

Don't Let Swollen Optic Nerves Make You Nervous

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Financial disclosures

- ◆ No financial disclosures

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Examination Techniques

- ◆ Stereoscopic viewing essential
- ◆ VA and VF: SVP
- ◆ Pupil testing and color vision
- ◆ Brightness comparison and red cap test



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Papilledema

- ◆ Bilateral* optic nerve head swelling secondary to increased ICP
- ◆ Swollen, blurred margins with splinter hemorrhages and exudates as well as nerve fiber layer edema. Patton's folds may be seen

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Papilledema

- ◆ May be asymmetric or very rarely unilateral (sequential swelling)
- ◆ VA varies but typically mild reduction only or no loss at all
- ◆ May get diplopia secondary to abducens nerve compression
- ◆ With increased ICP, can get choroidal folds only (before papilledema) at lower pressure levels

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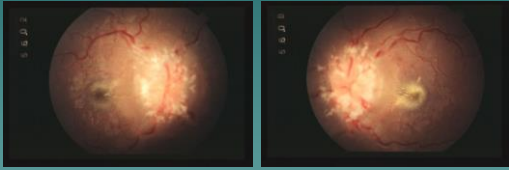
Papilledema

- ◆ VF usually shows enlarged blind spot
- ◆ No pupillary defect. Normal color vision
- ◆ SVP absent with obliterated cup



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Papilledema (IIH)



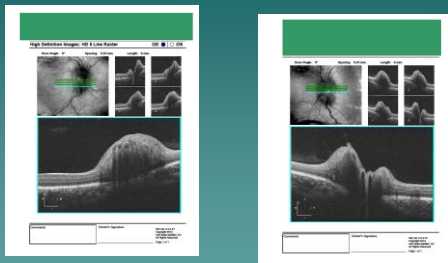
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Papilledema IIH age 15



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OCT



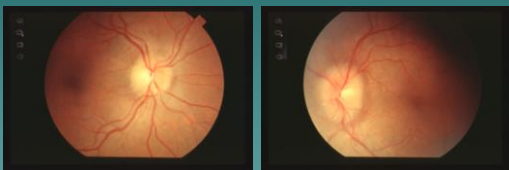
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Papilledema (HTN)



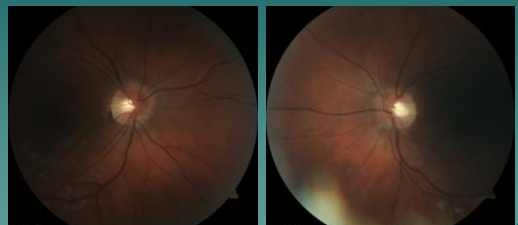
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Papilledema (tumor)



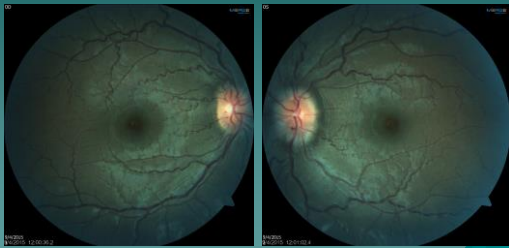
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Subtle papilledema (IIH)



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Papilledema IIH



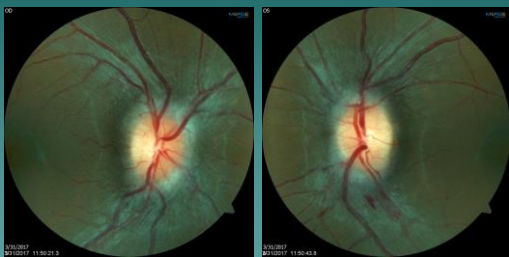
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Papilledema IIH



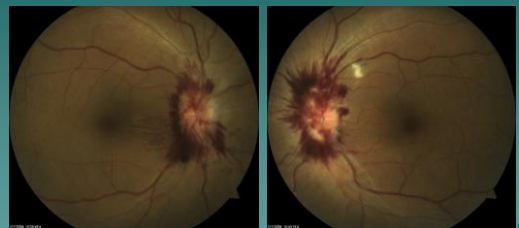
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Papilledema IIH



