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# Axial Eye Length Assessment in Silicone Oil-Filled Eyes

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## ABSTRACT

**Purpose:** to compare the reliability of axial eye length (AEL) measurement in silicone oil-filled phakic eyes by conventional B-scan ultrasonography through the eyelid, after a correcting factor, to partial coherence interferometry (PCI) measurement.

**Methods:** a prospective and comparative study was performed at Al-Zahraa University Hospital clinic from (January 2016 - December 2016). In total 13 phakic eyes of 13 patients who underwent vitrectomy and silicone oil filling were enrolled into the study. AEL was measured by B-scan and compared to measurement by PCI.

**Results & Conclusions:** there was no significant difference in AEL measurement by either B-scan ultrasonography through the eyelid, after a correcting factor, and PCI.

**Key words:** Silicone Oil, Optical biometry, B-scan ultrasonography.

## INTRODUCTION

Silicone oil (SO) has become increasingly useful as a tamponade in the vitreous cavity for complicated retinal surgery. The low sound velocity of SO can result in pronounced sound attenuation and difficulty in identifying the retinal spike. The sound velocity of SO varies depending on the particular SO used (e.g., 987 m/sec [1,000 centistokes (cs)] & 1,040 m/sec [5,000 cs])[3]. The optical and sound attenuation properties of SO make AEL measurement difficult. SO leads to the following artifacts in ultrasonography:

1. Longer eye due to slower sound speed,
2. Multiple fluid interfaces,
3. Sound absorption by the oil, leading to poor penetration[5]. In eyes that have SO as a tamponade agent, there is an apparent increase in AEL, as measured by B-scan. This is because the velocity of sound in SO is slower than in vitreous humour, being 987 m/s in SO of viscosity 1000 cS, compared to 1532 m/s in aqueous and vitreous. When the vitreous humour is replaced with SO, it takes approximately 1.5 times as long for an ultrasound pulse to traverse the vitreous cavity[2]. Accurate determination of AEL in SO-filled eyes can present a dilemma since the true AEL of the eye is often unknown, and AEL of the SO-filled eye measured by the conventional B-scan is greater than the true AEL[6]. Both PCI and B-scan could be used to measure the AEL in SO-filled eyes. However, the AEL obtained with B-scan is much longer than the actual value if not adjusted[10]. In comparison, the PCI may be a good solution for the measurement of the AEL in SO-filled eyes because of its optical interference mechanism[3,4]. AEL measurement using a conversion factor of 0.71 multiplied by the AEL measured in the presence of SO has also been suggested. The ratio of vitreous cavity diameter with oil to that without oil was 0.62. However, this was done for SO of 1,300 cs only. Oils of different viscosity may have different constants that must be determined[5]. Many siliconized eyes are highly myopic with posterior staphyloma, adding to the challenge of identifying the silicone–retinal interface at the macula and resulting in inaccurate calculation of IOL power[7]. The current study focused on the reliability of AEL measurement in SO-filled phakic eyes by conventional B-scan ultrasonography through the eyelid, after a correcting factor, compared to PCI measurement.

## SUBJECTS AND METHODS

This prospective and comparative study included 13 phakic eyes of 13 patients who underwent vitrectomy and SO filling in Al-Zahraa University Hospital. The patients were selected from the outpatient clinic from (January 2016 - December 2016) who attended for routine postoperative



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follow up. All eyes underwent complete ophthalmological examination prior to being enrolled into the study. Exclusion criteria were corneal opacities, cataract, retinal detachment and glaucoma. AEL measurement was carried by Mentor Advent™ A/B system equipped with 7.5 MHz real-time high frequency probe for B-scan technique and NIDEK-AL-Scan optical biometer for PCI technique. 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.**

***Statistical Analysis***

Data were analyzed by Microsoft Office 2010 (excel) and Statistical Package for Social Science (SPSS) version 16. Parametric data were expressed as mean ± SD, and non parametric data were expressed as number and percentage of the total. Comparing the mean ± SD of the two techniques was done using unpaired student's t 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**

