger (41-59 years) (4.21±0.85mm versus 4.01±0.86mm, p < 0.001). The mean LT in male and female patients were, respectively, 4.18±0.89mm and 4.12±0.84mm with any statistical significance (p<0.097). The mean LT was the highest in nuclear cataracts (4.79 ± 0.39mm), followed by cortical (3.9 ± 0.73mm) and posterior sub-capsular cataracts (4.16 ± 0.93mm). The relation between LT and the Grade of cataract was insignificant (p<0.078).*

Conclusion: *In this large Bangladeshi age-related cataractous population, we found that thicker lenses are associated with older age and nuclear cataracts.*

Key words: Cataract; Lens density; Lens thickness.

Introduction

The mean thickness of the human crystalline lens at the age of 3 months after birth is 3.91 ± 0.16 mm and from infancy up to 10 years, progressive thinning of the lens occurs. After this period, the LT continuously increases throughout life.[1] Some studies suggest that LT is influenced by age, gender, body mass index, stature, anterior chamber depth, hyperopic refractive error, central corneal thickness, cigarette smoking and diabetes.[2-6] The type of cataract and density of the nucleus have been reported to be associated with LT.[2-4,7] LT is one of the important parameters in ocular biometry. It is a necessary variable used in fourth-generation IOL formulas and its associations with other visual parameters may further affect actual lens position after surgery.[8-10] Meanwhile, during cataract development, morphological changes in the lens may also occur along with decreased transparency.[2] Therefore, the observation of LT among cataract patients is of great importance from both clinical and pathophysiological perspectives.

Previously, reports on LT were seen in countries such as Peru, the United States, Iran and Portugal.[11-15] A thinner lens was reported in the Iranian or Portuguese population than in the Peruvian or American study, indicating a potential racial difference in LT. With the higher prevalence of myopia and high myopia in Asia, the lens geometry of Asian eyes may also be different from that of Caucasian eyes.[12-15] However, no reports

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on LT have been published that include a large sample of Bangladeshi cataractous eyes.

Thus, in this study, based on a large sample of the Bangladeshi population, we aimed to investigate the LT of age-related cataracts and its relationship with age, gender, types, and densities of cataracts.

Materials and methods

This prospective, observational case-control study was performed at the Cataract Department of Bangladesh Eye Hospital Chattogram from July 2020 to June 2021. The study involved a total of 2066 eyes with age-related cataracts. Written informed consent was taken from all the participating patients.

Patients aged 40 years and above with uncomplicated cataracts, irrespective of gender, were included in the study. Those with white cataract, history of ocular trauma, history of invasive and non-invasive intraocular surgery, local or systemic steroids use for more than three months, axial length (>26 mm), increased intraocular pressure, uveitis, pseudo-exfoliation, non-dilating pupil (<7mm) and any other systemic disease were excluded.

After taking consent, all subjects underwent a complete eye examination, including uncorrected and best-corrected visual acuity, refraction, slit lamp and fundus examination. LT was measured using the immersion technique with A-scan ultrasound. After dilating the pupil with 1% tropicamide and 2.5% phenylephrine hydrochloride eye drops, the lens opacity was documented by an ophthalmologist using a slit lamp with an imaging system, which is attached with an external CCD camera (Model: L-0187, Inami and Co. Ltd, Japan). A single observer was used to avoid bias and to maintain reliability and consistency. The density of the lens nucleus was graded as Emery and Little classification.[16]

Data were analyzed using SPSS, version 23.0. Data were expressed as mean (±Standard deviation) and range. Independent sample t-tests or ANOVA tests were used to analyzed the differences between biometric values between different age groups, gender, and grade of cataracts. Significance was set at 95% CI ($p \leq 0.05$).

Results

A total of 2066 (n = 2066) participants were included in the study. Their ages ranged from 40-95 years, with a mean age of 62.76 ± 9.43 years. Of the participants, 937 (45.4%) were males, and 1129 (54.6%) were females. The overall LT was 4.15±0.86mm. Mean LT was higher among males than females without any statistical significance (p=0.097).

Table I Lens thickness in different sex groups stratified of the patients

Mean ±SD of Lens thickness in mm		
Total (n=2066)	Male (n=937)	Female (n=1129)
4.15±0.86	4.18±0.89	4.12±0.84

*p=0.097 by Independent sample t-test, between male and female.

LT stratified by age and gender are presented in Table II, which depicts that LT increases with increasing age. When stratified by gender, LT was generally greater in females than in males in the 40-59 age group, and a reverse trend was observed in patients 60 years and above.

Table II Lens thickness in different age groups stratified by sex of the patients

Age group	Mean ±SD of Lens thickness in mm		
	Total	Male	Female
40-59 years	4.01±0.86	3.98±0.90	4.02±0.84
>59 years	4.21±0.85	4.26±0.	4.18±0.82
p-value*	<0.001	<0.001	0.002

*Independent sample t-test.

The mean thickness values are 4.79 ± 0.39mm, 3.9 ± 0.73 and 4.16 ± 0.93 for nuclear, cortical and posterior sub-capsular cataracts, respectively.