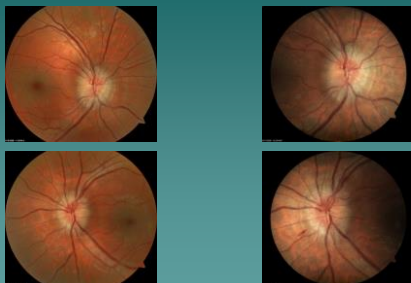
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Terson's and papilledema

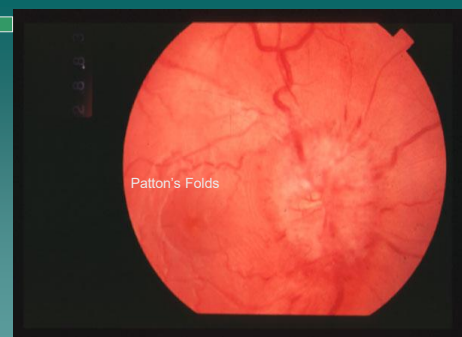


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Papilledema progression



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Patton's folds: RNFL thickness
231 in OD, 295 in OS



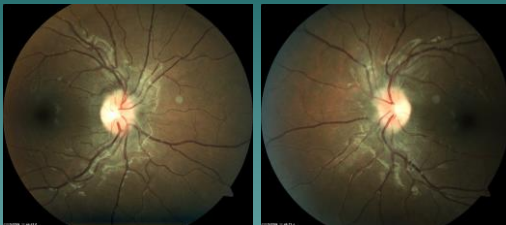
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Patton's folds: now you see
them.....



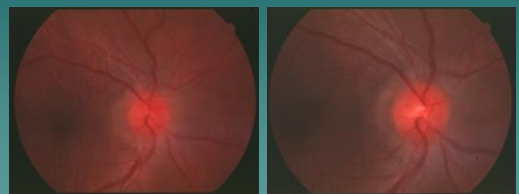
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Back then in 2007 you did not...



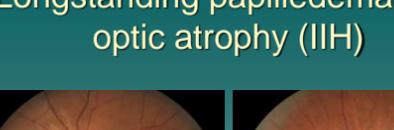
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Patton's folds



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Longstanding papilledema with
optic atrophy (IIH)



The image consists of two side-by-side fundus photographs. Both show a pale, swollen optic disc with blurred margins, characteristic of longstanding papilledema. The retinal vessels are visible crossing the disc, and the overall appearance suggests optic atrophy. The left image is labeled 'OD' (Oculus Dexter) and the right image is labeled 'OS' (Oculus Sinister).

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Papilledema OCT NFL

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NFL edema

Papilledema OCT

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Papilledema OCT

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Papilledema OCT

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Increased ICP

- ◆ Variations are due to anatomical considerations
- ◆ If the channels connecting the central cavity and optic nerve sheath allow equal flow on both sides and in both directions papilledema will occur and will improve with decreased ICP

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Increased ICP

- ◆ If there is a difference in the communications then the edema will be asymmetric. Usually the result of a smaller bony canal opening on one side limiting the swelling.
- ◆ If the valves are one-way then the swelling will not improve rapidly with Tx

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Increased ICP

- ◆ An acute rise in ICP that resolves rapidly is not typically associated with papilledema. Elevation must be chronic
- ◆ Increased pressure is transmitted from the sub-arachnoid space to the optic nerve head via the nerve sheath. Venous pressure in CRV increases
- ◆ Disruption in axoplasmic flow at lamina cribosa leads to swelling

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Increased ICP

- ◆ Studies show that ONH swelling as measured by OCT can decrease (but not instantly resolve) immediately after lumbar puncture
- ◆ Measured in lateral decubitus position with OCT sideways!
- ◆ Shows that reduction of ONH compression is very rapid
- ◆ Shows that pressure in spinal column is associated with pressure at ONH

