Axial Length, Anterior Chamber Depth, and Lens Thickness in Normal Libyan Eyes; Measured by the Aladdin Ocular Biometer

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Abstract

Background Ocular parameters as axial length (AL), anterior chamber depth (ACD), and lens thickness (LT) are important for refractive and cataract surgeries, and its normal data are important to be identified.

Aim This study was carried out to obtain data about AL, ACD, and LT parameters in normal Libyans.

Methods A cross-sectional study (first of July to end of August, 2021) was done in Benghazi teaching eye hospital on 106 nondiabetic volunteers aged between 17 and 75 years with no ophthalmic disease. Ocular parameters were measured using the Aladdin optical biometer that is a noninvasive machine and without the use of drugs. Descriptive statistics and data analysis were done by using SPSS version 23.0, IBM Corporation.

Results The mean age was 35.36 ± 13.35 years, the mean AL was 23.79 ± 0.91 mm, the mean ACD was 2.96 ± 0.62 mm, and the mean LT was 3.67 ± 0.62 mm. There was no statistically significant difference between these parameters regarding gender or age.

Conclusion This is the first study done on Libyan population to report the AL, ACD, and LT. It showed a comparable result with studies from other populations and that age and gender have no effect on these ocular parameters.

Keywords
► axial length
► anterior chamber depth
► lens thickness
► normal Libyans

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ملخص المقال باللغة العربي

الطول المحوري وعمق الغرفة الأمامية وسماكة العدسة في العيون الليبية العادية؛ مقاسة بمقياس علاء الدين البصري

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الأهداف: تعتبر المؤشرات العينية مثل الطول المحوري وعمق الغرفة الأمامية وسماكة العدسة مهمة لجراحة العين الانكسارية وكذلك إعتام عدسة العين (جراحة الساد)، أجريت هذه الدراسة للحصول على بيانات حول المؤشرات العينية الثلاث في الليبيين العاديين.

المواد والطرق: تم إجراء دراسة مقطعية من أول يوليو إلى نهاية أغسطس 2021 في مستشفى العيون التعليمي في بنغازي على 106 متطوعاً غير مصاب بالسكري تتراوح أعمارهم بين 17 -75 عامًا ولا يعانون من أمراض العيون باستخدام مقياس علاء الدين البصري وهو عبارة عن آلة غير باضعة وبدون استخدام الأدوية.

التحليل الإحصائي: تم إجراء الإحصاء الوصفي وتحليل البيانات باستخدام الإصدار 23 من SPSS لشركة IBM

النتائج: كان متوسط العمر 35.36 ±13.35 سنة، وكان متوسط الطول المحوري 23.79 ±0.91 مليميتر، وكان متوسط عمق الغرفة الأمامية 2.96 ±0.62 مليميتر، وكان متوسط سماكة العدسة 3.67 ± 0.62 مليميتر، لم يكن هناك فرق معتد به إحصائيا بين هذه المؤشرات فيما يتعلق بالجنس أو العمر.

الاستنتاج: هذه هي الدراسة الأولى التي أجريت على السكان الليبيين عن الطول المحوري وعمق الغرفة الأمامية وسمك العدسة، حيث أظهرت نتائج مقارنة لدراسات على مجموعات سكانية أخرى، وأن العمر والجنس ليس لهما أي تأثير على هذه المؤشرات العينية.

الكلمات المفتاحية: الطول المحوري العيني، عمق الغرفة الأمامية العينية، سماكة العدسة، ليبيا

Introduction

The difference in refractive errors between people is due to the diversity in the axial length (AL), the refractive power of the cornea, and the lens, in addition to the anterior chamber depth (ACD) and lens thickness (LT).[1]

The AL and ACD are essential parameters needed for the calculation of the power of the intraocular lens (biometry) and to define the refractive state of the eye before cataract and refractive surgeries that had been advanced over previous years. These eye parameters differ according to population due to race and genes variation.[2] The LT measurement is important in the study of myopia as well as in primary angle-closure glaucoma.[3]

It is essential to know the normality of the ocular parameters in the healthy population, in order to be able later to know what are the data that are out of normality. Currently, we can assess these parameters by multiple noninvasive methods, very quickly and without the need to use drugs.[4]

One of these noninvasive methods is the Aladdin that is a combination of a reflection-based topographer and an optical biometer that can measure corneal curvature, AL, ACD, LT, and intraocular lens calculation with a great accuracy.[5]

In spite of the importance of these eye parameters, there are not many studies on this subject.[6] In Libya, although cataract and refractive surgeries are done on daily basis, there is no information about these parameters in the literature; therefore, with the help of a noninvasive method and without the use of drugs, this study aims to gain an idea about the AL, ACD, and LT in normal Libyans.

Methods

A cross-sectional study was conducted at Benghazi teaching eye hospital in the period between July 1 and August 31, 2021. The study involved 106 Libyans of both genders. The participants were volunteering hospital's doctors, nurses, employees, and 4th year medical students, in addition to patients attending the hospital specialty clinic department with minor complaints like headache and minor refractive problem.

