

# A-Scan Biometry

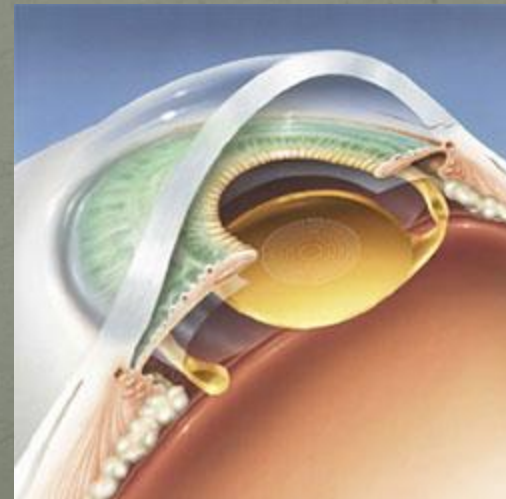
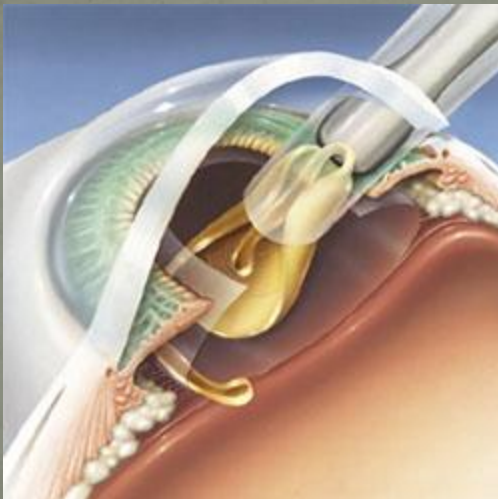
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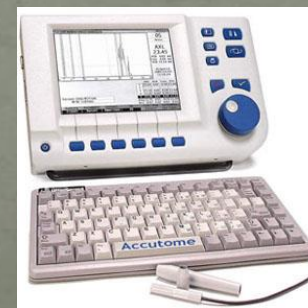
# A-Scan Biometry

- **Definition: Measurement of the axial length of the eye using ultrasound**
- **Generally used for calculating the strength of the intra-ocular lens to be inserted, either during a cataract surgery or a secondary implant procedure**



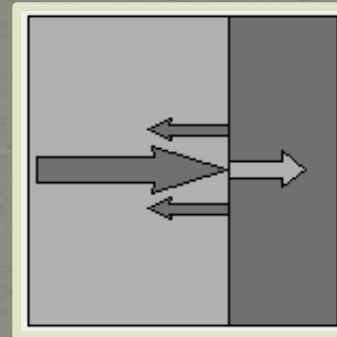
# Ultrasound: sound that has a frequency greater than 20,000 Hz (20KHz)

- Most ophthalmic A and B scan units use frequencies in the range of 10 million Hx (10MHz)
- This frequency is good for resolution of small structures, but does not penetrate tissues well



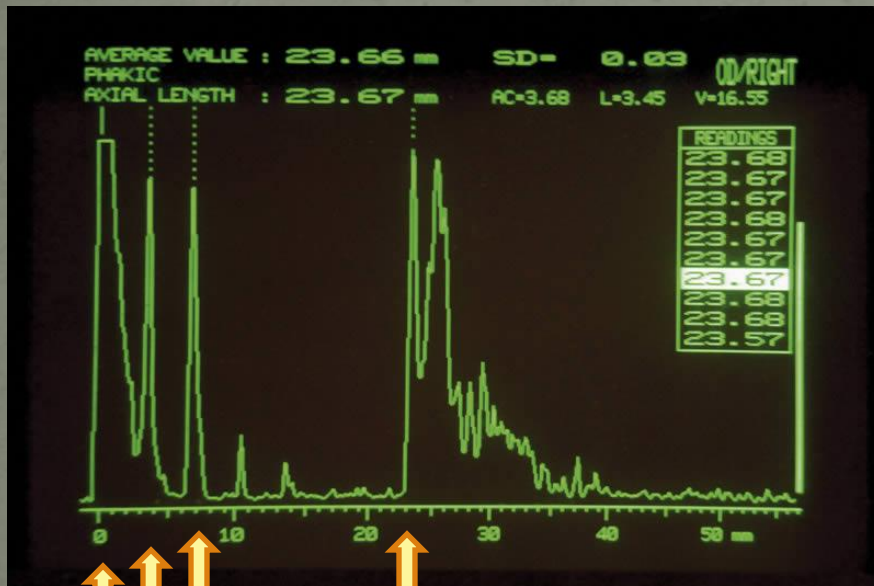
# How measurements are made

- When projecting sound waves through tissues, whenever an interface is crossed, some sound waves are reflected while some are transmitted.