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Etiologies of Increased ICP

- ◆ Space occupying lesion ; must always be ruled out!
- ◆ Infection or anatomical abnormality
- ◆ Malignant hypertension
- ◆ IIH
- ◆ Certain medications
- ◆ ? Sleep apnea (obesity): ICP may be elevated only at night! Men especially
- ◆ Must order MRI in all cases

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Idiopathic Intracranial Hypertension (IIH)

- ◆ Older term is "pseudotumor cerebri"
- ◆ Young overweight females (F 8X M)
- ◆ 5/ 100,000 in population as a whole ; 20 / 100,000 in 20 - 44 year old women 10% over ideal weight
- ◆ May be related to medications including TCN, HRT, lithium, high dose Vitamin A supplementation, steroid withdrawal
- ◆ Emerging evidence that elevated testosterone / androgen levels may be the cause
- ◆ Sleep apnea link
- ◆ Can affect children, often overlooked
- ◆ Doubles cardiovascular risk in females

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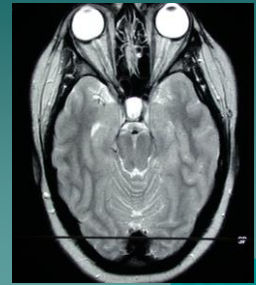
IIH

- ◆ Symptoms of transient blur, diplopia , tinnitus (intracranial noises, not just ringing) , headaches , etc.
- ◆ ICP usually severely elevated ; normal is 50 – 200 mmH₂O. Over 25 cm (250 mm) considered definitively abnormal. Single measurement can be misleading : levels can vary over 24 hours
- ◆ Very rare variant of normal pressure IIH. S/S, but repeatedly normal ICP

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IIH

- ◆ Diagnosis requires normal MRI / MRV and CSF studies with elevated ICP
- ◆ Watch for spinal chord tumors
- ◆ Differential: Cerebral Venous Sinus Thrombosis
- ◆ MRV



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CVST

- ◆ Mostly young women
- ◆ Often not overweight
- ◆ Can be life threatening
- ◆ Treat with blood thinners, Diamox
- ◆ Can be seen with MRI, but potentially missed if MRV not performed

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IIH Management

- ◆ Refer to a neurologist
- ◆ Medical management includes Diamox , Lasix
- ◆ Weight loss



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IIH Management

- ◆ If recalcitrant....
- ◆ Repeated lumbar taps (ugh!)
- ◆ Lumbo-peritoneal shunt
- ◆ Ventricular shunt

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IIH Management

- ◆ If progressive changes in visual acuity or visual field occur , consider an optic nerve sheath decompression
- ◆ Several small fenestrations in the optic nerve sheath are created to allow room for expansion
- ◆ Performed by a neuro-ophthalmologist. Often do worse eye only because 50% get improvement in the fellow eye

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Chronic IIH induced edema leading to atrophy: S/P decompression



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Foster Kennedy Syndrome

- ♦ Swollen optic nerve on one side , advanced optic atrophy on the other
- ♦ Advanced optic atrophy prevents swelling making a bilateral problem appear to be unilateral
- ♦ Often seen in chiasmal tumors

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Compressive Optic Neuropathy

- ♦ Compression leads to axoplasmic stasis and retrograde death of nerve fibers
- ♦ Pale, choked, swollen nerve
- ♦ Rarely see hemes; + APD

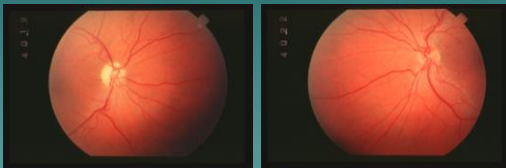
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Compressive Optic Neuropathy

- ♦ Optic atrophy and severe vision loss with time
- ♦ MRI with and without contrast: neurosurgery referral
- ♦ Possibly endoscopic optic nerve decompression?

