

# Detecting progression on local areas of retinal nerve fiber layer in glaucoma suspects and early glaucoma using optical coherence tomography

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## INTRODUCTION & PURPOSE

- Accurate detection of glaucoma progression is crucial to the clinical management of disease as it is important to prevent the development of functional disability.<sup>1</sup>
- We hypothesize that it may be possible to improve the accuracy of detecting progression by evaluating a region-of-interest (ROI) method applied on circumpapillary retinal nerve fiber layer (cpRNFL) thickness profile.<sup>2</sup>
- Purpose: To compare alternative methods of using optical coherence tomography (OCT) to follow eyes with or suspected early glaucoma [24-2 visual field (VF) mean deviation (MD) better than -6dB]

## METHODS

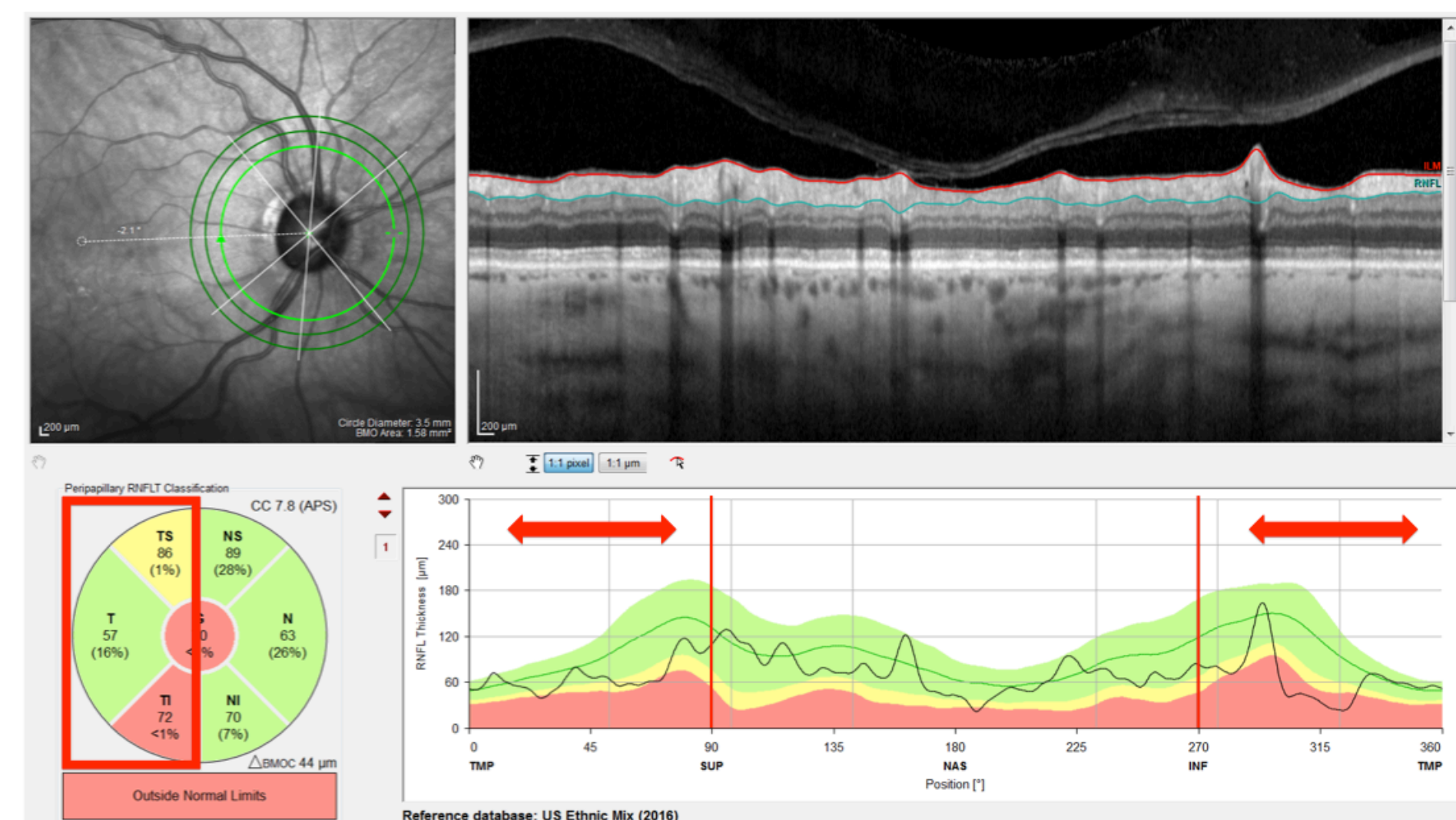
### Participants:

- 111 eyes from 68 patients with a mean age of  $61.8 \pm 15.9$  yrs [18.1 to 79.5].

