ONE LIMITATION OF THE OPTICAL BIOMETRY TECHNIQUE IS THE SUBSTANTIAL ATTENUATION OF LIGHT CAUSED BY OPAQUE OCULAR MEDIA

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Accepted: 10.12.2023 **Published**: 01.01.2024

Keywords: Cornea, Tear Film, Optical Biometry.

Abstract

Pathologies of the cornea and tear film may impede optical biometry measurement by causing fixation issues. In conclusion, the postoperative refractive result following cataract surgery is similar for both the A-Scan and the Optical Coherence methods. Measurement of axial length with a one-dimensional A-scan ultrasound is highly variable and may significantly affect the result. Although the patient was not required to focus or look in a certain direction, the measurement might not accurately reflect the distance to the fovea if the patient was not properly positioned. That was a serious issue. Regarding progress, the machine's effectiveness needs to be enhanced to better penetrate ultrasonic waves in Applanation Biometry or light waves in Optical Coherence Biometry. Even though there are a number of machine updates and new technologies available, the problem is still quite serious technically. The machine's operation is another crucial component. Both the patient's cooperation and the machine operator's understanding of this are crucial to the process. When using Applanation Biometry, it is crucial to indent the cornea and place the transponder on the corneal dome. If done incorrectly, this might result in an inaccurate assessment of the axial length, which ultimately impacts the surgical outcome for refractive error. Similarly, no additional machine operating expertise is needed for Optical Coherence Biometry; however, the light in the observation room and the density of cataracts impact the outcome. It is important to select the options for the IOL Power calculation formula provided by this machine based on the surgeon's preference and the criterion for axial length.

Paper Identification

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Introduction

Another crucial factor in calculating IOL Power is choosing the right formula; multiple studies have shown that certain formulae perform better when the axial length is outside of the typical range. For the computation of IOL Power, no single line has been set as the standard.A unique solution will eventually be accessible, but until then, the manufacturer's A-constants must be accurate and tailored to the optical Biometry approach. Research is undoubtedly underway in this regard.Optical biometry replaced ultrasonic measurement as a major paradigm shift in the history of biometry. With the introduction of optical biometry with the first IOL Master over ten years ago, refractive cataract surgery truly got its start. The most recent innovations, such as the Lenstar, IOL-Master 700, and others, enable us to measure extra parameters with little technical assistance. By adding swept-source optical coherence tomography to noncontact, one-click measurement, we can measure lens thickness, corneal pachymetry, and anterior chamber depth. With a two-dimensional configuration of the foveal anatomy, we may obtain a reliable measurement even in cases of a highly dense cataract. They acquire the measurements even faster.Additionally, the accuracy of keratometry readings has been enhanced by these equipment. That is the crucial factor in determining the ideal lens power. These days, automated keratometry is integrated into the widely used optical biometers, which means that the procedure is centralized into a single tool and that the data can typically be accessed with only one click. Repeat measurements are easy to collect and accuracy is increased as a result. The most recent iteration of the IOL Master 700 employs telecentric keratometry, which makes keratometry more repeatable. This method improves the reproducibility of the measurements even in cases where the user's keratometry is not perfectly focused.

Proper IOL power selection can be greatly impacted by aberrations like as corneal asphericity. Results will be improved by biometers that extract additional data from the cornea. The study contained 400 eyeballs in its sample size; 192 (48.50%) of the eyes were male and 208 (51.50%) were female. The participants were split into three age groups: 40–50, 51–60, and 61–70 years old. Their ages ranged from roughly 40 to 70 years old. There is a male to female ratio of 1:1.05. The study's mean ± standard deviation of age falls into two categories: 61.1 ± 7.95 for the App Biometry group and 62.06 ± 8.48 for the Opt. Coh. Biometry group.

The distribution of cases by age groups for individuals aged 40 to 50 years old shows that there are 23 cases (11.50%) for optometry and 29 cases (14.50%) for appbiometry. 56 (28.00%) instances for approximation biometry and 45 (22.50%) cases for optical coherence biometry are found in the 51–60 age group; 115 (57.50%) cases for approximation biometry and 132 (66.00%) cases for optometry coherence biometry are found in the 61–70 age group.

