Short notes on this long and detailed paper named below. More a very detailed presentation than a paper.

Optical Coherence Tomography Neuro-Toolbox for the Diagnosis and Management of Papilledema, Optic Disc Edema, and Pseudopapilledema. Sibony et al: J Neuro-Ophthalmology 2021: 41: 77-92

My Comments and additions in *italics.*

These notes are split into three sections 1. Key points 2. Key figures 3. Addition information to this paper.

1. Key points

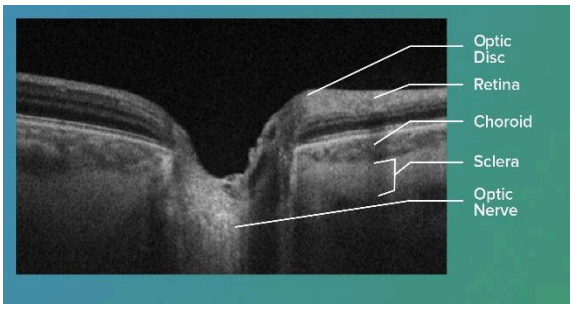
From this article's own conclusions, more is needed than OCT images to differentiate between pseudo-papilloedema and papilloedema. But OCT can give useful information, quickly, is non-invasive, but there are limitations. The limitations are the great variation of the normal appearance and poor normative data to compare with a scan.

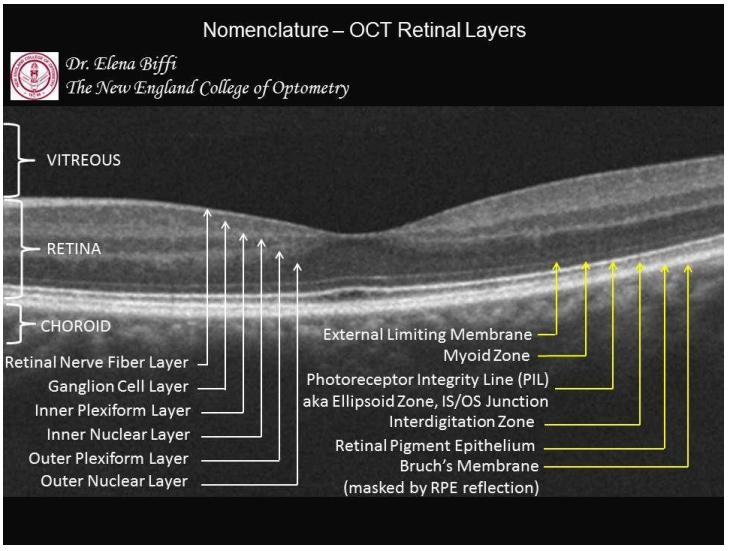
Raised intra-cranial pressure [ICP], can cause papilloedema with two main ocular effects.

First reducing the flow along the nervous tissue, stagnation, causing not just swelling of the optic nerve, but also the three inner retinal layers, 1. Retinal Nerve Fibre Layer [RNFL], 2. Ganglion Cell Layer [GCL] and 3. Inner Plexiform Layer [IPL].

Second effect, a swollen nerve is larger and pushes the surrounding retina forward to the vitreous.

Normal optic nerve and retina labled OCT scans.

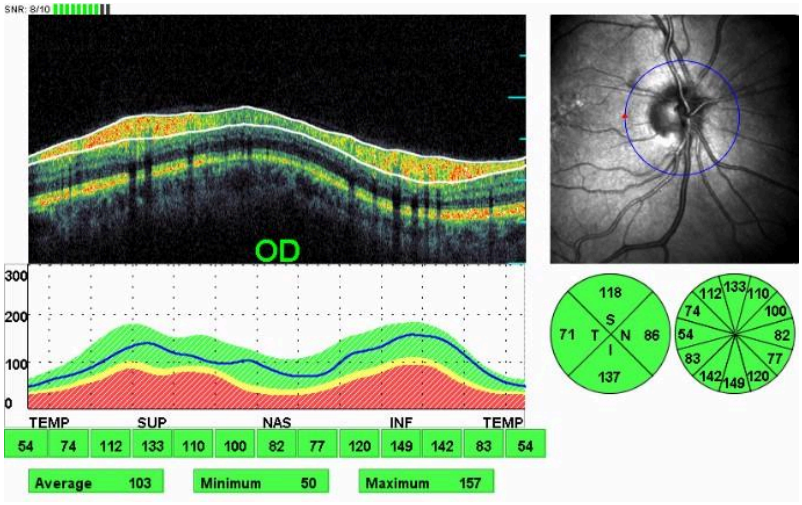




For the first ocular effect of raised ICP, the reduced flow and swelling, the RNFL, GCL and IPL thicknesses can be measured and compared to normative data. But the normative to age, race, spectacle Rx, etc is limited and incomplete.