### Optical Coherence Tomography:

- Each eye had 2 OCT scans, on average  $1.7 \pm 0.7$  yrs apart [0.8 to 3.3], with an averaged 3.5 mm diameter circle of the optic disc as part of the Glaucoma Module Premium protocol (Spectralis, Heidelberg Eng). See example of report in figure 1.

Figure 1



### Visual Fields:

- All eyes had two 24-2 (stimulus size III) VFs within 12 months of the scan date. All VFs had MD better than -6 dB.

### Assessment of “Possible Progression”:

Quantitative analysis of possible progression using:

- Summary metrics: Global (G), Temporal (T), Temporal Superior (TS) and Temporal Inferior (TI)(red box in fig. 1)
- ROI method: A Matlab program automatically detected ROIs on the 2<sup>nd</sup> scan of each eye, based on areas in yellow and red on cpRNFL thickness plots within the temporal regions; arrows and red lines in fig.. The same ROIs were applied to the 1<sup>st</sup> scan. The average cpRNFL thickness was measured for each scan and the difference between 1<sup>st</sup> and 2<sup>nd</sup> scan of each eye was calculated

### Statistical Analysis:

Eyes were labeled as significantly progressing (or improving) if they belonged to the lower (or higher, respectively) 5<sup>th</sup> percentile of the distribution of each parameter (i.e. each of the 4 summary metrics and the ROI). **XX**

### Post-Hoc Analysis

**Flicker Method:** The likelihood of progression on a scale of 0-100 was assessed by an OCT expert after reviewing both scans of each eye, with 100 being definitely progression and 0 being definitely no progression.<sup>3</sup>

