Country	CET/CPD information	Audience	Competencies	MCQs
UK	This article offers 1 non-interactive CET point (C-73781)	General Optical Council Approved CET For Optometrists	STANDARDS OF PRACTICE; OCULAR EXAMINATION; OCULAR DISEASE	6
ROI	All articles are CPD accredited in the Republic of Ireland			6

OCT in Glaucoma: Case Studies

by **Adam Wannell** MSc DipSV DipGlauc DipTp(IP) MCOptom

Outline

This series of case studies examines how clinicians can use OCT images to help in diagnosis and referral decision making in glaucoma.

About the author

Adam is Specsavers Head of Enhanced Services, module leader for postgraduate glaucoma module, Wales Optometry Postgraduate Education Centre (WOPEC), medical optometrist at the Bristol Eye Hospital and, until recently, was optometrist director of a community practice involved in delivery of a range of enhanced services. He has a postgraduate qualification in clinical teaching, a College of Optometrists Diploma in Therapeutics and Glaucoma and an MSc in Clinical Optometry from City University, London. He has a Diploma in Sports Vision Practice and has been involved with National Sports Vision Screening.

GOC's Enhanced CET Scheme

CET and CPD regulators require practitioners to reflect on their learning. Additional activities are required to gain CET for distance learning.

Log into your CET dashboard via iLearn. On the menu you reach you will find non-interactive CET for this unit of learning.

For 'non-interactive' CET you have to pass (>60%) a six-question multiple-choice quiz.

The learning objectives for this article are:

2.7.2 Optometrists will have an enhanced understanding of the use of OCT for assessment of patients with or at risk of chronic open-angle glaucoma

3.1.3 Optometrists will have an evidence-based understanding of the principles of use of OCT to assess various structures within the retina

6.1.8 Optometrists will have an enhanced understanding of the identification of glaucomatous features of an optic nerve head using OCT

Case 1: Missed glaucoma

Patient history

69 year old male was seen for a routine eye test, wearing spectacles for reading and computer use.

POH: Idiopathic nasolacrimal duct obstruction – bilateral dacryocystorhinostomy (DCR) and tubes in 2011

PMH: Fit and well, still works as company director

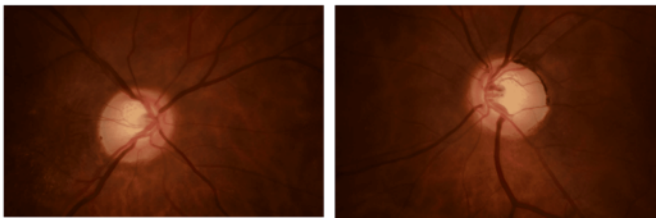
Medication: None

FOH: None

Examination

Unaided VA: R+L 6/6
Rx: R+L +0.50DS, Add =1.75
AC Van Herrick Grade 4 R+L
IOP R 16, L 17

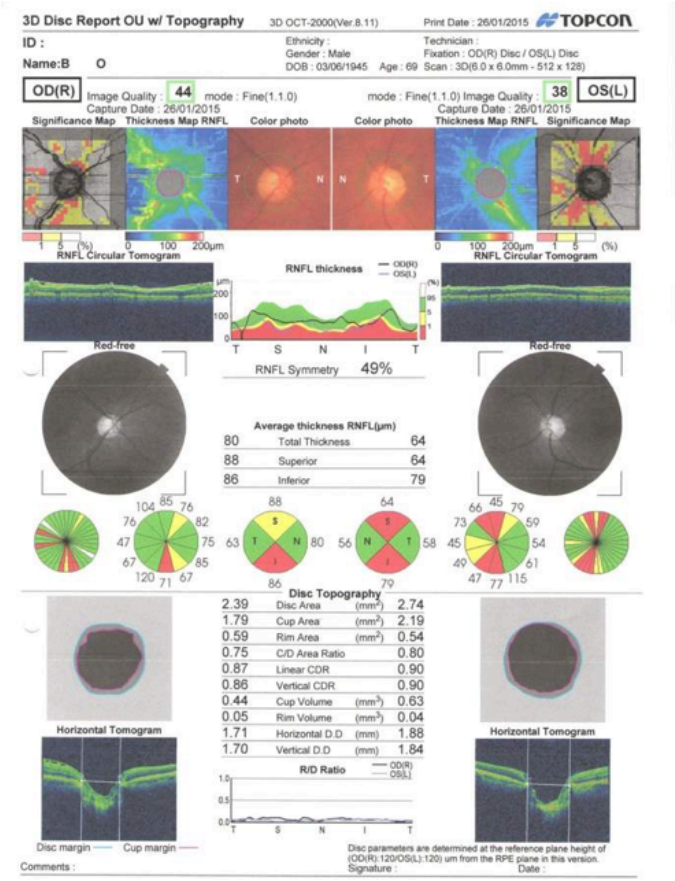
Henson fields: full (26-pt suprathreshold)
Discs: CDR RE and LE 0.6
Healthy fundus and macula