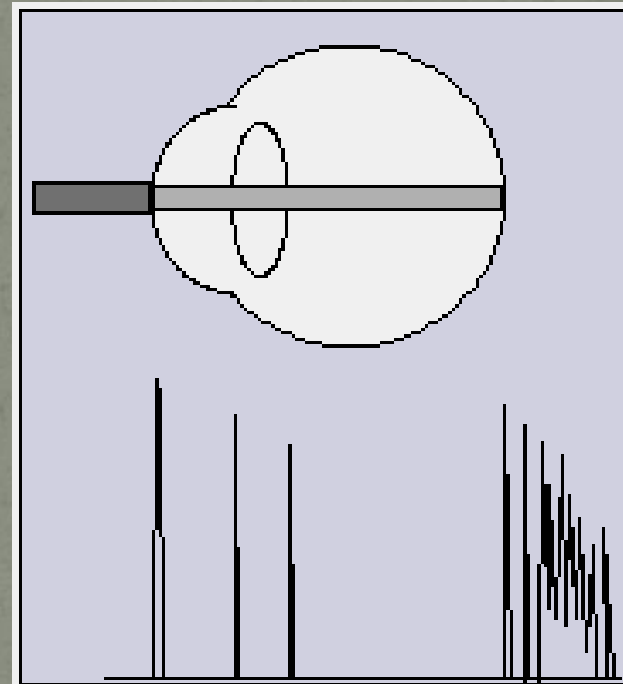


- By measuring the time it takes a given wave to travel from the sound wave generator (ultrasound probe) and then be reflected back to the same probe, and knowing the speed of the wave, the distance from the probe to the tissue that reflected the wave can be calculated.

# A-Scan tracing



- Probe / Cornea Spike
- Anterior lens Spike
- Posterior lens Spike
- Retinal Spike