Review of Literature

1) Jay Won Rhim, MD, Su Yeon Kang, MD and Hyo Myoung Kim, MD, PhD(2009) studied with 40 eyes (27 patients) for cataract surgery and had axiallengths measured with an Ocuscan RxP® biometer using both contact andimmersion techniques. As a reference, a contact type Ultrasonic biometer 820® (Method 3) was also used. They found 0.02 mm high value for axial length by the immersion biometry and concluded that the A-Scan applanation biometry (contact) and A-Scan immersion methods both are accurate for IOL power calculation if performed by a well-skilled examiner.[86]

2) Hrebcová J, Vasků A. et al. (2008) The axial length of 120 non-paired eyes was measured, using both contact and immersion techniques. The mean eye axial length using the contact technique was 23.28 mm, compared to the mean of 23.38 mm gained by the immersion technique. The standard deviation of the measurements using both techniques was less than 0.1 mm, [39].

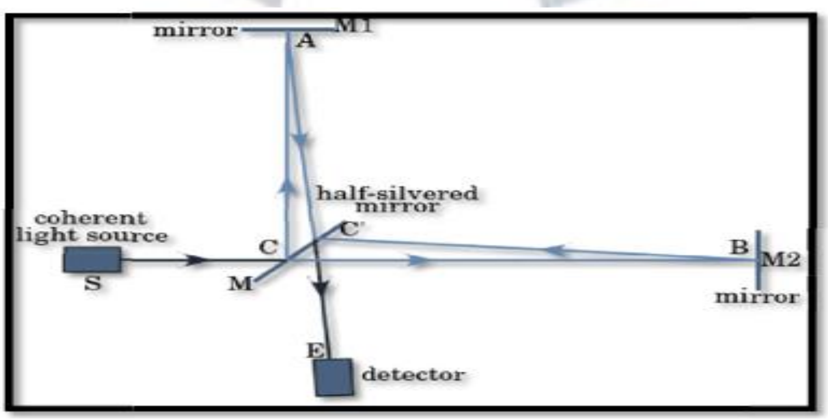
3) MARTIN FALHAR, JIŘÍ ŘEHÁK et al. (2010). The sample included 129 eyes of average age 73.65 scheduled for Cataract surgery. The average axial length was 23.12 mm. The average axial length of the eye was 23.12 mm, measured by the contact method and 23.26 mm, measured by the immersion method. The difference between the methods was 0.145 mm, [40].

Optical Coherence Biometry

Since optical biometry uses partial coherence interferometry and is thought to be extremely accurate, simple to use, non-invasive, and patient-friendly, it has emerged as the industry standard for ocular biometry.Optical coherence tomography (OCT) is an optical imaging method that has been developed for biometry and tomography using infrared laser light [42–46].Partial coherence interferometry (PCI), a dual beam OCT that measures the AL of normal and cataractous eyes with great precision and accuracy, is insensitive to longitudinal eye movements and employs the cornea as a reference surface. [39] Optical biometry equipment that is sold commercially typically measures optical AL using short-coherence infrared light (λ = 780 nm). The optical AL is then converted to geometric AL using a group refractive index [39–40].

In addition, it measures the cornea's curvature, depth in the anterior chamber, and diameter. It also uses the biometry data it has collected to calculate the ideal IOL power using a number of algorithms integrated into its computer software [39–40].

Albert Abraham Michelson created the Michelson phenomenon, a typical configuration used in optical interferometry. The beam splitter divides a light source into two arms. All of those are reflected back toward the beam splitter, which interferometrically mixes their amplitudes [47]. A Michelson interferometer fitted with a beam splitter M and mirrors M1 and M2. Light from source S strikes beam splitter surface M at location C in Figure 5. Because M, the beam splitter, is somewhat reflecting, some light is reflected in the direction of A and some is sent through to point B. At point C', both beams recombine to create an interference pattern that is detected by the detector at point E, which is the retina of a patient's eye. An image detector will record a sinusoidal fringe pattern if the two returning beams have a tiny angle variation.

