Introduction

The axial length is conventionally measured with ultrasonography, using a biometry unit. Measurement of the axial length is achieved using an immersion or a contact technique. It is always advisable to have both eyes measured for comparison purposes.
Variations in axial length measurement are due to the use of different examination techniques and/or to the use of different sound velocities by the ultrasound biometry.
The immersion technique of biometry is accomplished by placing a scleral shell between the patient's lids, filling it with saline, and immersing the probe into the fluid, avoiding contact with the cornea. This method is more accurate and faster method than the contact method because corneal compression is avoided.
Another current method for highly accurate axial length measurements uses optical coherent light rather than ultrasound. In this method, optical coherent light passes through the visual axis and reflects back from the retinal pigment epithelium.
Interferometry is then used to measure the distance from the cornea to the retina. Because this is a noncontact method, as is immersion ultrasound, its accuracy is superior to contact ultrasound biometry.
However, this noncontact method cannot be used in the event of media opacity, such as dense cataracts, corneal or vitreal opacity due to absorption of the light, or inability of the patient to fixate on

target. For highly accurate anterior chamber depth and lens thickness measurements, immersion ultrasound should be used.

المقدمة

من المتعارف عليه أن الطول العين المحوري يقاس باستخدام الموجات فوق الصوتية بوحدة مقياس العين.

يتحقق قياس الطول العين المحوري باستخدام طريقة الأنغماس أواللمس للعين ، ومن الضروري أن نقيس كلتا العينين من أجل المقارنة بينهما .

تستخدم طريقة الأنغماس للعين عن طريق وضع قشرة خارجية بين جفني المريض و يستخدم محلول الملح لذلك، ومن مميزات هذه الطريقة أنها دقيقة و سريعة ولا تلمس القرنية مقارنة بطريقة اللمس للعين.

حديثاً توجد طريقة آخري وهى فى غاية الدقة عن الموجات فوق الصوتية لقياس الطول المحورى باستخدام الضوء البصرى الملتحم.

ويمر الضوء البصرى الملتحم عن بطول المحور البصرى وينعكس مرة أخرى من النسيج الطلائى الملون للشبكية.

و هنا يستخدم المقياس المتداخل لقياس المسافة من القرنية للشبكية وتعتبر هذه الطريقة شديدة الدقة عن اللمس و الأنغماس للعين.

ولا تستخدم هذه الطريقة فى وجود وسط معتم بالعين مثل المياة البيضاء وعتامات القرنية و الجسم الزجاجى نتيجة لأمتصاص الضوءأو عدم قدرة المريضعلى التركيز على الهدف .

حديثا تم المقارنة بين المقياس المتداخل الملتحم الجزئى و الموجات فوق الصوتية المتلامسة لمزيد من الدقة ولقياس الطول العين المحورى قبل عملية المياة البيضاء للعين.

لقياس عمق الخزانة الأمامية للعين و سمك العدسة البللورية يستخدم طريقة الأنغماس بالموجات فوق الصوتية ، و للحصول على أعلى درجة من الدقة يمكن استخدام طريقة الأنغماس بالموجات فوق الصوتية و القياس البصرى الملتحم معًا.

المقارنة بين تداخل الليزر والموجات فوق الصوتية
فى قياس قوة العدسات

رسالة
توطئة للحصول على درجة الماجستير فى طب و جراحة العيون

مقدمة من
الطبيبة/ علا عبد الحميد حسن هلال
بكالوريوس طب و جراحة بطب عين شمس

تحت إشراف

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Laser interference Biometry versus Ultrasound Biometry