Medical history and ophthalmic history were taken from all participants. Complete ophthalmic examination was done as best corrected visual acuity, slit-lamp examination for both anterior and posterior segment (using +90D lens), and measurement of intraocular pressure to rule out any eye pathology.

Table 1 Mean gender analysis of age, axial length, anterior chamber depth, and lens thickness

Variable	Total ($n = 106$)	Male ($n = 50$)	Female ($n = 56$)	p-Value[a]
Age ± SD (y) Range (y)	35.36 ± 13.35 17–75	33.64 ± 13.29 17–67	36.89 ± 13.34 19–75	0.77
Axial length ± SD (mm) Range (mm)	23.79 ± 0.91 21.00–26.00	23.88 ± 1.04 21.00–26.00	23.72 ± 0.77 22.00–25.50	0.19
Anterior chamber depth (mm) Range (mm)	2.96 ± 0.62 1.40–4.24	2.91 ± 0.68 1.40–4.24	3.01 ± 0.58 1.51–4.00	0.14
Lens thickness (mm) Range (mm)	3.67 ± 0.62 2.11–5.00	3.69 ± 0.63 2.19–5.00	3.65 ± 0.62 2.11–5.00	0.85

Abbreviations: mm, millimeter; n, number of participants; SD, standard deviation.
[a]Differences between gender using unpaired Student's t-test.

Inclusion Criteria

People aged 17 years and more having no ophthalmological diseases (cornea, lens, retina) with no previous eye surgery, and people with refractive errors limited to ± 3.00D sphere and less than 2.00D cylinder with decimal best corrected visual acuity of 1.0 were included in this study.

Exclusion Criteria

Diabetics, children less than 17 years of age, people with any ophthalmological disease or having previous eye surgery or laser treatment were excluded.

Measurements

The Aladdin (Topcon, Tokyo, Japan), was used to measure the AL, ACD, and LT. Aladdin machine was positioned carefully so that the examiner has a clear scene of the eye with the presence of quality control image (green eye). The participant was asked to fixate on a red target point then the examiner pressed the button of the joystick. The AL, ACD, and LT measurements were obtained from only the right eye of all participants by the same skilled ophthalmologist. A previous study confirmed the accuracy and reproducibility of Aladdin.[5]

This study followed the rules of the Helsinki Declaration; it was approved by the ethical committee of Benghazi teaching eye hospital and participants gave informed consent after an explanation of the procedure was done for them.

Statistical Analysis

The Statistical Package for the Social Sciences (SPSS version 23.0; IBM Corporation, Armonk, New York, United States) was used. Data were presented as mean ± standard deviation and frequencies. Unpaired Student's t-test was used to test the differences in the measured variables between gender. Analysis of variance (ANOVA) was used to compare variables within age groups. A p-value ≤ 0.05 was considered statistically significant.

Results

►**Table 1** shows gender of patients, their age, AL, ACD, and LT measures, participated in this study. There were no significant statistical differences between male and female regarding age distribution, AL, ACD, and LT measures using unpaired Student's t-test ($p > 0.05$).

►**Table 2** shows descriptive statistics of ALs, ACD, and LT (mms) according to age groups. ANOVA done on the mean differences in AL, ACD, and LT measures showed no significant differences across the age groups.

Discussion

This is the first published study done in Libya to obtain knowledge on the AL, ACD, and LT in normal Libyans performed by the Aladdin optical biometer.

Table 2 Descriptive statistics of axial lengths, anterior chamber depth, and lens thickness (mms) according to age groups

	Axial length (mm)[a]		Anterior chamber depth (mm)[b]		Lens thickness (mm)[c]	
Age grouping years, (n)	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	Range
< 20 (10)	23.99 ± 0.51	23.07–25.00	3.12 ± 0.58	2.20–3.77	3.60 ± 0.39	3.11–4.11
21–40 (66)	23.83 ± 0.90	21.79–26.00	3.01 ± 0.65	1.40–4.24	3.67 ± 0.64	2.11–5.00
41–60 (24)	23.67 ± 0.69	22.03–24.77	2.77 ± 0.59	1.51–3.52	3.68 ± 0.69	2.59–5.00
>60 (6)	23.55 ± 2.01	21.00–25.50	2.83 ± 0.47	2.23–3.30	3.63 ± 0.59	3.06–4.37
Total (106)	23.79 ± 0.91	21.00–26.00	2.96 ± 0.62	1.40–4.24	3.67 ± 0.62	2.11–5.00

Abbreviations: ANOVA, analysis of variance; mm, millimeter; SD, standard deviation.
[a]ANOVA between age groups $F = 0.46$, df = 3.00, $p = 0.70$.
[b]ANOVA between age groups $F = 1.18$, df = 3.00, $p = 0.32$.
[c]ANOVA between age groups $F = 0.06$, df = 3.00, $p = 0.98$.