Further examination

- At this point, no abnormality was detected
- The optometrist recorded that the ISNT rule was not followed, but no other features/concerns were noted
- As the patient was keen to utilise technology, he elected to have baseline OCT performed

OCT results



These reports tell us a multitude of information, frequently depicting the same data in several ways with the thickness map, significance map, RNFL thickness TSNIT graph and sectoral thickness pie charts.

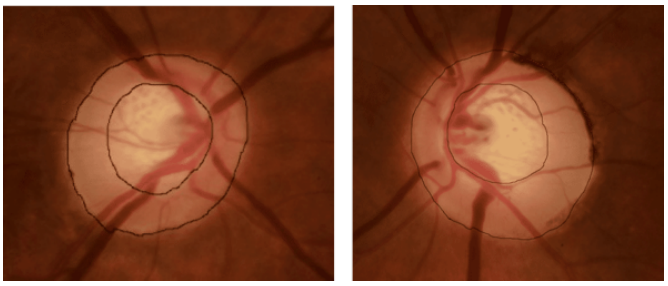
In this case:

RE: CDR 0.87 with an RNFL thickness unlikely to be normal in the inferior quadrant, particularly thin at 6 o'clock

LE: CDR 0.9 with a diffusely thin RNFL unlikely to be normal in both superior and inferior quadrants

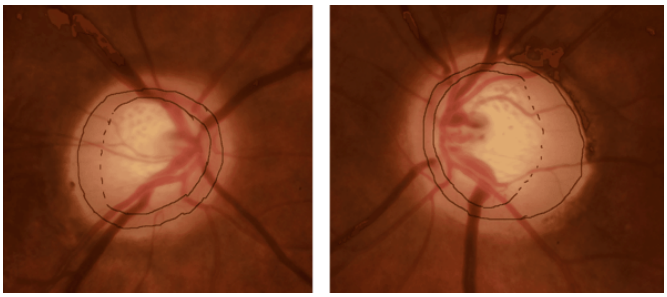
OCT results lead to a more accurate assessment. Here, threshold fields revealed an early inferior defect with nasal step in the RE, and early superior arcuate defect in the LE.

Cursory glance



With a cursory glance, the optometrist's CD ratio appears correct.

Detailed scrutiny



On much closer scrutiny, both discs have significantly thinner neuroretinal rim (NRR). This is due to two factors: the prominent scleral rings give the appearance of a larger disc and the colour change from cup to rim does not coincide with the true NRR, making the NRR width considerably thinner than first thought.

The temporal NRR are difficult to discern due to sloping so the dash line indicates best guess based on vessel directions.

Case 1: Reviewed

Original findings:

CDR RE and LE 0.6

Screening fields full

IOP RE 16, LE 17

DIAGNOSIS: No suspicion of glaucoma

Revised findings:

CDR RE and LE 0.85

Early bilateral field loss

IOP underestimated: OCT pachymetry RE 479, LE 472

Thin RNFL L>R

PROVISIONAL DIAGNOSIS: Bilateral COAG

Several factors were involved in the misdiagnosis. Firstly, the disc assessment incorrectly identified the NRR width; secondly, screening suprathreshold fields failed to indicate early or shallow field defects; thirdly, thin corneas masked an apparently normal IOP, and lastly, structural changes (NRR and RFL thinning) outweighed functional changes (visual field loss). Thankfully, the OCT findings were highly inconsistent with the initial results, raising doubts about the findings which led the optometrist to review the patient with more accurate testing. Take more time in the disc examination and, if your evaluation is significantly different to the OCT, do not be afraid to go back and re-assess the patient to make sense of all the findings.