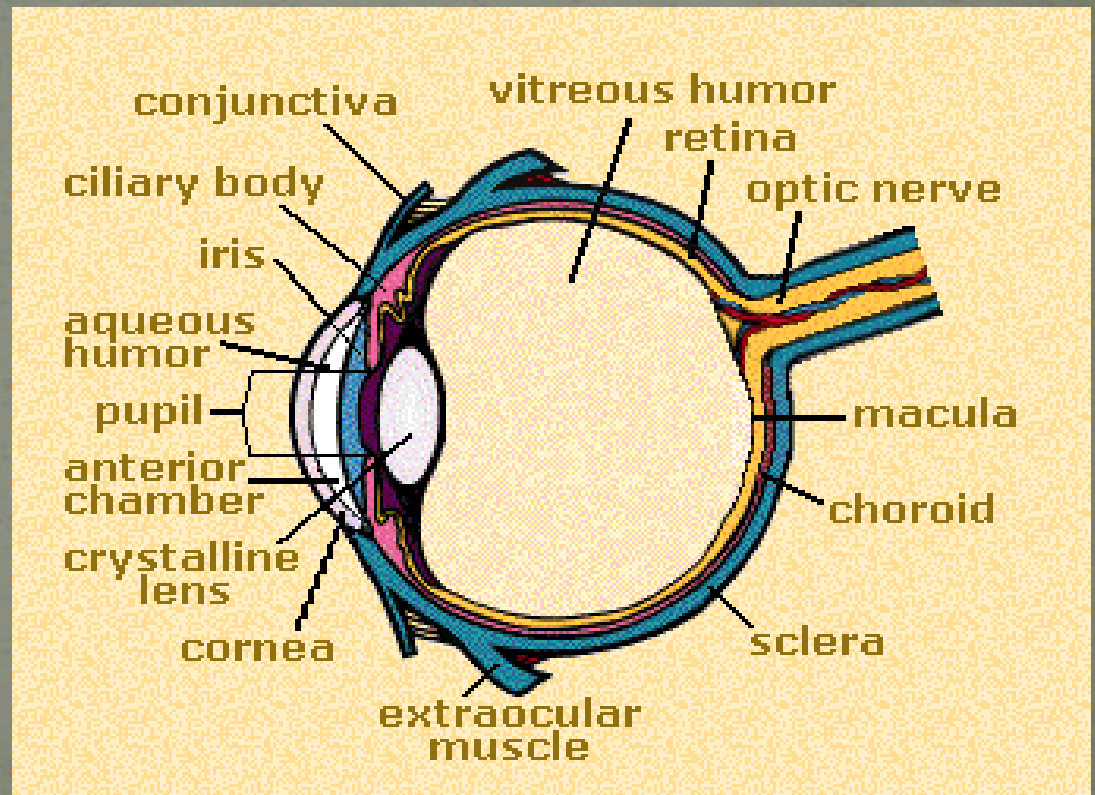


# Sound Velocity

- The speed of sound through material – in this case ocular tissues – will vary with the density of the tissue.
  - The more dense the tissue, the faster the wave will travel. As an example, sound travels much faster through water than through air – **speed through air... 343 meters per second**
- *The speed of sound through various parts of the eye....*
  - *cornea - 1641 m/s (meters per second)*
  - *aqueous - 1532 m/s*
  - *normal lens - 1640 m/s*
  - *cataractous lens - 1629 m/s*
  - *vitreous - 1532 m/s*
  - *PMMA IOL – 2718 m/s*
  - *Acrylic IOL – 2120 m/s*
  - *Silicon – IOL 1049 m/s*
  - *Silicon Oil – 980 m/s*

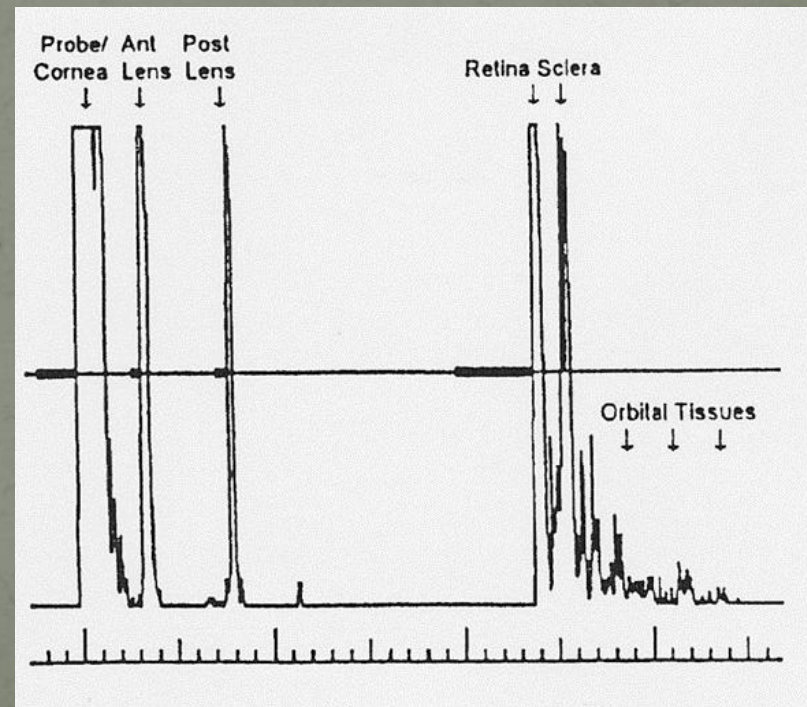
# Anatomy

- The Eye: What are we measuring
  - Cornea/tear film
  - Anterior Chamber
  - Lens
  - Vitreous
  - Retina/Choroid



