Refractive outcomes after cataract surgery: LENSTAR versus Immersion A-Scan Ultrasound Biometry
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Abstract:

• **Purpose**: To determine the accuracy of intraocular lens (IOL) calculations in eyes undergoing phacoemulsification cataract surgery with IOL implantation using Immersion A-scan Ultrasound (US) and LENSTAR biometry.

• **Method**: In this prospective study, either LENSTAR or Immersion A-scan US biometry was performed to determine the IOL dioptric power of 200 eyes of patients prior to phacoemulsification cataract surgery. Pre and postoperative refractive outcomes of these two groups of patients was compared.

• **Results**: The result showed no significant difference between the target spherical equivalent (SE) and the post-operative SE value by the LENSTAR (p-value = 0.632) or Immersion A-scan US biometry (p-value = 0.438) devices. The magnitude of difference between the 2 biometric devices were the same (p-value = 0.868).

• **Conclusion**: There was no significant difference in the predicted postoperative refractive outcome between immersion A-scan US biometry and LENSTAR. Based on the results, the immersion A-scan technique is as accurate as LENSTAR in the hands of an experienced operator.

#There is no financial interest in any product mentioned in this study
INTRODUCTION

• Currently two optical biometry devices are used to calculate the IOL power for cataract surgery.
  1) Partial coherence interferometry (PCI) the IOL Master, Carl Zeiss Meditec AG
  2) Optical Low-Coherence Reflectometry (OLCR) the LENSTAR LS900, Haag-Streit

- An alternative to the above two devices which has shown to provide a reliable, fairly accurate biometry is the Immersion A-scan ultrasonography
- There has been conflicting reports to whether optical biometry is superior to immersion A-Scan US for biometry (1),(2)
- A study done in our institution, showed that both optical biometry devices were accurate in biometry measurements and was superior to the Immersion A-Scan US(3)
- Sheridan Lam, MD(4), stated that OLCR group was superior to the immersion A-Scan US group in obtaining the desired refractive outcome. However he did not mention about the expertise of the Immersion A-Scan US operator(5). However in our study, we have utilized an operator with five years experience in this field.

(3)Jasvinder S, Khang TF, SarinderKKS, LooVP, Subrayan V. Agreement analysis of LENSTAR with other techniques of biometry. Eye 2011, 25, 717-724
OBJECTIVE
To compare the accuracy of IOL calculations in eyes undergoing phacoemulsification cataract surgery with immersion A-scan Ultrasound biometry and LENSTAR.

METHODS
This is hospital-based randomized prospective study where 2 months post-operative spherical equivalent was compared to the targeted predictive refractive outcome in biometry from 2 devices (LENSTAR LS900 vs. Immersion A-Scan US) in patients undergoing phacoemulsification surgery at the Ophthalmology clinic, University Malaya Medical Centre, during January to December 2012.

SELECTION CRITERIA
Adult patients (50 years – 80 yrs), elective cases, patients with no ocular pathology or media problem, eyes with axial length between 20 mm to 25 mm, patients with corneal astigmatism <1.5 diopters and without complications

SAMPLE SIZE
The sample size necessary for this study with 85% of power was calculated using the G*Power software v.3.0.10 Franz Faul, Kiel University, Kiel, Germany. According to this calculation, patients (1 eye from each patient) were enrolled until 100 patients were subjected to Immersion A-Scan US (Quantel Medical Fort Worth, TX, USA) group and 100 patients in the OLCR (LENSTAR LS 900, version 4.1 Switzerland) group.

The SRK-T formula was used to calculate the IOL power in all patients.

SURGICAL CRITERIA
• Surgeons operating had at least 5 years experience in phacoemulsification
• The operation was done from a superior approach with 2.4mm corneal incision made at the 11 o’clock position
• Accepted operation time was within 30 minutes
• All patients were implanted with an IOL into the capsular bag
RESULTS

Table below shows demographics of the patients recruited for the study:

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number of Patients (%)</th>
<th>p-value (Chi-square test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malay</td>
<td>52 (26%)</td>
<td>0.070</td>
</tr>
<tr>
<td>Chinese</td>
<td>78 (39%)</td>
<td></td>
</tr>
<tr>
<td>Indian</td>
<td>70 (35%)</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>87 (43.5%)</td>
<td>0.066</td>
</tr>
<tr>
<td>Female</td>
<td>113 (56.5%)</td>
<td></td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Diabetic</td>
<td>101 (50.5%)</td>
<td>0.888</td>
</tr>
<tr>
<td>Diabetic</td>
<td>99 (49.5%)</td>
<td></td>
</tr>
</tbody>
</table>