Case 2: False positive

Patient history

71 year old female presents wanting new glasses but complaining of gradually blurring vision RE. Denies any other symptoms

The patient seemed particularly concerned about glaucoma due to her older sister and mother (now deceased) 'going blind'

POH: None

PMH: Hypertension; spinal osteoporosis with kyphosis

Medication: Bendrofluamethiazide, calcium tablets

FOH: Mother and sister glaucoma, no additional conditions

Driver. Retired

Examination

Unaided VA: RE 6/36, LE 6/18

Refraction:
RE +1.25/-0.50x90
LE: +1.50/-0.25x85

BCSVA: RE 6/18, LE 6/6

IOP: RE 19, LE 15

HVF: Unable to hold head in correct position to perform fields

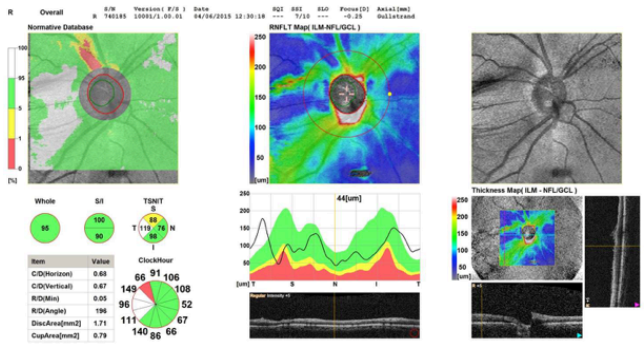
Confrontation: R+L full

Discs: R+L CDR 0.5 appear healthy

OCT RNFL thickness:
RE superior sector ONL
LE WNL

Although this patient was unable to hold her head in the correct position for HVF, it is important to have at least a gross assessment of the field status, hence confrontation. Fortunately, she was able to cooperate long enough for OCT measures to be taken.

OCT of RE



Here we have an RNFL measure for the problematic RE. The key features are:

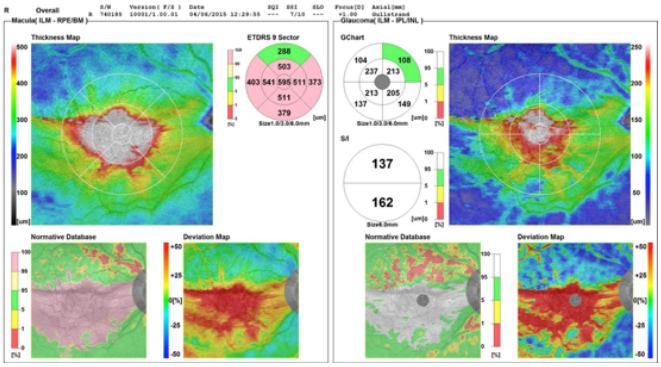
- Superior-temporal sector focal thinning, which is highlighted in the normative database colour map and clock hour pie chart – this appears to be a focal RNFL wedge defect
- Increased inferior disc thickness, as shown on the RNFL thickness colour map – this may indicate a raised optic nerve head
- TSNIT graph displaying thickness falling outside of the normal limits
- A temporal quadrant thickness above normal limits

RE colour fundus

Dilated examination of the RE fundus revealed a fibrous membrane appearance extending across the macula. The disc appeared normal with no suspicious features, particularly in the 11 o'clock sector as shown on the OCT.

