HVF Hoopla

Pearls and Pitfalls of Visual Field Testing

Humphrey Visual Field (HVF)

- Basics
- When is a field reliable?
- Common Errors
- Pearls

Zeiss HVF Analiser

What are we testing?

- Ability of a patient to see a white(red) light the size of 0.5 degrees(stimulus III) and 2 degrees (stimulus V) of increasing intensity/contrast against a white background in an algorithm arranged sequence to estimate an area of the patient's entire field.
    - Patients responses are compared to database of normal controls for that stimulus and intensity to give a representation of their field. (Automated perimetry)
- The first number indicates the degrees from fixation of the field for the eye and the second number is the testing protocol the machine performs. It's a function of how close the stimulus presents to the horizontal and vertical meridian.
    - Ex: 24-2 tests 24 degrees of the patients field from fixation. and the 2 means the stimulus is presented no closer than 3 degrees of the assumed horizontal and vertical meridians
    - Ex: 30-1 tests 30 degrees to either side of fixation and the 1 means it is testing within 1 degree(directly on) the assumed horizontal and vertical meridians
        - The -1 fields are not used as it does create some issues with easily distinguishing horizontal and vertical meridians for both the patient and the interpreter/print out.

Stimulus Arrangement

- Standard(SAP)/SITA/SITA Fast (Swedish Interactive Threshold Algorithm)
  - Different algorithms used to test the patients field of view in a particular sequence.
  - As we move to the right we test fewer points with some assumptions made between the untested areas(decreased accuracy) but the test duration also decrease for patient attention span(meaningful field).
    - ~10 minutes for a Full field and ~3 minutes for SITA fast to be completed.
- First few lights test 4 areas within the perimeter edge of the macula.
- Then a randomized arrangement with the entire field(including the blind spot)
  - Arranged in such a pattern and with sub-threshold stimuli that a patient is predicted to miss 50% of the total lights shined during the test duration.
  - Very helpful to explain to your Field techs and patients to reassure them about their experience.

Basics

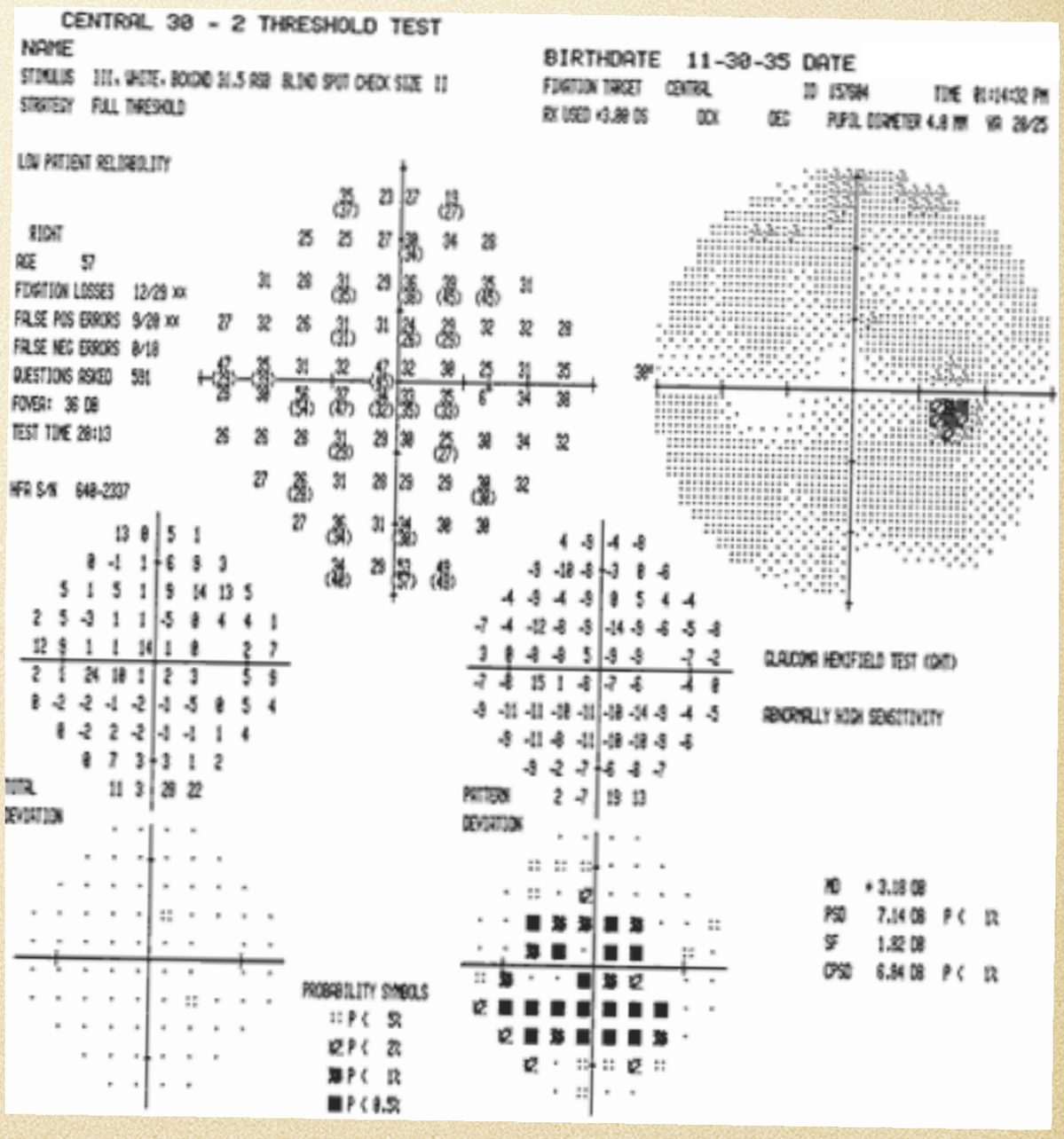
- Name and Age
  - Fields are compared to patients of same age(20-80) and NOT a range like OCT.
  - Extremes out of this range must be extrapolated.
- Field Test Numbers(30-2)
- Eye Side
  - Wrong eye in field(Monocular OS pt)
- Pupil Size(Recommend Undilated)
  - <2.5mm or >5.5mm pupils will effect field. Important to compare pupil sizes between series of tests.
- Refractive Error
  - Must enter the refractive error of patient into machine and appropriate ADD power every time!
  - Changes >1 D will cause ~1.26dB drop in peripheral defects and generalized depression with stimuli.
  - Patients with high refractive errors should wear their contacts when possible.
- Stimulus Size
  - Important to compare fields with same stimulus size based on degrees measured.
  - Stim III(4mm^2 or 0.5 degree), Stim V(64mm^2 or ~2 degrees)
  - Use Stim V or 10-2 for those with low vision or difficult test takers!

When is a Field Reliable?

- False Positives
- False Negative
- Fixation Losses
- Mean Deviation
- Visual Field Index
- Pattern Standard Deviation
- Total Deviation

False Positives

- Patient responds to light when it is below normal threshold.
- Nervous Patients/Click Happy
- Produces White Scotomas in field/Gray Scale
- Useless test
- Repeat with assurance they should see bright and dim lights and miss 50% of the lights during the test.



