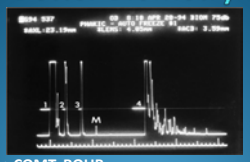
Slide 1

Better Biometry



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Division of Ophthalmology

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Camden County College
Ophthalmic Science

Slide 2

Discussion points

- Patient history
- Keratometry
- IOL master
- Principles of ultrasound
- A-Scan biometry

Slide 3

Patient history

- Did the patient have prior surgery?
  - Lasik/PRK/Refractive procedures change keratometry measurements
  - Retinal detachments – scleral buckling procedures elongate the eye 0.5mm to 1.0 mm
  - Is the patient phakic? Pseudophakic? If so, what lens materials (Silicone, PMMA, Acrylic)? Aphakic?
    - You will need to adjust the settings on IOL M. and/or A-scan
  - Do they have a PK or corneal opacity?
    - If you can't see the retina, a B-Scan is always indicated and billable!

Slide 4

Patient history

- Key points for axial length measurements:
  - Myopic eyes are generally longer
  - Hyperopic eyes are generally shorter
  - Average eye is 23.5mm long
  - Keratometry measurements can explain emmetropia in a patient with unusual AL

Slide 5

Keratometry

- Auto-K's vs. Manual K's vs. IOL Master K's?????
  - Standardize your K readings!
  - Manual K's are the least reproducible amongst biometrists
  - Pick a method and stick with it!
  - Always use two methods for K's to verify the validity of the measurements.

Slide 6

Keratometry - Manual

- Uncorrected refractive error of the examiner WILL result in erroneous measurements. ALWAYS focus your eye piece FIRST!
- ALWAYS keep the fellow eye OPEN while measuring
- Focus the horizontal meridian mires first, then measure.
- You can re-focus the mires now to take the vertical measurements.
  - Especially important for highly astigmatic patients

Key point: 1D error in keratometry reading will result in 1D post-op refractive error

Slide 7

Keratometry

- The two eyes should be with in 1D of each other
- Long eyes usually have flat K's
- Short eyes usually have steep K's
- Average K reading is 43-44D

Slide 8

Keratometry

- Soft lenses should be out for about a week
- Gas perm lenses or hard lenses should be out until the K's are stable!

Slide 9

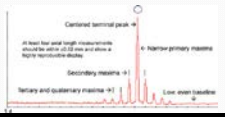
IOL Master

- Axial length
- Keratometry
- ACD
- White to white
- Formulas: Haigis, HofferQ, Holladay, SRK II, SRK/T
- Can be linked to Holladay II program and other network systems

Slide 10

IOL Master

- Measuring Axial length:
- It is useful to take all 20 measurements. At least four of these measurements should be within 0.02 mm of one another, and should exhibit the characteristics of an Ideal Display. An ideal axial length display is more important than a high signal-to-noise ratio (SNR).



Slide 11

IOL Master

- Reasons for Low Signal-to-Noise Ratio:
  - Dense medial opacity along the visual axis
  - Restless patient
  - Alignment of device to patient eye is not optimal
  - Very high ammetropia (> 6 D)
  - Corneal scars
  - Pathologic changes in the retina.

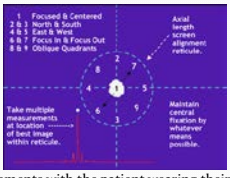
Slide 12

IOL Master

- Troubleshooting:
  - Adjust the joystick, try scanning in all 4 quadrants of the circle
  - Pull back or push forward– de-focus the reflecting light to fill the entire circle
  - Observe- sometimes you can see where the opacity is and try to scan around it

Slide 13

IOL Master



Did you know?
You can take measurements with the patient wearing their glasses. This can improve fixation in patients with high refractive errors and will not interfere with AL measurements

Slide 14

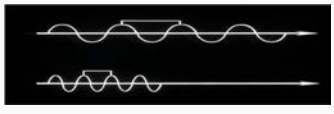
IOL Master

- Key Points:
  - Don't be a button pusher! Understand the information you're getting.
  - Read the manual!
  - Instruct the patient.
  - 80-90% of patients can be scanned
    - What about the other 10-20%?

