Biometry tips

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Types of Biometry

- Ultrasound (A-Scan)
- Contact
- Immersion
- Laser Interferometry (IOL Master)
Patient History

- Use the oldest possible MRx to include for calculations since myopic shifts up to 10 diopters can be caused by the changes in the lens.
- Necessary for Holladay 2 formula
- Ask about prior refractive surgeries: LASIK, PRK these can change K readings and require special calculations
Patient History

Remember
Myopic eyes are usually longer 25.16+/-1.23mm
Hyperopic eyes are usually shorter 22.62 +/- 0.6m
Emmentropic eyes are usually 23.5mm long
Patient History con’t

- Retinal surgery: Scleral buckles can elongate the eye 0.5 - 1.00mm
- Pseudophakic patients find out what IOL material was used: PMMA, Silicone or Acrylic
- Aphakic: IOL setting must be adjusted
- PK or corneal opacity
- Slit lamp exam: Ocular surface disease, Eg. Severe dry eyes
Patient History con’t

- Ocular history: glaucoma, prior surgery, eye meds
- Medical history: prostate; leads to floppy iris syndrome if patient on Flomax
- Social history: job type, social activities, drug use
Keratometry

- Manual
- Automatic: Autorefractor / IOL Master
- Pick a method and stick with it
- Use two methods for K readings to verify
- Eyes should be within 1D of each other
- NB: Myopic eyes are long and have flat OA's
- Hyperopic eyes are short with steep K's
- Average eye is 23.5mm
- Average K reading 43.00- 44.00D
Keratometry

\[ P = \frac{(n-1)}{r} \]

- \( P \) = power
- \( n \) = standardized keratometric index of refraction usually 1.3375
- The index of refraction refers to theoretical single refractive lens with a stable ratio of anterior to posterior corneal curvature
Keratometry con’t
Keratometry con’t

- Manual keratometry considered the ‘Gold standard’ seldom used due to better automated keratometers
- Always focus your eye piece first as in lensometry since uncorrected refractive errors of the examiner will result in erroneous measurements
Keratometry con’t

○ Keep both eyes open when measuring
○ Focus the horizontal meridian first then measure
○ Then refocus mires to measure the vertical axis
○ Much needed in high myopes
○ NB 1D error K’s = 1D post-op refractive error
Keratometry con’t

- CL’s wearers:
  - Soft CL wearers should take lenses out for about one week prior to measurements
  - GP and HL should be out until K’s are stable
  - NB. Prior to K reading no procedures ointments or drops are to be used that will distort mires
  - 1 drop of anaesthetics GTTs can be used to smooth mires
  - Calibrate weekly
Topography

○ Topography is used to detect any deformities of the corneal surface e.g. Keratoconus, PK, RK
○ The cornea is provides 70% of the eye’s refractive power
○ Keratometry measures the central 3mm of cornea VS Topography measuring entire anterior corneal surface
○ More accurate for corneas << 40D or >> 46D & irregular
○ Best when used in conjunction with Keratometry. An average taken between when K’s are disparate
○ much needed when measuring for toric IOL’s
A-Scans

- Immersion - You will need scleral shell: Hansen or Prager
- BSS & anesthetic gtts
- Position patient as for contact method
- Have the machine in a position where you can see and easily access screen as for contact
- Can be done manually or automatically
- Instill gtts
Contact

- Patient must be comfortable and informed of what you are going to do
- Patient can be sitting or reclining
- Instill anesthetic gtts
- Place probe directly on central cornea
- Align probe along visual axis come off cornea before making any major movements other than tilting

A-Scans Contact vs Immersion
A-Scans Contact vs Immersion

**Immersion**

- Insert shell with probe attached for Prager or in the case of Hansen shell just insert into eye
- Immerse probe in BSS
- Align probe along visual axis
- Lateral movements are used to obtain measurements
A-Scans Contd.

- For either method take 10 readings per eye
- Immersion
  - is more accurate but difficult at first to learn
  - Messy at first
  - Takes longer at first
- Contact
  - Corneal compression
  - Corneal abrasion
  - Fluid bridge
  - Dry Eye
Sources of Error

You may have some situations that require contact so perfect the skill

- Causes of errors
  - Short measurements
  - Corneal compression
  - Velocity too low
  - Improper gate placement
  - Gain too high
  - Misalignment of sound beams
Errors

- Long measurements
  - Fluid bridge
  - Velocity too high
  - Improper gate placement
  - Gain too low
- Misalignment of sound beam
  - Improper techniques
  - Poor patient fixation: Strabismus, NLP in one eye
  - Internal vs External fixation
  - Pathology: disciform scar or saphyloma
Macula Localizing Technique

- Find optic nerve
- Tilt probe to direct sound until scleral spoke shows
Laser Interferometry

- IOL master uses light to measure axial length
- Advantages
  - Non-contact
  - Very accurate
- Disadvantages
  - Cannot penetrate dense cataracts
  - Difficulty measuring Pseudophakic eyes due to high degree of reflection
Axial Length Measurements

- Good fixation
- Good corneal tear film
- Not a fool proof method
- Nuclear cataracts may require off-axis measuring technique
- Dense opacity of posterior capsule may produce error message
- Ametropia of more than 6D may require patient to wear glasses for best results
IOL Master

Useful for measuring eye with posterior staphyloma (protrusion of sclera causing an irregular shaped posterior eye) this is because the axial length measurements is required along the axis of patient fixation.