False Negatives

- Patient has loss interest, fell asleep, malingering
- Classic is clover leaf defect
  - Due to starting with 4 foveal border points
- Correct this with observation or Stim V

Single Field Analysis

Eye: Right

Name:

DOB: 01-02-1954

ID: 19833

Central 24-2 Threshold Test

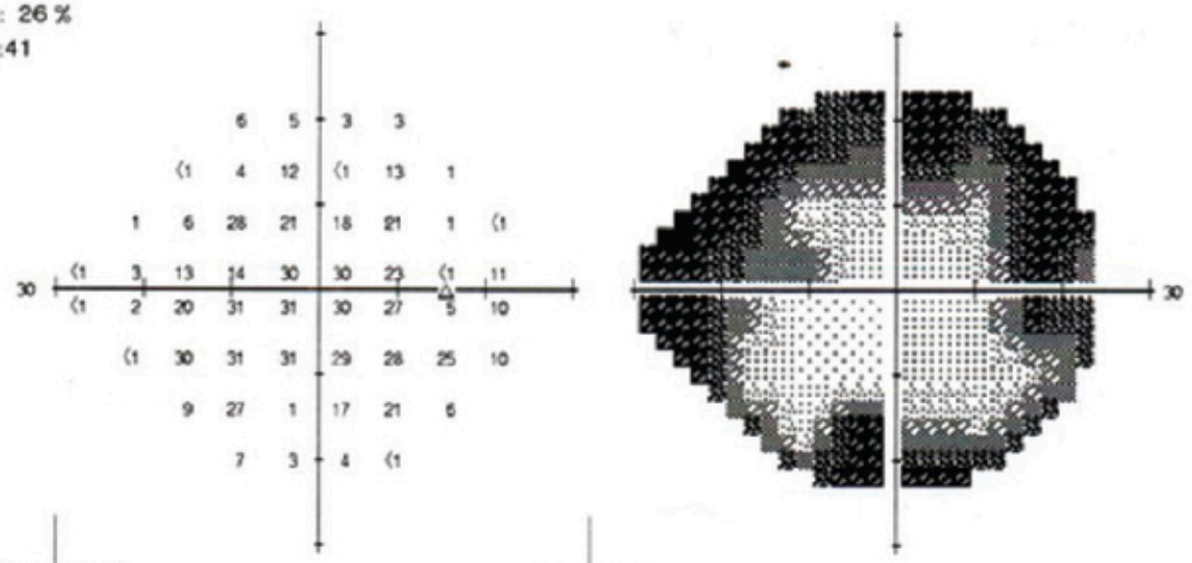
Fixation Monitor: Gaze/Blind Spot
Fixation Target: Central
Fixation Losses: 0/18
False POS Errors: 0 %
False NEG Errors: 26 %
Test Duration: 09:41

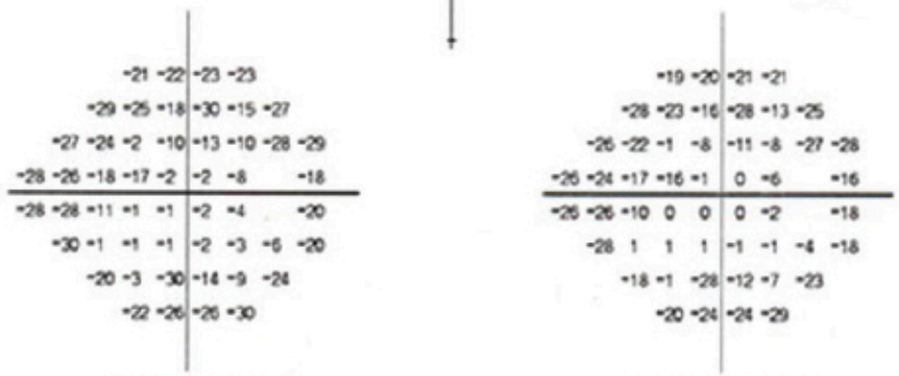
Fovea: 34 dB

Stimulus: III, White
Background: 31.5 ASB
Strategy: SITA-Standard

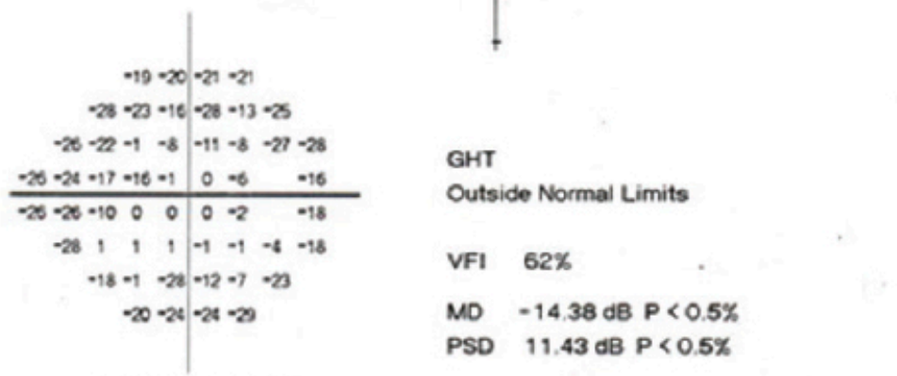
Pupil Diameter: 3.0 mm
Visual Acuity: 6/12
RX: +0.50 DS -0.75 DC X 135

Date: 19-09-2015
Time: 11:21 AM
Age: 61





Total Deviation



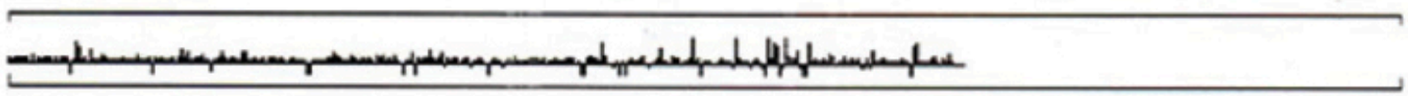
Pattern Deviation

:: < 5%
< 2%
< 1%
■ < 0.5%

GHT
Outside Normal Limits

VFI 62%

MD -14.38 dB P < 0.5%
PSD 11.43 dB P < 0.5%



HFA II 745-7409-5.1/5.1

Fixation Losses

- Blind Spot is ~15 degrees temporal to fixation
  - Calculated using Heijl-Kracku Technique
    - Maps Blind spot early, then will shift for fixation.
- If all else is good may consider a field good with high fixation losses still.
- Confirm with the Gaze tracker
  - Up ticks are fixation losses, Down ticks are blinks
- Correct this by reassuring they should miss 50% of lights

Single Field Analysis

Eye: Right

Nan

DOB: 16-11-1945

ID: 1

Central 24-2 Threshold Test

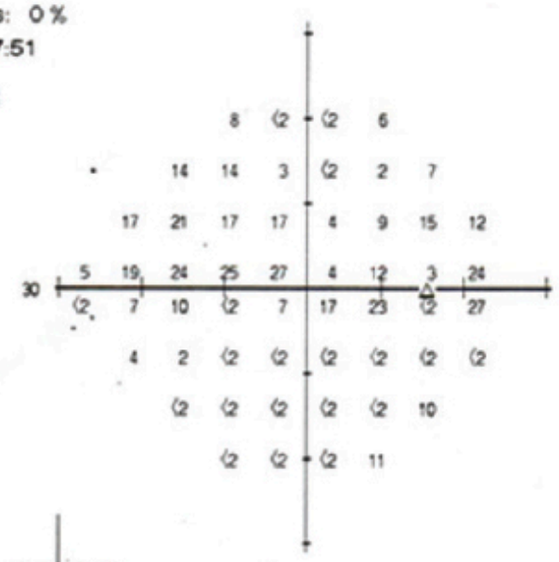
Fixation Monitor: Gaze/Blind Spot
Fixation Target: Central
Fixation Losses: 0/16
False POS Errors: 2 %
False NEG Errors: 0 %
Test Duration: 07:51

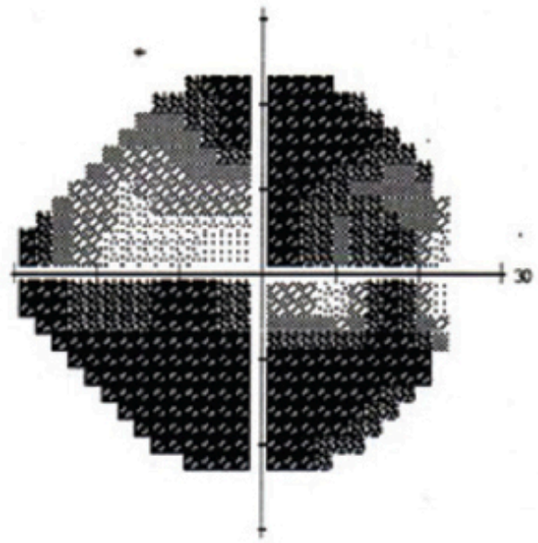
Stimulus: III, White
Background: 31.5 ASB
Strategy: SITA-Standard

Pupil Diameter: 3.0 mm
Visual Acuity:
RX: +1.75 DS DC X

Date: 27-02-2016
Time: 10:19 AM
Age: 70

Fovea: 32 dB ::





Total Deviation

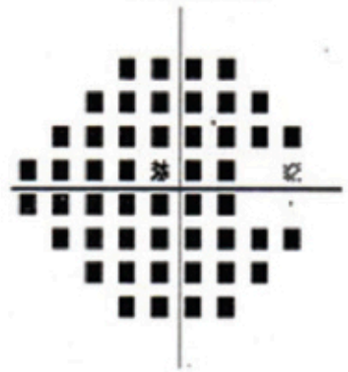
Pattern Deviation not shown for severely depressed fields. Refer to Total Deviation.