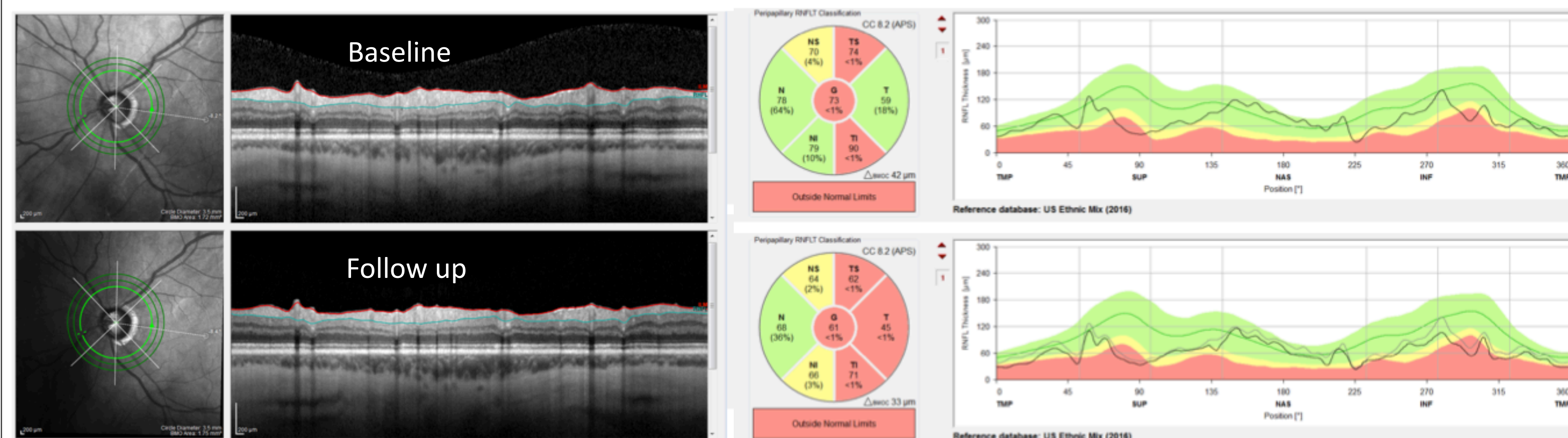
## RESULTS

### Summary Metrics Assessment

16 eyes showed “possible progression” by at least 1 Summary Metric

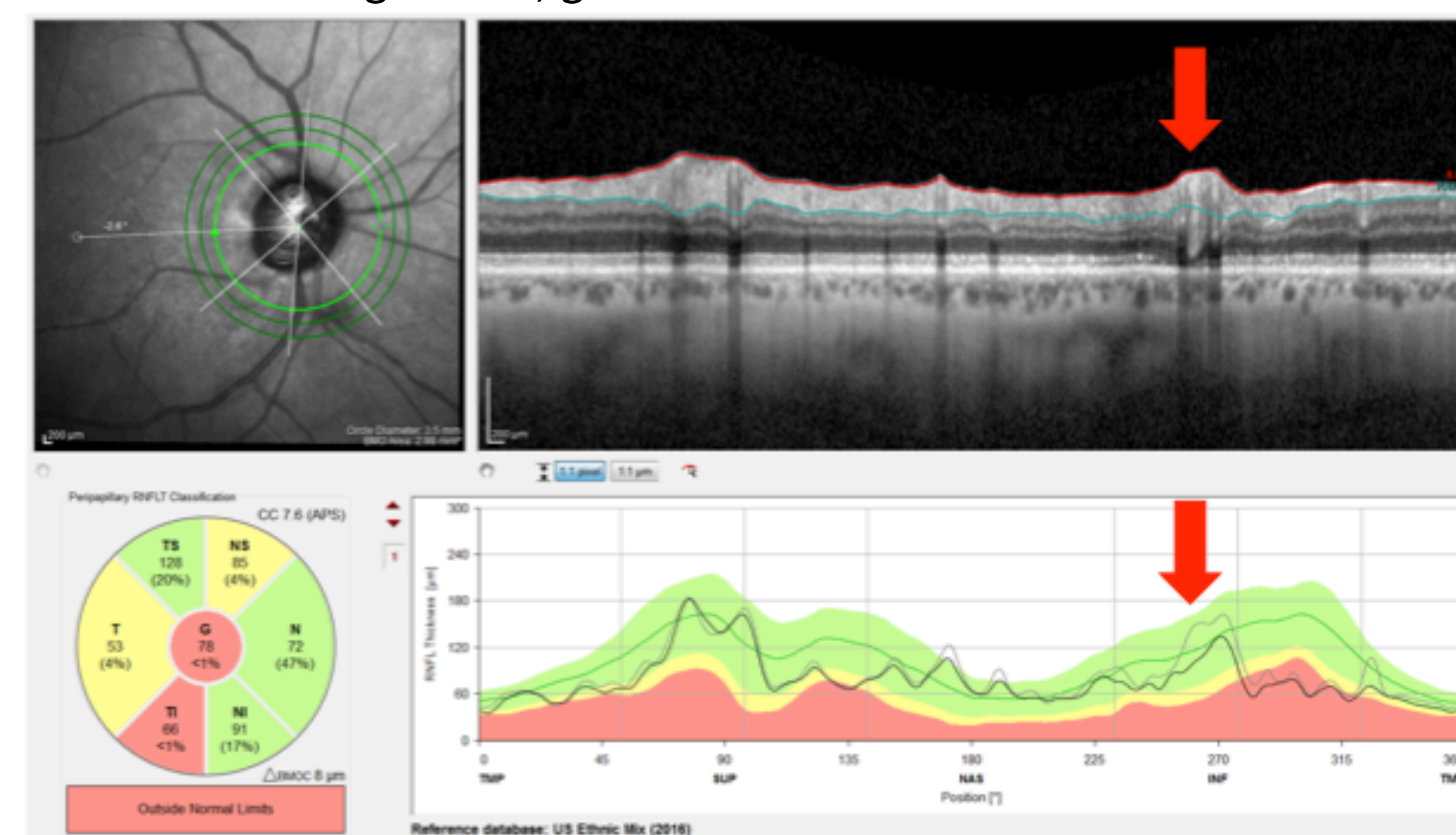
- 6 eyes were confirmed with the post-hoc assessment (example in Fig 2)

Figure 2: Example of an eye showing progression in G, T and TI summary metrics



- 2 eyes were graded by the OCT expert as Probable Progression; graded 70 and 65 – one of them shown in Fig 3

Figure 3: Example of an eye showing possible progression in G summary metrics and graded with 65 by the OCT Expert. Minor segmentation errors (red arrow) may have contributed to the “Probable Progression” rating from the Expert.