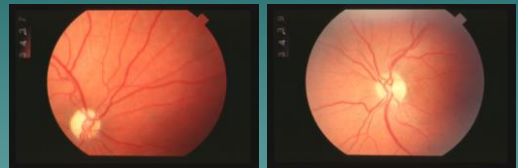
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Pituitary tumor



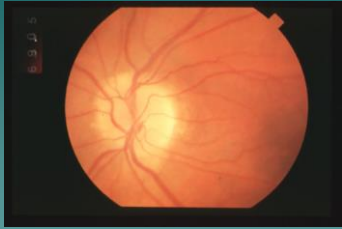
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Pituitary tumor post surgery



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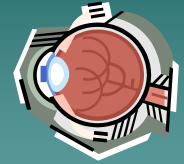
Sphenoid wing meningioma



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ION

- ◆ Nonarteritic
- ◆ Arteritic



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Nonarteritic ION

- ◆ Swollen, hyperemic nerve with splinter hemes and exudates
- ◆ Often sectoral
- ◆ Ischemic / hyperfusion event caused by interruption of micro-vascular circulation, often at night.
- ◆ Highly associated with sleep apnea (75-90% in several studies)
- ◆ NAION has 5x risk of sleep apnea, 8x risk in women

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NAION

- ◆ No systemic symptoms; normal ESR / CRP
- ◆ Most common cause of ONH swelling over the age of 55 (2-10 cases per 100,000 per year)
- ◆ 45-60 year olds (any age possible) with no sex predilection; C > AA

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Nonarteritic Etiologies

- ◆ 1) Sleep apnea! Up to 90%
- ◆ 2) Hypertension (med related?)
- ◆ 3) Idiopathic
- ◆ 4) Diabetes
- ◆ 5) Atherosclerosis
- ◆ 6) Migraine
- ◆ 7) Increased Homocysteine / Decreased vitamin B6
- ◆ 8) HIV infection

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Nonarteritic ION

- ◆ Idiopathic cases (and others) are more common in disc at risk patients.
- ◆ Approximately 15% of cases will involve the fellow eye in 5 years (more common with VA < 20/200 in first eye, diabetics, and platelet polymorphisms). Repeat attacks in same eye < 5%

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NAION

- ◆ VA varies widely from normal to severe loss: 45% 20/40 or better but 33% 20/200 or worse
- ◆ VA loss progresses over 2-4 weeks
- ◆ VA improves by up to three lines at six months in 40%
- ◆ In patients under 50 years of age, there is a higher rate of bilateral involvement and more visual recovery

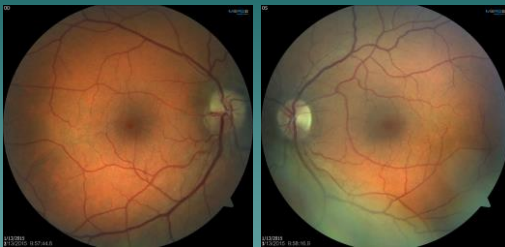
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Nonarteritic ION

- ◆ Often APD , color vision usually normal
- ◆ Most frequent visual field defect is inferior nasal / partial altitudinal but may get essentially any type. FDT may be more sensitive and often shows spillover of loss in to "non-affected" hemifield
- ◆ After swelling resolves the nerve is pale but often not cupped-cupping may occur, however
- ◆ Why does area of swelling not always match VF defect?

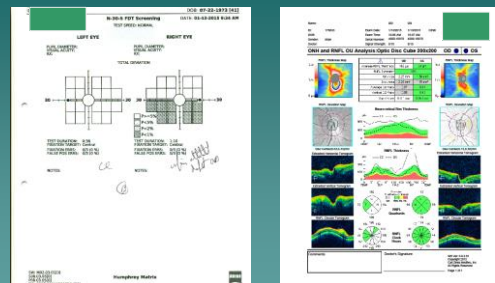
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NAION 2 weeks after onset of symptoms



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NAION



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Nonarteritic ION Treatment

- ◆ No treatment other than managing the underlying cause has proven to be consistently effective
- ◆ Blood thinners may debatably protect the fellow eye but will not alter the course of recovery.
- ◆ Order CBC , ESR and CRP , lipid profile , hemoglobin A1C. Check BP
- ◆ Check for sleep apnea!

