ACCURACY OF INTRAOCULAR LENS CALCULATIONS USING THE ZEISS IOL MASTER. A PROSPECTIVE STUDY

This work has been presented at the BSCRS meeting during OB2000.

ABSTRACT

Purpose
Partial Coherence Interferometry (PCI) is a fast, non-contact method to calculate lens implant power for cataract surgery. It has been reported as a potentially more accurate method than ultrasound biometry.
Prospective study of the refractive outcomes of a consecutive series of patients undergoing phacoemulsification surgery with preoperative biometry by both ultrasound A-scan and PCI.

Methods
A series of 50 eyes of 35 patients underwent small-incision phacoemulsification cataract surgery and lens implantation by one single surgeon. All patients had preoperative biometry performed by both ultrasound using the Sonomed and IOL Master optical biometry. The IOL Master results were included in the SRK II formula to calculate the lens implant power. Postoperative refractive assessment was performed 4 weeks after surgery.

Results
The mean difference in axial length between ultrasound and optical biometry was 0.2 mm. The IOL Master measures a longer axial length. The mean keratometric power using the Javal instrument was 43.4D and for the Zeiss IOL Master was 42.9D. At the week 4 postsurgery assessment, the overall refractive outcome was in the range of (1D. Five patients were unable to undergo PCI biometry due to the density of cataract.

Conclusions
Intraocular lens calculations using the Zeiss IOL Master are easy to perform and result in excellent refractive outcomes. A-scan biometry is still needed in case of mature cataract.

INTRODUCTION: EMMETROPIA IS THE GOAL

Cataract extraction and artificial intraocular lens (IOL) implantation is one of the most frequent and successful ophthalmic surgical procedures today. One of the remaining problems, however, is accurate calculation of IOL power, in order to obtain the desired postoperative refraction.
While techniques in cataract surgery are constantly improving, the demand of patients and surgeons for a high predictability in the refractive result increases dramatically.
At a time where multifocal foldable lenses could be the future, a precise calculation of the power of intraocular lenses becomes even more critical. The data required for accurate intraocular lens calculations include axial length, corneal curvature and anterior chamber depth. These data are integrated in calculation formula's. The most commonly used are the SRK II, SRK-T and Holladay formula.

In **ultrasound biometry** (1) measurements of axial length can be obtained either by an applanation or an immersion technique. The resolution in axial length measurements is about 0.1 mm, corresponding to a mean postoperative error of 0.25 D.
When considering the **SRK II formula**: P = (A+C) - 2.5AL - 0.9K it is obvious that axial length is the biggest source of error in IOL power calculations. (4) Immersion scans are more precise because there is no corneal indentation. Keratometry is the second most important parameter leading to possible errors due to calibration and patient fixation.
Recently, **optical biometry** (2,3) techniques offer new possibilities. The technology of an instrument like the Zeiss IOL Master is based on laser interferometry with partial coherent light, often termed as partial coherence interferometry (PCI). Some important features of the IOL Master are the fact that it is a non-contact measurement with higher speed and higher accuracy with a resolution going up to 0.01 mm. The time needed for measurements is about 0.5 sec. The IOL Master provides a measuring range of 14 to 39 mm. The measurement results are operator independent: the reproducibility is high. Axial length can be measured in phakic, pseudophakic and aphakic eyes. The IOL Master still gives reliable results in pseudophakic eyes, in eyes with silicone in the vitreous and in eyes with asteroid hyalosis.

SUBJECTS AND METHODS

The purpose of the study was to compare IOL power calculations using the IOL Master versus ultrasound biometry and standard keratometry.
In a prospective study, optical and applanation ultrasound biometry were pre-operatively performed on 50 cataractous eyes. We used the optical biometry data given by the Zeiss IOL Master to calculate the desired IOL power with the SRK II formula.
In all patients the Allergan SI40 NB silicone foldable intraocular lens was implanted through a self-sealing 2,5 mm temporal incision after phacoemulsification. All interventions were performed by the same surgeon (Dr. J.C.V.). Patients were operated on using topical anesthesia.
Four weeks after surgery, the refractive outcome was determined. The preop ultrasound biometry data were retrospectively integrated in the SRK II formula to determine the refractive outcome.

RESULTS

Ultrasonic instruments measure the distance between the anterior surface of the cornea and the internal limiting membrane, whereas the IOL Master measures the distance between the anterior cornea surface and the pigment epithelium. Due to the thickness of the cell layer, the resulting differences of the measured axial length are between 150 -350 (m. Measurements using the ultrasonic contact technique cause additionally an applanation of the eye. In our study, we had a mean difference in axial length of 0.2 mm. (Fig. 1)

When using Javal keratometry, the mean corneal curvature was 43.4 D while mean IOL Master measurement was 42.9 D. (Fig. 2)

The difference of the IOL power according to optical biometry and according to US biometry is shown in Fig. 3. The IOL Master calculates an IOL that is 1.5 D or 1D less in about 30% of cases, an IOL that is 0.5 D less in 45% of cases and the same IOL as compared to ultrasound biometry in 20% of cases.

