

Laser Interference Biometry and Conventional Acoustic Biometry on Staphylomatous Eyes

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Summary

While acoustic biometry measures along the optical axis of the eye, laser interference biometry evaluates the length of the visual axis. The possibility of fixation by the patient is advantageous, if present. Therefore, optical biometry by means of laser interferometry can be superior to ultrasonic measurements in asymmetrically shaped eyes.

Introduction

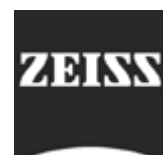
For ocular length measurement, which - apart from keratometry - yields the most significant parameter for intraocular lens calculation (IOL calculation), recently laser interference biometry (LIB) has become available in addition to conventional acoustic biometry [2], [3]. It is well known that especially highly myopic eyes show a higher incidence of eyeball deformities [1]. In these cases, the visual axis may considerably differ from the optical axis of the eye, i.e. the fixation point in the fovea need not necessarily coincide with the point aimed at by ultrasound. The following case report shows the different measurement results of both techniques and their effect on IOL calculation.

R/L	Stat	VK/mm	LD/mm	AL/mm	R1/mm	R2/mm	sph/D	cyl/D	CL/D	Visus
RA	N	3.16	3.94	25.54	7.40	7.48	0.00	0.00	0.00	1/25
LA	N	3.22	4.06	22.58	7.40	7.52	-0.50	-0.50	0.00	0.7

1			2			3		
IOL/D	REF/D	ANI/%	IOL/D	REF/D	ANI/%	IOL/D	REF/D	ANI/%
15.5	-2.9	14.4	16.0	-2.8	13.9	16.5	-2.9	13.4
15.0	-2.5	15.0	15.5	-2.4	14.6	16.0	-2.5	14.1
14.5	-2.2	15.7	15.0	-2.1	15.3	15.5	-2.1	14.8
> 14.0 <	-1.8	16.4	> 14.5 <	-1.7	16.0	> 15.0 <	-1.8	15.4
13.5	-1.4	17.1	14.0	-1.4	16.6	14.5	-1.4	16.1
13.0	-1.1	17.8	13.5	-1.0	17.3	14.0	-1.1	16.8
12.5	-0.7	18.5	13.0	-0.7	18.0	13.5	-0.8	17.5

RAYNER 755U poAC: 4.9 mm IOL-1	Memory lens U940A poAC: 5.4 mm IOL-2	IOL mit A=119.0 poAC: 5.7 mm IOL-3
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Fig. 1 Preoperative lens calculation based on results obtained by acoustic biometry.



Case History

In December 1997, a 67-year old female patient visited our Eye Hospital for cataract extraction on the right eye. The visual acuity with her own correction amounted to: OD -3.0 sph. -1.5 cyl./ $135^\circ = 0.1$ and OS -0.5 sph. -0.5 cyl./ $42^\circ = 0.7$. The use of other lenses did not improve visual acuity. The patient claimed to have always seen worse with the right eye, which gave rise to the assumption of an existent amblyopia. The anterior eye segment on the right eye showed a marked nuclear sclerosis and posterior capsular opacity; the fundus showed a small staphyloma as well as a distinctly inversely oblique entrance of the optic nerve. With the exception of a posterior capsular opacity, the left eye did not show any abnormalities.

The axial length measurement by means of acoustic biometry resulted in an ocular length of 25.54 mm on the right eye, and 22.58 mm on the left eye. As can be seen from Fig.1, the target refraction was -1.8 D for a Rayner lens Type 755U of $+14.0$ D.

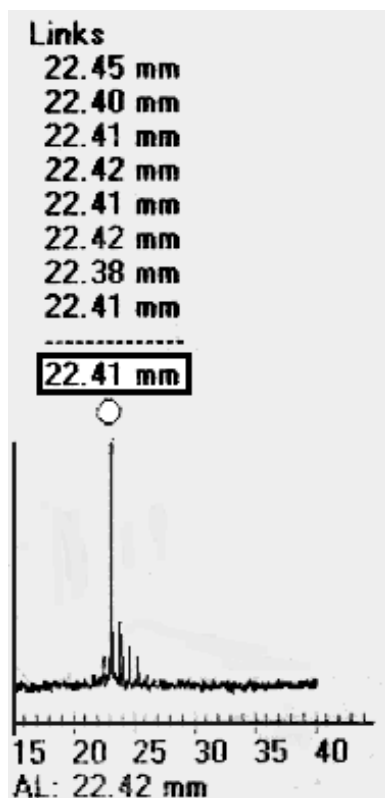


Fig.2 Postoperative axial length measurement with laser interference biometry of the left eye.

Results

When, 1.5 years later, the patient came for cataract extraction of the second (left) eye, the refraction of the already operated right eye amounted to $+4.0$ sph. -2.0 cyl./ 120° (spherical equivalent: $+3.0$ D) instead of the intended -1.8 D with a BCVA of 1.0. Thus, a refractive surprise of 5.8 D had occurred. In order to obtain a tolerable aniseikonia, it was now necessary to aim at a hyperopic target refraction of $+1.3$ D for the left eye. This was achieved by implantation of a $+21.0$ D Memory Lens U940A.

Postoperatively, we already had the possibility to perform laser interference biometry with the *IOLMaster of Carl Zeiss Jena*. With this instrument the following optical axial lengths were measured: 23.18 mm on the right eye, 22.42 mm on the left eye. Taking the pseudophakic correction factor of 0.11 mm into account, the axial length difference compared to ultrasound was -0.06 mm on the left eye, and -2.25 mm on the right eye. The latter results in a difference of IOL power of about 6.75 D (Figs. 2 and 3). Hence, the calculation based on laser interference biometry would not have led to such a severe hyperopisation.