A circular scan around the disc, is cut and flattened out in to a horizontal 2 humped strip

The RNFL thickness around the disc is section up into areas. Traffic light coding, green is good.



Swollen retinal layers distort into wrinkles, undulations and folds. These changes in architecture can be found looking 1. en face/on the surface 2. vertically/sagittal scans possibly better than horizontal 3. Circular to the disc. See figure 13

For the second ocular effect of raised ICP, the movement of the retinal towards the vitrous there is no normative data, OCT reveals an infinite variation of retinal contour. The best normative data is a previous OCT scan.

2. **Key Figures**

Worth looking at the pictures/figures in the article. If time limited possibly just Figure 8 and 13.

Figure 2

Demonstrates with raised ICP, how all or part of the posterior retina moves forward with a stretched optic nerve.

From OCT scans, the optic disc's cross-section profile is allotted by shape into 4 groups, set in columns.

Group 1. V-flat [V being the disc's cup] 2. W in profile 3. S on it's side in profile 4. Dome

Easier to detect if you have previous B scan, as there is an infinite variation in the B scan appearance of the optic nerve head.

Figure 3

Papilloedema with a failed shunt/drain. The disc is swollen and lifted. Flattening after treatment.
The GCL and IPL can also thin with atropy.

There is a wide variation in retinal profiles. So it is hard to be confident in suggesting possible raised ICP from the shape of one scan. Change is easier to detect from a previous scan.

Figure 4

Uniocular swollen disc – Rare to be raised ICP – Here space occupying lesion optic nerve sheath meningioma easily miss-diagnosed initially as non-arteritic anterior ischaemic neuropathy. *Unilocular swelling can be found with MS, retinal vein occlusion [RVO], etc.*

Figure 6

How papilloedema swelling is reduced with Acetazolamide a carbonic anhydrase inhibitor.

The thickness of the swollen RNFL reduced with time.

A line [dotted on the figure] drawn between 2 points, far away and equidistant of the optic nerve, gives a reference line. From this line the position of a line drawn between either side of the Bruch's membrane opening [BMO] [white line] can be measured. RNFL thickness can also thin due to atrophy.

Why not measure the movement of BMO position with sequential scans? Both the reference line and the BMO move with changes in swelling. The reference dotted reference line is not fixed.

Figure 7

Drusen. The dense/black/hypo-reflective spaces in the disc, occasionally surrounded by an irregular ring of white/hyper-reflective dots. The dots if present, help recognition of drusen and their position.

Figure 8

Excellent images of Pseudo-papilloedema without drusen.

A – Tilted, rotated and oval. *Crisp disc. Vessels not obscured. Novel pattern of blood vessels.*

B – Myopic Obliquely Inserted Disc [MOID]. *[See 8 E also] Though not labelled, a left eye? View the oblique nerve with a cross-sectional B scan. The insertion of an oblique optic nerve originates nasally, so the angle to the retina is less than the normal 90^0insertion. Often more like 65^0.The edge of the tilted disc rim is often raised nasal and inferiorly,*

plus also possible inferior retina bowing/staphyloma with occasional superior VF loss. Disc pigment crescent are temporal.

C –MOID with haemorrhage. *Worth a OCT scan to check for vitreous traction over the blood vessel. Not all disc haemorrhages are linked to raised IOP/glaucoma.*

D – Late fluorescein Angiography. *Fluorescent dye is injected into an artery, it takes time to travel through to the late venous phase . The bright glow at nasal disc rim, show slight permeability/leakage of the dye.*

E – OCT of tilted optic nerve, at an angle so the nasal portion entering the eye first so is raised.

