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Distribution of Axial Length, Anterior Chamber Depth and Lens Thickness of Pre-Operative Cataract Patients in Indonesian Population

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Abstract

Purpose: Biometry measurement of pre-operative cataract patients plays a major role in calculating intraocular lens power. This study aimed to review and determine the distribution of biometry components, such as axial length (AL), anterior chamber depth (ACD), and lens thickness (LT) of pre-operative cataract patient in Indonesian population. **Methods:** A cross-sectional study data were obtained from 2015-2018 cataract surgery at Prima Husada Citra Hospital, Surabaya, East Java, Indonesia. A total of 1295 eyes with cataract was included in the study based on their medical record. We analyzed the data using descriptive analysis and correlated each variable using the Spearman's Rho analysis. **Results:** Mean AL, LT and ACD was 23.81 ± 1.46 mm, 4.49 ± 0.55 mm, 3.25 ± 0.70 mm respectively. Male has longer AL and deeper ACD with ($p < 0.001$), while LT was found thicker in female ($p = 0.005$). The increase of AL was accompanied by ACD ($r = 0.457$; $p < 0.001$) and a thinner LT ($r = -0.101$; $p < 0.001$). **Conclusions:** LT is increased with age while AL and ACD are shortened with age. There was a positive correlation between AL and ACD, but an inverse correlation between AL and LT.

Keywords

Anterior Chamber Depth, Axial Length, Cataract, Lens Thickness

1. Introduction

One of the most common surgical procedures in developing countries is cataract surgery. The accuracy of biometry measurement, especially the AL, plays a major role in calculating the intraocular lens power, which is an important factor for the surgery [1] [2] [3]. A previous observational study stated that postoperative ACD depends only on the AL, however, another study showed that post-operative ACD is related to preoperative biometry components such as AL, ACD, LT, cornea curvature and refraction [4]. This study aimed to review and determine the distribution of biometry components, such as AL, ACD, and LT of pre-operative cataract patients in Indonesian population. Our study worked with a large sample trying to give a better representation of biometry characteristic in Indonesian population.

2. Material and Methods

This cross-sectional study data were obtained from 2015-2018 cataract surgery at Primasatya Husada Citra (PHC) Hospital, Surabaya, East Java, Indonesia. A total of 1295 pre-operative cataract eyes medical records were examined. The inclusion criteria for this study are patients who underwent cataract surgery in the period of year 2015-2018 in PHC Hospital Surabaya with complete medical record data. The exclusion criteria were any co-morbidities in ophthalmology including glaucoma, retinal detachment, traumatic cataract, and any other ophthalmology condition except cataract. Medical records with missing data were excluded from the study. The data of age, sex, AL, ACD and LT were collected based on the medical records.

3. Results

In this study, there were 1295 eyes of preoperative cataract patients met the inclusion criteria. The mean age of the patients was 63.57 ± 9.52. The mean age of male was 63.49 ± 10.15 and the mean age of the female was 63.63 ± 8.95. **Table 1** shows the demographic characteristic of the patients. The mean of biometry parameters are shown in **Table 2**.

Independent t-test showed a significant difference between AL, LT and ACD between group of sex. Both AL and ACD were longer and deeper in male while LT mean was found thicker in female as shown in **Table 3**.

Table 1. Summary of demographic profile of Cataract patient.

Baseline Characteristic	Value
Sex	
Male N (%)	598 (46.2%)
Female N (%)	697 (53.8%)
Age Mean ± SD	63.57 ± 9.52
Laterality	
Right Eye	665 (51.4%)
Left Eye	630 (48.6%)

As shown in Table 4 and Figure 1, most of the patients were aged 56 - 65 and patients aged 66 - 75 were ranked second. Figure 2 and Figure 3 further explain the distribution of AL, LT, and ACD by the group of age. As shown in Figure 2, in our study the axial length decreases by age. Figure 3 shows how LT increases with age whereas ACD decreases with the increment of the LT and Age. This correlation between age, ACD, and LT is further discussed in Table 5.

Figure 4 showed the distribution of axial length was skewed toward myopic side but increased in the last category (>27.00 mm). The shortest axial length in the first category was 13.30 mm, while the longest axial length was 37.63 mm. About 548 of 1295 (42.3%) eyes were categorized in 23.00 - 23.99 group of AL. Mean AL was 23.81 ± 1.46 mm. The distribution of lens thickness ranges between the thinnest lens (1.36 mm) and the thickest lens (8.73 mm). The majority of eyes (457 of 1295) were having thickness between 4.50 - 4.99 mm.

Table 2. Patient's baseline characteristic.

