BIOMETRY CHALLENGES

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GOALS

- Describe different methods of biometry highlighting the pros and cons of each method
- Discuss several cases to illustrate how biometry can affect the optical outcomes of cataract surgery

FINANCIAL DISCLOSURE

- I have no financial interests to disclose

REFRACTIVE TARGET
OLD TECHNOLOGY VS NEW TECHNOLOGY

Ultrasound Biometry

Optical Biometry

A-SCAN (ULTRASOUND) BIOMETRY

Used for biometry since the 70’s

- A thin parallel sound wave (10MHz) is directed through eye
  echoes are produced as the sound waves passes through an
  interface
  
  - The echoes are detected by the probe and converted into spikes

  - The amplitude of the spike is proportionate to the difference
    between the media at each interface (A=amplitude)
  
  - The known velocities of sound through the different media are
    used to calculate length

ULTRASOUND BIOMETRY VS OPTICAL BIOMETRY


A-SCAN (ULTRASOUND) BIOMETRY

- Contact Technique and Immersion Technique
  - Requires anesthetic
  - Potential for infection, corneal abrasion
  - Compression artifact with contact method
  - Requires skilled technician

- Resolution 0.1mm
OPTICAL BIOMETRY

- Became available in the 90's
- Partial coherence laser interferometry (PCLI)
- Low-coherence reflectometry (LCR)
- Uses infrared light waves (780nm)
- Resolution is 0.01mm
- Limited use in dense lenses and media opacities
- Requires ability to fixate
- No contact with eye
- Quick requires 1-3 minutes per eye
- Less user dependent
- Provides additional data: keratometry, CCT, ACD, Lens Thickness, WTW, Pupil size/centration

SUMMARY BIOMETRY METHODS

A-Scan Biometry

Pros
- Broad range of applications
- Does not require ability to fixate
- Less costly

Cons
- Technically more challenging
- More time to perform
- Requires separate instrumentation
- Risk of intraocular damage

Optical Biometry

Pros
- Less technically challenging
- Time efficient
- Non-contact
- Measures along optical axis
- Keratometry, CCT, ACD, LT, RT, WTW, pupil
- More accurate for posterior staphyloma

Cons
- Cost
- Requires clear light path:
  - Dense Lenses
  - Media Opacities
  - General Scans
  - Epithelial membranes
- Inability to focus

OPTICAL BIOMETRY

Optical Axial Length

Immersion A-scan Biometry

Anatomic Axial Length
65 yo tennis player who complains of “difficulty seeing the ball recently” and he wants excellent spectacle free distance vision “like he used to have”

- VA sc: 20/20 OD; 20/50 OS
- MRX: plano OD; NI OS
- Lens: Trace NS OD; Trace NS, 2+PSC OS
- Plan: Phaco/PCiol OS  Target: plano OS

Post-op MRx: -1.25+0.50x180

REFRACTIVE SURPRISE
**CORNEAL COMPRESSION**

- Most common error in contact technique
- More significant with lower IOP
- Varies even with same technician
- 1mm axial length≈2.80D refractive change
- Monitor anterior chamber depths
  - Discard shallower depths even with good spikes
- Use immersion technique or Optical Biometry

**CHALLENGE #2**

- 57 yo male H/O Phakic RRD
- s/p scleral buckle
- Recurrent retinal detachment
- s/p PPV/silicone oil
- Visually Significant Cataract
- Plan: Silicone oil removal/Phaco/IOL
- How do you calculate lens implant power?

**SILICONE OIL**

- Optical Biometry
  - Lens opacity is not too dense and patient can fixate
  - Use Silicone Filled Eye-Phakic Setting
- Intraoperative A-scan after oil removal
  - Logistical coordination
  - Requires broad lens consignment
- Pre-operative A-scan
  - Any lens density
  - Fixation not required
  - Requires extra calculations

**SILICONE OIL BIOMETRY**

**PRE-OPERATIVE A-SCAN**

- Axial Length will be erroneously long without correction
- Use velocity conversion
- Speed of sound in silicone oil is slower
- Silicone Oil:
  - 1,000 mPa.s. slows sound to 980 m/sec
  - 5,000 mPa.s. slows sound to 1040 m/sec
- Vitreous (1532 m/s)
SILICONE OIL BIOMETRY
PRE-OPERATIVE A-SCAN

- Measure the Axial length in Phakic Setting
- ACD and lens thickness(LT) are subtracted from the total measured Axial length
- The result is the Apparent Vitreous Length(AVL)
- True Vitreous Length(TVL)=980 or 1040/1532 X AVL
- Accurate Axial Length=TVL + ACD + LT
- Biometry should be performed with patient sitting upright to avoid bubble artifacts

CHALLENGE #3

- 52 yo pt with painless progressive LOV OD
- Va ODcc: 20/200
- MRx: NI
- Lens: anterior subcapsular plaque, 1+NS, 3+PSC
- Plan: Phaco/PCIOL OD
- Target Rx: Plano

Optical Biometry Attempted
**CHALLENGE #3**

A Scan Biometry

**CHALLENGE #4**

POSTERIOR STAPHYLOMA

- Present a biometry challenge due to differences between anatomic axial length and refractive axial length
- More common in longer eyes >26.5mm
- Difficulty in getting a distinct retinal spike on A-scan biometry
- Inconsistent axial length readings
- Optical biometry is best suited for staphyloma
- Immersion vector-A/B-scan combination is alternative

**CHALLENGE #5**

- 75 yo male with progressive LOV OS
- Va cc 20/30 OD; CF’s OS
- WRX: -2.00DS OD; -2.25+0.75x90 OS
- Lens: 1+NS OD; 2+NS, 4+PSC OS
- Plan: Phaco/PCIOL OS
- Target MRx: -2.00
CHALLENGE #5
- Post-op MRx: +0.75+0.75x085 (Δ3D Hyperopic)

CHALLENGE #6
- 73 yo female with progressive LOV OS
- Va cc: 20/30-2 OD; 20/50-2 OS
- MRx: -0.25+0.75x175 OD; -1.75+0.25x008 OS
- Lens: 2+NS, 2+CS OD; 2+NS, 3+CS
- Plan: Phaco/PCIOL OS
- Target MRx: Plano
CHALLENGE #6

To Dr. [Name],

Dear Doctor,

First, I would like to thank you for removing the cataract in my left eye. The vision in my right eye is now clearer. However, I must let you know that I am disappointed and angry that the vision in my left eye was changed to the degree that I am no longer able to read glasses.

I feel tricked and violated that you changed a part of me that cannot be reversed. We planned the bilateral cataracts. I was instructed during the procedure, you could have told me something to me then.

I did not discover this until Tuesday when I struggled to read. When we ended, did discuss the situation, you seemed pleased that once I could "buy my glasses at Walgreens." I prefer prescription glasses. A week and disappointed as you at the time that it is my opinion that you will never have to feel as I do today.

Sincerely,

[Signature]

M.D.

CHALLENGE #6

- 73 yo female with progressive LOV OS
- Va cc 20/30-2 OD; 20/50-2 OS
- MRx: -025+0.75x175 OD; -1.75+0.25x008 OS
- Lens: 2+NS, 2+CS OD; 2+NS, 3+CS
- Plan: Phaco/PCIOL OS
- Target MRx: Plano

CONCLUSIONS

- Ultrasound Biometry and Optical Biometry are accurate and methods for intraocular lens calculation
- Each method has unique challenges and advantages
- Attention to scan details can prevent postoperative refractive surprises
- Patient expectations are as important as accurate biometry in achieving successful outcomes.