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Optical Biometry versus Applanation Ultrasound Biometry in Axial Eye Length Measurement in Pseudophakia

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ABSTRACT

Purpose: to compare axial eye length (AEL) measurement in pseudophakic eyes by optical biometry and applanation ultrasound (u/s) biometry.

Methods: a prospective, case controlled and comparative study was performed at Al-Zahraa University Hospital clinic from (January 2016 – December 2016). In total 45 eyes were enrolled; 24 pseudophakic eyes were attending the clinic for routine post operative follow up; and 21 eyes with clear crystalline lens as a control group. AEL was measured in both groups using both optical biometry and applanation u/s biometry.

Results & Conclusions: both optical biometry and applanation u/s biometry show no significant difference in AEL measurement in pseudophakic eyes as well as the control group.

Key words: Pseudophakia, Ultrasound biometry,

INTRODUCTION

AEL plays a main role in determining postoperative refraction and is responsible for 54% of the actual refractive error. AEL error of 100μm translates to a postoperative refraction error of 0.28 D[(1)]. The advent of new premium implant technologies has increased patient expectation for exceptional postoperative vision, in turn decreasing the acceptable margin for error in Intra ocular lens (IOL) power calculation[(2)]. Until recently, AEL was measured by using applanation technique, which involves contact with the cornea and can result in corneal epithelial injury, infection, and patient discomfort[(3)]. To overcome this limitation, a partial coherence interferometer (PCI) was introduced (optical biometry). AEL measured by this method was comparable to that of other methods in precision. Especially considering that the method is of the non-applanation type, it has the advantage of giving the patient less discomfort and has a low interobserver error[(4)]. Currently, the AEL can be obtained by using either the applanation u/s biometry or the optical biometry. Optical biometry has been gaining popularity due to the fact that it offers an easy, contact- free method to quickly and accurately assess the AEL[(5)]. Optical biometry is also superior to applanation u/s biometry in the measurement of pseudophakic and silicone oil-filled eyes[(6)]. The current study focused on the accuracy of optical biometry in AEL measurement in pseudophakic eyes and comparing these measurements with applanation u/s biometry to help later in IOL power calculation in eyes necessitating IOL exchange.

SUBJECTS AND METHODS

This prospective, case controlled and comparative study included 45 eyes, in which 24 eyes were pseudophakic and 21 eyes with clear crystalline lens (as a control group). The patients were selected from outpatient clinic of Al-Zahraa University Hospital from (January 2016– December 2016) who attended for routine examination. All the eyes were examined by slit lamp (S/L) first to assess the anterior segment (Cornea, tear film) and state of the lens. B- scan was performed in pseudophakic eyes with insufficient clear media to be excluded from the study. Other exclusion criteria include inability to fixate, head tremors, tear film abnormalities and previous ocular surgery rather than cataract extraction. AEL measurement was carried by Mentor Advent^{TM} A/B system equipped with 7.5-15 MHz real-time high frequency probe with the contact method for applantation u/s biometry technique and NIDEK-AL-Scan biometer for optical biometry technique. The eyes were classified according to AEL into hypermetropic eyes with AEL less than 22.50 mm, emmetropic eyes with AEL 22.50-24.50 mm and myopic eyes with AEL more than 24.50 mm. Optical biometry was always performed first followed by applanation u/s biometry to avoid the confounding effect of potential corneal indentation by the probe which may decrease A.C. depth with subsequent decrease in AEL measurement. Statistical analysis was performed for both measurements. **The study was approved by the Ethics Board of Al-Azhar University and an informed written consent was taken from each participant in the study.**

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Statistical Analysis

Data was analyzed by Microsoft Office 2010 (excel) and Statistical Package for Social Science (SPSS) version 16. Parametric data was expressed as mean ± SD, and non parametric data was expressed as number and percentage of the total. Comparing the mean ± SD of 2 groups was done using paired and unpaired student's test P value > 0.05 is considered non- significant (NS). P value ≤ 0.05 is considered significant.
P value ≤0.01 is considered highly significant.

RESULTS

Of the 45 eyes included in the study; 24 eyes were pseudophakic; (5 eyes were hypermetropic, 12 eyes were emmetropic and 7 eyes were myopic) and 21 eyes had clear crystalline lens (of them 7 eyes were hypermetropic, 7 eyes were emmetropic and 7 eyes were myopic).

The results were scheduled according to AEL in the following figures and tables.