GHT
Outside Normal Limits

VFI 31%

MD -21.11 dB P < 0.5%
PSD 9.65 dB P < 0.5%

Pattern Deviation



Pattern Deviation not shown for severely depressed fields. Refer to Total Deviation.

:: < 5%
<2 < 2%
<1 < 1%
■ < 0.5%

HFA II 745-7409-5.1/5.1

Mean Deviation

- Index used to determine the average difference in visual field response in (dB) from person of same age. (0 to -2dB is WNL)
- Also used to monitor progression over time esp in moderate stage disease (-6 to-12dB)
- Past -12dB MD is not useful for progression monitoring (Severe disease)

Visual Field Index

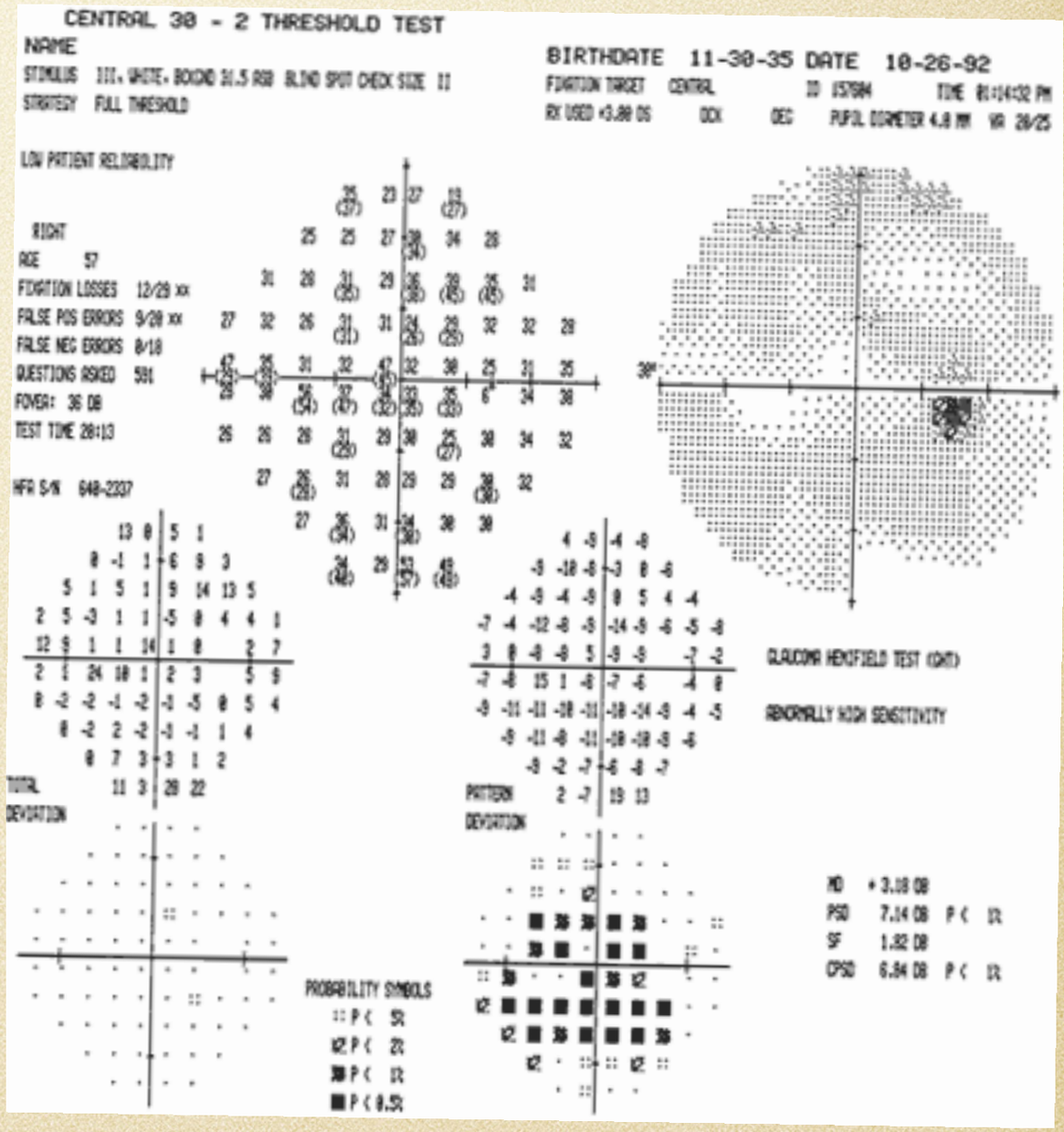
- Percentage estimation of field remaining
- Has good correlation with Mean Deviation
- Useful for monitoring progression or giving patients an idea of severity of condition.

Pattern Standard Deviation

- Plot of the patients responses(dB) to the field to indicate field depression or loss.
  - Examine size, shape and location
- Most important plot to observe and confirm for glaucomatous defects or early defects.
  - Most useful for tracking mild stage disease progression
- Should closely match total deviation plot with removed generalized field loss
  - If Large PSD defects and no corresponding TD defects = high FP
- Not effected by cataracts