F – Colour image of the same optic nerve from E. *Nasal disc Indistinct wide oblique nerve insertion. Temporal disc narrow crisp neuro retina rim [NRR].*

Figure 9

Scans of uniocular disc swelling. Not all classical papilloedema.

A – Non-Arteritic anterior ischaemic neuropathy.

B – Neuroretinitis

C – Atypical Papilloedema.

Figure 10

Folds/peripapillary wrinkles due to swelling. *Needs a lot of swelling for folds at the choroid?*

A – Paton's folds/wrinkles. Temp to disc. Many waves of fine wrinkles in RNFL. Best seen with OCT.

B – Peri-papillary. 360^0 to disc. A few gentle undulations in inner RNFL and below. Found more after lowered ICP.

C – Inner retinal folds. Radial to disc. Undulations in the inner half of the retina.

D – Choroidal folds – Random pattern. Undulations in the outer retina. Many choroidal folds are idiopathic, the rest of the retina appears normal.

Figure 13

Suggests the need to take a series of scans to find retinal irregularities. Vertical/sagittal [not horizontal] and circular to the disc appear the most effective scans at finding irregularities secondary to swelling.

3 Additional information to this article. For papilloedema.

Symptoms

H/A - New, intense, vomiting without nausea, persistent, often on waking, worse when laying down, worse with coughing or bending. Laying down horizontally increases ICP. Sitting up reduces the symptoms.

Sight – Transient Visual Obscuration [TVO]. Total shutter loss of sight, for minutes. Monocular but can be binocular. Often when looking in a particular position of the eyes, especially convergence when the swollen optic nerve is twisted in the retina. Occasional TVO precipitated on quick postural changes, for example standing quickly. Reduced sight, ''not right'', fuzzy, washed out in colour, detail, and contrast.

Diplopia -- VI nerve palsy. Horizontal diplopia at distance. Or an acquired, large, asymmetrical, esophoria at distance.

Ocular Signs

Disc changes – Fluffy disc suggesting swelling. Loss of disc margin and cup. Obscuration of B/V especially fine arterioles at the disc margin, swollen vessels especially veins with a reduced return flow. Disc telangiectasia/irregular fine blood vessels. Disc haemorrhages.

Changes in retinal contour – Wrinkles, waves and folds

Loss of disc spontaneous venous pulsation SVP, but not everybody has a venous pulsation.

Tests

Loss of visual field, especially enlarged BS, arcuate and nasal step. Central area spared. BS is not easy to plot.

Subtle colour vision changes – Hard to record with a simple test, more by pts reporting reduction in saturation.

Contrast sensitivity reduction – Hard to record with a simple test, more by pt reporting pale washed out sight.

Pupil becomes dilated.

Systemic changes/associated with

Bradycardia [slow heart rate] and high BP. Worth measuring BP.

Problems breathing.

Change of character. Especially children. ''Not herself''. Confused. Problems talking.

Whooshing in the ears – Forms of tinnitus. Hear own heartbeat or pulse clearly.

Back pain

Female > Male.

Overweight – high BMI

Classically - Caucasian overweight females in 30s

Refer to

Papilloedema is an ocular sign of a systemic problem raised ICP.
There are many causes of raised ICP, malignant hypertension, space occupying lesions, idiopathic, infection meningitis, etc.

For patients with more advanced or obvious papilloedema, with signs and symptoms+, they are best managed in a neuro-surgery unit entered via the onsite A&E. Provide a letter with the provisional diagnosis of papilloedema. A neurosurgery unit is used to dealing with raised ICP, the investigations [MRI, lumbar puncture, etc], medication and surgery. A general hospital might struggle to provide the appropriate care. Few general hospitals have a neurosurgery unit. For Essex, in the north there is Addenbrookes and for the south Queens Romford. To the south of Essex the Royal London, Whitechapel, and Queen Marys Paddington.
Send the patient with copies of the OCT scans and images on their camera phone. Plus an image of a normal disc. Advise the patient to ask the A&E doctor are they familiar with OCT scans, most are not. Often good for the pt before going to hospital to collect an over-night bag with medicines, medicine list, change of underwear, PJs, dressing gown, toiletries, phone charger, phone credit, spectacles, cash, good book, etc

For suspect patients better to refer to ophthalmology urgently as they have shorter waiting than neurology. State the diagnosis if only provisional. It is easy for care to be delayed.