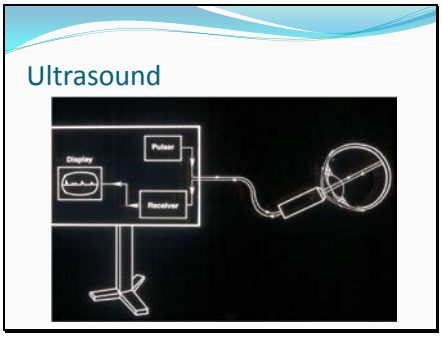
Slide 15

Ultrasound

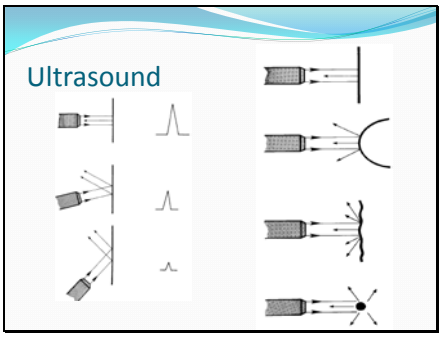
- Measured in hertz: One hertz is one cycle per second
- The human ear hears sounds 20Hz – 20,000Hz
- Ultrasound has a frequency of >20,000Hz
- Ophthalmic ultrasound uses a frequency of approximately 10,000,000 hertz (10Mhz)
- Higher frequency means less penetration but greater resolution



Slide 16



Slide 17



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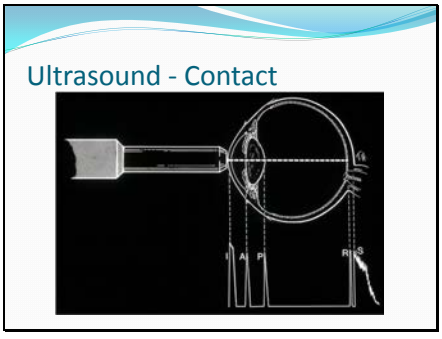
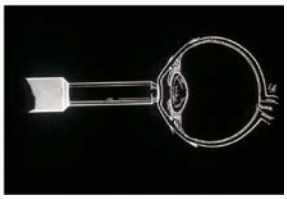


Slide 19

Ultrasound - Contact

Oops!



Slide 20

Ultrasound - Contact

- Corneal compression!
  - This is inaccurate even in the hands of the experienced biometrist
  - Compression is UNAVOIDABLE.
  - Studies show the contact method compresses the cornea 0.14mm-0.36mm
  - Compression varies with IOP and corneal thickness
    - We can't predict or control this!

Slide 21

Ultrasound – Contact

- Fluid bridge measures the eye erroneously long

Slide 22

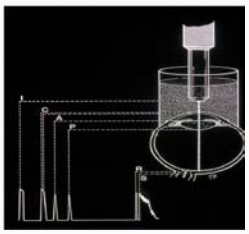
Ultrasound - Contact

- "There is really scant defense for applanation anymore given the refractive demands of our cataract patients, our refractive lens exchange patients and even more so, the patients who have already had refractive surgery once."
- "Along with the immersion ultrasound technique, partial coherence interferometry has rendered the applanation method obsolete when calculating a highly accurate IOL power is the goal."

Ophthalmology Management April 2005 "Sizing Up Your Biometry Options"

Slide 23

Ultrasound - Immersion



Slide 24

Ultrasound - Immersion

- Hansen shells –
  - Various sizes

16mm, 18mm, 20mm, 22mm, 24mm

- Patient must be reclined

Slide 25

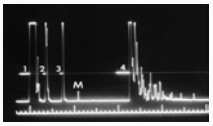
Ultrasound - Immersion

- Prager shell
  - Not position dependent
  - Probe locks in place

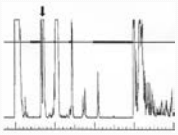
Slide 26

Ultrasound – Immersion

- 4 gates, 5-6 spikes
  - Cornea (2), anterior lens, posterior lens, retina, **sclera**



Poor screen resolution

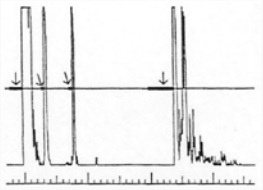


Better screen resolution

Slide 27

Ultrasound - Gates

- Gates MUST be on the ascending edge of spike

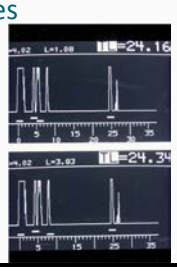


A-Scan Biometry, Rhonda Waldron

Slide 28

Ultrasound – Gates

- Always check the gate placement – incorrect placement means incorrect measurements



Slide 29

Ultrasound – Velocity

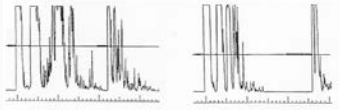
- Cornea 1,641 m/s
- Aqueous 1,532 m/s
- Lens 1,641 m/s
- Vitreous 1,532 m/s
- Average 1,550 m/s

