

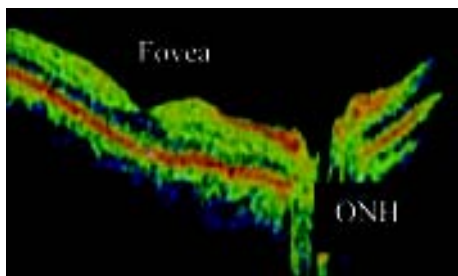
## Optical Coherence Tomography in Nonglaucomatous Optic Nerve Disorders

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**Abstract:** OCT is well known for its usage in diagnosis of macular pathology & plays important role in decision making in Glaucoma. Its role in diagnosing Optic nerve disorders other than glaucoma is less talked about. Cross sectional profiling of the ONH & Nerve fiber layer by OCT is useful for clinical dilemmas originating from Optic Nerve.

### Useful Scan Protocols of Stratus III OCT

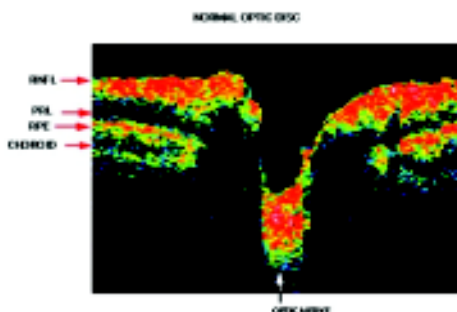
**1) Papillomacular Axis-** Line tomogram of macula & peripapillary region. Fovea, optic disc & retinal profile are identifiable by their characteristic morphology



Line scan through papillomacular axis

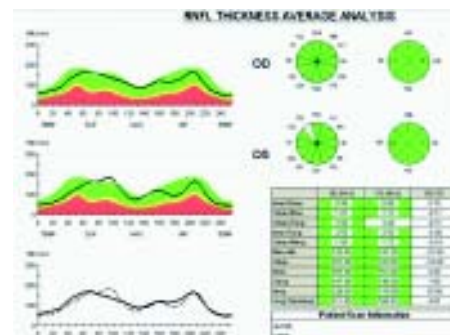
**2a) Optic disc scan-** Stratus OCT has routine & fast Optic disc scan strategies which are group of six linear scans through the disc at 30 degree angle from each other.

**2b) Fast Optic disc scan-** compresses 6 scans into one scan & acquires scans in short time of 1.92 seconds.



**Interpretation:** The point at which RPE-Choriocapillaries terminates at lamina cribrosa determines the disc boundaries. Extrapolation of the points to retinal surface defines disc diameter. The point at which Nerve fiber layer terminates determines the margin of cup.(fig)

**3) RNFL Mapping-** OCT measures the thickness of RNFL in peripapillary region. RNFL thickness increases from macula to Optic disc. RNFL measurement with circular scan of 1.34mm radius, centered on ONH has been shown to have a maximum reproducibility. RNFL may be thickened, thinned or normal depending on the nature of disease affecting Optic Nerve.



### Various Neurophthalmic conditions where OCT can be useful:

- *Congenital Optic Nerve abnormalities:* These are important because they are relatively common, may give rise to field defects, often create diagnostic dilemma & can be mistaken for disc edema.
- Evaluation and follow up of *Disc edema*
- Evaluation and follow up of *Optic Neuropathy*

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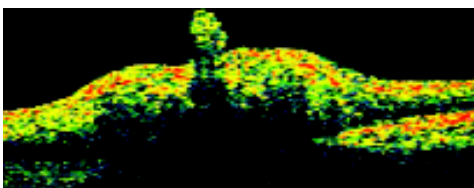
## Congenital Optic Nerve Head anomalies where OCT can be useful

### Optic Nerve Hypoplasia:

Reflected in OCT (RNFL) as thinning of RNFL in all the sectors

### Bergmeister's papilla:

Arises from centre of Optic disc, consists of small tuft of fibrous tissue & represents a remnant of Hyaloid artery fibrous sheath. OCT of ONH shows hyperreflective area over Optic Nerve Head (ONH)



### Tilted Disc:

Caused by oblique insertion of nerve into globe & is seen on routine examination. It looks as superotemporal elevation of disc & inferonasal portion appears displaced posteriorly with long axis of disc obliquely inserted. Visual fields may present with bitemporal hemianopia which do not strictly respect vertical meridian & tends to disappear after refractive correction.

OCT picture is essentially normal and thus any clinical confusion of sectoral edema due to elevated appearance of nerve can be easily ruled out by doing an OCT (RNFL).

There is a rare possibility of congenital suprasellar tumor, thus Neuroimaging is warranted if associated field defects respect vertical meridian & do not disappear after refractive correction

### Optic Disc Drusen:

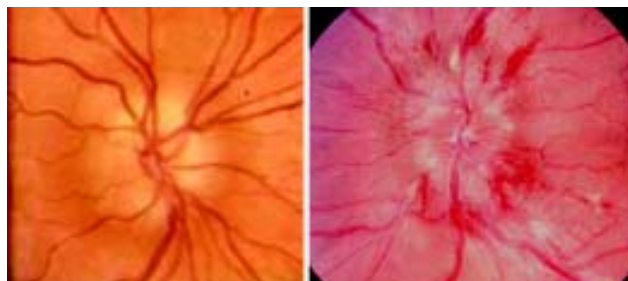
Clinically seen in 0.3% of population. It is often bilateral & familial. It is caused by deposition of hyaline like calcific material within prelaminar portion of ONH.