Baseline Characteristic	Value
Axial Length Mean ± SD (mm)	23.81 ± 1.46
Lens thickness Mean ± SD (mm)	4.49 ± 0.55
Anterior Chamber Depth Mean ± SD (mm)	3.25 ± 0.70

Table 3. Mean distribution by sex.

	Male	Female	p-value
AL	24.01 ± 1.34 mm	23.63 ± 1.53 mm	<0.001
LT	4.44 ± 0.54 mm	4.53 ± 0.55 mm	0.005
ACD	3.38 ± 0.90 mm	3.14 ± 0.42 mm	<0.001

Table 4. Distribution of AL, LT, and ACD as mean by sex and age.

	n (%)	AL (mm) Mean ± SD	LT (mm) Mean ± SD	ACD (mm) Mean ± SD
Sex				
Male	598 (46.2%)	24.01 ± 1.34	4.44 ± 0.54	3.38 ± 0.90
Female	697 (53.8%)	23.63 ± 1.53	4.53 ± 0.55	3.14 ± 0.42
Age				
<46	48 (3.7%)	24.01 ± 1.93	4.45 ± 0.90	3.27 ± 0.47
46 - 55	179 (13.8%)	24.29 ± 1.93	4.30 ± 0.48	3.41 ± 0.43
56 - 65	517 (39.9%)	23.80 ± 1.41	4.46 ± 0.52	3.29 ± 0.97
66 - 75	434 (33.5%)	23.71 ± 1.21	4.58 ± 0.53	3.16 ± 0.39
>75	117 (9.0%)	23.38 ± 1.27	4.56 ± 0.55	3.14 ± 0.42

Table 5. Spearman's correlation age.

	AL	LT	ACD
Age	r = −0.115 $p < 0.001$	r = 0.173 $p < 0.001$	r = −0.184 $p < 0.001$
AL	-	-	r = 0.457 $p < 0.001$
LT	-	-	r = −0.101 $p < 0.001$

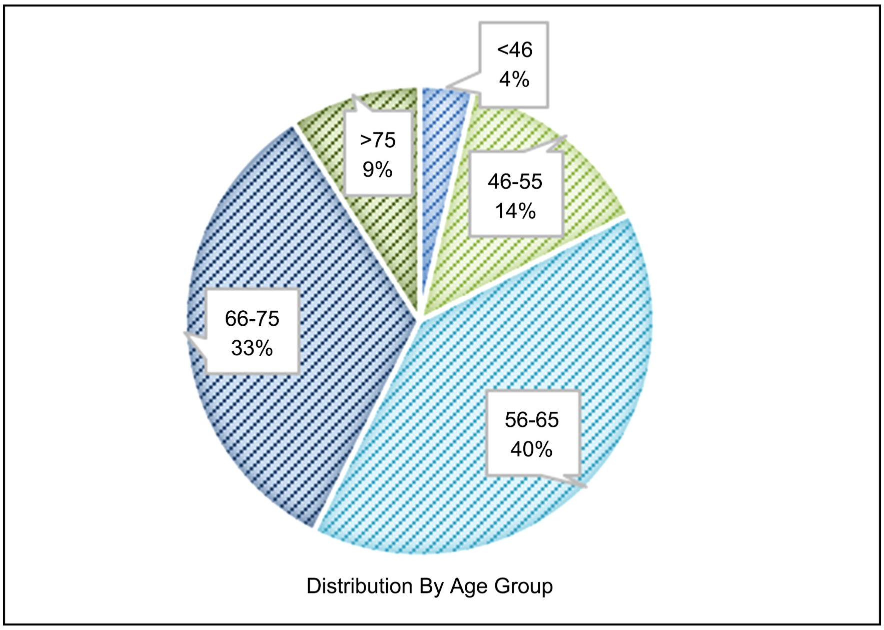

Figure 1. Distribution by age group.

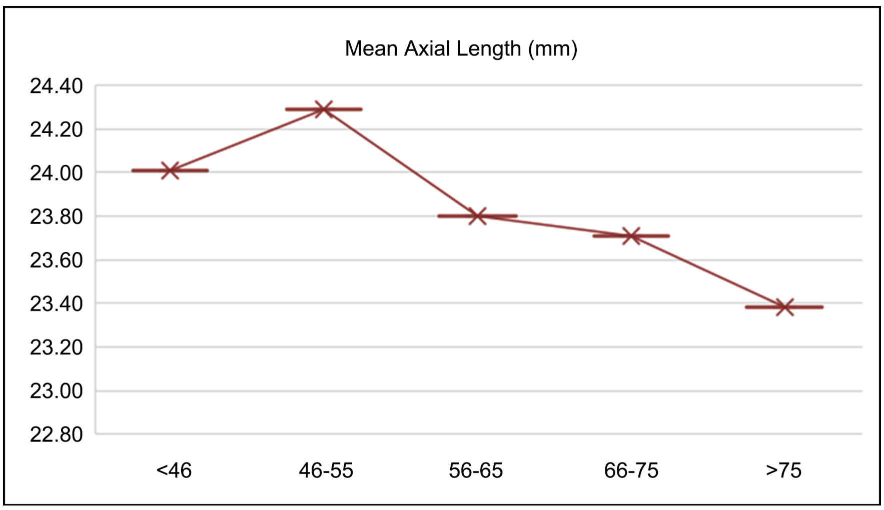

Figure 2. Distribution of axial length mean by age group.