Classic High False Positive

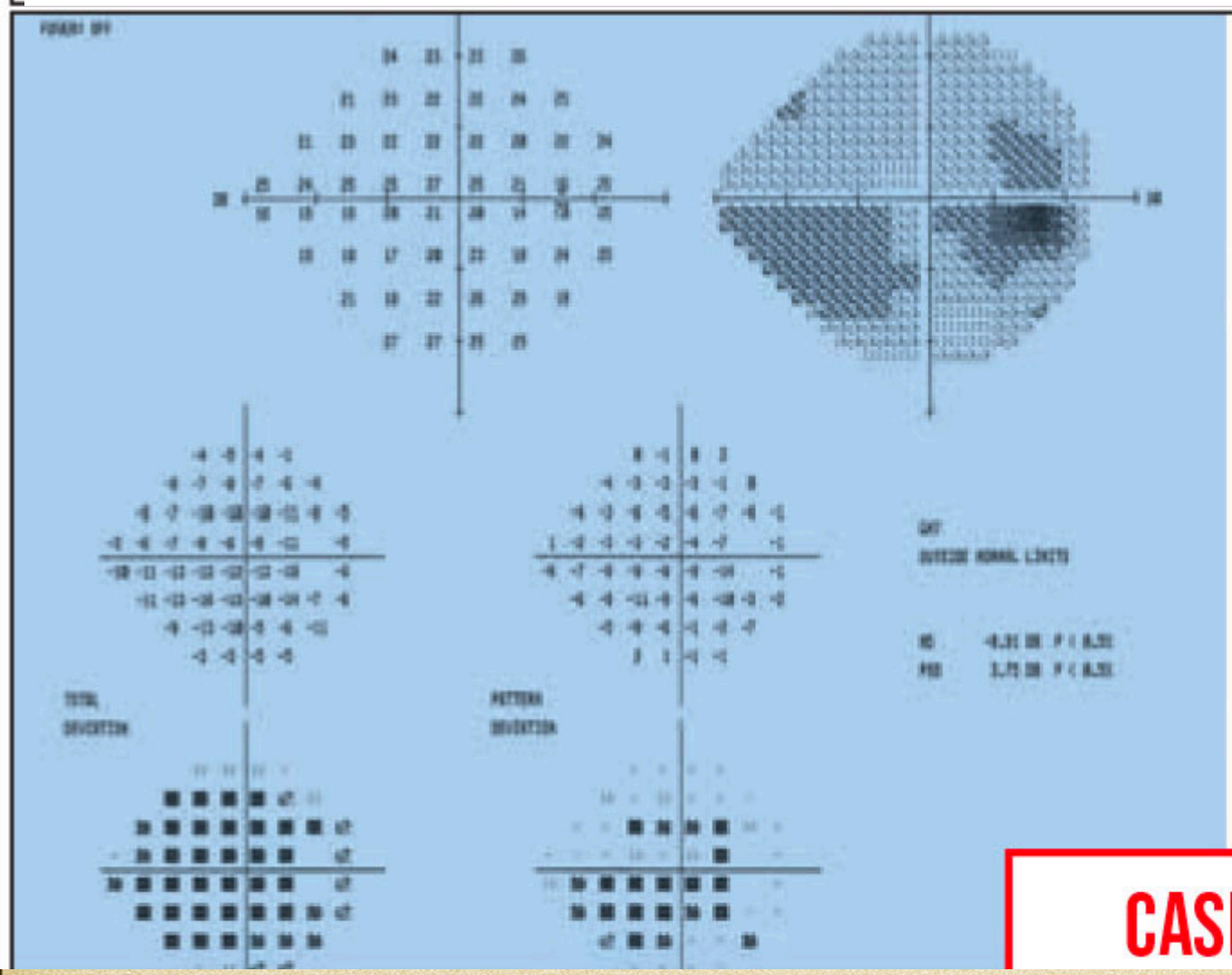
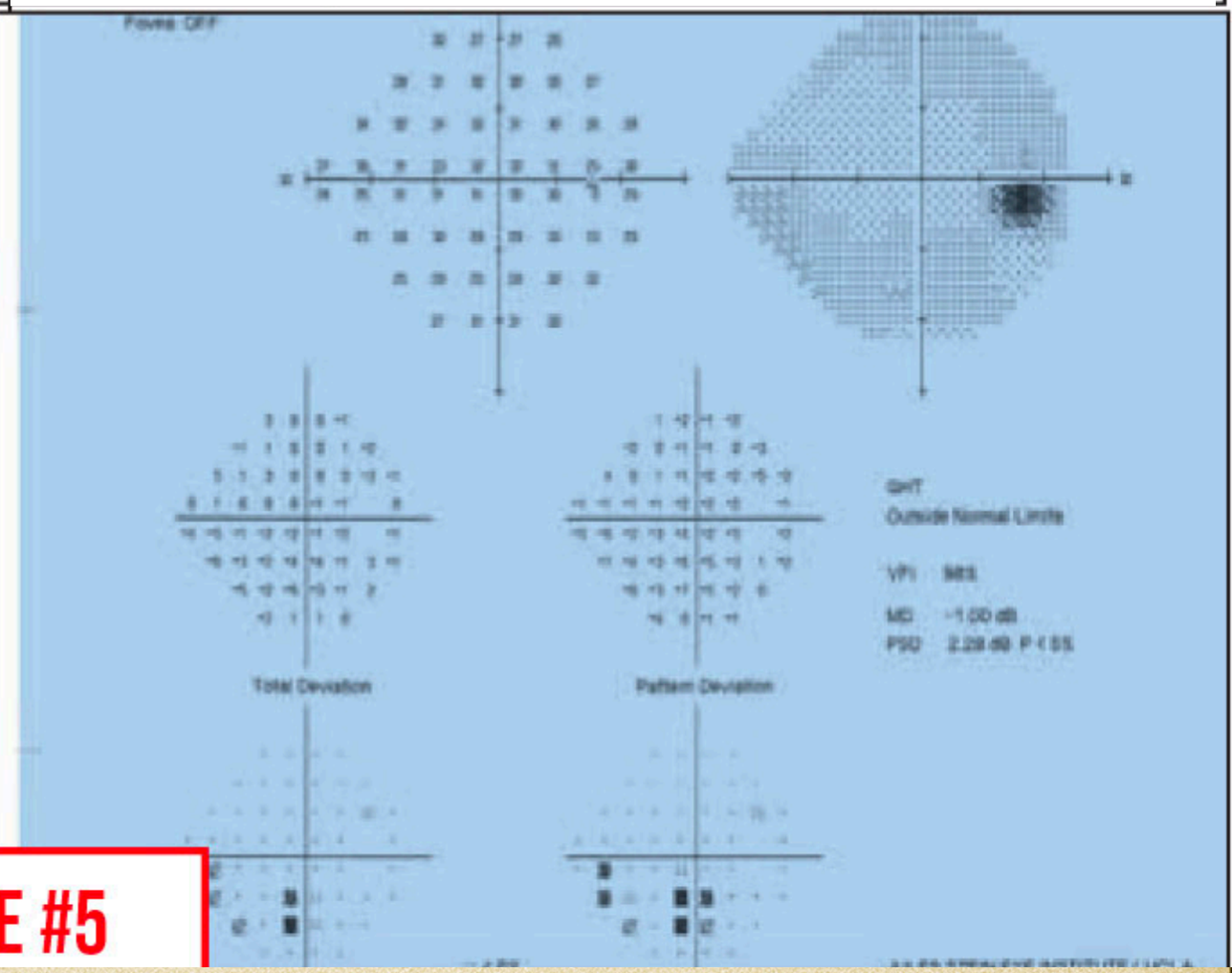
- Very irregular PSD plot
- No corresponding TD
- White Scotoma on Grey Scale
- Trigger Happy PT
- Useless field
- Needs reassurance



Total Deviation

- Plots the patient's VF that are different from normal patient of same age.
- Look at size, shape and location of plot points.
- Can be effected by corneal and lenticular opacity
  - Need to look at PSD instead

Media Opacity Effect on TD

Before Surgery	After Surgery
	

CASE #5

Pearls for HVF

- Confirm the Basics (5R's)
  - 1. Right Test, 2. Reliable, 3. Review PSD/TD, 4. RNFL correlation, 5. Reaffirm Dx. If 1 of 5R's are wrong then REPEAT HVF.
- Look at PSD/TD for mild-mod disease progression
- Look at MD for moderate disease progression
- Fields improve with repetition (>80% of time).
- Don't be afraid to use Stim V and 10-2.
- Explain to patients to press when they see a bright or dim light.
- Reassure patients they should miss 50% of lights during testing.

OCT Mumbo Jumbo

Pearls and Pitfalls of OCT in Glaucoma

Clint Simpson MD

Optical Coherence Tomograhpy(OCT)

- Non-Contact, Non-invasive imaging device used to exam layers of the retina by looking that the interference patterns of reflected laser light from the individual tissues.