- 8 eyes were not validated upon post-hoc assessment – possible “false positives”.
- Reasons for “false positives”
  - 5 of the 8 eyes had segmentation errors due to other pathologies such as schisis (Fig.4) and epiretinal membrane (Fig. 5) 3 of those eyes had disc centering issues. (Fig.6)

Note: 6 of those 8 eyes were within uncertainty (i.e. graded between 40-60); while 2 were graded <40 by the OCT expert, meaning Probably or Definitely Healthy

Figure 4

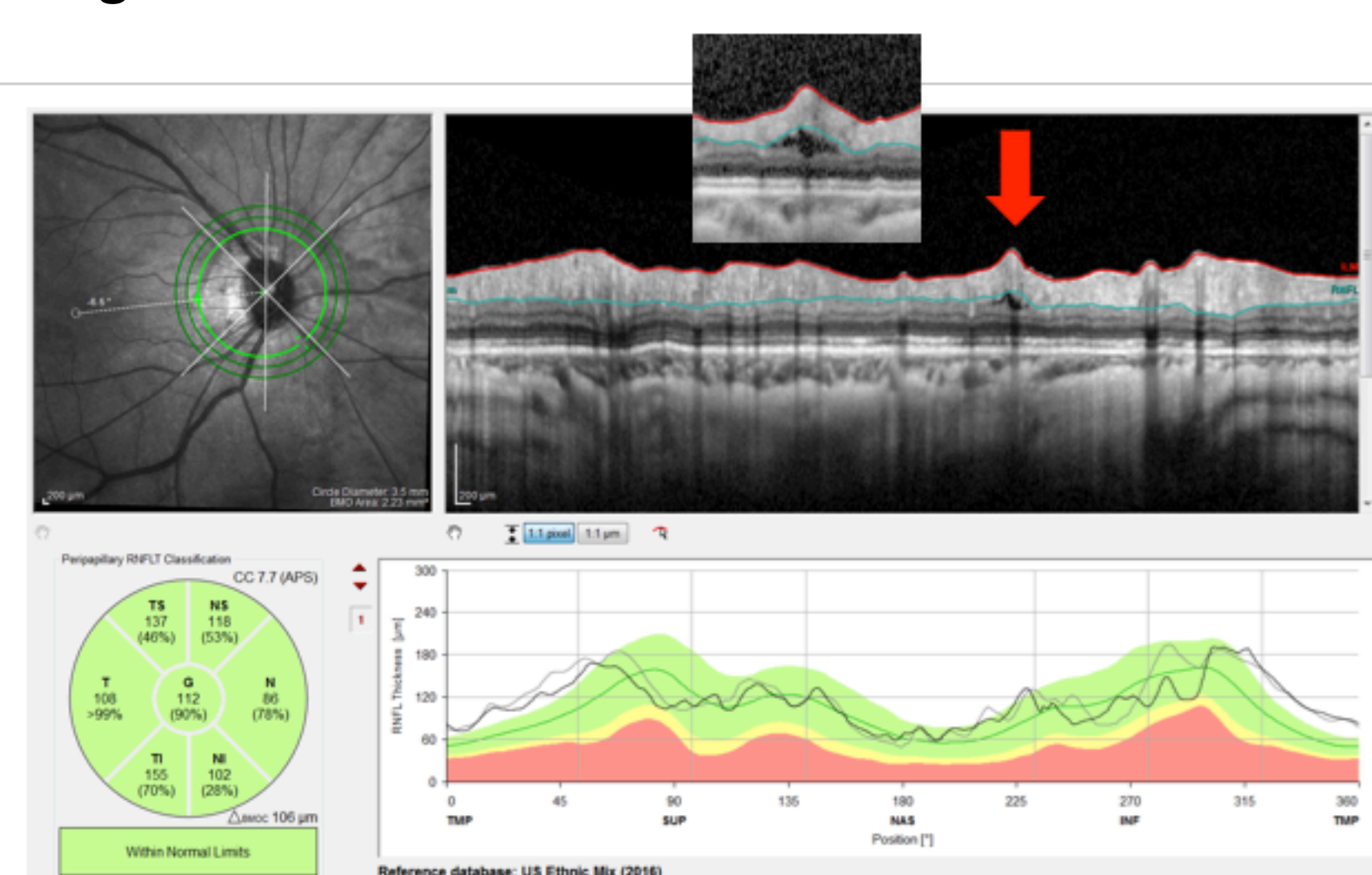


Figure 5

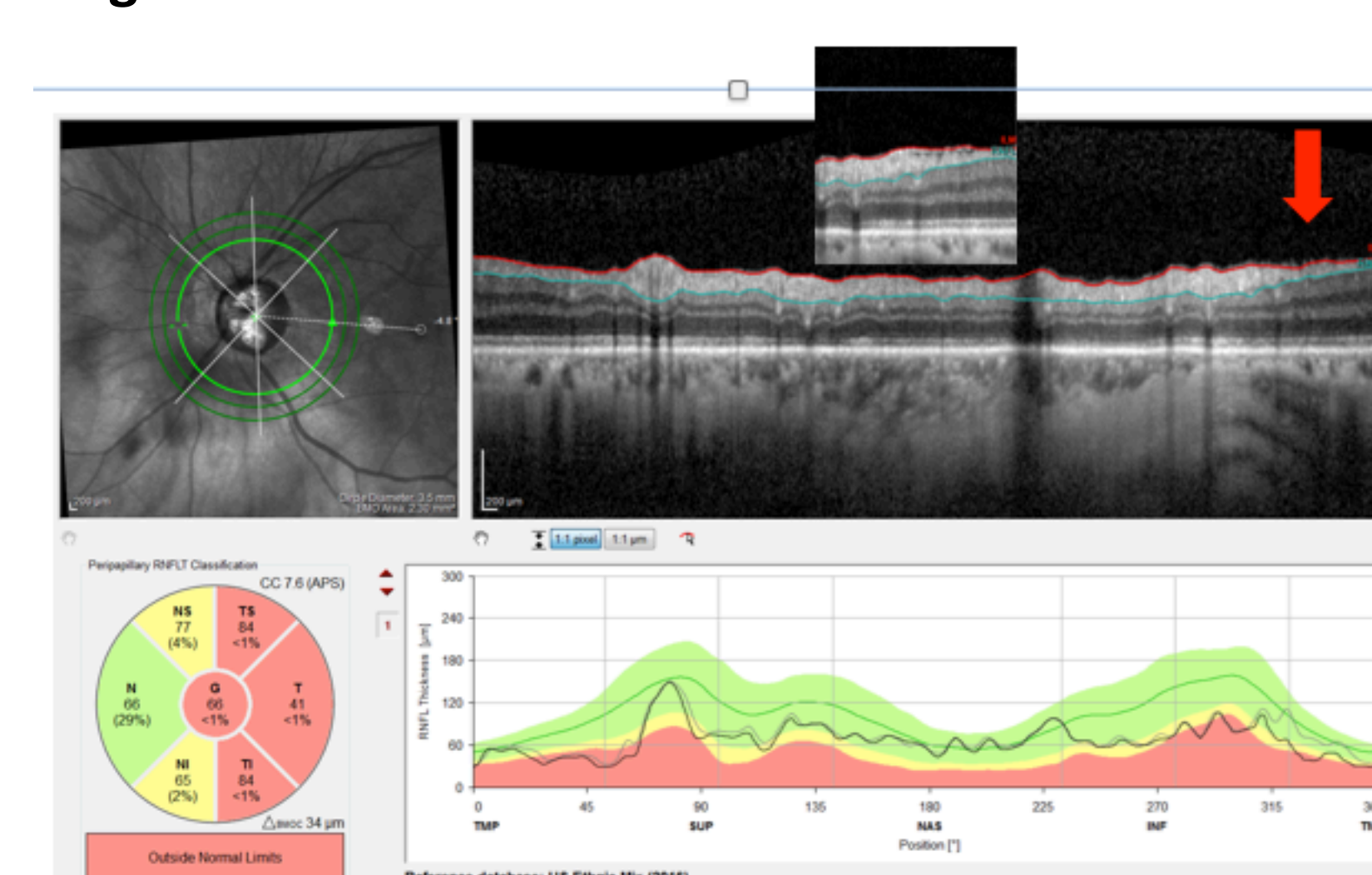
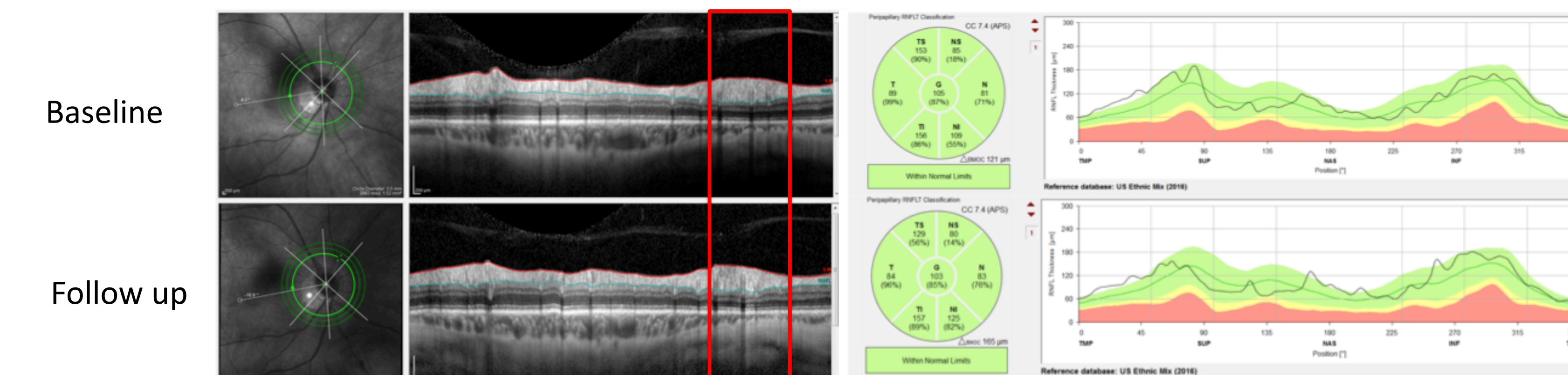