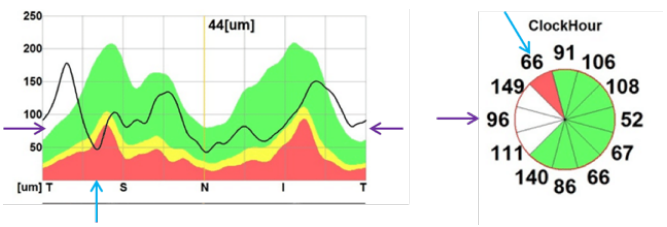
Subsequently, a macular OCT scan was ordered.

Macular thickness map



The macular thickness map and EDTRS sectors clearly demonstrate significant increase in thickness to the central and inferior macula, coinciding with the epiretinal membrane appearance on fundoscopy. The macula has been effectively stretched by the ERM making any comparison to normative data irrelevant. This explains the patient symptoms, poor VA and increased temporal thickness, but what about the other concerns?

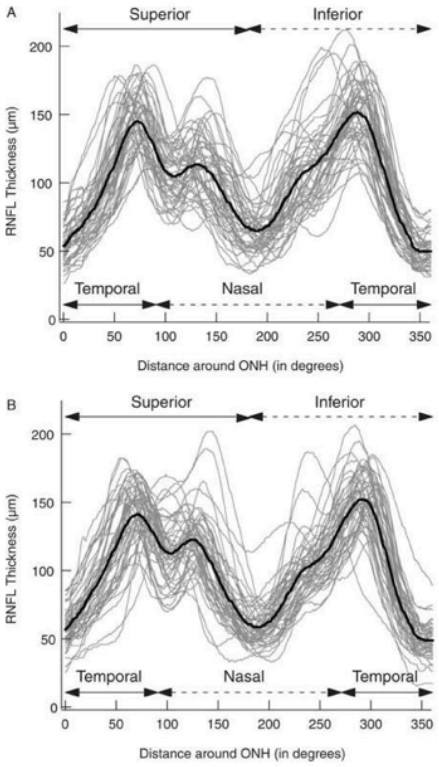
RNFL thickness



The TSNIT graph and pie chart detail show that the RNFL is thinner than normal superiorly, but thicker than normal temporally. The overall picture shows the double hump pattern; however, it does not coincide with the normative database.

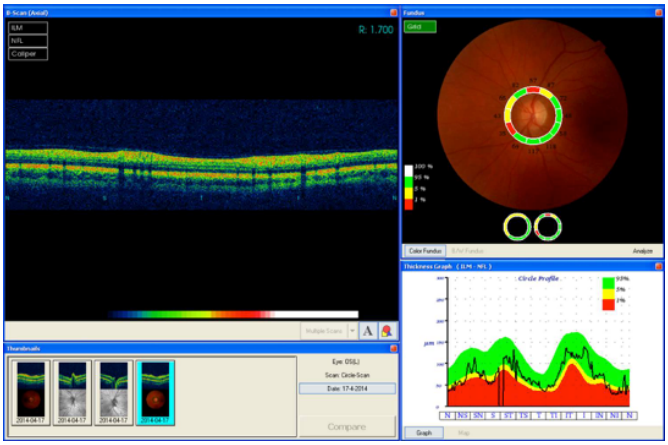
It is likely that the RNFL thickness for this patient is normal, but it has been spread out wider than the expected map. This is not uncommon in myopic eyes due to the enlarged disc size; the reverse can be true for small discs.

Normal variation of RNFL



As shown here, RNFL thickness varies considerably between individuals. Maximum and minimum thickness also occurs in a variety of positions within the disc quadrants. Consequently, TSNIT graphs showing particularly wide or narrow peaks and troughs may fall outside of the average values and, as a result, are then incorrectly flagged as 'red'.

Inconsistencies with OCT scans



Other common errors in the TSNIT map can be seen here. Look at the S/ST superior sector thinning. The data in the graph drops off – falling to zero. The report indicates that it is outside normal limits, but the patient simply blinked and no data were recorded for that sector, so no judgements can be made. This error type has largely been eliminated as a result of multiple scanning.

