Role of OCT in Glaucoma

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Glaucoma is an optic neuropathy which involves loss of retinal ganglion cells and their axons leading to characteristic optic nerve head (ONH) appearance for which intra ocular pressure (IOP) is one of the main risk factors.[1] This leads to functional deterioration, apparent in the form of visual field loss. Several studies have provided evidence that RNFL defects (structural loss) precedeONH and visual field alterations (functional loss).[2]OHTS results show that without optic disc assessment,up to 55 % of glaucoma patients may be missed.[3]

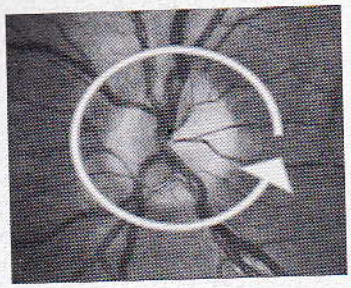
Role of OCT

OCT is an imaging technology that uses low coherence interferometry to acquire cross sectional images of ocular tissues. It has evolved from Time domain technology to the recent Spectral domain technology, which boasts of higher speed, better axial resolution and 3-dimensional imaging.

OCT Software Analysis

- Retinal Nerve Fibre Layer (RNFL)
- Optic Nerve Head (ONH)
- GCC Mapping

RNFL analysis



- Circular scanning is done around the centre of ONH at a radius of 3.45 mm.
- Three scans are acquired and data averaged and compared with normative data base of age matched subjects.
- Scan begins temporally.

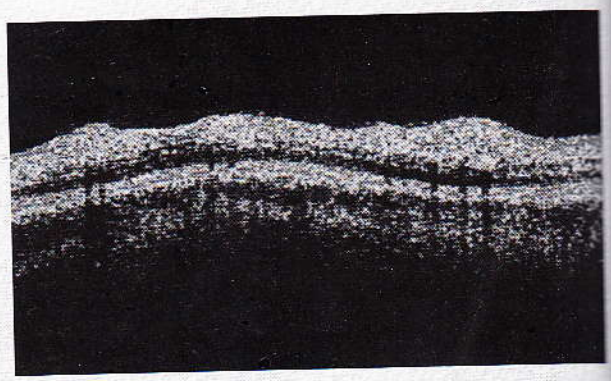


Fig 1: Peripapillary RNFL scan

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RNFL thickness average analysis printout -7 zones