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Steroids?:

- ◆ SS Hayreh: 2008 study utilizing oral steroids....
- ◆ If VA 20/70 or worse, oral prednisone resulted in VA improvement (3 or more lines) in 70% of treated patients, only 40% of untreated
- ◆ Beginning dose of 80mg for 2 weeks with slow taper.
- ◆ Small study with IVK was positive
- ◆ Small study with IV Rho-Kinase inhibitor (Fasudil) was positive

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Incipient ION

- ◆ We see it coming, but can we do anything about it?
- ◆ Will it always end badly?

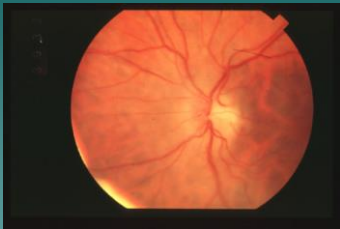
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NAION



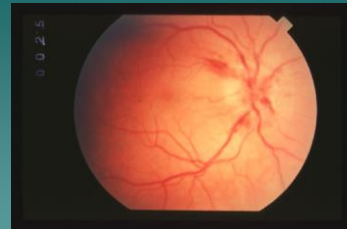
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NAION



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NAION



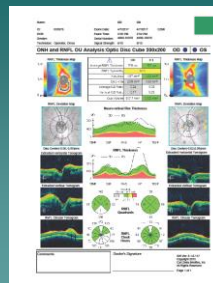
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NAION



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NAION secondary to OSA



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NAION OD secondary to HIV



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Another HIV induced optic neuropathy



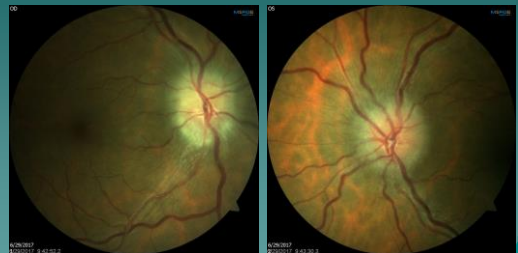
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Old NAION OD



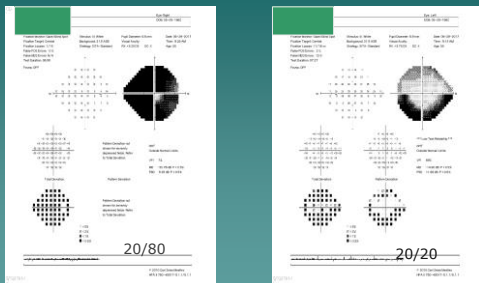
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Bilateral NAION secondary to OSA (40% blood oxygen level)



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Accompanying VF



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NAION OD and fellow eye

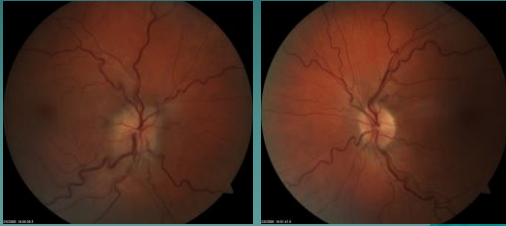


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NAION OD: The Beginning

NAION

Fellow Eye

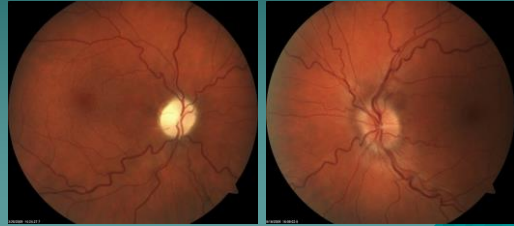


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Optic atrophy / incipient ION

Optic Atrophy

Incipient NAION



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NAION OS

Optic Atrophy

NAION OS



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Optic atrophy OU

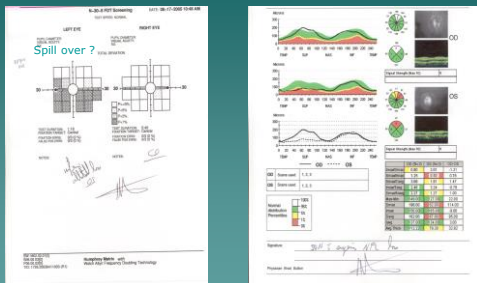
Post NAION

Post NAION



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ION OS with matching VF / NFL loss