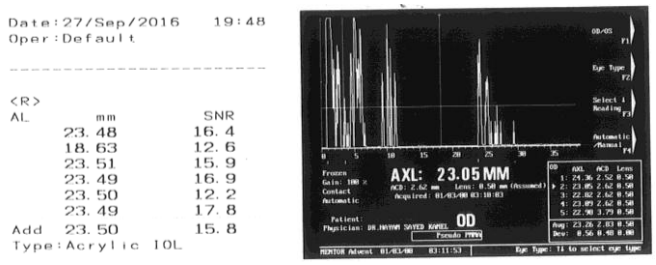
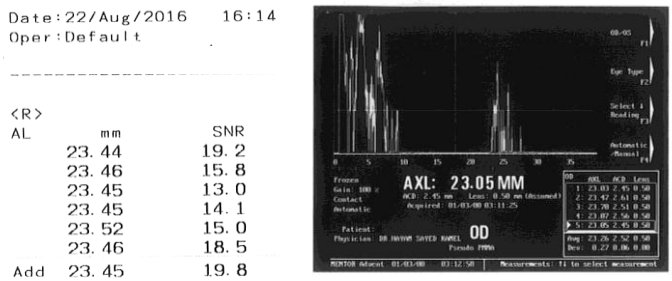


Fig.1. A- Case (2). Pseudophakic – emmetropic



B- Case (11). Pseudophakic - emmetropic

Emmet. = Emmetropia, Hypermetr. = Hypermetropia, Myopia = Myopia, App. = Applantation u/s biometry
Optical = Optical biometry.

Table 1. Statistical analysis of pseudophakic emmetropic eyes

Emmet.	App.	Optical
Mean	*23.39*	*23.69*
SD	*0.63*	*0.62*
Min	*22.24*	*22.57*
Max	*24.86*	*24.69*
P value	*0.244*	
	NS	

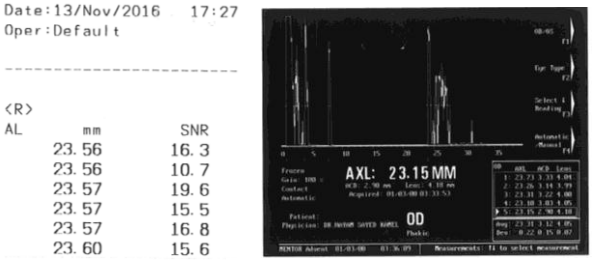
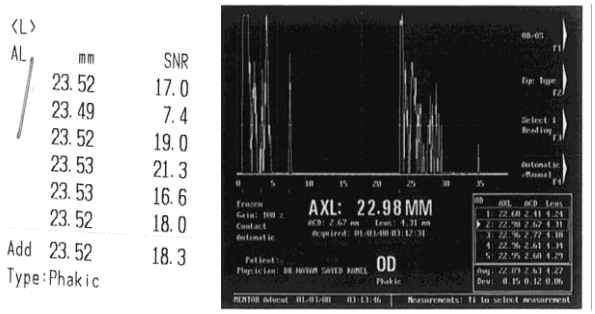


Fig.2. A-Case (1). Phakic - emmetropic



B-Case (7). Phakic - emmetropic

Emmet.	App.	Optical
Mean	*23.42*	*23.41*
SD	*0.15*	*0.15*
Min	*23.18*	*23.18*
Max	*23.57*	*23.6*
P value	*0.890*	
	NS	

Table 2. Statistical analysis of phakic - emmetropic eyes

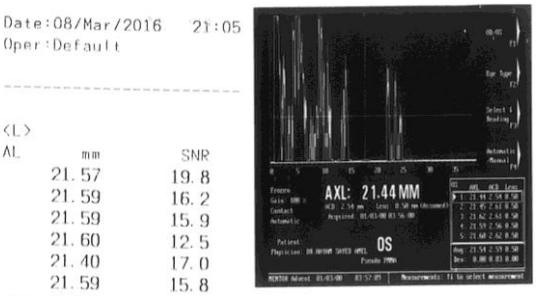
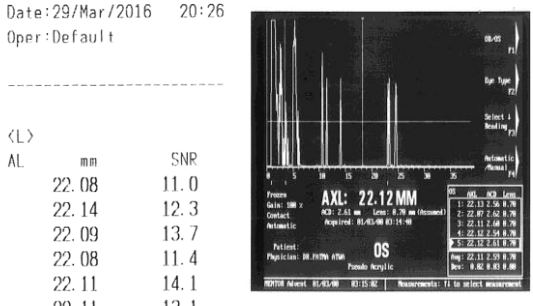