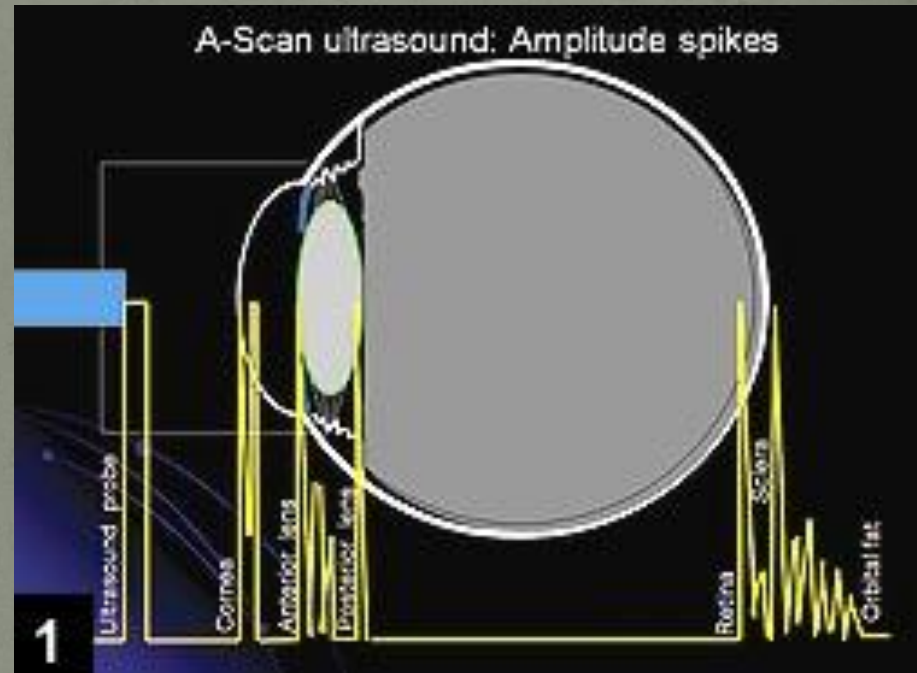
# Normal measurements

- Tear Film 3 – 5 microns
- Cornea 500 – 550 microns
- Anterior Chamber average 3.15mm
- Lens mean 4.0 mm
- Vitreous +/- 16mm
- Retina +/- 250 microns
- Total +/- 23.5mm



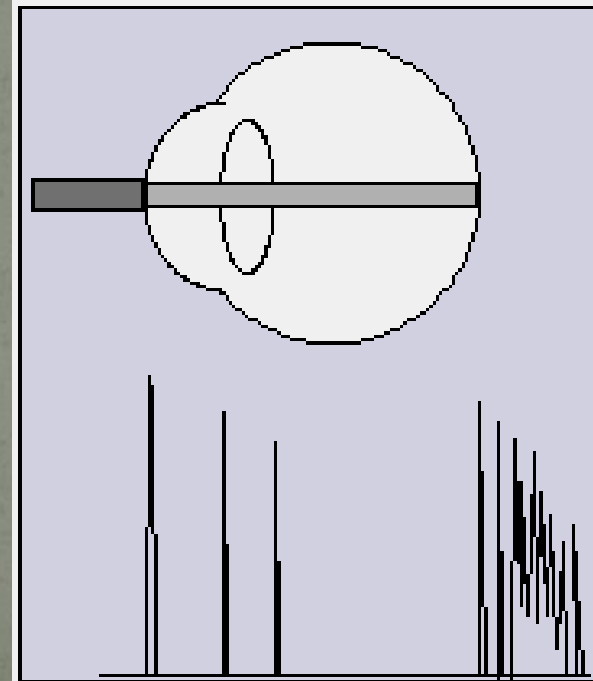
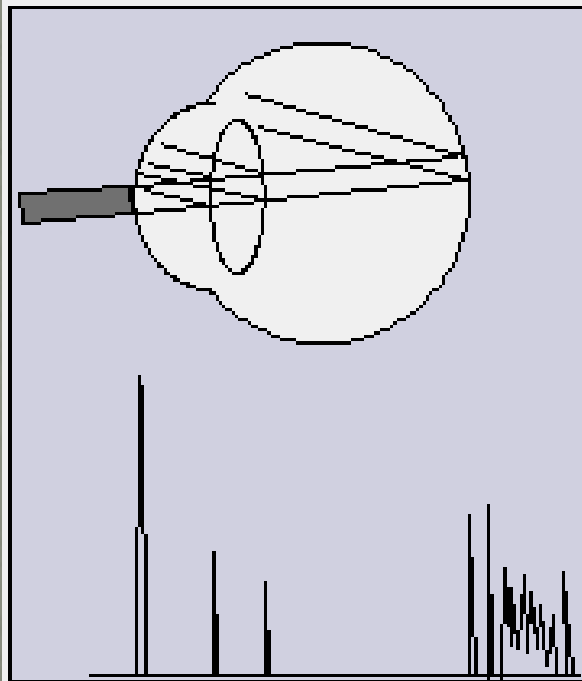
# A-Scan Measurements