Table 3 Mean AL, ACD, and LT reported in previous studies compared to the present study

Author	Place	Mean age (y)	Age range (y)	Measurement technique	AL (mm)	ACD (mm)	LT (mm)	Lens status
Albashir and Saleem[8]	Sudan	62.86	18–107	Ascan ultrasonography	23.09	NR	NR	NR
Gessesse .et al[9]	Ethiopia	40.31	18–69	Compact touch AB Scan Biometer	22.96	2.91	4.29	Cataract+ clear lens
Abdelaziz and Mousa[10]	Egypt	57.4	43–75	IOL master	24.70	NR	NR	NR
Bamahfouz[11]	Saudi Arabia	58.1	14–103	IOL master	23.48	3.10	NR	Cataract
Hashemi et al[6]	Iran	50.9	40–64	LENSTAR/BioGraph	23.14	2.62	4.28	NR
Praveen et al[12]	India	52.48	25–71	Ascan ultrasonography	NR	NR	4.38	Clear
He et al[13]	China	64.4	> 50	Ascan ultrasonography	23.11	2.67	4.44	Cataract+ clear lens
Wong et al.[14]	Tanjong Pagar	NR	40–81	Ascan ultrasonography	23.23	2.90	4.75	Cataract+ clear lens
Palencia et al[15]	Colombia	27.59	8–56	Ascan ultrasonography	23.13	3.32	NR	NR
Lee et. al[16]	Beaver Dam (older Caucasian population	71.9	65–75	IOL master	23.69	3.11	NR	Cataract+ clear lens
Wojciechowski et al[17]	Eskimo	59.5	40–79	Ascan ultrasonography	23.70	2.96	4.74	Cataract+ clear lens
Mashige and Oduntan[18]	South Africa	28.15	10–66	Ascan ultrasonography	23.05	3.21	3.69	Clear
Mallen et al[19]	Jordan	NR	17–40	Ascan ultrasonography	23.13	3.19	3.85	Clear
Present study	Libya	35.36	17–75	Alladdin optical biometer	23.79	2.96	3.67	Clear lens

Abbreviations: mm, millimeter; AL, axial length; ACD, anterior chamber depth; IOL, intraocular lens; LT, lens thickness; NR, not reported.

This study involved 106 normal Libyan participants, with a mean age of 35.36 ± 13.35 years; the mean AL in the total study population was 23.79 ± 0.91 mm; this was slightly different from other studies from many countries that may be due to differences in race, genes, and diversity in age between the studies.[7] However, our reported values fall near the midrange of these studies that range between 22.96 and 24.7mm (see ►**Table 3)**.

Although the AL for males was slightly more than females (23.88 ± 1.04 vs. 23.72 ± 0.77; ►**Table 1**), this difference was statistically nonsignificant. It was also noticed that the AL decreases nonsignificantly (p= 0.70) with aging in the total study population (►**Table 2**); this observation goes well with some other studies that reported shorter AL with older people.[14,17,20] Grosvenor explained the decrease in AL with aging by the tendency of the eye to be emmetropic in order to counteract myopic shift caused by the increase in eye refractive power.[20]

The mean ACD in our study is comparable with the studies from Ethiopia,[9] Alaskan Eskimos,[17] Tanjong Pagar[14] (see ►**Table 3**), but it is deeper than other studies done in Iran[6] and China.[13] The ACD shows decrease in size with aging in the total study population (►**Table 2**) and a tendency to increase after 60 years of age (although number of participants in this age group is small), a result that was explained previously by researchers as a result of posterior rotation and atrophy of ciliary body by aging.[17]

The ACD unexpectedly was shallower in male participants than females (2.91 ± 0.68 vs 3.01 ± 0.58; ►**Table 1**), although this difference was not significant (p = 0.14); it is the opposite to many other studies. Hsu et al in their study found that gender is not an associated factor with ACD; it was the age and body height.[21]

The mean LT in the present study is 3.67 ± 0.62 mm, which was similar to Mashige and Oduntan study who reported a mean LT of 3.69 ± 0.25 mm in their study in South Africa; although differently less than other studies, (►**Table 3**), this difference could be explained based on that our study was done on younger population with clear lens, while most other researchers work on older population with cataractous lens. The males in the present study were having thicker lens than females (3.69 ± 0.63 vs 3.65 ± 0.62 mm), a result that is similar to other researchers.[6,18]

We noticed that the LT increased with age up to 60 years old then it started to decrease; this was statistically nonsignificant (p = 0.98; ►**Table 2**). We cannot rely on this decrease in thickness after 60 years of age because of small number of participants in this age grouping (only six). It was reported by other investigators that LT increases by age due to increase in the fibers formed inside the lens.[6,17]

Limitation of the Study

This study was limited by the small number of subjects included, as well by the absence of other information such as refractive errors, body height, and educational level of participants, since other studies showed a significant association with these factors.[13,16,21]

Recommendation

A longitudinal study with larger number of participants is needed to confirm the present study findings.

Conclusion

This study has shown that the AL, ACD, and LT in normal Libyans performed by the Aladdin optical biometer was comparable with studies from other populations. Age and gender differences have no effect on these parameters in Libyan patients.

Conflict of Interest
None declared.

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