Fig.3. A- Case (2). Pseudophakic - hypermetropic



B- Case (3). Pseudophakic – hypermetropic

Table 3. Statistical analysis of pseudophakic hypermetropic eyes

Hypermetr.	App.	Optical
Mean	*21.72*	*21.30*
SD	*1.02*	*0.83*
Min	*20.8*	*20.38*
Max	*23.28*	*22.09*
P value	*0.488*	
	NS	

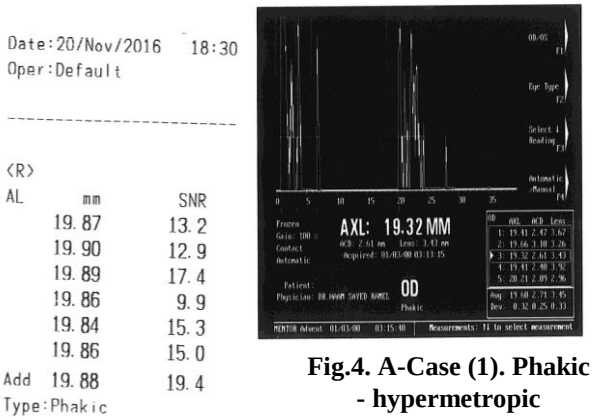
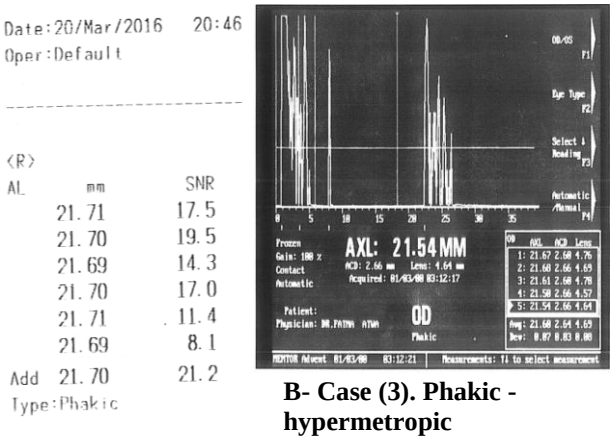


Fig.4. A-Case (1). Phakic - hypermetropic



B- Case (3). Phakic - hypermetropic

Table 4. Statistical analysis of phakic - hypermetropic eyes

Hypermetr.	App.	Optical
Mean	*21.49*	*21.32*
SD	*1.13*	*1.31*
Min	*19.88*	*19.3*
Max	*22.46*	*22.53*
P value	*0.800*	
	NS	

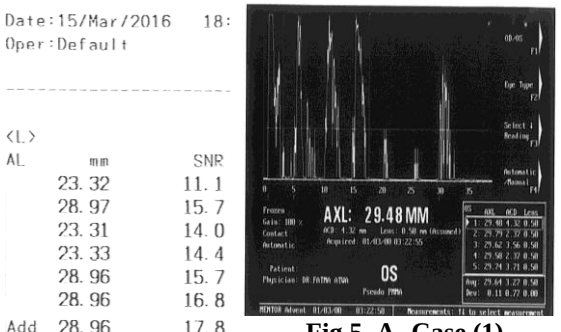
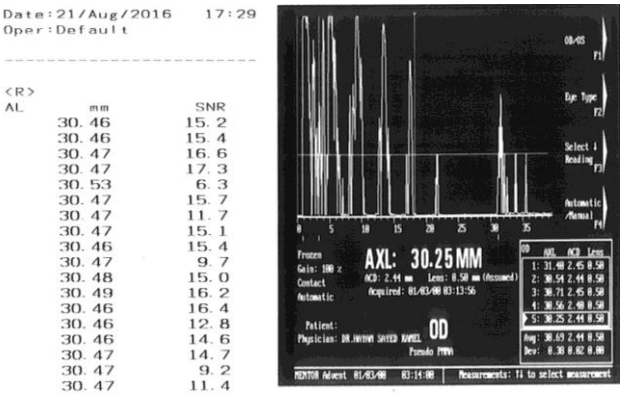


Fig.5. A- Case (1). Pseudophakic - myopic



B- Case (3). Pseudophakic - myopic

Table 5. Statistical analysis of pseudophakic myopic eyes

Myopia	App.	Optical
Mean	*27.27*	*28.99*
SD	*3.39*	*2.84*
Min	*21.34*	*25.37*
Max	*30.69*	*32.33*
P value	*0.326*	
	NS	