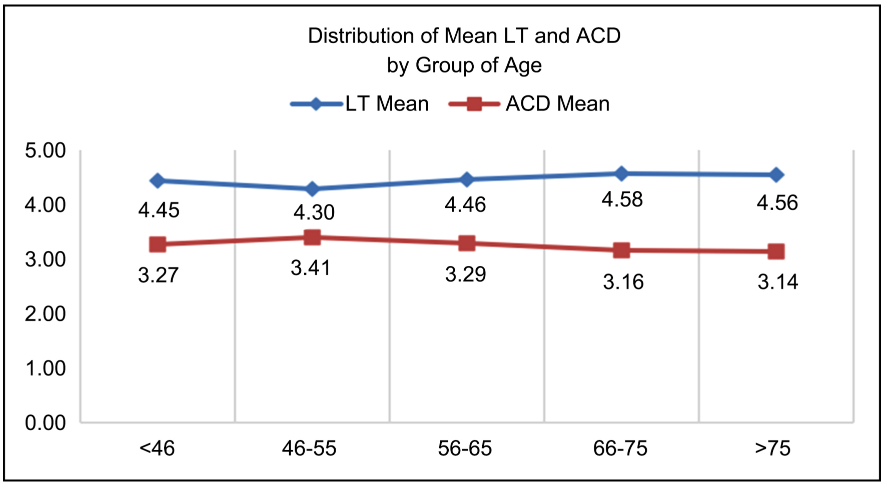

Figure 3. Distribution of lens thickness and anterior chamber depth mean by age group.

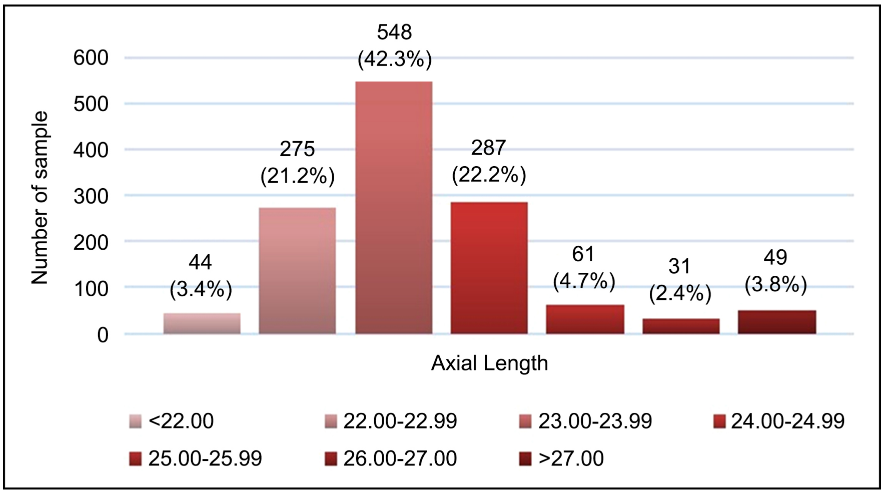

Figure 4. Distribution of axial length characteristic.

Table 5 comprises the correlation between age, AL, and LT. A positive correlation between age and LT was found in this study, however, age, AL and ACD were an inverse correlation. Older patients tend to have thicker lens ($r = 0.173$; $p < 0.001$). The increase of age is followed by shorter AL ($r = -0.115$; $p < 0.001$) and shallower ACD ($r = -0.184$; $p < 0.001$). Table 5 shows the correlation of ACD and LT to the AL. The increase of AL was followed by a profound ACD ($r = 0.457$; $p < 0.001$) and a thinner LT ($r = -0.101$; $p < 0.001$).

4. Discussion

The goal of cataract surgery is to give the best accuracy of refractive errors. The refractive errors after surgery are resulting from the intraocular lens (IOL) and corneal cylinder in patients with normal retinal and optic nerve function. IOL power calculation is influenced by ocular biometry such as AL, ACD, LT and K. Besides the ocular biometry, the other important factor is the position and stability of IOL which can be measure by the ACD which represent the effective lens position (ELP) [5].