- PMMA 2,718 m/s
- Acrylic 2,120 m/s
- Silicone 980-1100 m/s

Slide 30

Ultrasound - Pseudophakia

- Find out what type of lens they had implanted – *Maybe* the patient actually kept the lens card?
- *Maybe not…*
  - *The various lens materials have unique spike patterns*



PMMA Acrylic

A-Scan Biometry, Rhonda Waldron

Slide 31

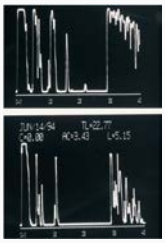
Ultrasound – Gain

- When do you adjust the gain?
  - Turn the gain up for dense cataracts that are yielding a poorly rising retinal spike
  - Turn the gain down for pseudophakic scans to reduce reverberating spikes
  - Use CAUTION when adjusting the gain! Only adjust as much as is needed to get the scan

Slide 32

Ultrasound – Gain

- Too high
  - Erroneously short measurement
  - Extra noise =
    - extra spikes =
      - incorrect gate placement



Slide 33

Ultrasound - Gain

- Too low
  - Erroneously long measurement
  - Low amplitude spikes

Slide 34

Ultrasound – Pattern

- The most important thing about your A-Scan eye length measurements is the PATTERN OF YOUR SCAN
- Standard deviation means nothing if you do you not have the correct pattern
- It is entirely possible to get multiple erroneous measurements with good standard deviation – BUT – the pattern is wrong!
- Do NOT be misled by reproducibility if you have any doubts about the pattern of your scan.
- Ten bad scans with the same axial length are just ten bad scans. Pattern trumps reproducibility.

Slide 35

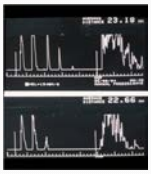
Ultrasound – Troubleshooting

- Can't get a steeply rising retina spike?
  - Misalignment of the sound beam
  - Localizing the macula
  - Posterior staphyloma
  - Macular pathology

Slide 36

Ultrasound – Troubleshooting

- You must be perpendicular to the visual axis
- Retina spike MUST BE 90 degrees angle from the baseline and steeply rising



Slide 37

Ultrasound– Misalignment

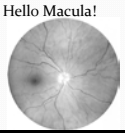
- A beautiful A-Scan with no scleral spike is a bad measurement YOU ARE MEASURING TO THE OPTIC NERVE

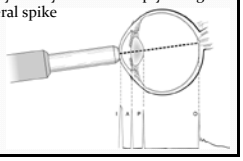
- This eye is actually 22.72mm long when measured to the macula

Slide 38

Ultrasound – Localizing the Macula

- Point the probe nasally until you see the previous pattern without a scleral spike– Now you know where you are.
- Tilt the probe temporally until you see a sharply rising and clearly defined scleral spike
- Hello Macula!

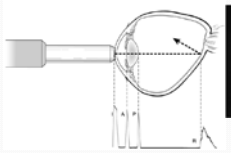


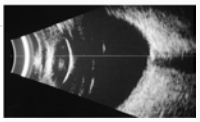


Slide 39

Ultrasound – Posterior Staphyloma

- Irregular contour of the staphyloma impairs reflectivity of sound





Slide 40

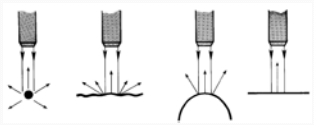
Ultrasound – Posterior Staphyloma

- IOL Master measures these eyes most accurately
  - Consider B biometry in conjunction with A-Scan

Slide 41

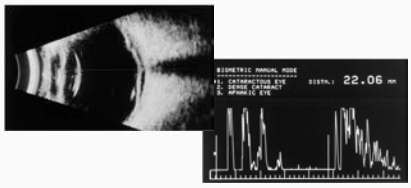
Ultrasound – Macular Pathology

- An eye with a macular pathology may yield poor quality retinal spike (AMD, VMT, ERM, RD)
  - The prognosis and treatment plan may change.