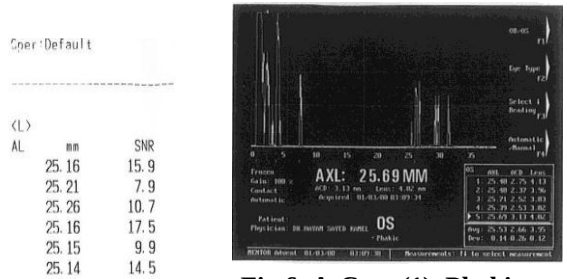
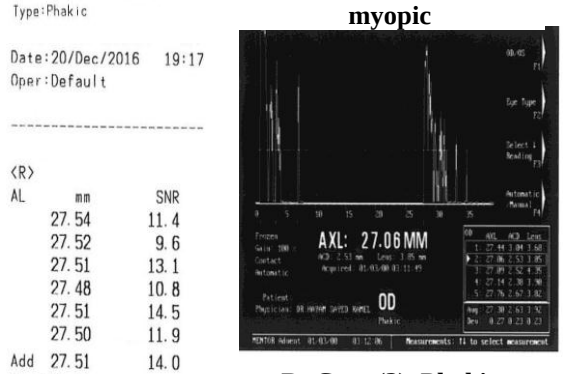


Fig.6. A-Case (1). Phakic - myopic



B- Case (3). Phakic - myopic

Table 6. Statistical analysis of phakic- myopic eyes

Myopia	App.	Optical
Mean	*28.45*	*28.47*
SD	*1.25*	*1.20*
Min	*26.47*	*26.48*
Max	*30.21*	*30.25*
P value	*0.976*	
	NS	

Tables 7-9 are collecting tables of pseudophakic eyes.

Table 7. Emmetropic eyes

Emmet.	App.	Optical
Case 1	*23.89*	*24.49*
2	*23.26*	*23.50*
3	*22.64*	*22.57*
4	*23.41*	*23.44*
5	*23.91*	*23.30*
6	*23.30*	*23.91*
7	*23.17*	*23.80*
8	*23.26*	*23.49*
9	*22.67*	*23.06*
10	*23.89*	*24.34*
11	*23.26*	*23.45*
12	*24.36*	*24.42*

Table 8. Hypermetropic eyes

Hypermetr.	App.	Optical
Case 1	*21.28*	*21.99*
2	*21.54*	*21.58*
3	*22.11*	*22.09*
4	*20.89*	*20.38*
5	*20.80*	*20.44*

Table 9. Myopic eyes

Myopia	App.	Optical
Case 1	*29.64*	*28.96*
2	*24.48*	*25.37*
3	*30.69*	*30.47*
4	*30.12*	*32.33*
5	*31.34*	*32.33*
6	*27.38*	*27.78*
7	*26.87*	*26.27*

Tables 10-12 are collecting tables of control eyes.

Table 10. Emmtropic eyes

Emmet.	App.	Optical
Case 1	*23.31*	*23.57*
2	*23.33*	*23.41*
3	*23.52*	*23.33*
4	*23.57*	*23.31*
5	*23.31*	*23.35*
6	*23.18*	*23.47*
7	*22.89*	*23.52*

Table 11. Hympermetropic eyes

Hypermetr.	App.	Optical
Case 1	*19.60*	*19.88*
2	*19.30*	*19.91*
3	*21.68*	*21.70*
4	*21.71*	*21.75*
5	*22.46*	*22.22*
6	*22.40*	*22.19*
7	*22.32*	*22.43*

Table 12. Myopic eyes

Myopia	App.	Optical
Case 1	*25.53*	*25.15*
2	*29.17*	*29.01*
3	*27.30*	*27.51*
4	*30.21*	*30.18*
5	*26.47*	*26.57*
6	*28.43*	*28.53*
7	*27.43*	*27.67*

DISCUSSION

In applanation u/s biometry, the AEL is determined by measuring the reflection of the anterior surface of the cornea and the internal limiting membrane of the retina. The optical biometry measures AEL from anterior surface of the cornea to the retinal pigment epithelium[7]. According to previous studies, It is known that optical biometry show greater or similar accuracy compared to the applanation u/s biometry technique in AEL measurement in phakic eyes[8]. However in pseudophakic eyes many studies reported optical biometry benefit over the applanation technique[9]. Conversely, other studies reported similar precision between those two techniques[10].

In our study, we found high precision and reproducibility with both techniques in AEL measurement in pseudophakic eyes. The AEL measurement showed no significant difference in emmetropic, myopic and hypermetropic eyes. This is very crucial in eyes necessitating explantation of an IOL and replacement with other suitable IOL.

The high accuracy level of both techniques was also demonstrated before[9,10].

This study suggests that, applanation u/s biometry can replace optical biometry – if not available – in AEL measurement in pseudophakic eyes and offers a similar degree of accuracy.

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