Figure 6



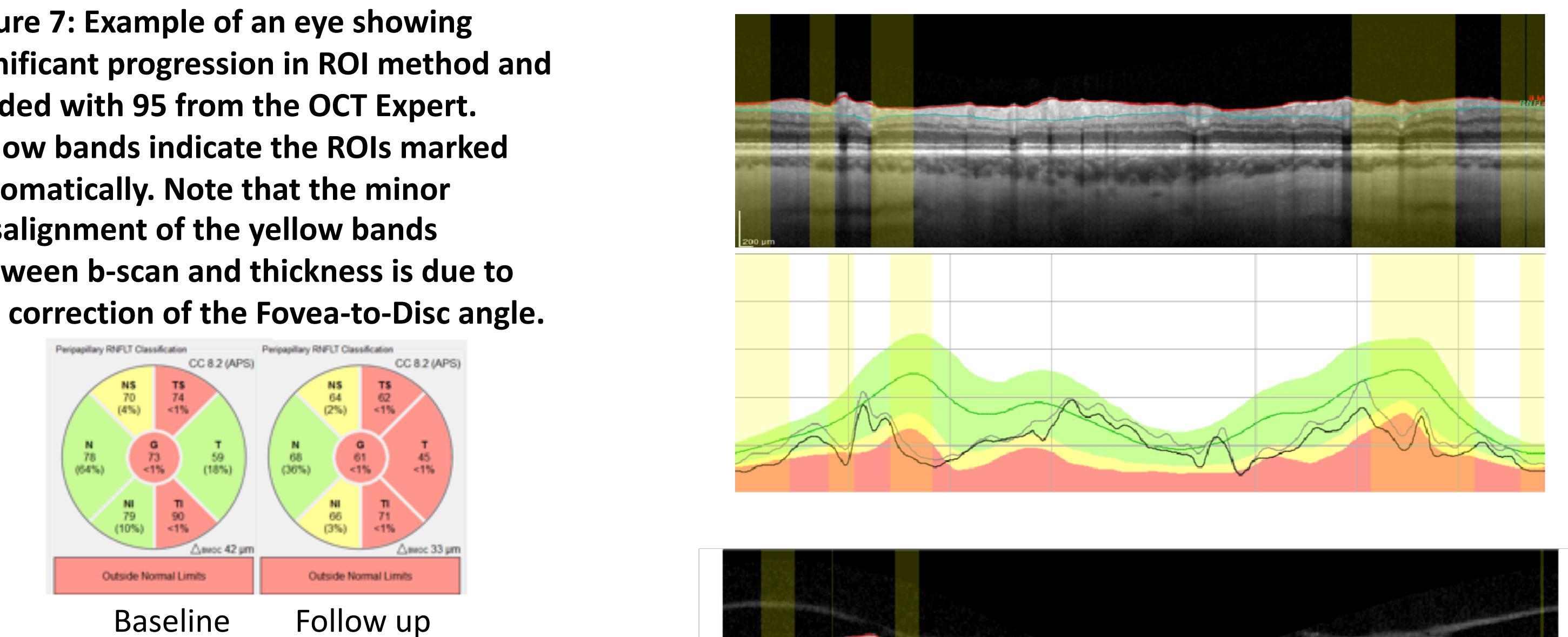
## RESULTS

### ROI Assessment

6 eyes showed “possible progression” by ROI (marked automatically based on the 2<sup>nd</sup> scan)