Essay
Submitted in Partial fulfillment for
The Master Degree in Ophthalmology

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References

- Berges O., Puech, M., Assouline M., Letenneur L. and Gastellu-EtchegorryM. 'B-mode-guided vector-A-mode versus A-mode biometry to determine axial length andintraocular lens power', Journal of Cataract and Refractive Surgery, 24(4), 529-535(1998).
- Byrne S.F and Green R.L: Ultrasound of the Eye and Orbit. 2nd ed. St Louis, MO: Mosby, Inc; (2002)
- Connors I. R., Boseman I. P. and Olson R. J. 'Accuracy and reproducibility of biometry using partial coherence interferometry', Journal of Cataract & Refractive Surgery,28(2), 235-238(2002).
- Drexler W., Baumgartner A., Findl O., Hitzenberger C. K., Sattmann H. and Fercher A. F. 'Submicrometer precision biometry of the anterior segment of the human eye', Investigative Ophthalmology & Visual Science, 38(7), 1304-1313(1997).
- Findl O., Drexler W., Menapace R., Hitzenberger C. K. and FercherA. F. 'High precision biometry of pseudophakic eyes using partial coherence interferometry',Journal of Cataract & Refractive Surgery, 24(8), 1087-1093(1998b).
- Gobin L. 'Reproducibility of the IOL Master', Journal of Cataract and Refractive Surgery, 28(7), 1087-1088(2002).
- Packer M., Fine I. H., Hoffman R. S., Coffman P. G. and Brown L. K. 'Immersion A-scan compared with partial coherence interferometry:

Outcomes analysis',Journal of Cataract & Refractive Surgery, 28(2), 239-242 (2002).
- Haigis W., Lege, B., Miller, N. and Schneider, B. 'Comparison of immersionultrasound biometry and partial coherence interferometry for intraocular lens calculationaccording to Haigis', Graefes Archive for Clinical & Experimental Ophthalmology, 238(9), 765-773(2000).
- Haigis W. 'Optical coherence biometry', Developments in ophthalmology, 34, 119-130(2002).
- Kiss B., Findl O., Menapace R., Wirtitsch M., Drexler W., Hitzenberger C. K. and Fercher A. F. 'Biometry of cataractous eyes using partial coherence interferometry: clinical feasibility study of a commercial prototype I', Journal of Cataract &Refractive Surgery, 28(2), 224-229(2002a).
- Lam A. K. C., Chan R. and Pang P. C. K. 'The repeatability and accuracy of axiallength and anterior chamber depth measurements from the IOLMaster[TM]', Ophthalmic& Physiological Optics, 21(6), 477-483(2001).

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Introduction

The Eye is considered a perfect organ to be examined by ultrasound because it has an anterior location and its anatomical structures and shape enhance the echograms produced by ultrasound.
These characteristics allow the use of higher frequencies in ophthalmic ultrasound than in other specialties of medicine,e.g. 10, 20 and 50 MHz probes are used on the eye.

Sound is defined as a vibratory disturbance within a solid or liquid that travels in a wave pattern with a frequency from 20-20,000 hertz (Hz). To be considered ultrasound, sound waves must have a frequency greater than 20,000 Hz (20 KHz), rendering them inaudible to human ears. In ophthalmology, most A-scan and B-scan ultrasound probes use a frequency of approximately 10 million Hz (10 MHz) predesigned by the manufacturer. This extremely high frequency allows for restricted penetration of the sound into the body, but excellent resolution of small structures **Massin and Lambrinakis (1990)**.

This meets the unique needs, because the probe is placed directly on the organ to be examined, and its structures are quite small,requiring excellent resolution.

The velocity of sound is determined completely by the density of the medium through which it passes. Sound travels faster through solids than through liquids, an important principle to understand because the eye is composed of both solids and liquids.

In A-scan biometry, the sound travels through the solid cornea, the liquid aqueous, the solid lens, the liquid vitreous, the solid retina, choroid, sclera, and then orbital tissue; therefore, it continually changes velocity **Kendall (1990)**.

The axial length is conventionally measured with ultrasonography, using a biometry unit. Measurement of the axial length is achieved using an immersion or a contact technique or laser interferometry (non contact). It is always advisable to have both eyes measured for comparison purposes.

Accurate estimation of the required power of the intraocular lens (IOL) is central to the success of modern cataract surgery.

The average corneal refractive power, anterior chamber depth and axial length of the eye are key determinants of the required lens power **Watson and Armstrong (1999)**.

- ❖ **There are three main categories of ultrasonography in ophthalmology:**

1. A-Scan Biometry: measures the axial length of the eye in order to make the intraocular lens (IOL) calculations for patients who will be undergoing cataract surgery.

2. B-Scan: used for diagnosis in the posterior eye segment.

3. Ultrasound Biomicroscopy (UBM): used for diagnosis in the anterior eye segment (mainly) & posterior segement **Susan, etal (2003).**