NB: when using an A-Scan proper alignment is at best estimated with a staphyloma.
Corneal Curvature Measurements

- **K Reading's**
  - Susceptible to the same error factors as the keratometer
    - Poor tear film
    - Corneal irregularly
    - Image obscured by eyelids or eyelashes
    - Improper focusing
Many of the IOL calculation formulas use ACD as part of calculation.

IOL master uses a projected slit beam to measure ACD.

Excessive accommodation by patient can cause divinations, if so measure after dilation.

ACD will NOT be accurate on a Pseudophakic eye.
IOL Calculations & Formulas

- 4 primary pieces of information needed for IOL calculations:
  - A-Scan axial length measurements
  - Average K readings
  - A-constant for IOL to be implanted
  - Desired post-op refraction
- Formulas: Haigis, HofferQ, Holladay, SRK II, SRK/T
- Can be linked to Holladay II program and other network system
- Know which formulas are most appropriate for the measurements you acquired.
IOL Calculations & Formulas

○ Both eyes must be measured to identify any potential sources of error
○ IOL power should be within 1D between both eyes
○ Theoretical formulas 1st Gen Fyodorov, Binkhorst, Holladay Shammas used A-scan ultrasound and K readings to devise these formulas
○ Are all based on the same equation

\[ P = \frac{n}{L} - ACD - n \times K/n - K \times ACD \]

Regression formulas

**SRK** \( P = A - 2.5L - 0.9K \)

Gave better results with normal eyes than the theoretical formulas
Formulas

- 2nd Gen formulas were used to improve the accuracy of IOL calculations for short & long eyes
- Increase in PIOL vs Iris-plane IOLs a factor
- SRK altered by combining a linear regression analysis for short and long eyes this became SRKII
- 3rd Gen formulas arose after doctors express discomfort with a formula based on an artificial linear model. The authors of SRK devised then SRK/T an new theoretical formula.
- SRK/T is similar to the Holladay & relies on the ACD constant rather than surgeon factor
Formulas

- 4th & 5th Gen formulas are: Holladay, Haigis, Olsen & Barrett Universal II
- These can use as many as seven variables (keratometry, axial length, anterior chamber depth, lens thickness, horizontal white-to-white measurement, age and pre-op refraction in the case of the Holladay II
Formulas

- To get the most from many of the latest-generation formulas, you also need to have an optical biometer such as the IOLMaster 700 or the Lenstar. This is because two of the newer formulas, the Holladay II and the Olsen, require a measurement of the lens thickness that these instruments provide.
Clean & Calibrate

- **IOL Master**
  - Clean Chin rest and head rest with Alcohol wipes between patients
  - Once per week calibrate with test eye if available or staff member with stable Rx

- **Ultrasound Machine**
  - Soak shells in Hydrogen Peroxide prior and after each patient but rinse with water prior to inserting into the eye
  - Probe tip can be soaked in peroxide or wipe with alcohol
  - Calibrate using a staff member
Summary

- For successful biometry
  - Examiner must have knowledge of proper techniques
  - High quality consistent scans
  - IOL calculations
  - Biometry standards
  - Have a 2nd examiner re-measure patient anytime you are unsure
  - Triple check your work
  - Never stop learning!
NB: take home points

- For successful post-op outcomes take into consideration:
- The surgeon’s expectations
- The patient’s expectations
- The increasing use of Premium IOLs
- The world of biometry is heading to optical vs ultrasound with the increasing demands for optimum visual outcomes
References/ Resources

- A-Scan -Axial Eye Length Measurements A Handbook For IOL Calculations- Sandra Frazier Bryne
  Grove Park Publishers
  https://quizlet.com(ROUBflashcards)
  www.ophthalmicedge.org
References/ Resources

- www.jcahpo.org
- www.atpo.org
- https://www.reviewofophthalmology.com/article/power-calculation-how-to-up-your-game
- Ultrasound of the Eye & Orbit 2nd
  Sandra Frazier Bryne Ronald L. Green
THANK YOU!

C.A.O.T.P.
Caribbean Association of Ophthalmic Technical Personnel