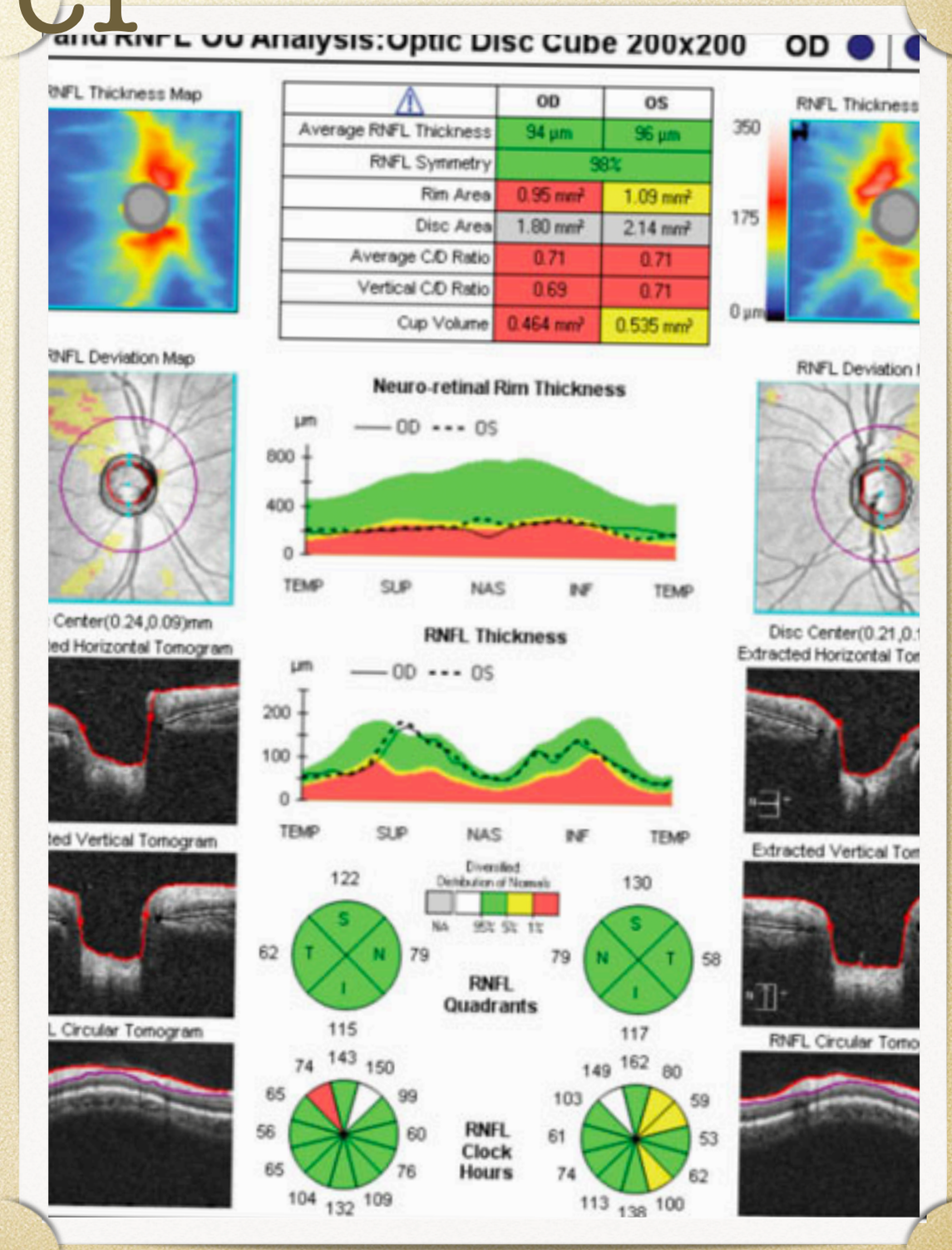
- Glaucoma (Retinal Nerve Fiber Layer, RNFL)

Types of OCT

- Time Domain OCT (TD-OCT)
    - Stratus OCT
- Spectral Domain OCT(SD-OCT)
    - Higher Resolution with faster image capture
    - Cirrus SD-OCT(Zeiss)
    - Spectralis OCT (Heidelburg)
    - RTVuve-100 (Optovue)
- Ultrahigh speed swept source, ultrahigh resolution, adaptive optics OCT

Retinal Nerve Fiber Layer

- 3.4mm circle of RNFL is scanned to create a TSNIT map.
- Compares patient thickness to a normative database (284 pts)
- Clocks and Quadrants

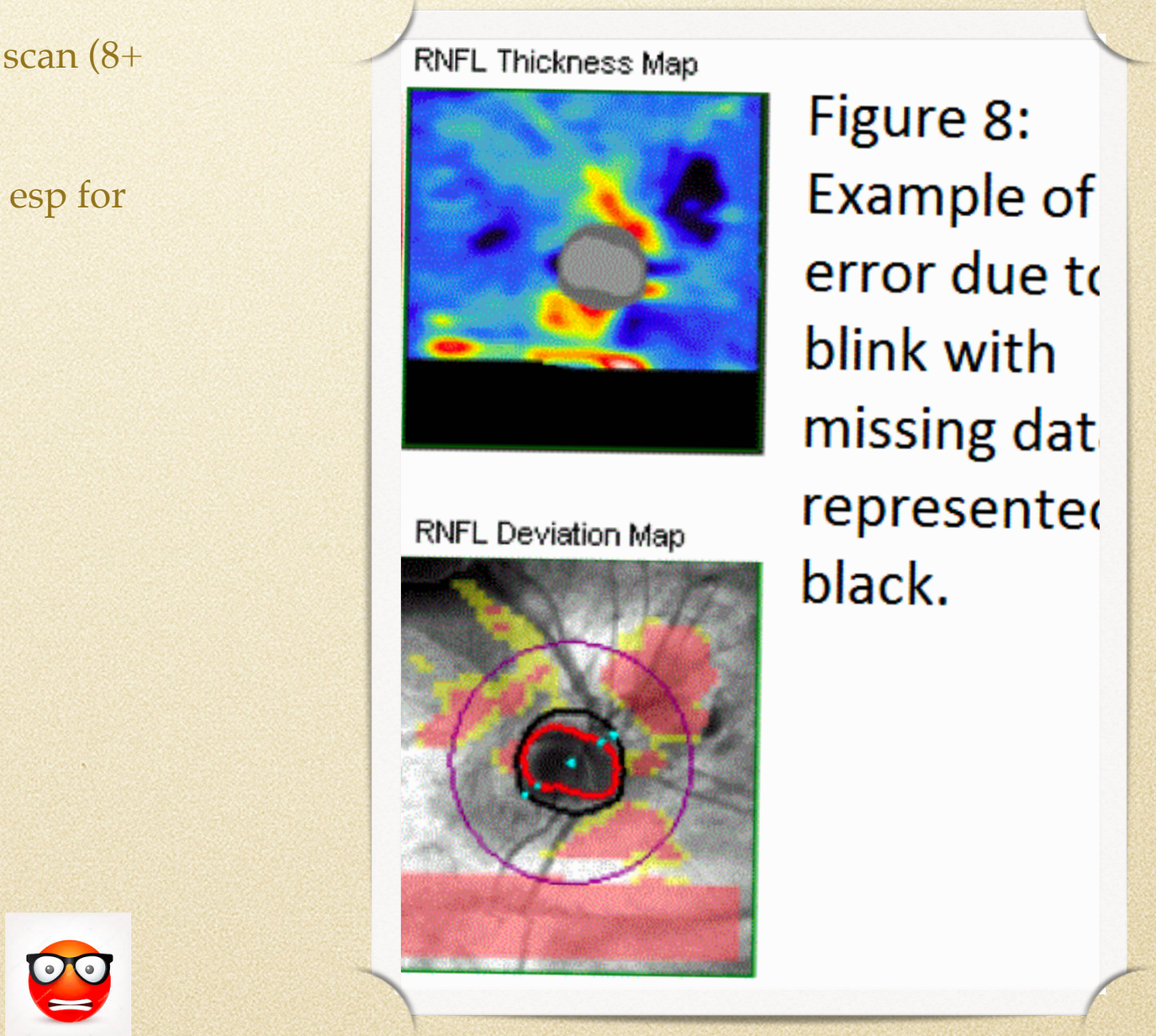


Pitfalls with RNFL

- **Look at Signal Strength (6+/10, Ideal 8+/10)**
  - **Poor due to Tech, patient(blink,movement) or media**
  - **Segmentation Errors**
- The High Myope!! Split Inf/Sup NFL Bundle
  - Look for triple hump sign
- Testing Variability with Guided Progression Analysis
  - 3-5 um is considered normal average variability
  - Become suspicious for progression at 8-10um avg total loss(2 S.D./95% CI)
  - Become suspicious for progression at 5-6um in any single quad (Sup/Inf)
  - Pseudophakia (demonstrated to increase RNFL thickness up to 9% post CEIOL!!)
- Natural Progression of RNFL loss
  - 0.5-1um/year avg; 1-1.5um/year sup/inf avg

Signal Strength

- Always exam Signal Str of every scan (8+ ideal and 6+ is mandatory)
- Delete these scans from database esp for progression analysis.
- Look at image collected
  - Blinks miss inf half of RNFL
    - Black=0um measurement!!
  - PVDs block based on location
    - Thin RNFL
  - Cataracts reduce RNFL up to 9%
    - Cortical>PSC>NS
  - Asteroid Hylosis
    - DON'T GET ME STARTED!