- The tracing seen on A-scan units represent the intensity of the waves reflected back to the probe by the various interfaces that are passed through. The highest intensity will be achieved when the reflected wave is directly reflected back to the probe after striking a surface that is perpendicular to the direction of travel of the sound wave



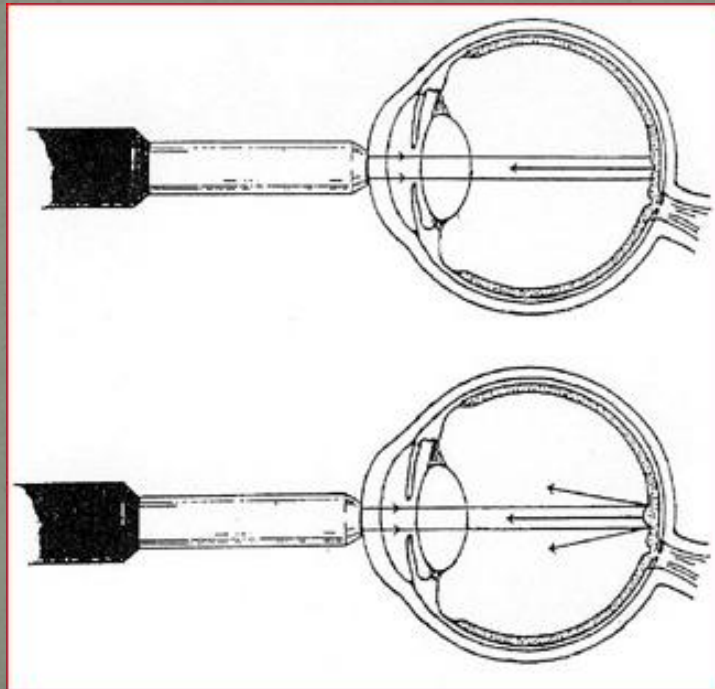
# A-Scan Measurements

- *Thus the “spikes” seen will vary with how the probe is placed on the eye. The more perpendicular the probe is held the higher the spikes will be*



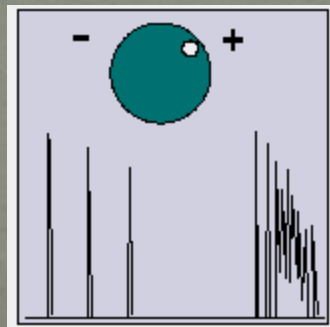
# A-Scan Measurements

- *The reflected waves are also affected by the microscopic irregularities of the surface. For instance, with Macular edema the surface of the macula is more irregular, which scatters the sound waves more than a normal macula, thus decreasing the amplitude of the retinal spike*



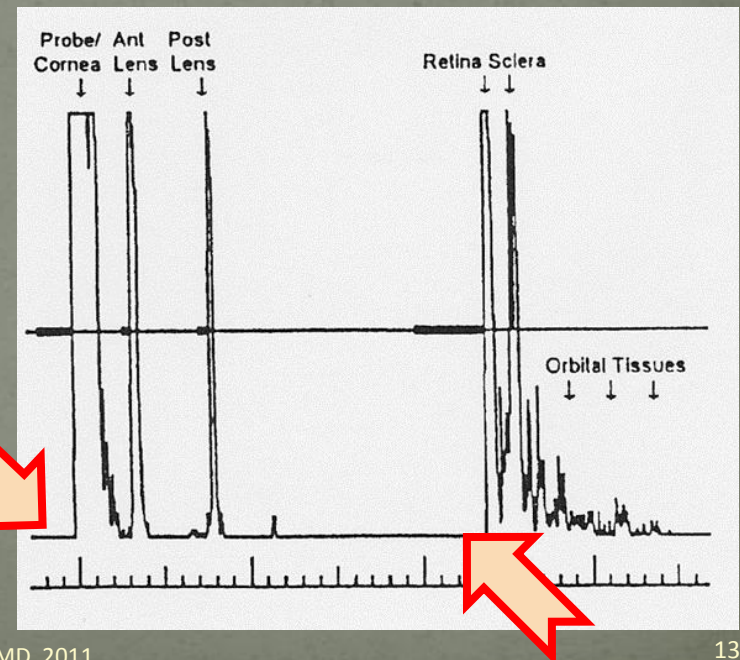
# A-Scan Measurements

- Spike size is also affected by the amount of power applied to the vibrating crystal that generates the sound waves. The more power applied to the crystal (Gain), the higher the spikes recorded. (relate this to sound amplifier). If the gain is set too high the spikes on the display will begin to blur into one another.
- If the Gain is set too low, you will miss some of the interfaces.