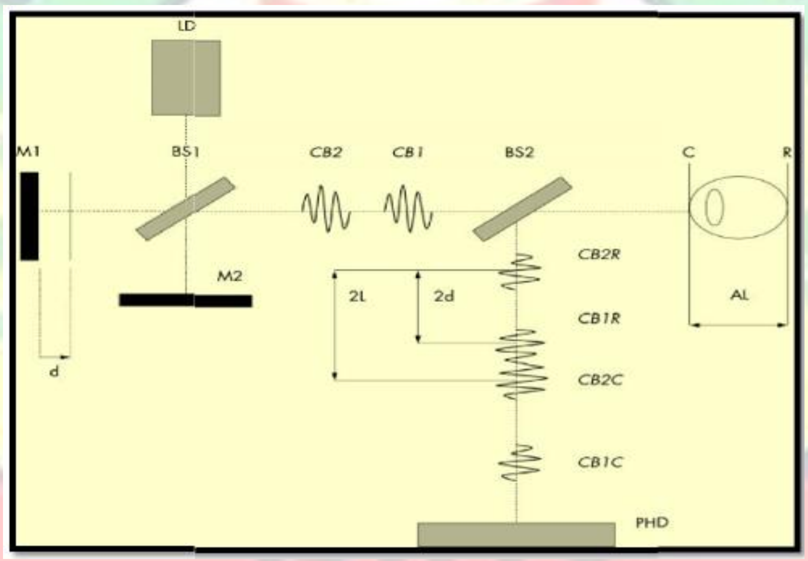


(Fig-1 Path of light in Michelson interferometer)

The returning beams won't form any pattern if there is perfect spatial alignment between them; instead, they will produce a constant intensity across the beam that is dependent on the differential path length. Such a design is challenging and necessitates extremely accurate beam path control.

To get a high interference contrast, one can use white light from a discharge or narrowband spectral light. Reducing the differential path length below the light source's coherence length is crucial. Only in micrometers is it possible for white light. Optical energy is preserved if a lossless beam splitter is used. Every point on the interference pattern inside a beam should return in the direction of the source in order for this to happen [48].

A novel commercially available instrument that measures axial length using partial coherent interferometry (PCI) offers definite improvements over conventional ultrasound measurement techniques. The opt. oh. Biometer claims significantly higher resolution measures of axial length compared with ultrasound methods (plus or minus 0.01 mm versus plus or minus 0.15 mm), anterior chamber depth (plus or minus 0.01 mm versus plus or minus 0.15 mm), and has additional facilities to measure corneal curvature (plus or minus 0.01 mm), all without requiring contact with the eye and reducing the risk of corneal abrasion [49–50].



(Fig-2 Optics of IOL Master)

Six light spots are reflected from the air-tear contact and are organized in a hexagonal configuration with a diameter of 2.3 mm by the Opt. Coh. Biometer.Through the use of internal software for measurements and the toroidal surface curvature computed from three fix meridians, the objective separation of opposite pairs of light is measured. Figure 6 illustrates how the IOL master uses a partial coherence interferometer Michelson interferometer to detect optical axis length. Thrometry, which is based on laser diode (LD), produces light (λ = 780 nm) with a short coherence length (CL = 160 μm), which is split into two coaxial beams and reflected into the eye y mirrors M1 and M2.

B1's beam splitter between CB1 and CB2. When the two coaxial beams separate, they enter the eye and reflect at the interfaces of the cornea (C) and retina (R). The photodetector (PHD), following passage through a second beam splitter (BS2), detects the frequency difference between the coaxial beams as they exit the eye. A Doppler modulation in the frequency of reflected coaxial light reaching the photodetector is caused by the mirror M1 moving at a constant speed during the measurement. The length AL between the cornea and retina can be precisely measured by determining the displacement of the mirror M1 and linking it to the reflected signals received at the photodetector.

Conclusion

The fact that opaque ocular media greatly attenuate light is a disadvantage of the optical biometry method. Consequently, in patients with advanced cataracts, it is more challenging to get accurate measurements. Pathologies of the cornea and tear film may impede optical biometry measurement by causing fixation issues. In conclusion, the postoperative refractive result following cataract surgery is similar for both the A-Scan and the Optical Coherence methods. Measurement of axial length with a one-dimensional A-scan ultrasound is highly variable and may significantly affect the result. Although the patient was not required to focus or look in a certain direction, the measurement might not accurately reflect the distance to the fovea if the patient was not properly positioned. That was a serious issue.Regarding progress, the machine's effectiveness needs to be enhanced to better penetrate ultrasonic waves in Applanation Biometry or light waves in Optical Coherence Biometry. Despite the fact that there are a number of machine updates and new technologies available, it's not a major problem in theory. The machine's operation is another crucial component. Both the patient's cooperation and the machine operator's understanding of this are crucial to the process. When using Applanation Biometry, it is crucial to indent the cornea and place the transponder on the corneal dome. If done incorrectly, this might result in an inaccurate assessment of the axial length, which ultimately impacts the surgical outcome for refractive error. Similarly, no additional machine operating expertise is needed for Optical Coherence Biometry; however, the light in the observation room and the density of cataracts impact the outcome. This device offers a number of choices for the IOL Power calculation algorithm, and the surgeon can select the one that best suits their needs and criteria for axial length.

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