Segmentation Errors

- Deviation Map Centration
  - Confirm centration around the disk in 3 dimensions!
- Segmentation Error (Look at Segmentation Lines on tomograms)
  - Confirm scans are not in zero range of tomogram (near top of image range)
  - Occurs in myopes with staphylomas/PPA and Optic Nerve Tilt
- SD-OCT has eye tracking feature which allows for more accurate measurements
  - Uses blood vessels for alignment
  - Make sure its on (Machine)

Segmentation Error

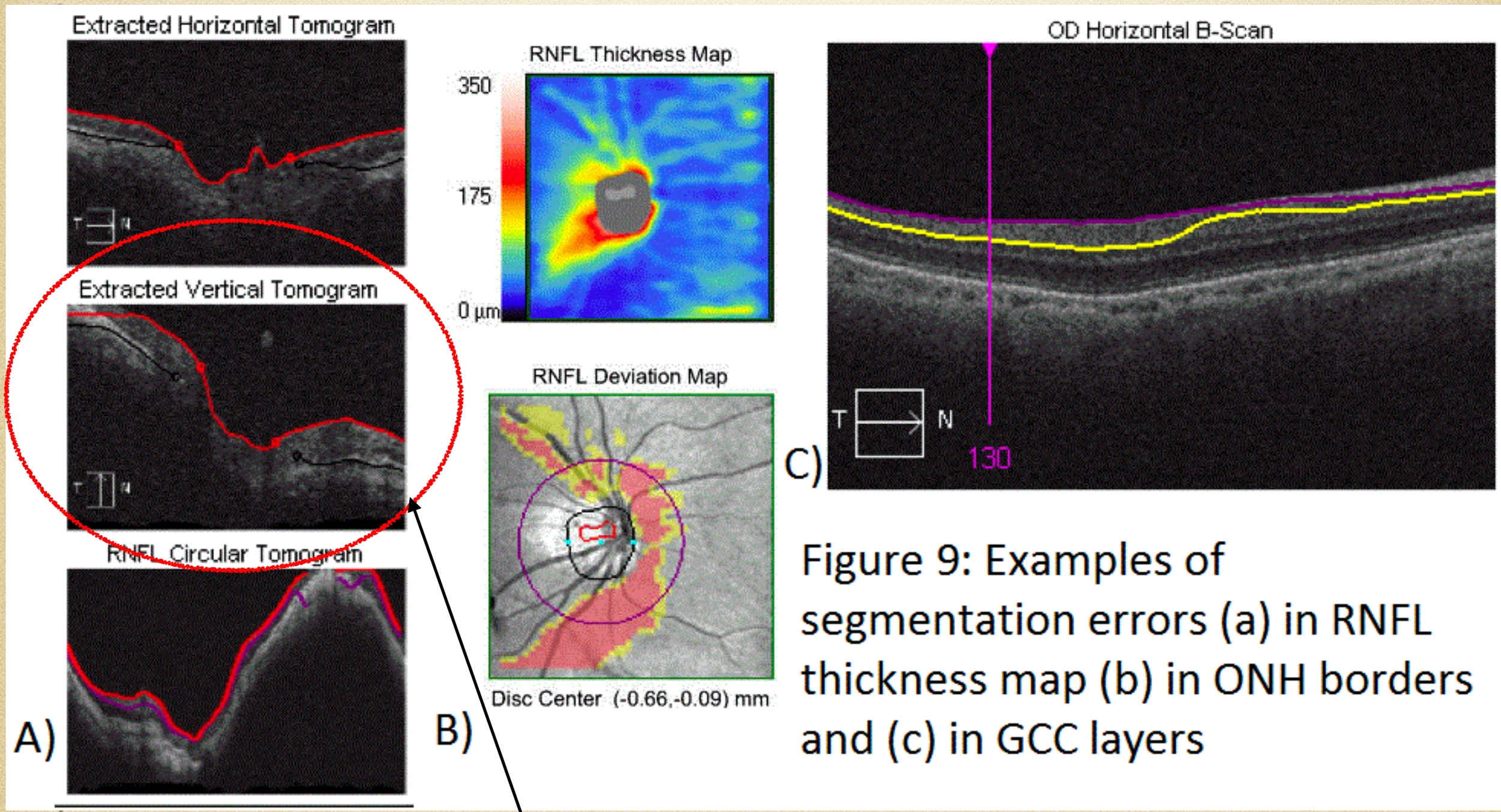


Figure 9: Examples of segmentation errors (a) in RNFL thickness map (b) in ONH borders and (c) in GCC layers

Large degree of Temporal Tilt with PPA

Pitfalls with RNFL

- Look at Signal Strength (6+/10, Ideal 8+/10)
  - Poor due to Tech, patient(blink,movement) or media
- The Myope!! Split Inf/Sup NFL Bundle
  - Axial length, large C:D, Flooring Effect, Look for triple hump sign
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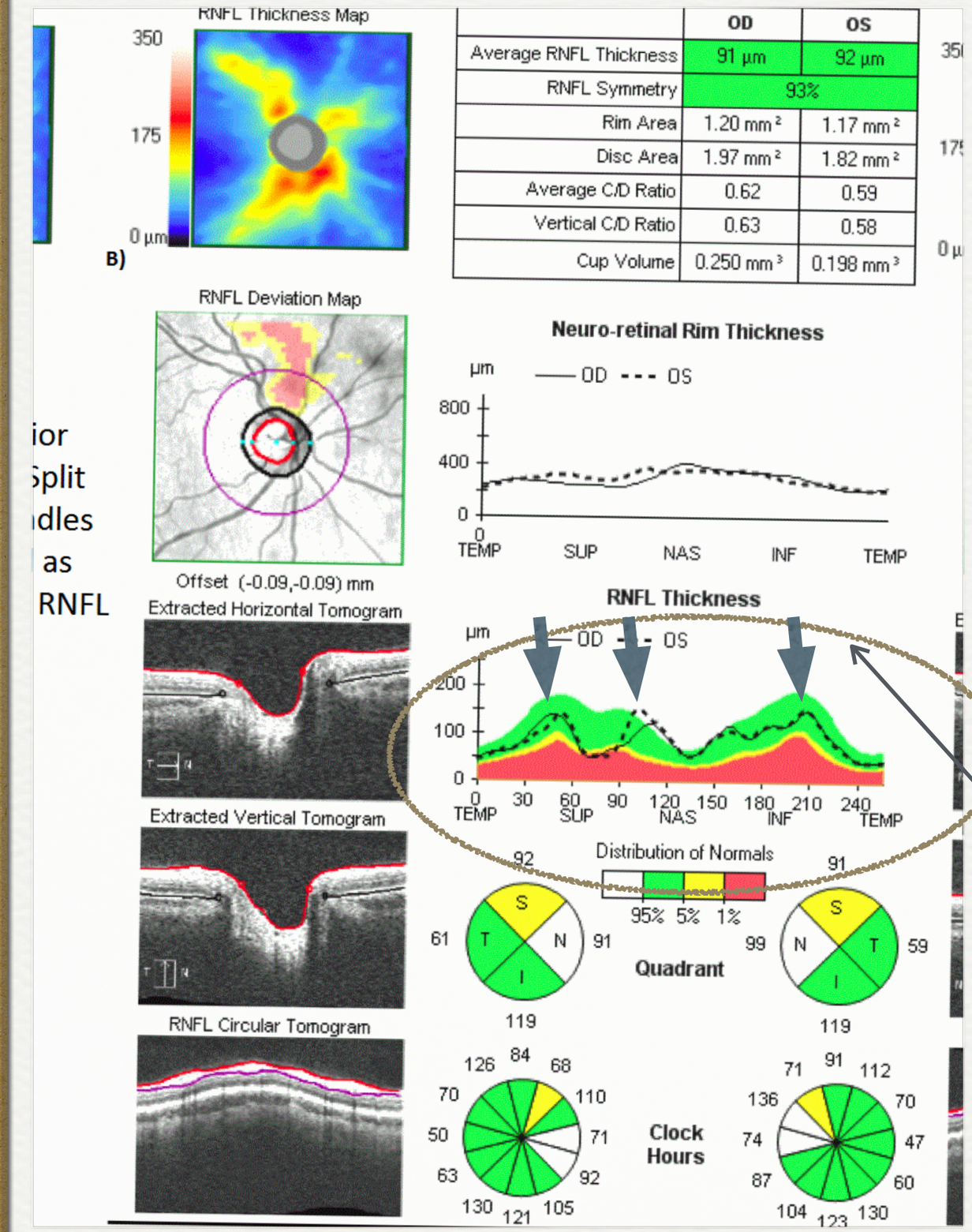
  - 0.5-1um/year avg; 1-1.5um/year sup/inf avg