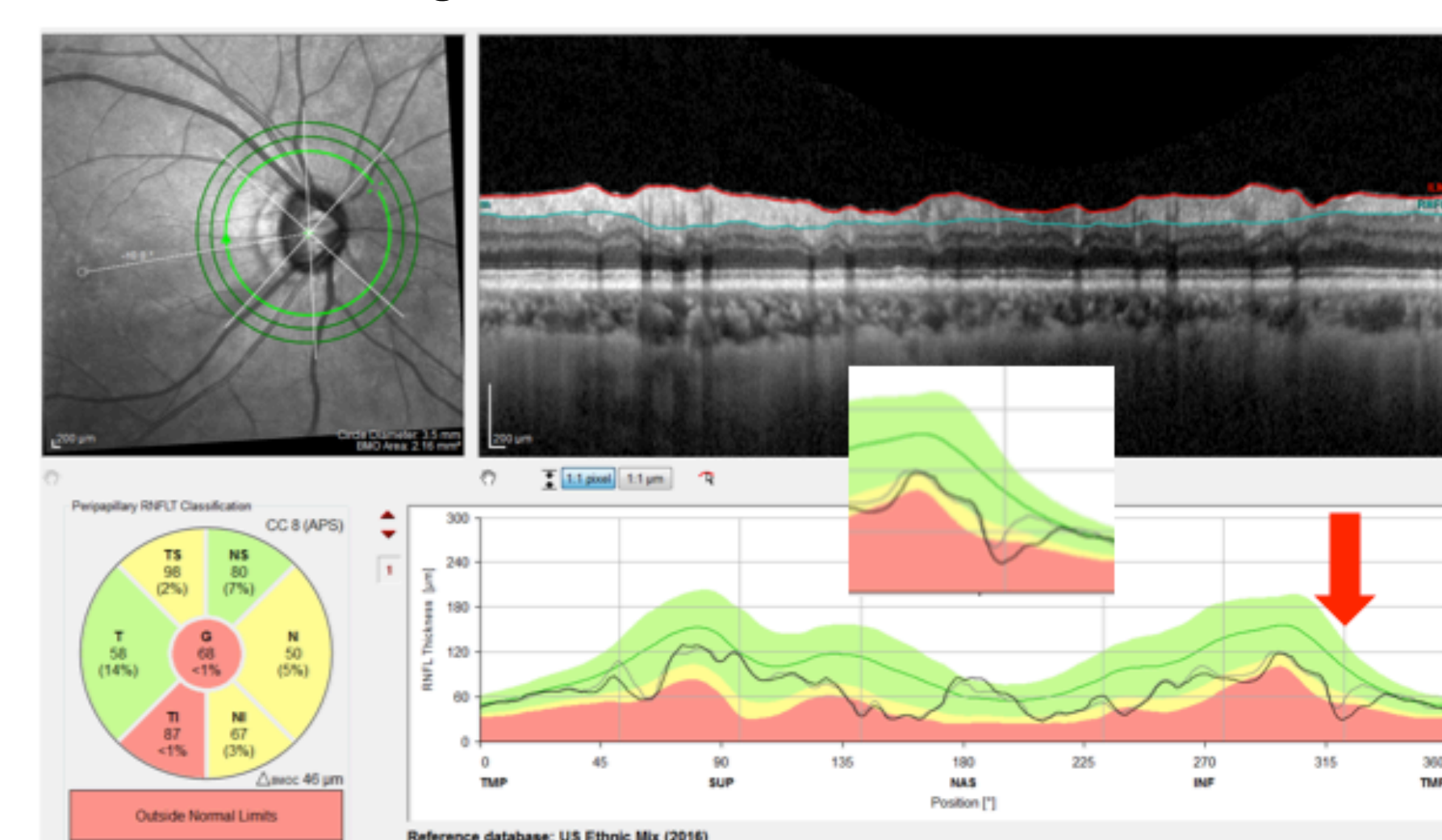
- 3 eyes were confirmed with the post-hoc assessment (example in Fig 7)
- All 3 eyes were also marked as possible progression based upon the summary metrics

Figure 7: Example of an eye showing significant progression in ROI method and graded with 95 from the OCT Expert. Yellow bands indicate the ROIs marked automatically. Note that the minor misalignment of the yellow bands between b-scan and thickness is due to the correction of the Fovea-to-Disc angle.