Zone 1 : Patient ID

Zone 2 : TSNIT with age matched normative data-base

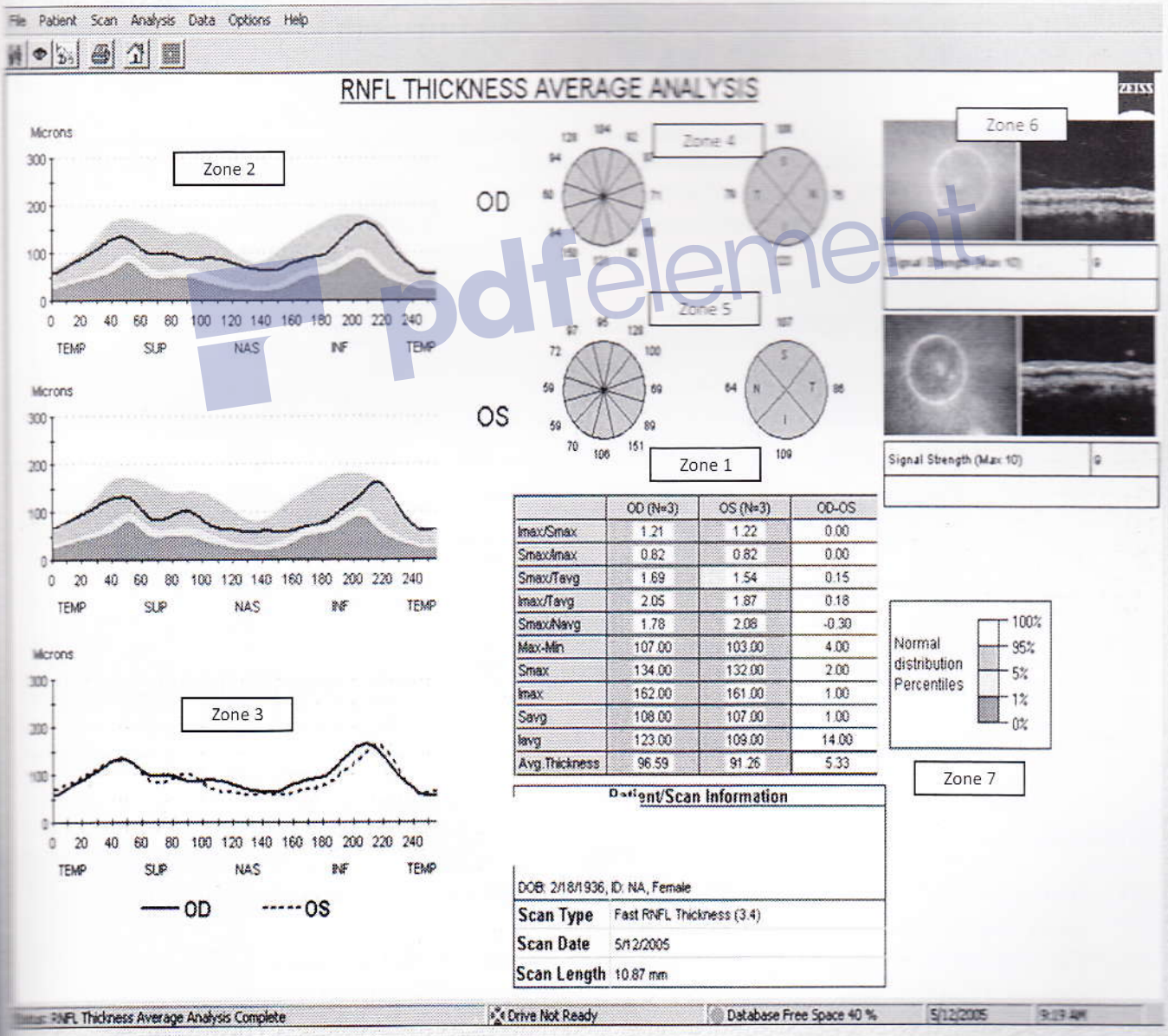
Zone 3: TSNIT overlap of 2 eyes

Zone 4 : Circular scan-quadrant/clockwise

Zone 5 : DATA TABLE-ratio/average

Zone 6 : RED FREE PHOTOGRAPH-position

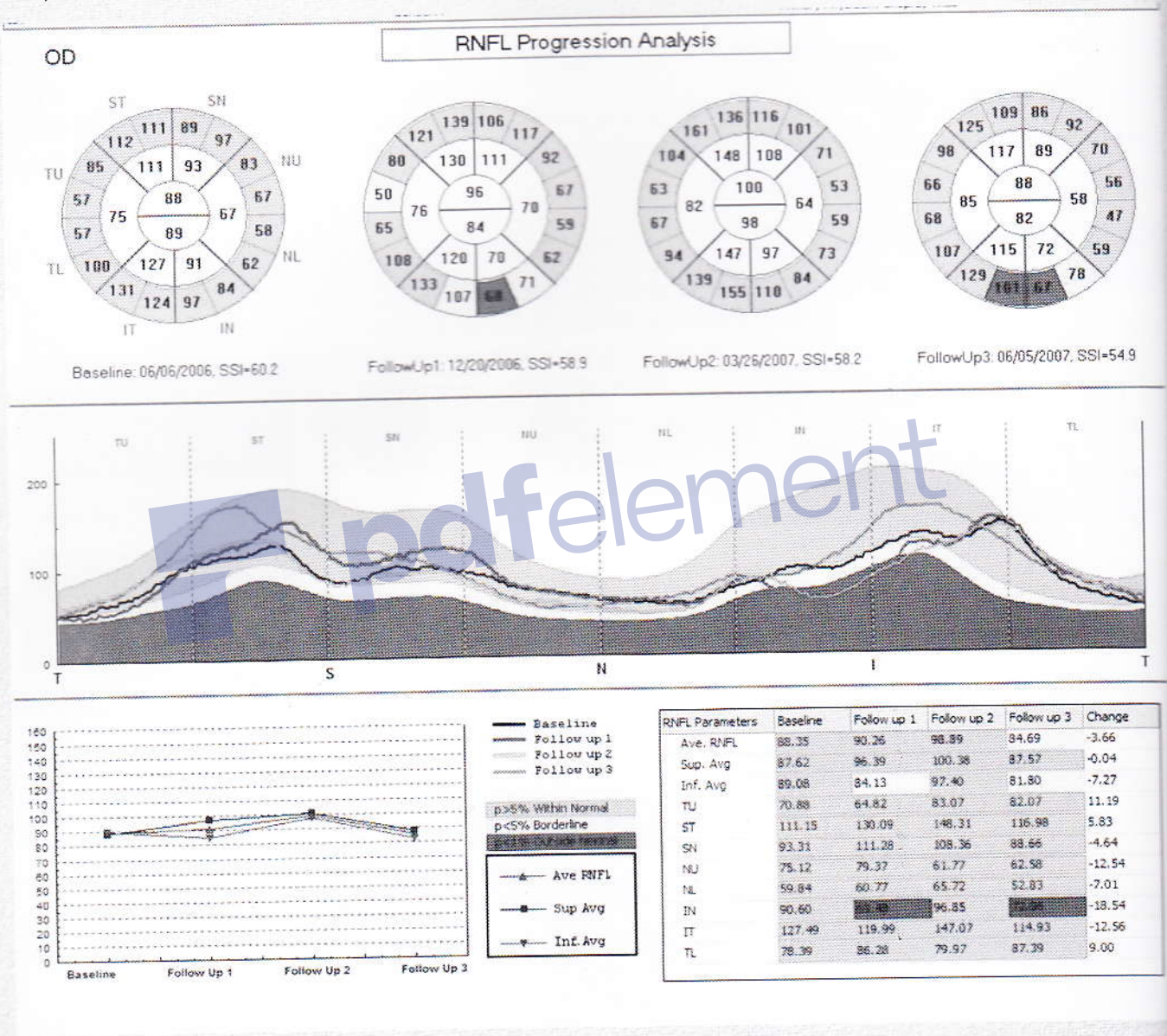
Zone 7 : PERCENTILE COLOR CODING



	OD (N=3)	OS (N=3)	OD-OS
Imax/Smax	1.21	1.22	0.00
Smax/Imax	0.82	0.82	0.00
Smax/Tavg	1.69	1.54	0.15
Imax/Tavg	2.05	1.87	0.18
Smax/Navg	1.78	2.08	-0.30
Max-Min	107.00	103.00	4.00
Smax	134.00	132.00	2.00
Imax	162.00	161.00	1.00
Savg	108.00	107.00	1.00
Iavg	123.00	109.00	14.00
Avg.Thickness	96.59	91.26	5.33

RNFL PROGRESSION ANALYSIS

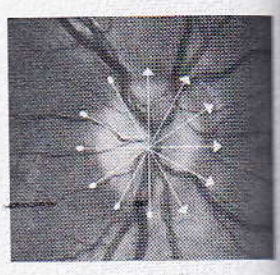
It compares the change detected over time to the variabilities of the measurements seen in a patient with glaucoma of the same stage. Areas of statistically significant changes are colour coded yellow when noted first, and red if it persists on subsequent scans.



RNFL Parameters	Baseline	Follow up 1	Follow up 2	Follow up 3	Change
Ave. RNFL	88.35	90.26	98.89	84.69	-3.66