The Myope

- The Most Difficult Interpretation
- Normative Nomogram (284 patients)
  - Ranged from -12.0D to +8.0D (Handful of pts were >-6.0D)
  - Best comparison is usually the patient to themselves (serial scans 3+ to start)
- Axial Length Induced Magnification (>25.0mm)
  - Artificial thinning of NFL and poor estimations(shrinking) of neuroretinal rim
  - Larger C:D estimations and severe thinning estimates (Floor Effect)
  - Not currently accounted for on any OCT software/nomograms
  - Not due to refraction unless greater than -20.0D
- Temporal Tilt and Peripapillary Atrophy/Staphaloma (Segmentation Errors)
  - Split RNFL, Large Staphaloma or marked PPA make for reproducibility nightmares
- Best correlated with great 8/10 repeat scans, ignore the nomograms and serial FF and HVFs

High Myope Split Nerve Fiber Layer Bundle



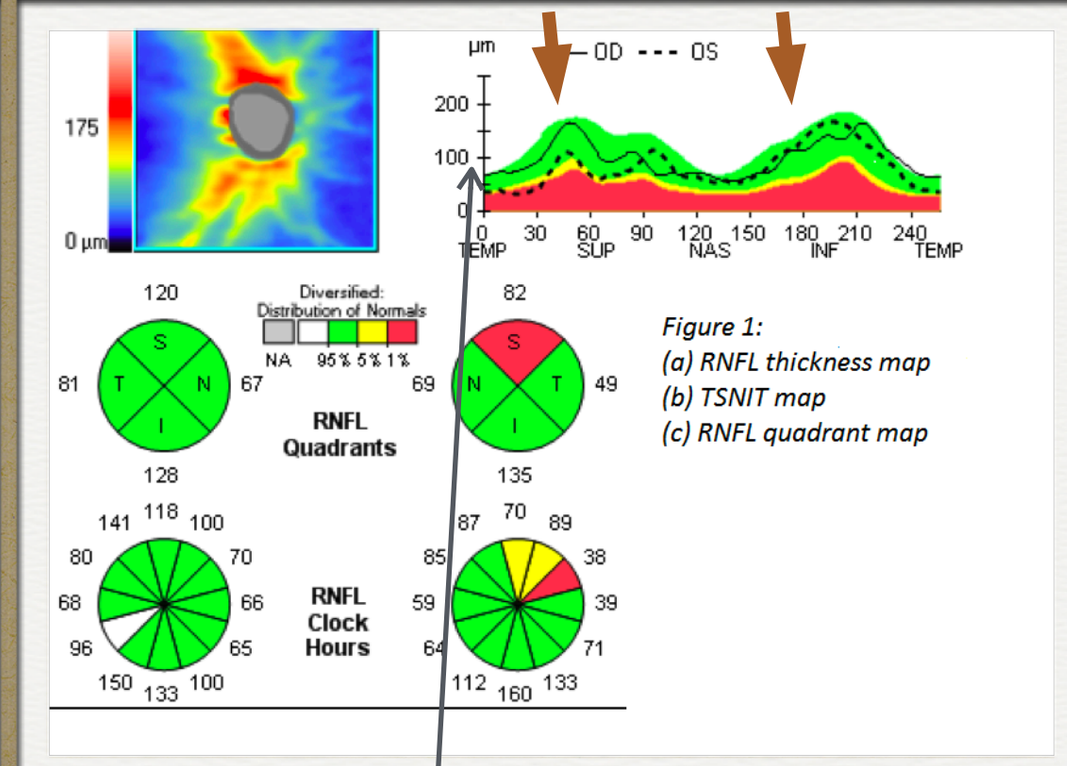


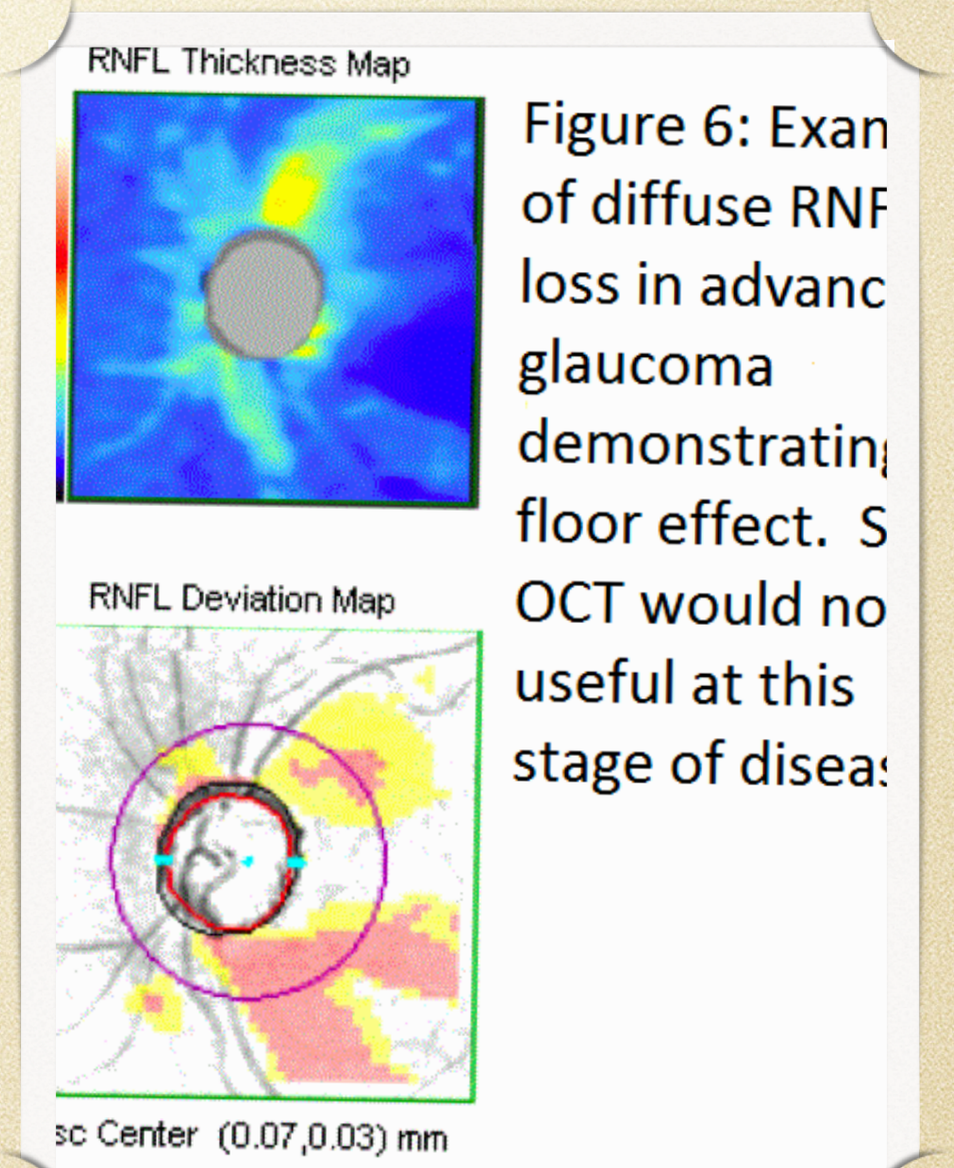
Figure 1:
(a) RNFL thickness map
(b) TSNIT map
(c) RNFL quadrant map

Double Hump with Superior Thinning

Triple Hump with "Sup Thinning"

Floor Effect

- Severe Thinning of RNFL
  - Seen in Myopes and Advanced Glaucoma
- Be suspicious for Floor Effect when
  - Scan quality is good(no black)
  - Rim is thin
  - Measurements are <45um
    - Glial cells +BV and connective tissue =40um.
- If scan cannot be improved, must rely on visual fields and fundus photos