- The other 3 eyes did not show evidence of progression based upon the post-hoc assessment – “false positives”
- 1 was probably FP due to epiretinal membrane (Fig 5)
- 2 were probably FP due to segmentation errors (Fig 8)

Figure 9: Post-hoc assessment labeled one eye as Definitely Progression (95), while both summary metrics and ROI failed to show – “false negative”

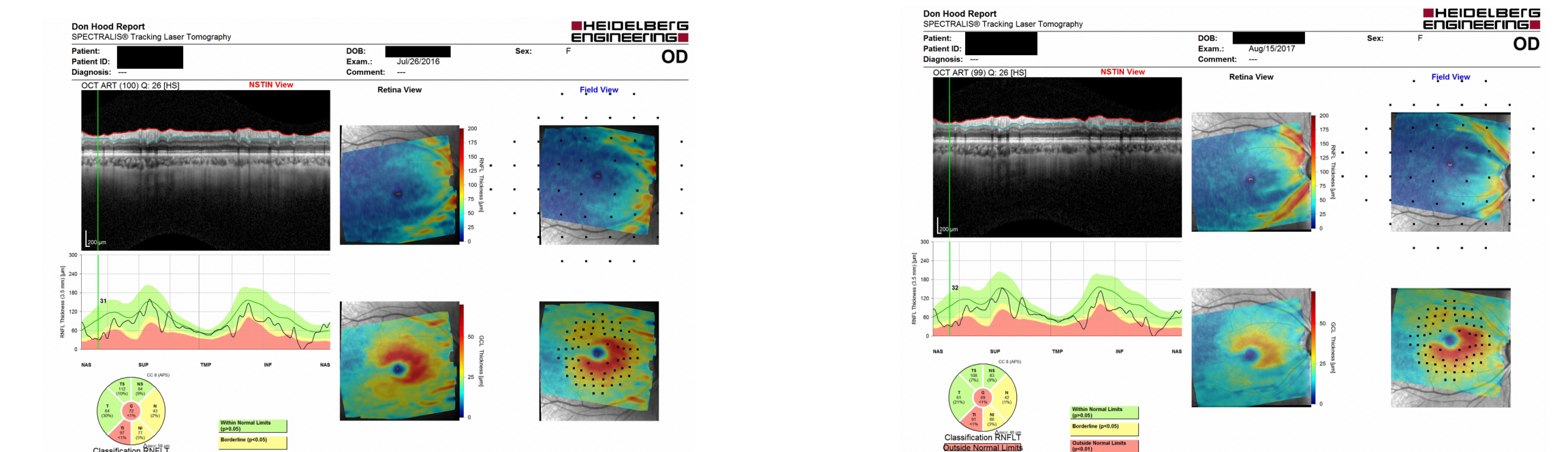


The follow up scan showed a deepening progression of a local defect in temporal inferior

## CONCLUSIONS

- Automated ROI performed better than did the summary metrics in identifying glaucomatous progression (i.e. thinning) of the cpRNFL thickness derived from OCT circle scans.
- However, issues such as segmentation errors and the presence of other pathologies (e.g. schisis) can affect the assessment of both the ROI and the summary metrics method.
- Therefore, post-hoc qualitative (flicker) review is needed to confirm the results of these techniques.
- Qualitative approaches such as a manual ROI method, and especially including GCL and RNFL thickness plots will probably improve the outcomes.

**Appendix :** OCT reports from eye of Fig. 9 suggest the possible progression of the ROI in TI thickness plot that correlate with the superior retinal view defect .



### References:

- Vianna JR. Prog Brain Rev. 2015; 2. Hood DC et al. JAMA Ophthalmol. 2015;3. Wu Z et al. TVST. 2018;4. Wu Z et al. TVST. 2018.
- Support:** DCH: F,R,C (Topcon, Inc; Heidelberg Eng), CGD: F (Heidelberg Eng, Topcon, Inc, Zeiss).All other authors: none.