Table III Correlation between the density of nuclear cataracts and lens thickness

Morphological type of cataract	The thickness of the lens (mm)		p-value*
	Mean	Std. Deviation	
Nuclear	4.79	0.39	<0.001
Cortical	3.98	0.73	
Posterior subcapsular	4.16	0.93	
Mixed	4.07	0.75	

*p-value obtained from the ANOVA test.

The mean LT was the highest in Grade I cataracts, followed by Grade V, Grade II, Grade III and Grade IV (Table IV). However, the mean differences among grades were statistically insignificant (p=0.078).

Table IV Correlation between the density of lens and lens thickness

Density of lens	The thickness of the lens (mm)		p-value
	Mean	Std. Deviation	
Grade I	4.30	0.81	0.078
Grade II	4.21	0.75	
Grade III	3.93	1.01	
Grade IV	3.81	1.11	
Grade V	4.27	0.71	

*p-value obtained from the ANOVA test.

IAHS Medical Journal
Volume 05 Issue 02 December 2022; 58-61

Discussion

The lens is a transparent, biconvex, crystalline structure situated behind the pupil and in front of the vitreous, suspended by Zonules of Zinn (Suspensory ligaments) which contributes 15-20 Diopters (D) out of the total 60 D refractive power of the eye in its non-accommodative state of refraction. Its weight, volume, and thickness increase gradually with age due to the continuous production of new lens proteins in the cortex. According to Adler, the average thickness of a human crystalline lens is 4.3 mm at 40 years of age, 4.45 mm at 50 years, 4.7 mm at 60 years, and more than 4.7 mm after 60 years.[17] The Beaver Dam Eye Study results found that age is the most significant factor for lens thickness.[14] In the present study, mean LT at the age of 41-60 and above 60 years of age was, respectively,4.01 ± 0.86 and 4.22 ± 0.85 mm, which was statistically significant.

In an Indian study, gender was found to influence lens thickness, with females having slightly higher thickness than males of the same age group.[18] In another study in Shanghai, China, showed that males had thicker lenses than females.[19] In the present study, the mean lens thickness for males was 4.18 ± 0.89 mm and the mean thickness for females was 4.12 ± 0.84 mm, irrespective of age. But these values are not statistically significant (p=0.097). After matching the ages of both sexes, the results showed that at age 60 years and above, the mean value of lens thickness in males is slightly higher compared to the females of that age. But 40-59 years, females were found to have more increased lens thickness than males. As the distribution of different densities of cataracts between both genders among the recruited patients did not differ to a great extent, we can assume that there was no significant influence of density of cataracts on lens thickness between the sexes.

Many studies suggested that thickness was decreased in the cataractous lens.[2,20,21] The reason, as speculated by some of these studies, was that decreased production of normal cortical fibres was related to reduced lens thickness in the case of cortical cataracts.[22] Another study also postulated that senile cataract leads to short fibre and protein synthesis, causing diminution of lens thickness.[23] Although lens thickness is related to cataracts; the results are variable considering the different morphological types of age-related cataracts found in several studies. Some studies suggested nuclear cataracts had greater lens thickness than cortical and posterior sub-capsular cataracts.[2,3,20,24] This study also finds nuclear cataracts to have more thickness than cortical cataracts and posterior sub-capsular cataracts, which is similar to the results of the above studies. One previous study found lens thickness to be highest in nuclear cataracts and lowest in posterior sub-capsular cataracts.[20]The mean LT was 4.79 ± 0.39mm, 3.9 ± 0.73mm and 4.16 ± 0.93mm, respectively, for nuclear, cortical and posterior sub-capsular cataracts. These findings show that nuclear cataract has the greatest thickness, followed by posterior sub-capsular cataract and cortical cataract, which has the least thickness.

It has been long assumed the harder the lens, the thicker it is; that is, the thickness of the lens could be possibly related to lens density. But results of various studies are contradictory. The Beaver Dam study and Kashima et al. found a relationship between nuclear density and lens thickness, such that the more severe nuclear sclerosis, the more the lens thickness.[3,24] Another study revealed that lens thickness does not seem dependent on lens density when it is a mild to moderate cataract.[12] While analysing lens thickness in cataracts with different densities, this study found no significant relation between lens thickness and density of cataracts.

Limitations

The present study had a few limitations. The different types and grades of cataracts were analysed using subjective methods. Besides, the study did not involve eyes with clear lenses and included only those with isolated age-related cataracts.

Conclusion

Lens thickness is associated with the ageing process. Nuclear cataract has the highest lens thickness, followed by posterior subcapsular and cortical cataract. But there is no significant relationship between the thickness of the lens and lens density.

Recommendation

Future studies are needed to analyse the refractive prediction error of different intraocular lens formulas using preoperative LT in eyes with very thick or thin eyes.

Disclosure

All the authors declared no competing interest.

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IAHS Medical Journal
Volume 05 Issue 02 December 2022; 58-61

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