Sup. Avg	87.62	96.39	100.38	87.57	-0.04
Inf. Avg	89.08	84.13	97.40	81.80	-7.27
TU	70.88	64.82	83.07	82.07	11.19
ST	111.15	130.09	148.31	116.98	5.83
SN	93.31	111.28	108.36	88.66	-4.64
NU	75.12	79.37	61.77	62.58	-12.54
NL	59.84	60.77	65.72	52.83	-7.01
IN	90.60	[illegible]	96.85	[illegible]	-18.54
IT	127.49	119.99	147.07	114.93	-12.56
TL	78.39	86.28	79.97	87.39	9.00

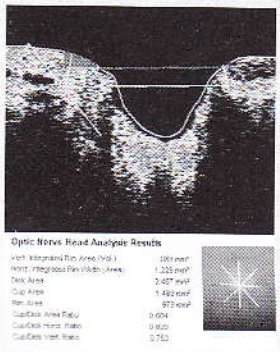
ONH Analysis

- ONH scans are composed of six linear scans in a spoke pattern separated by 30-degree interval centered on the ONH.
- The algorithm detects and measures all features of the disc anatomy based on the anatomical markers on each side of the disc where the RPE ends.



ONH scan

- Disc line: At the terminal ends of choroid, at level of pigment epithelium
- Cup line: 150 micron above disc line
- Nerve head volume: area above disc line
- Rim volume: area above cup line



GANGLION CELL COMPLEX (GCC)

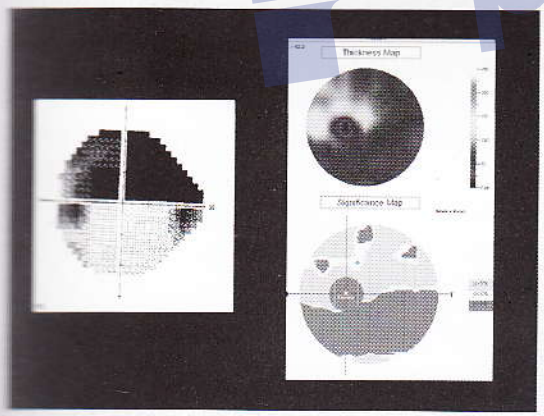
Glaucoma preferentially thins the Ganglion Cell Complex (GCC) which includes the axons, cell bodies, and dendrites of retinal ganglion cells