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Arteritic ION

- ◆ Pale disc swelling with splinter hemorrhages
- ◆ Over 50 years old (usually much) , F>M
- ◆ Increased ESR and C-Reactive protein
- ◆ ESR normal in about 25%!
- ◆ VA 20/200 or worse in 60% of cases
- ◆ Traditional thinking from past studies of a high predilection for Caucasians, but a large 2019 study showed only a slight predilection for Caucasians over African Americans.

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Arteritic ION

- ◆ Sudden, painless loss of vision with APD
- ◆ Altitudinal VF loss most common, others possible
- ◆ Symptoms of GCA but about 1/3 are symptom free
- ◆ Very high five year mortality rate

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Giant Cell Arteritis

- ◆ GCA is a disease of unknown etiology (emerging evidence that zoster may be involved?) affecting the large and medium arteries including the temporal, ophthalmic, and posterior ciliary arteries
- ◆ Symptoms include HA, scalp tenderness, jaw claudication, malaise, fever, and fatigue

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GCA

- ◆ May also see CWS, CRAO, and amaurosis fugax
- ◆ 20% of cases with ocular involvement are CRAO, 80% ION
- ◆ Obtain stat Westergren ESR, CRP, CBC with platelets

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Giant Cell Testing

- ◆ Normal ESR is age/2 for men and age +10/2 for women
- ◆ C-Reactive protein testing is not specific for GCA but it is nearly 100% sensitive so very useful test
- ◆ Temporal artery biopsy when indicated

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Giant Cell Arteritis

- ◆ 25% of untreated patients develop AION
- ◆ 2/3 will develop in the second eye within weeks if not treated
- ◆ Rheumatology referral



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Giant Cell Treatment

- ◆ IV hydrocortisone followed by long term oral prednisone. Maintenance dose of 10mg daily for years. Follow ESR, other markers
- ◆ Average cumulative steroid dose over course of treatment.....over 5000 mg of prednisone!

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Temporal (Giant Cell) Arteritis

- ◆ Newly FDA approved treatment
- ◆ Subcutaneous Tocilizumab (Actemra)
- ◆ Used with steroids (not in place of): makes steroid dose much lower
- ◆ Immunosuppressant
- ◆ Risk of infections, no live vaccines
- ◆ Delivered IV
- ◆ Also used with RA and other forms of arthritis

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Amiodarone induced optic neuropathy

- ◆ Mimics NAION in nerve appearance but bilateral instead of unilateral
- ◆ Afflicts 2% of patients taking it
- ◆ Slow, insidious onset of visual loss
- ◆ Slow, complete recovery over many months after medication is discontinued (very long half-life)

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Viagra / Cialis / Levitra and NAION

- ◆ 553 cases officially reported to the FDA by the end of 2014. 443 were Viagra
- ◆ ? Under reported
- ◆ These medications also occasionally used for pulmonary HTN
- ◆ Visual loss most often noted upon awakening the morning after use
- ◆ Is the association real or coincidence?
- ◆ Likely the "straw that broke the camel's back" in those with risk factors. But.....

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ED drugs and NAION

- ◆ Very interestingly, has been reported in a 7 month-old infant, 28 year old, and 33 year old, presumably all taking them for pulmonary HTN
- ◆ At those young ages, not as likely to have other NAION risk factors
- ◆ Also, 2 reported cases of PION with Sildenafil, one in a 39 YO female with pulmonary HTN

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Viagra / Cialis

- ◆ What is the proposed mechanism? Nitrous oxide release actually dilates vessels....but drops blood pressure.
- ◆ Do ION patients have faulty autoregulation?
- ◆ Ask all males with NAION about ED drug use, D/C if using to protect fellow eye.