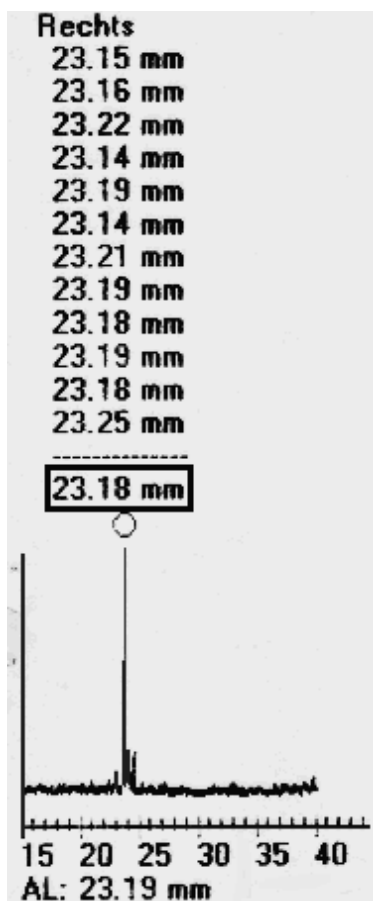


Fig. 3 Postoperative axial length measurement with laser interference biometry of the right eye.

OS:

**pseudophakic,
IOL = Memory lens U940A, 21.0 D**

AL = 22.41 + 0.11 mm

Optical: AL = 22.52 mm

Acoustic: AL = 22.58 mm

Difference: Δ AL = 0.06 mm

OD:

**pseudophakic,
IOL = Rayner 755 U, 14.0 D**

AL = 23.18 + 0.11 mm

Optical: AL = 23.29 mm

Acoustic: AL = 25.54 mm

Difference: Δ AL = 2.25 mm

$\cong \Delta$ IOL \approx 6.75 D

To find out, why the two measuring techniques resulted in such different results, a B-scan ultrasound examination was performed. The left eye showed a normal shape of the eyeball, whereas the right eye revealed a distinct staphyloma to the nasal side (Fig. 4). Thus, the fovea was not located along the longest axis of the eyeball, but at its shorter, steeper hemisphere. Since in laser interference biometry patients can fixate, measurements are taken along the visual axis. Therefore, the optical result was more accurate than the acoustic measurement, which is taken along the optical axis of the eye.

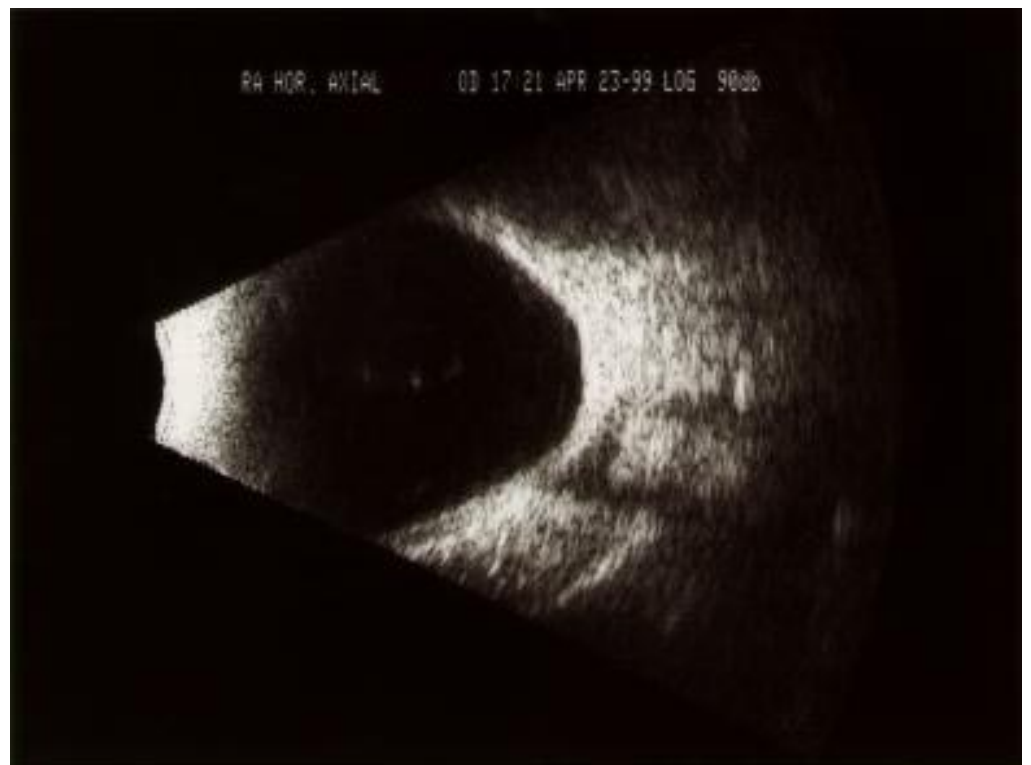


Fig. 4 Ultrasound B-scan echogram of the right eye in horizontal-axial section: distinct staphyloma towards nasal.

References

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- [2] HAIGIS W, LEGE BAM: Ultraschallbiometrie und optische Biometrie, in: Kohnen T, Ohrloff C, Wenzel M, (Ed.): 13. Kongress d. Deutschspr. Ges. f. Intraokularlinsen-Implant. und refraktive Chirurgie, Frankfurt 1999, Biermann-Verlag Köln, 180-186, 2000
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