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

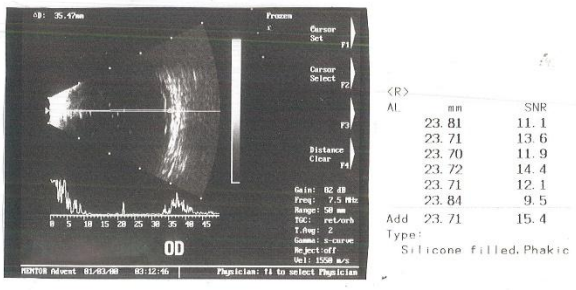


**Fig. 1. Case (12). Paraxial B-scan measurement of AEL (visual line) vs. PCI measurement of same eye**

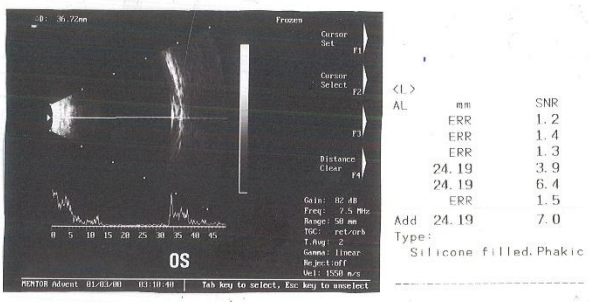


**Fig.2. Case (4). Paraxial B-scan measurement of AEL (visual line) vs. PCI measurement of same eye**

PCI = AEL measurement by PCI.
B-scan corr. = AEL measurement by B-scan after a correcting factor (0.64).
All measurements are in mm.

**Table 1. Collecting table of examined eyes**

| Cases | PCI | B-scan corr. | B-scan |
|---|---|---|---|
| 1 | 27.48 | 25.42 | 38.13 |
| 2 | 22.78 | 21.26 | 31.89 |
| 3 | 27.97 | 26.16 | 39.24 |
| 4 | 24.19 | 24.48 | 36.72 |
| 5 | 24.63 | 25.55 | 38.33 |
| 6 | 23.65 | 22.05 | 33.13 |
| 7 | 27.06 | 26.85 | 40.28 |
| 8 | 23.92 | 22.81 | 34.22 |
| 9 | 24.47 | 24.93 | 37.40 |
| 10 | 24.17 | 23.12 | 34.69 |
| 11 | 23.21 | 23.02 | 34.53 |
| 12 | 23.71 | 23.64 | 35.47 |
| 13 | 23.32 | 22.52 | 33.78 |

**Table 2. Statistical analysis of the examined eyes**

| | PCI | B-scan corr. |
|---|---|---|
| Mean | 24.64 | 23.99 |
| SD | 1.74 | 1.71 |
| Min | 22.48 | 21.26 |
| Max | 27.97 | 26.85 |
| P value | 0.34611 | |
| | NS | |

The results of this study revealed no significant difference in AEL measurement by either B-scan ultrasonography through the eyelid, after a correcting factor, and PCI.

## DISCUSSION

Success in visual improvement of SO-filled eyes that require oil and/or cataract removal, and intraocular lens (IOL) implantation in one operation depends on an accurate AEL measurement. However, AEL measurement in SO-filled eyes is difficult to perform and measurement may be unobtainable, due to inclusion of optical and sound attenuation in SO properties. It has been suggested that PCI is more precise and useful in problematic eyes, including high myopia, staphyloma, or SO-filled eyes[(9)]. Accurate AEL measurement in siliconized eyes depends on accurate identification of the spikes of each segment inside the eye and using appropriate sound velocity for each segment[(7)]. To determine AEL in SO-filled eyes using B-scan ultrasonography data, previous studies showed a conversion factor of 0.64, which is a calculated ratio of the speed of sound (987 m/s) in SO with 1000 cS viscosity to that (1532 m/s) in vitreous humour[(8)]. It has been previously reported that the reliability of AEL measurement performed with B-scan ultrasonography, after a correcting factor, might be influenced by the presence of SO in vitreous cavity[(1)]. This is due to slow sound speed, error in measurement from multiple fluid interfaces, or poor penetration from sound absorption by oil[(9)]. The results of the current study suggest that there is no significant difference in AEL measurement in SO-filled phakic eyes by either B-scan ultrasonography through the eyelids, after a correcting factor, and PCI. So B-scan ultrasonography is as reliable as PCI in AEL measurement in SO-filled phakic eyes.

## CONCLUSION

Measurement of AEL in SO filled- phakic eyes by conventional B-scan ultrasonography through the eyelid after a correcting factor is as reliable as a PCI.

Although the use of AEL measurement of the fellow eye was undertaken before as an estimate of AEL measurement in SO-filled eyes, still AEL measurement before SO injection is a potential way to avoid fallacies in AEL measurement after SO injection. It's recommended to examine wide scale of eyes to confirm our results.

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