Clinically it is described as 'lumpy-bumpy' disc which gives appearance of elevation due to buried drusen, thus is one of the cause of pseudopapilloedema. There is anomalous premature branching of blood vessels in 10% of cases. There is no associated Optic nerve dysfunction.

### Course of ON Drusen :

Early childhood- It lie deep and can be confused with early papilloedema.

Early teens- It emerge to the surface and waxy pearl like irregularities are seen on surface.

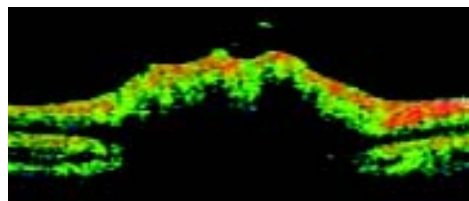


Optic disc drusen

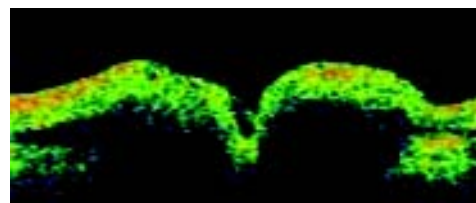
Optic disc oedema

To differentiate it from papilloedema OCT of ONH & RNFL can be useful

OCT(ONH) - shows shadowing of structures under Drusen, whereas disc edema shows typical increased retinal thickness at the border of visible RPE. (fig. below)



Drusen

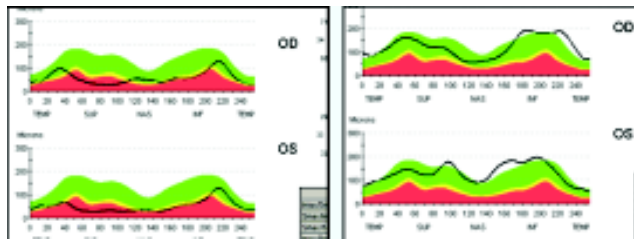


Disc oedema

OCT(RNFL) - In case of disc drusen shows RNFL thinning that correlates with visual field loss secondary to drusen if any. OCT may be helpful in monitoring patients who have ONH drusen with raised IOP as features of both overlap.

In case of papilloedema OCT (RNFL) shows increased RNFL thickness in all the sectors due to edema in Henle's layer. (fig. next page)

Unique features - exhibits phenomenon of Autofluorescence, USG B Scan shows highly reflective nodule within ONH even at low gain, clearly visible in CT scan as nodule of same density as bone.



Drusen

Disc Oedema

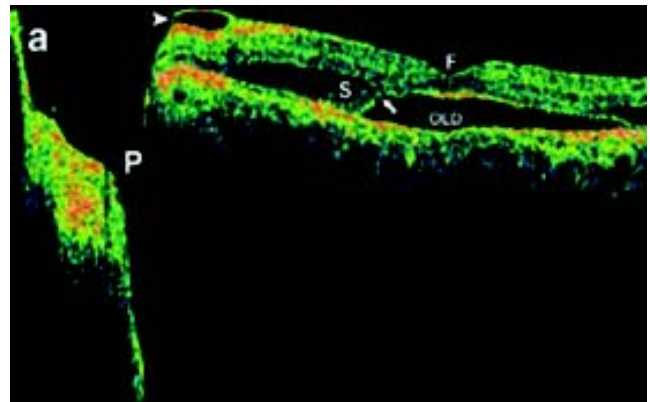
OCT (RNFL) in Drusen and Disc Oedema

### Optic Disc Pit:

Unilateral condition, seen as round or oval grayish white crater in optic disc. It is caused by incomplete closure of foetal fissure.

Disc is little larger than fellow eye. Round or oval pit seen in ONH usually located temporally. 45% temporal pits develop retinal elevation at macula due to neurosensory detachment. Various theories of serous detachment are there of which most accepted is abnormal communication between subarachnoid space & pit, through which CSF percolates into subretinal space.

OCT picture of ONH (below) depicts the course of detachment. Initially retinoschisis develops which is in communication with pit & finally leads to serous retinal detachment.



P-Pit, S-Schisis, F-Fovea

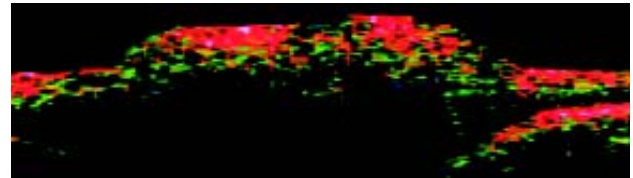
Treatment of choice in such macular detachments is photocoagulation temporal to disc along with gas tamponade.