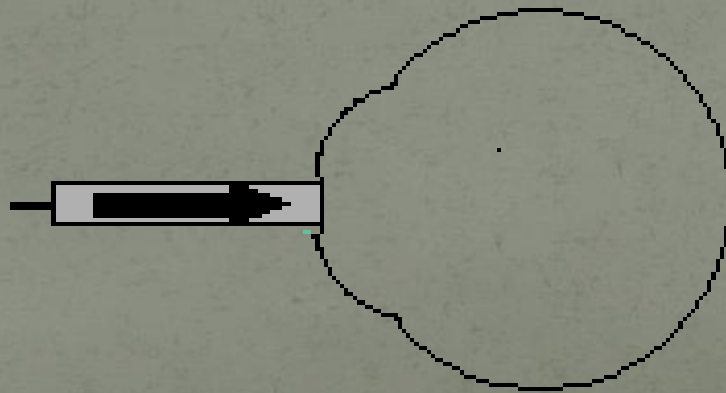
# Calculating the distance

- In order to calculate the distance from the corneal surface to the retina, the machine needs to know which spikes to compare. This is done by controlling what are called Gates on the ultrasound unit. Each unit works a little differently, but most let you control the position of the Gates. Some units are now completely automatic and will determine proper spikes by pattern recognition.



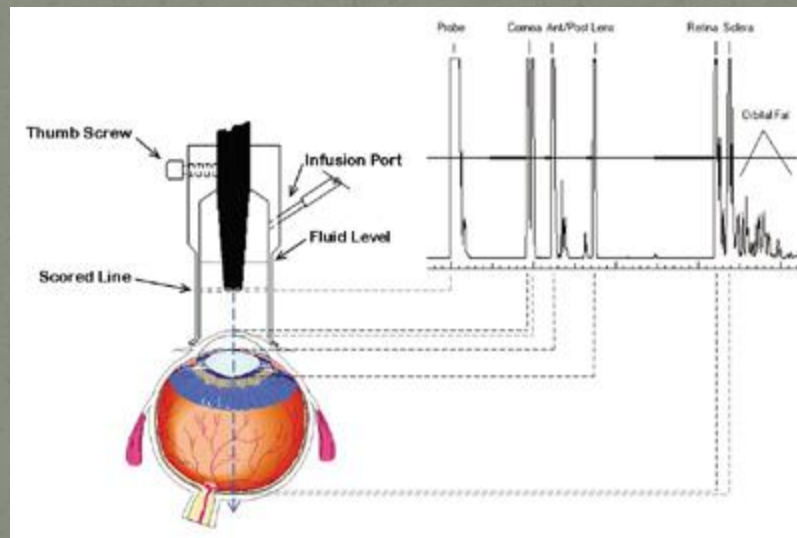
# Immersion vs Contact Biometry

- One of the most common errors in measurement of axial length occur because the operator has a “heavy hand” and pushes the probe too heavily against the cornea-indenting it – thus shortening the measurement. (this is important because for every 0.1mm of error, the IOL calculation will be off by 0.25 Diopters!)