Using the data given by the IOL Master to calculate the IOL, we obtained an excellent refractive outcome. (Fig. 4) About 30% of patients had a spherical equivalent of 0 D, and the overall refractive outcome was in the range of ± 1 D.

Retrospectively, we calculated the refractive outcome that would have resulted when using the US biometry. (Fig. 5) We considered a 1 D difference in IOL power to result in a 1 D difference in refractive outcome. About 30% of patients would have had a spherical equivalent of -0.5 D, but in 6% of cases, the refractive outcome was higher than 1.5 D in myopia. In these 3 patients, there was an absolute difference in axial length measurements of ≥ 0.45 mm.

CONCLUSION

We evaluated the ease of use of the Zeiss IOL Master. It scored high as to its users-friendliness and reproducibility, making it an instrument which can be manipulated by paramedicals. The measurement itself takes less than a minute.
In patients with a very dense cataract however, the signal reflected at the retina is so small that it cannot be used for exact axial length measurement. In these circumstances ultrasound biometry is still needed: in our small series this represents 5 patients out of 50.
We may conclude that IOL measurements performed with the Zeiss IOL Master, using partial coherence interferometry, are easy to perform. The measurement requires minimal cooperativeness and fixation capability of the patient.
The refractive outcome obtained was excellent.

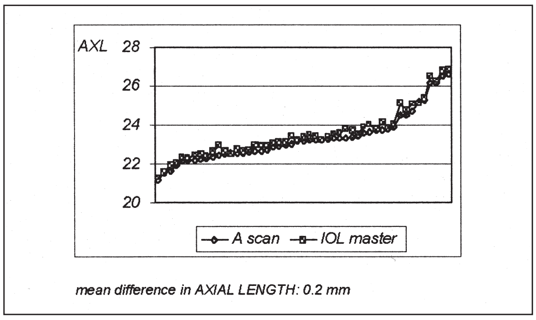

Fig. 1

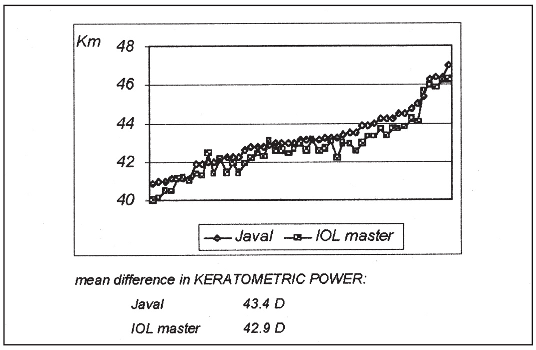

Fig. 2

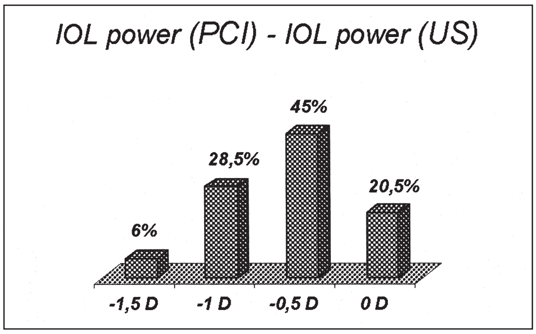

Fig. 3

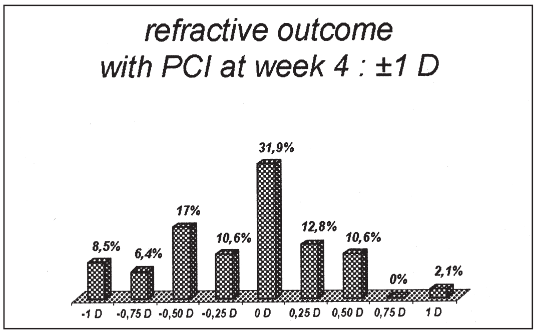

Fig. 4

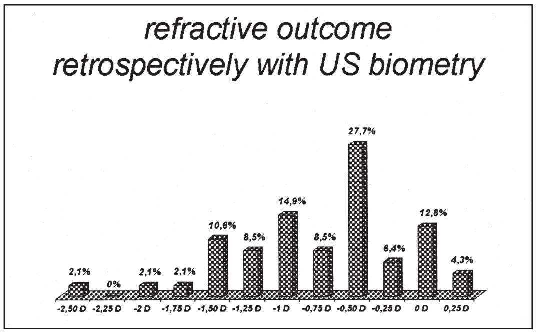

Fig. 5

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