Boxplots and normal quantile-quantile plots were used to check visually for violation of the assumptions of equal variance and normality of the data. The spread of the boxplots were similar between the distributions from LENSTAR and Immersion A-Scan US for all measurements. However, there were possibly some outliers. Some boxplots displayed skewness indicating possible departure from normality assumption for the population of the measurements by LENSTAR and Immersion A-Scan US, particularly in the axial length and IOL power.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>LENSTAR Mean ± SD (Median)</th>
<th>Immersion A-Scan US Mean ± SD (Median)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Post Operative SE</td>
<td>-0.397 ± 0.207 (-0.375)</td>
<td>-0.421 ± 0.182 (-0.400)</td>
</tr>
<tr>
<td>Spherical Equivalent</td>
<td>-0.369 ± 0.557 (-0.250)</td>
<td>-0.380 ± 0.529 (-0.250)</td>
</tr>
</tbody>
</table>

Table above shows the mean ± standard deviation (SD) as well as the median for the measurements for LENSTAR and Immersion A-Scan US device.
Bar charts shows that a majority of the prediction errors and absolute prediction errors based on the measurements from LENSTAR and Immersion A-Scan US devices fall in the range of ±0.5D from the center 0.0D.

<table>
<thead>
<tr>
<th>Differences</th>
<th>LENSTAR</th>
<th>Immersion A-Scan US</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target - Spherical Equivalent, (Mean ± SD)</td>
<td>-0.0279 ± 0.5812</td>
<td>-0.0409 ± 0.5247</td>
</tr>
<tr>
<td>p-value (Paired t-test)</td>
<td>0.632</td>
<td>0.438</td>
</tr>
<tr>
<td>Means difference, (Mean ± SD)</td>
<td>0.0130 ± 0.0789</td>
<td></td>
</tr>
<tr>
<td>p-value (t-test)</td>
<td>0.868</td>
<td></td>
</tr>
</tbody>
</table>

From below quantile plot, the differences between the Target and Spherical Equivalent values were normally distributed.

Paired t-test results above showed no significant differences between the Target value given by LENSTAR (p-value = 0.632) or Immersion A-Scan US (p-value = 0.438) device with the corresponding Spherical Equivalent value. Also, the independent t-test shows that these magnitudes of differences due to LENSTAR and Immersion A-Scan US devices are the same (p-value = 0.868).
Targeting the desired post-operative refraction has been an important goal for surgeons performing cataract surgery.

- In this study, both the Immersion A-Scan US as well as the LENSTAR groups have shown to have exceeded the benchmark of visual acuity after cataract extraction\(^6\) (more than 55% within + 0.50 D and more than 85% within ±1.00 D from that of target refraction)

- Sheridan Lam reported refractive outcome was better in the OLCR group when compared with the immersion US group. He attributed this to the resolution of OLCR(LENSTAR), which at 0.01mm was higher than the resolution of immersion US, at 0.15 mm. The resolution of PCI (IOL Master) was 0.02 mm\(^7\), which is also higher than the resolution of Immersion A-Scan US. However, in this paper there was no information regarding the experience of the biometry operator, while in our study we had used an operator with 5 years experience in US biometry.

- In our study, the differences between the target and postoperative spherical equivalent values measured by LENSTAR and Immersion A-Scan US were normally distributed. \(t\)-test showed no statistical significant differences between the target SE and post op SE for LENSTAR (\(p\)-value = 0.632) and Immersion A-Scan US (\(p\)-value = 0.438). Independent \(t\)-test showed the magnitudes of differences between the LENSTAR and Immersion A-Scan US were the same (\(p\)-value = 0.868).

Hence Immersion A-Scan US and LENSTAR showed similar postoperative refractive outcome. Therefore Immersion A-Scan US is a reliable method that can be used for calculating the required intraocular lens for adult cataract surgery. It is important to note that immersion A-Scan biometry is much cheaper than optical devices and in situation where there is budgetary concern becomes an important consideration.


LIMITATION

Many surgeons factor, diabetes status of patients and different types of IOL brands used were limiting factors in this study.

CONCLUSION

Based on our study, Immersion A-Scan US is as accurate as LENSTAR in the calculation of IOL power in the hands of an experienced operator.