Case 2: Reviewed

VA drop associated with a significant epiretinal membrane (ERM)

Outside normal limits finding for RNFL thickness associated with natural variation

In this case, this was exacerbated by the influence of ERM on measures

ERMs typically confound macular thickness values

Apply caution when interpreting OCT reports from particularly large or small ONH

Case 3: Co-pathology

Patient history

84 year old female presented for a routine eye test following RE cataract extraction 2/12

The patient feels that her vision has improved, but it is not as good as her LE

Wears near vision Rx only and is aware that she needs an updated Rx

POH: bilateral pseudophakia: LE 2 years ago

PMH: Osteoarthritis, generally well

Medication: Ibruprofen, paracetamol

FOH: mother glaucoma when elderly

Driver. Retired, but does part time voluntary work

Examination

VA: RE 6/24, LE 6/9; no improvement with Rx

AC: R+L deep and quiet

IOP: RE 17, LE 20

Clear IOLs, no PCO

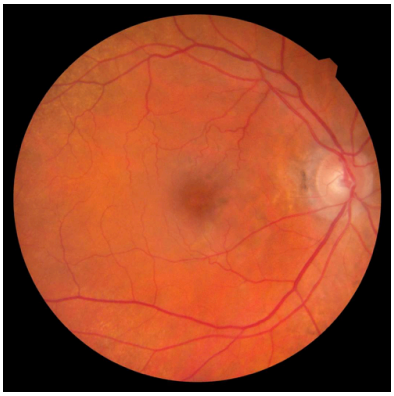
Fundus unremarkable R+L

ONH: R+L CDR 0.5

Visual fields: inconclusive, poor reliability

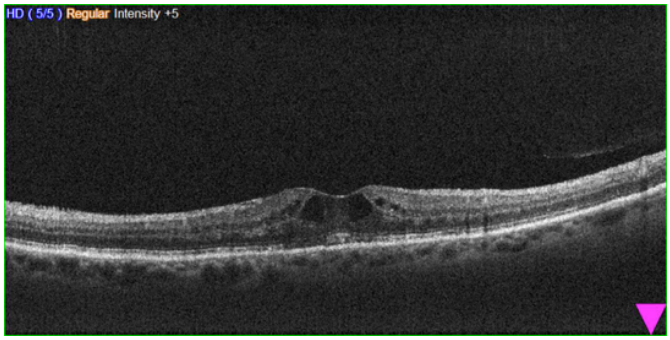
Elected to perform both macula and disc OCT to investigate poor VA in RE

RE fundus photo



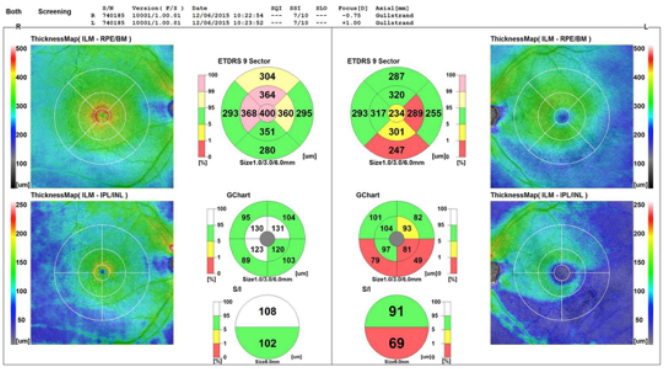
LE fundus photo

RE macular OCT



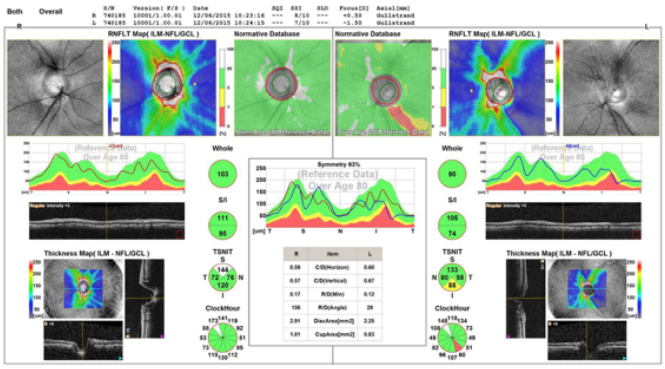
The OCT image shows several intraretinal fluid pockets or cysts at the central macula. Given the patients age, this could be choroidal neovascular membrane (CNVM), but the uniformity of the RPE/Bruch's membrane and lack of clinical signs of drusen, atrophy or haemorrhage in either eye does not support this. With the recent surgery, central macular oedema (CMO) is a much more likely provisional diagnosis.