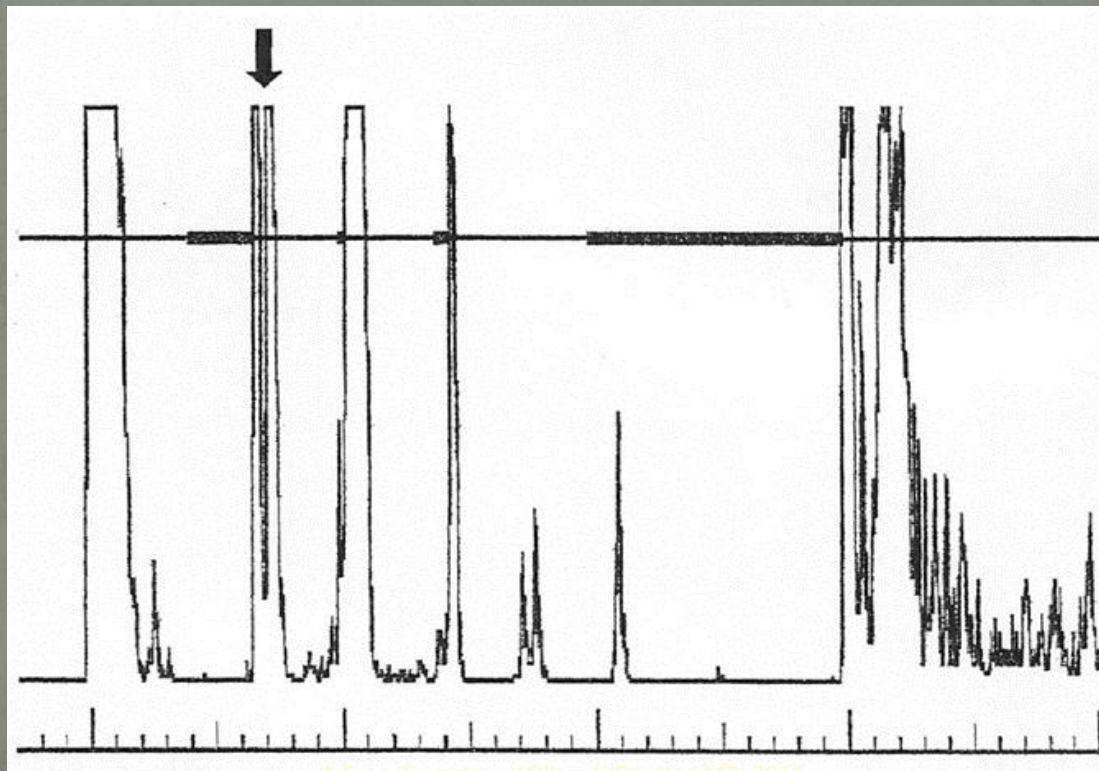
# Immersion Biometry

- The Immersion technique allows the probe to get its measurements without actually touching the surface of the eye. Saline is used as a coupling material. With immersion techniques generally more accurate measurements can be obtained. **HOWEVER**, a talented & practiced ultrasound technician can get equivalent measurements with applanation and immersion.



# Immersion Biometry

- The main difference on appearance of scan is the twin corneal spikes, representing front and back surfaces of the cornea



# Taking Measurements

- **Applanation:**
  - *Be sure probe is perpendicular to corneal surface*
  - *Properly located over visual axis – patient to maintain fixation*
  - *Light pressure, don't indent cornea.*
  - *If you have too much tear film and too light a touch you will get erroneously long measurements because your measurement will include the thickness of that “coupler”*
  - *If you don't have enough tears you will get poor quality, low intensity spikes*



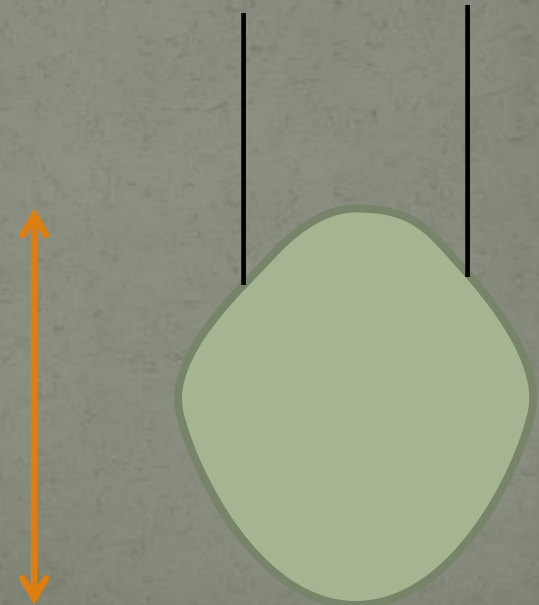
# Immersion:

- *Recline patient*
- *Proper placement of probe in prager shell, adequate fluid, and you will likely need more – syringe w/ 3 – 5 cc of saline*
- *Maintain perpendicularity to corneal surface*
- *Best with patient fixing on object with other eye*



# Immersion Biometry

- Source of error.....
  - With immersion technique, if the operator presses the praeger shell too hard against the eye, it will actually cause the globe to slightly elongate, so you can get an erroneously long axial length.