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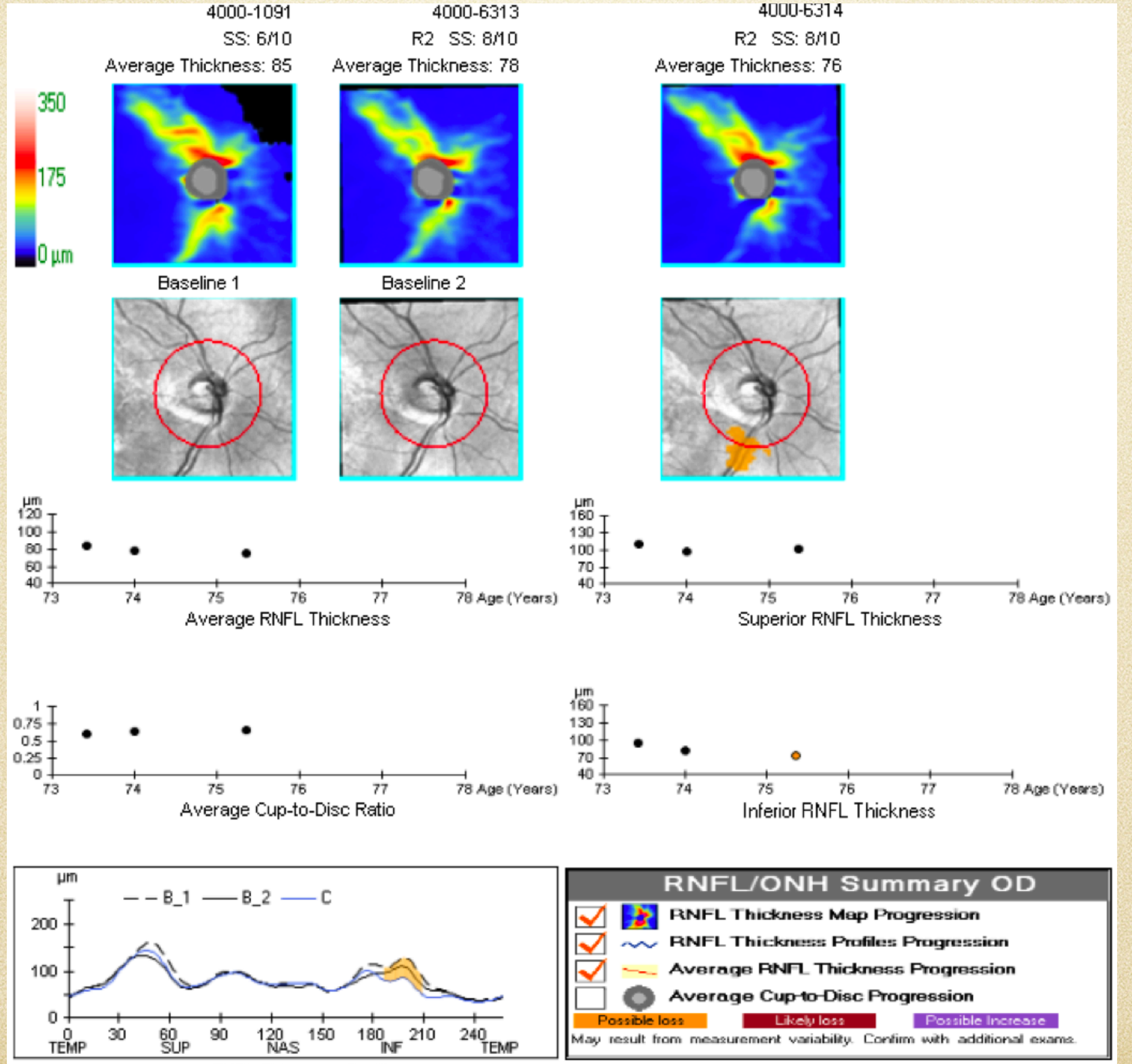
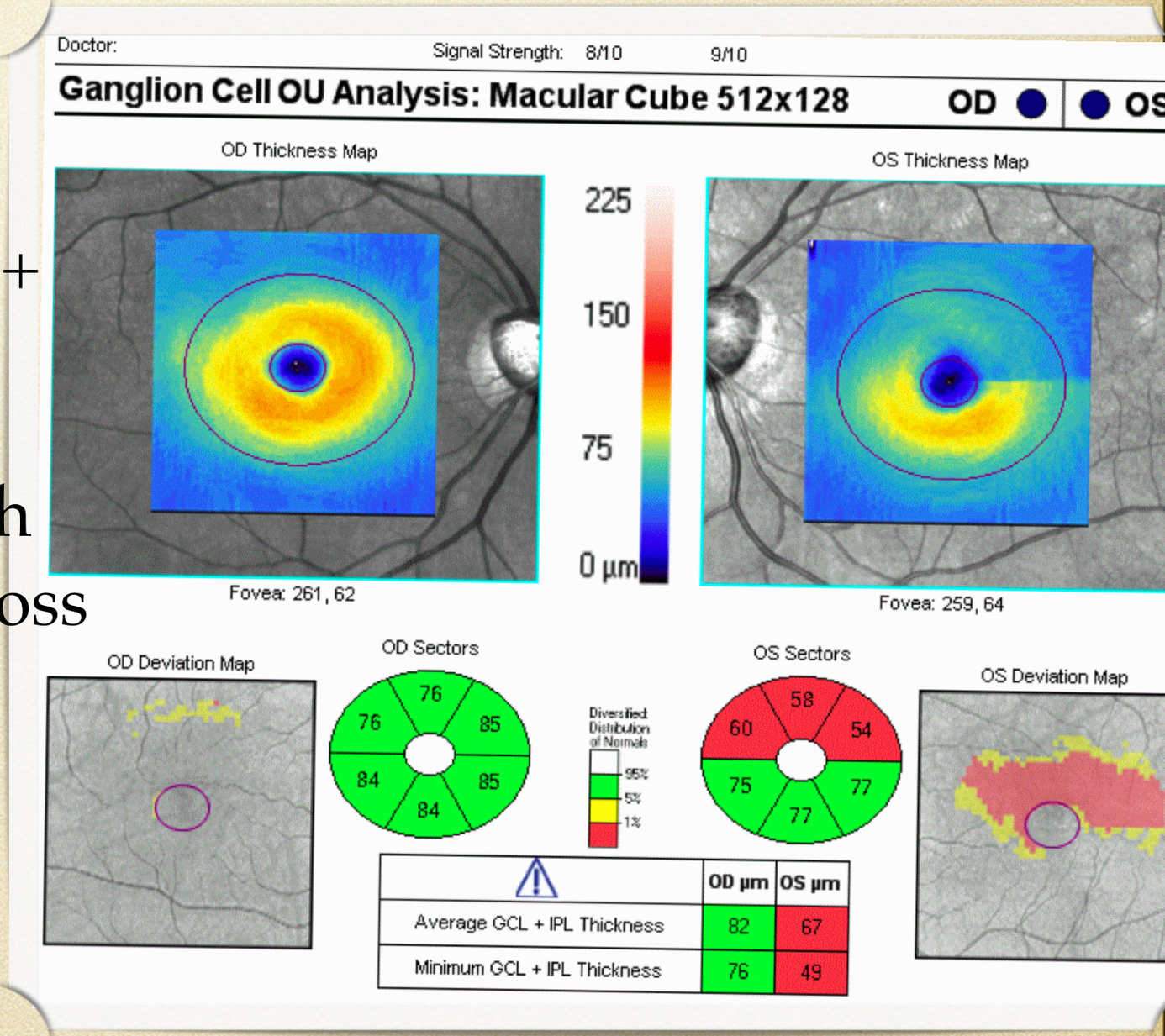
Guided Progression Analysis



Ganglion Cell Analysis

- Measurement of GCL + IPL of Macula
- Strong correlation with RNFL loss and GCL Loss
- GCL loss may detect earlier glaucoma than RNFL measurements



Pitfalls to GCA

- GCC of macula is about 50% of total RGCs at disc
- Anything that effects the macula will effect GCA accuracy/usability
  - ERMs, DME, CME, BRVO,BRAO,CNVM/ AMD and Myopic Degen

Conclusion

- OCT in any form is a useful test for monitoring and diagnosing glaucoma

- However it should NEVER be the sole means for diagnosis and monitoring of disease.

- Must be used in conjunction with other modalities and physician judgement/ interpretation.

For the Visual Learners

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Thank You