Macular thickness map



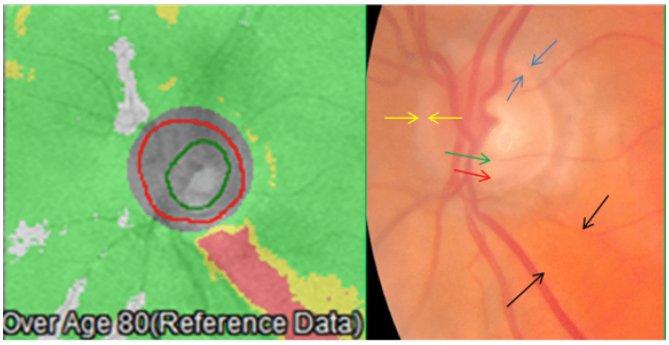
The macular thickness map of the RE confirms the increased central retinal thickness due to the likely CMO, but the LE flags up unexpected inferior thinning of the overall retinal thickness, particularly the innermost retinal layers. This thinning appears to be arcuate in nature, giving a step appearance at the horizontal raphe. The thinning also appears to be emanating from the optic nerve head. A circumpapillary OCT scan was arranged to further investigate this aspect.

RNFL thickness



The RNFL thickness map of the RE indicates a healthy RNFL in all sectors. However, the LE results highlight a focal thinning of the RNFL inferior-temporally compared to normals in the thickness map, TSNIT graph and clock hour pie chart, confirming that the RNFL thinning is adjacent to the disc margin. Disc topographic data shows a mild vertical disc CDR asymmetry (RE 0.57, LE 0.67), but importantly also a disc size difference (RE area 2.91, LE 2.25) exacerbating the cup asymmetry. Focal thinning of this nature, seen here in both the disc and macular scans, is highly specific for glaucoma. But how could we have missed this probable glaucoma?

Disc assessment



With the help of the OCT, several features of the disc become more apparent.

The presence of a scleral ring, (blue arrows) highlighted by the red ring of the OCT map, has meant the disc size was overestimated. This was also exacerbated by the nasal PPA making the nasal disc margin indistinct and difficult to distinguish (yellow arrows) Careful scrutiny of the slightly blurry inferior aspect of the disc, reveals misidentification of the neuroretinal rim (NRR); initially presumed at the green arrow, but truly here, at the red arrow, as confirmed by the OCT image showing inferior cupping and NRR thinning. The eagle-eyed amongst you will have also noted the RNFL defect is visible clinically as a faint wedge defect (black arrows).

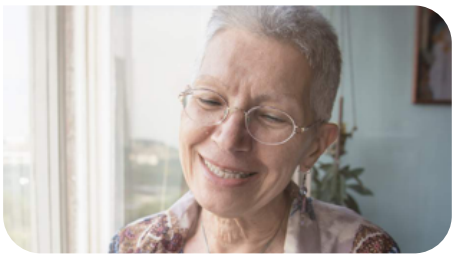
Case 3: Reviewed

Initial concern over decreased vision in the RE led to OCT investigation

RE CMO at 2/12 post-cataract surgery needs referral to the relevant cataract surgical team triage for confirmation and potential treatment

LE glaucomatous disc and macular features require routine referral to the glaucoma team for suspected chronic open angle glaucoma

Case 4: Comparison over time



Patient history

62 year old female regular patient reviewed as necessary to epilate misdirected lashes in both eyes