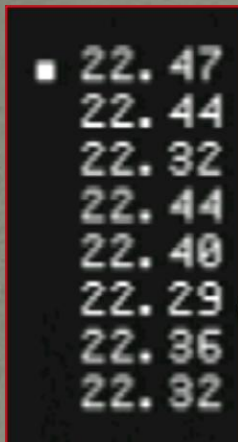


# Some useful information

- One of the formulas used to calculate IOL power, the SRK-TII
- IOL Power= A-constant – 0.9\*Avg K – 2.54\*Axial Length
- So, an error in axial length is actually multiplied by 2.54

# Keys to A Scan Biometry

- *Always take a series of measurements. Measurements should not vary by more than a few hundredths of a mm*



- *As a rule, throw out the aberrant measurements, or better, repeat until you have none*

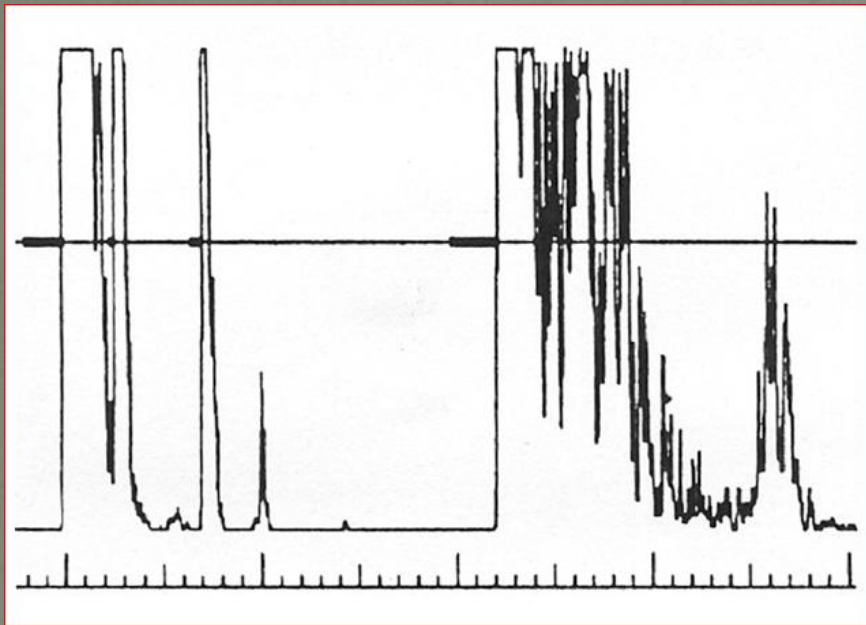
# Keys to A Scan Biometry



- *Look for good spikes, even amplitudes, perpendicular retinal spike without “chatter” in front of it.*



# Keys to A Scan Biometry



Gain set too high – note the flat tops of the spikes and the blurring or merging of posterior spikes

- *Be sure that the Gain is set adequately high, without being too high – on automatic machines setting the gain too high will give you erroneous readings, setting too low will give you no readings.*

# Keys to A Scan Biometry

- *PRACTICE, PRACTICE, PRACTICE INITIALLY WITH SUPERVISION OF SOMEONE QUALIFIED.*
  
- *Practice Makes Permanent.....*  
*Perfect Practice Makes Perfect.*

# IOL Master

- The IOL master by Carl Zeiss Meditec is an optical biometer that was approved in March 2000.
- Optical biometers use infrared light to perform They are different from traditional A-scan ultrasonography because they use infrared light to calculate axial length, keratometry and anterior chamber depth, all in one machine. They measure the distance from the corneal vertex to the retinal pigment epithelium using a patented interference optical method called partial coherence interferometry.



# Lenstar by Haag-Streit

- LENSTAR is an Optical Biometer capable of highly accurate measurements along the visual axis and IOL calculation.

Technology overview: 820nm Superluminescent Laser Diode combined with Optical Low Coherence Reflectometry (OLCR) allow capture of 9 measurements with one scan.