Slide 42

Ultrasound – Mac off RD



FYI – If a patient has an RD that will require scleral buckling along with CE/IOL is it appropriate to add 0.75mm to the axial length since SB's will elongate an eye 0.5mm-1.0mm

Slide 43

Ultrasound- Sources of Error

Byrne, SF. A-Scan Axial Eye Length Measurements

- Causes of a short measurement:
  - Air bubble adherent to the transducer in a water filled probe
  - Corneal compression(contact method)
  - Sound velocity is too slow
  - Corneal gate to the right of the corneal spike
  - Retinal gate too far left of the retinal spike
  - Gain set too high
  - Lens measured too thin
  - Misalignment of the sound beam

Slide 44

Ultrasound- Sources of Error

Byrne, SF. A-Scan Axial Eye Length Measurements

- Causes of a long measurement:
  - Air bubble in the fluid bath (immersion)
  - Fluid bridge (contact method)
  - Sound velocity too fast
  - Retinal gate to the right of the retinal spike
  - Gain set too low
  - Lens measure too thick
  - Misalignment of the sound beam

Slide 45

Standard Dimensions– Axial Length

- Average eye ranges 22.0mm to 24.5mm
- Measurements for the same eye should be within 0.2mm
- The two eyes should be within 0.3mm of each other
  - Any disparity needs to be explained.
  - BOTH eyes should ALWAYS be measured for comparative purposes
- 0.1mm in an average eye is equal to approx 0.25D
  - **This is more significant in a short eye and less significant in a long eye**
- Post op refractive errors:
  - If eye measured too short then post op myopic error
  - If eye measure too long then post op hyperopic error

Slide 46

Standard Dimensions

- Average ACD 3.24mm
- Average lens thickness 4.6mm – Will increase with progression of cataract
- K's 43-44D
  - Should be within 1D of each other
- White to white 11.7mm +/-0.46mm

Slide 47

Hyperopia

Right eye

- MR +3.50 +1.25 x 025
- Axial length 21.37mm
- K's 44.00/45.50

- MR +2.50 +1.50 x 015
- Axial length 24.00mm
- K's 41.37/39.75

Left eye

- MR +3.75 +1.75 x 130
- Axial length 21.27mm
- K's 43.75/45.25

- MR +2.75 + 1.00 x 165
- Axial Length 23.85
- K's 41.62/40.12

Slide 48

Myopia

Right eye

- MR -6.00 + 1.00 x 135
- Axial length 27.33mm
- K's 43.00/44.37

- MR -8.00 + 2.75 x 090
- Axial length 23.30mm
- K's 48.25/50.00

Left eye

- MR -5.75 + 0.75 x 045
- Axial length 27.47
- K's 43.50/44.50

- MR -8.50 + 2.25 x 090
- Axial length 23.50mm
- K's 48.12/49.75

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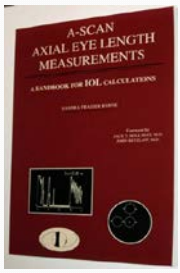
Emmetropia

Right eye	Left eye
• MR plano +.50 x 022	• MR +0.25 +0.25 x 157
• Axial length 22.24mm	• Axial length 22.33mm
• K's 45.50/45.87	• K's 45.37/45.25
• MR plano	• MR plano
• Axial length 24.92	• Axial length 25.02
• K's 42.00/41.87	• K's 41.75/42.12

Slide 50

Resources



Slide 51

Resources

- **The Ophthalmic Biometrist**
  - Fort Lauderdale 2008, Philadelphia 2011
- Rhonda G. Waldron MMSc, COMT, CRA, ROUB, CDOS
Diagnostic Echographer, Senior Associate in Ophthalmology
Emory Eye Center, Atlanta GA
Owner, Eye Scan Consulting
rhondawaldron@comcast.net
Phone (404) 286-9067
- **A-Scan Biometry**, Rhonda Waldron
  - http://emedicine.medscape.com/article/1228447-overview

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Resources

Warren E. Hill, MD, FACS

http://doctor-hill.com/

- Biometry
- IOL master
- Formulas
- Optimization
- Post refractive calculations
- Great for techs and physicians

Slide 53

References

- Devgan, U. (September/October 2011). Cataract Surgery in Small Eyes. *Premier Surgeon*, 10-11.
- Farrell, T. (May 2009). Precision Biometry. *Ophthalmology Management*.
- Parkinson, J. (April 2005). Sizing Up Your Biometry Options. *Ophthalmology Management*.
- Savini, G., Hoffer, K. J., & Zanini, M. (April 2007). IOL Power Calculations After LASIK and PRK. *Cataract and Refractive Surgery Today - Europe*, 37-44.
- Shammas, H. J. (2004). *Intraocular Lens Power Calculations.* Thorofare New Jersey: SLACK Incorporated.
- Tyson, F. (August 2006). Choosing the Proper Formula for Accurate IOL Calculations. *Ophthalmology Management*.
- Zeiss IOL Master User Manual, Software 5.xx,