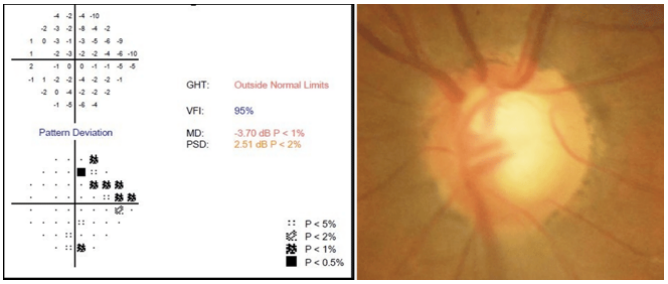
Left disc “mildly suspicious appearance” noted in 2009, but with full fields and normal IOPs

The patient elected to have OCT performed at each visit as a objective measurement and save any unnecessary referral to hospital

The patient presents to you for her latest appointment in June 2015

This case will focus on the LE

Examination



VA: RE and LE 6/6

IOP: RE 12, LE 14

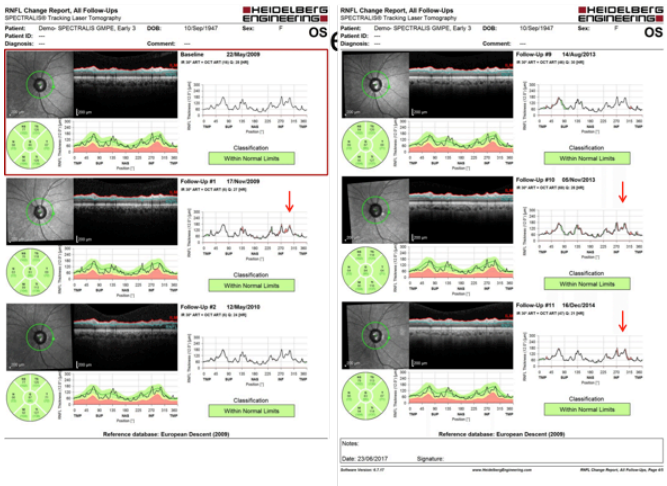
Disc medium to large size, RE CDR 0.65, even NRR, LE CDR 0.7 mildly suspicious IT and SN

HVF: RE full, LE early superior nasal defect

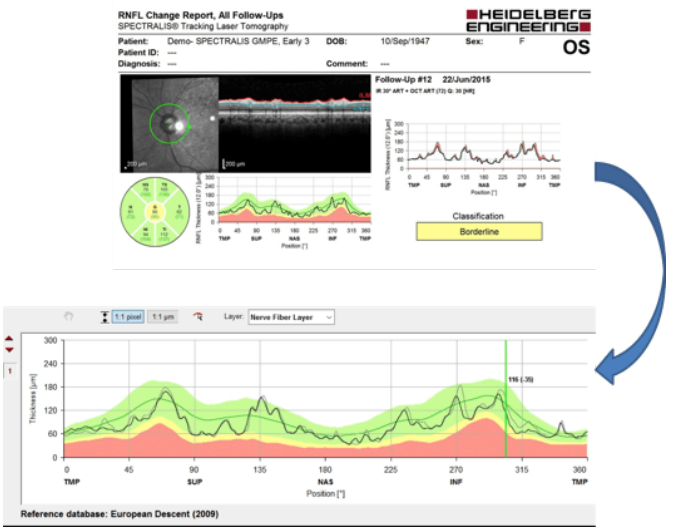
Impression: LE suspicion of glaucoma

With this patient, we have the benefit of details of several previous visits. The comparison of measures over time is beneficial to give a clearer understanding of the current status.