### Morning glory syndrome:

Congenital disc anomaly that is typically unilateral & most often results in visual acuity between 20/200 & counting fingers.

Optic nerve lies centrally within an excavation of the posterior globe.

OCT (ONH) shows peripapillary excavation lined with RPE.



OCT line scan through papillomacular bundle helps to identify possible serous retinal detachment between disc and macula.

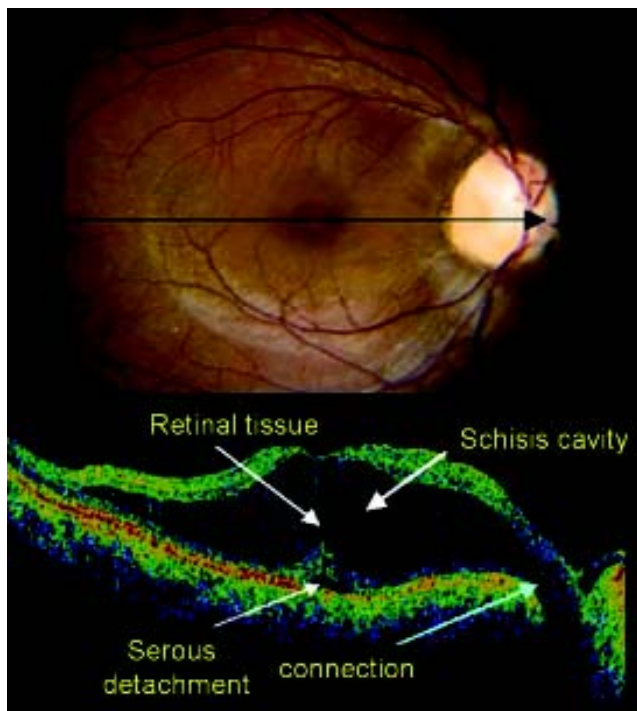
### Myelinated Nerve Fibres:

OCT (RNFL) reveals thickened NFL on OCT in affected area of retina.

### OCT in Disc Oedema

It is swelling of Optic nerve. Four I's may cause this condition

1. Increased intracranial tension (Papilloedema)
2. Infarction (AION, Compressive lesions)
3. Inflammation (Optic Neuritis)
4. Infiltration (Neoplastic)



OCT (RNFL) reveals RNFL thickness above 95<sup>th</sup> percentile of normative data.

#### **Papilloedema/Neuritis:**

Pattern of RNFL thickening is diffuse. After resolution of oedema it returns to normal if there is no permanent damage. If there is RNFL loss it shows thinning as compared to pattern seen during phase of oedema.

OCT (ONH) in disc edema shows typical increased retinal thickness at the border of visible RPE.

#### **AION:**

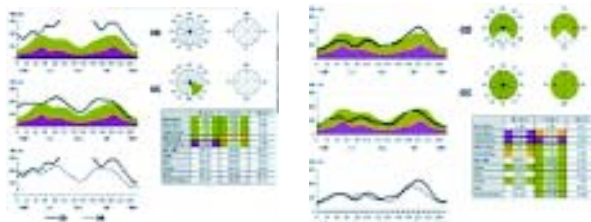
Thickening of RNFL is seen in sectoral pattern corresponding to sector involved in AION. OCT (ONH) helps to evaluate contra lateral 'disc at risk'.

OCT (RNFL) can be used for follow up and monitoring the response to treatment as seen in figure below. Pseudopapilloedema can be differentiated by no apparent change overtime in RNFL thickness.

Line scan through the papillomacular bundle may reveal subretinal fluid, apparent optic disc elevation.



AION: Fundus photos at presentation and after 3 months



AION same case as above: OCT (RNFL) at presentation and after 3 months

#### **OCT in Optic Atrophy:**

RNFL atrophy can be seen secondary to ischemia, compression, demyelination, raised ICT. Patterns of RNFL loss can be measured by OCT that may correlate with visual field defects & this helps in localizing lesion along visual pathway.

Progression or stability during follow up can be monitored with OCT.

In compressive neuropathy if RNFL thickness is normal it denotes favorable outcome following decompression.

#### **Compressive Chiasmal lesion:**

'bow-tie' atrophy depicted in OCT (RNFL) as thinning of RNFL in nasal & temporal quadrant, with average reduction of RNFL thickness.

#### **Acute Leber's Hereditary Optic Neuropathy:**

Average RNFL thickness is more than normal.

#### **Atrophic Leber's Hereditary Optic Neuropathy:**

Average RNFL thickness is significantly reduced.

#### **Toxic Neuropathy:**

Significant RNFL loss in temporal quadrant which is consistent with papillomacular bundle damage in toxic neuropathy.

#### **Conclusion:**

OCT is a noninvasive, fast, easy to use modality for evaluation of Optic nerve. It has good reproducibility & is safe tool for monitoring response to treatment other than visual acuity, fields, color vision, ONH photography. The advantage over these tests is OCT is an objective test and can be documented scientifically. Newer techniques of OCT like Spectral Domain and 3D OCT should prove to be better in imaging retina & optic nerve anatomy.