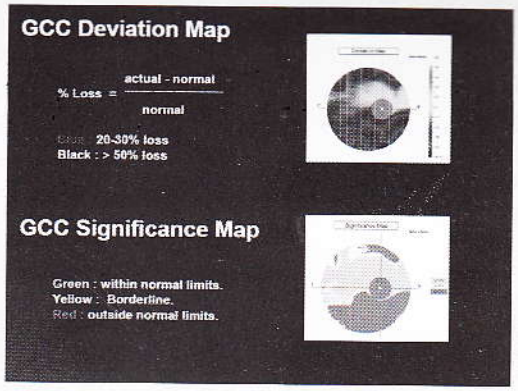
Ishikawa H., et al., *IOVS* 2005
Tan O, et al., *Ophthalmology*, 2008;115:949-56.

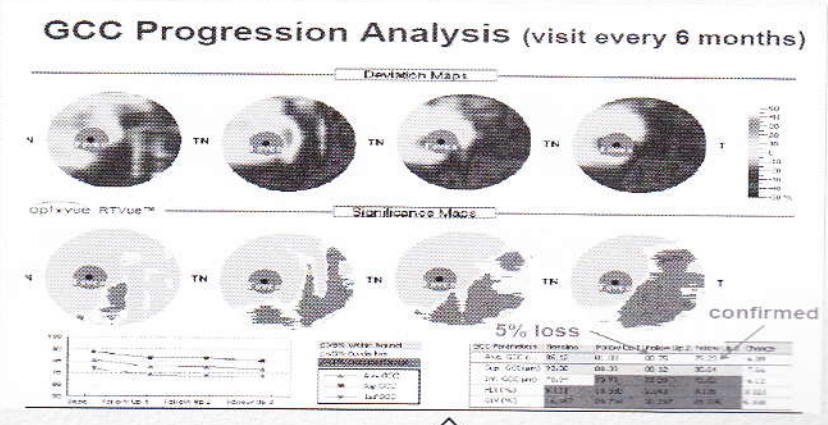
GCC includes the retinal nerve fibre layer (RNFL), the ganglion cell layer (GCL) and the inner plexiform layer (IPL), which becomes thinner in glaucoma. The thickness of GCC in macular region gives an analysis compared to a normative database.

The GCC map is colour coded, where the hot colours (red and yellow) represent thicker areas and cooler colours (blue and green) represent thinner areas.

Inferior GCC thinning corresponding with superior arcuate defect seen on field analysis.





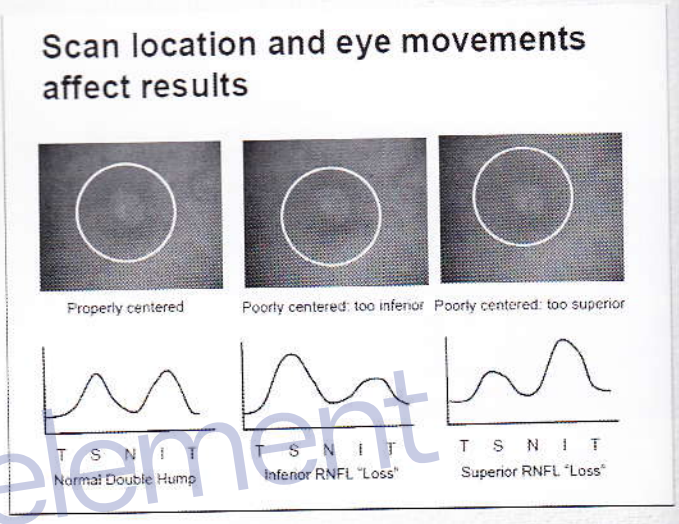


CLINICAL APPLICATIONS OF OCT

- It is a useful tool for baseline and follow up RNFL assessment in disc suspects and ocular hypertensives.
- In glaucoma patients with poor fixation or macular pathology, where field test may not be possible, OCT can help in determining progression.
- OCT has good sensitivity and specificity from differentiating normal from glaucomatous eyes.

LIMITATIONS OF OCT

- Scan location and eye movements affect results.
- Inaccurate detection of disc and RNFL borders due to optical opacities.
- Localised NRR/ optic cup changes can be missed by the interpolation algorithm.



CONCLUSION

Inspite of being a useful adjunct in the diagnosis and follow up of glaucoma patients, it is important to remember that OCT cannot replace a good clinical examination. The clinician must correlate the IOP, ONH and NFL appearance, visual field data with the quantitative data by OCT to detect glaucoma and its progression.

REFRENCES:

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