In this study, the mean ACD was 3.25 ± 0.70 mm. Another study in Iran showed the mean ACD was 2.62 mm which is lower than our study [6]. The mean ACD was comparable with a study in South China (3.13 mm), Myanmar (2.81 mm) and USA (2.86 ± 0.45 mm) [7] [8] [9]. Our study showed that the mean ACD is greater in male with 3.38 ± 0.90 mm than female 3.14 ± 0.42 mm. Similar gender difference also showed in Reykjavik Eye Study with mean ACD in male 3.20 mm and female 3.08 mm [10]. In Mongolian population, a report also stated that ACD in male is greater than female, with 2.87 mm and 2.77 mm [11]. Meanwhile, a study in BMES showed that the ACD is greater in female than male with 3.06 mm and 3.04 mm [3].

As shown in **Table 6**, we compare our mean AL which is slightly higher than study in the USA, South China, Iran and Myanmar where the mean AL was 23.46 ± 1.03 mm, 23.48 mm (23.40 - 23.55), 23.14 mm and 22.76 mm consecutively [6] [7] [8] [9]. We found that mean AL is slightly higher in male (24.01 ± 1.34 mm) than female (23.63 ± 1.53 mm). This study also consistent with several studies that also showed that male has higher axial length than female. In Iranian population study showed axial length in male 23.41 (23.37 - 23.46) is longer than in female 22.95 (22.91 - 22.98) [6]. A study in Blue Mountain Eye Study within 10 years showed the mean AL is greater in male 23.76 mm than in female 23.19 mm [3] [12]. In an age population in South China male AL (23.68 mm) was significantly longer than female AL (23.23 mm) [8].

Our study showed that mean LT is 4.49 ± 0.55 mm. This is thicker than the study in Iran where the mean was 4.28 mm (4.27 - 4.29) [6], but thinner compare with the study in the USA where the mean LT was 4.93 ± 0.56 mm (3.03 - 6.41 mm) [9]. Our study found the mean of LT were thicker in female (4.53 ± 0.55 mm) than male (4.44 ± 0.54 mm). This result was different compared to a study in Iranian population where male has shorter LT (3.68 - 4.85 mm) than female (3.71 - 4.90 mm) [6].

Our study found a correlation between age with AL, ACD and LT. AL was shortened with the increase of age and ACD were shallowed whole LT increasing with age. Similar with our study, an Iranian study found that AL and ACD were shortened with age and LT increased [6].

Table 6. Comparison of AL and ACD current and previous.

Study	Axial Length (AL)	Anterior Chamber Depth (ACD)
Iran	23.14 mm	2.62 mm
South China	23.48 mm	3.13 mm
Myanmar	22.76 mm	2.81 mm
USA	23.46 ± 1.03 mm	2.86 ± 0.45 mm
Indonesia	23.81 ± 1.46 mm	3.25 ± 0.70 mm

A study in Los Angeles Latino Eye Study Group also showed that older individuals had shallower ACDs ($P < 0.001$) [13]. Another study in an older Caucasian population found that from age 59 years or older, there is a mean reduction for 0.12 mm per decade in women and 0.02 mm in men [14]. Jivrajka *et al.*, showed that AL was found to be longer ($r = -0.127$; $P < 0.001$) and ACD was found deeper ($r = -0.250$; $P < 0.001$) in younger individuals, while LT tended to be thicker ($r = 0.385$; $P < 0.001$) in older individuals [9]. The trend for an axial length decrease that is in parallel to aging was also found in researches done in the US, China, India, and Mexico [3] [15] [16].

Also linear with our study, a study in Nigeria showed a positive correlation between AL and ACD. This study stated that a 1 mm increment of AL is associated with 0.07 mm increment of ACD [17]. Results in our study was also similar with a study conducted in South Africa which found a positive correlation between AL and ACD ($r = 0.66$; $p < 0.001$) and negative correlation between LT and ACD ($r = -0.68$; $p < 0.001$) [18].

The increasing of AL was followed by a deeper ACD ($r = 0.423$; $p = 001$) and a thinner LT ($r = 0.179$, $p = 001$) [9]. There was positive correlation between AL and ACD [3]. Jivrajka *et al.*, shows the increase in AL was followed by the deeper ACD ($r = 0.423$; $p = 001$) and thinner AL ($r = 0.179$, $p = 001$) [9]. Similar with the previous study, Fotedar *et al.* also reported a positive correlation between AL and ACD [3].

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5. Conclussion

LT is increased with age while AL and ACD are shortened with age. There was a positive correlation between AL and ACD, but an inverse correlation between AL and LT.

Conflict of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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