RNFL change report

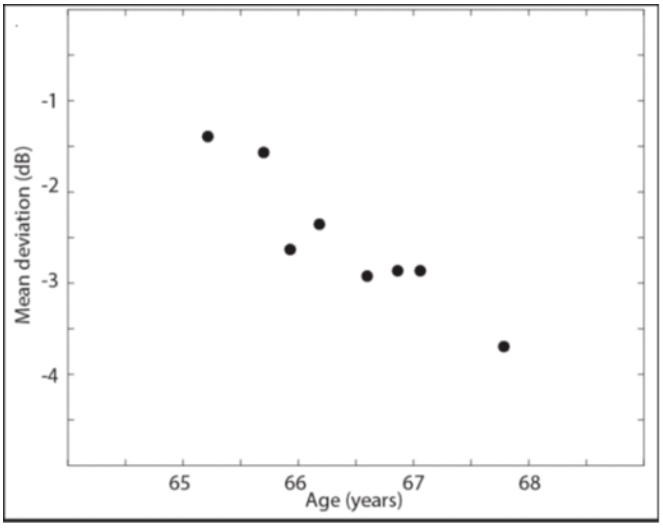


Here we have an RNFL change report comparing the results from this appointment with a baseline measure recorded in 2009. As you can see, all sectors of the TSNIT map fall into normal statistical limits, but there does seem to be some slight non-statistically significant changes to the height of the inferior-temporal thickness at several time points (highlighted by the red arrows).



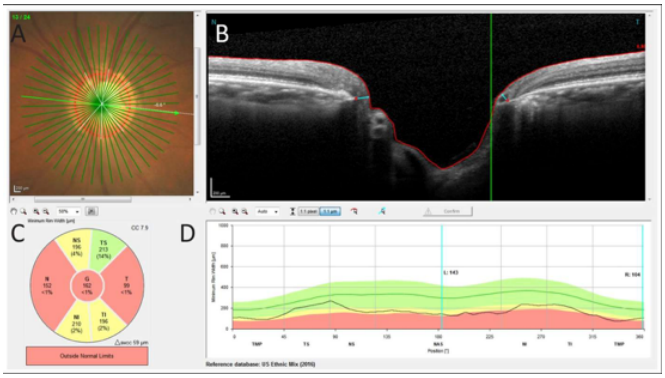
Again, the latest report shows no sectoral changes, but a borderline statistical global thickness reduction (as shown in yellow). Furthermore, it is evident in the enlarged TSNIT graph that there may be some thinning inferiorly.

Evidence over time



Comparison of the LE fields also indicates a downward trend in mean deviation over time, but this could reflect simple age-related media changes. At this stage, there is nothing conclusive, but there are an increasing number of "not completely normal" results. Are there any other measures we could utilise to assist our diagnosis here? One is to look at IOP measures over time to look for either a mean increase or fluctuation between episodes of 10mmHg or more i.e. a pathological diurnal variation (note that normal diurnal variation is typically up to 5mmHg). Another would be to use a different programme on the OCT – in this case we have the minimum neuroretinal rim width, but you could also examine the ganglion cell complex thickness at the macula.

Minimum rim width



Minimum rim width (MRW) uses line scans centred on the disc to measure the minimum thickness of the neuroretinal rim around the entire disc – shown here as teal arrows – precisely the measurement we are subjectively assessing during clinical evaluation of the disc. For our patient, the MRW indicates thinning at a 98% confidence interval for all sectors bar one, and globally beyond a 99% confidence interval. This additional evidence has strongly tipped the balance in favour of supporting a tentative diagnosis of glaucoma and therefore Hospital Eye Service referral.

Case 4: Reviewed

Asymptomatic patient with below average IOP, mildly suspect disc and field loss

OCT RNFL monitoring over time suggested possible thinning in the suspected location, but it did not reach statistical significance

Utilising additional OCT scan types assisted in determining whether any abnormality was present

It is vital to combine results from all measures to build a more complete picture of a patient's ocular status

Summary

- Correct interpretation of OCT can provide a very useful adjunctive measure in our quest for glaucoma detection
- Measures of RNFL, macula ganglion complex and neuroretinal rim thicknesses may highlight structural changes which are difficult or impossible to see clinically
- The natural variation of anatomical measures and statistical analysis of OCT will always mean false positive and negative cases — use other clinical measures and reasoning to identify
- Upon finding surprising results from the OCT, do not be afraid of going back to clinical examination or reviewing other measures to ensure your evaluation of the patient is correct
- The combination of OCT scan types with traditional clinical measures gives the best diagnostic capability
- Longitudinal data to monitor changes over time may be useful, but it needs to be backwards compatible
- OCT is just one of many pieces of the jigsaw puzzle that is glaucoma