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Optic Neuritis

- ◆ Unilateral (usually) swollen nerve. Often retrobulbar (2/3) with no visible abnormality. Hemes uncommon
- ◆ Diffuse visual field loss or enlarged blind spot. Subtle defects often present in the fellow eye
- ◆ Centro-cecal defect with Goldmann perimetry
- ◆ About 5% in US bilateral, but 30% in Asia

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Optic Neuritis

- ◆ Younger patients (20-40 peak), F > M: more common in Caucasians
- ◆ APD, wide range of VA loss, decreased color vision; pain on eye movement

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Optic Neuritis

- ◆ Often associated with post viral syndromes or demyelinating diseases such as MS (initial symptom in 20% of cases-usually retrobulbar)
- ◆ VA recovers over weeks to months to near baseline level but often seems dim or washed out to the patient
- ◆ Get MRI in most cases
- ◆ May represent form fruste MS
- ◆ Several cases reported linked with use of TNF (tumor necrosis factor). Used for RA & JA; etanercept, infliximab, etc.

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Optic neuritis with atrophy after six weeks



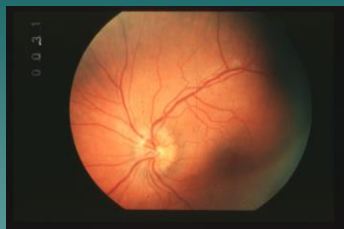
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Optic neuritis associated with MS



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Optic neuritis



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Optic Neuritis Treatment Trial

- ◆ 457 patients in three treatment groups 1) oral steroids (1mg / kg / day X 14 days), 2) IV steroids (250mg Q 6h X 3 days) followed by orals (as above for 11 days), 3) placebo
- ◆ Orals followed by short taper of 20 mg on day 15 and 10 mg on days 16 and 18
- ◆ Hospitalized while on IV methylprednisone
- ◆ Traditional treatment of oral steroids proved to be the least effective of the three! Actually increased recurrence rate

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ONTT

- ◆ IV followed by orals hastens VA recovery by about 2 weeks but does not improve end result
- ◆ Delays the onset of MS symptoms up to 2-3 years: no benefit at 5 years

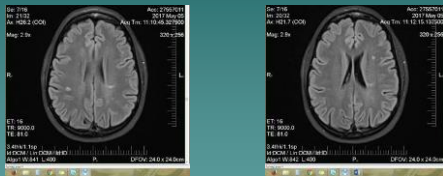
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ONTT 15-year F /U

- ◆ 294 patients seen 15 years out
- ◆ 15-year risk of developing MS was 50% (6% had known MS entering the trial)
- ◆ 72% if lesions on original MRI, 25% without
- ◆ VA 20/20 or better in 72%
- ◆ Factors indicating a lesser chance of developing MS include: 1) male gender, 2) optic disc swelling, 3) peripapillary hemorrhages and exudates, 4) no pain on eye movement, 5) NLP vision

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MS lesions



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Optic Nerve Head Drusen

- ◆ Increased prevalence in small nerves with small cups. Therefore, more common in whites than in AA. Higher incidence in patients with RP (10%)
- ◆ Compression of axons leads to stasis of axoplasmic flow and hyaline is excreted then calcifies over time, leading to the formation of drusen
- ◆ Nerve appears elevated but no splinter hemes or exudates and the margins are distinct.
- ◆ Abnormal vessel branching

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Optic Nerve Head Drusen

- ◆ Not always visible! Buried early in life but become visible with time. Creation of more drusen push some forward to the surface of the nerve
- ◆ Can cause decreased vision and variable visual field defects. More loss with visible drusen
- ◆ Common and under diagnosed

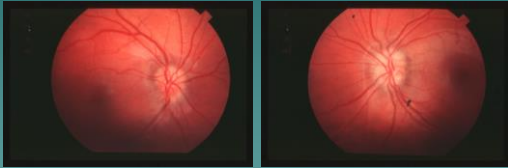
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Optic Nerve Drusen

- ◆ SVP/EVP not affected: APD and color vision loss rare but possible
- ◆ Change with time
- ◆ Use B-scan or OCT to detect buried drusen
- ◆ Also seen with CAT scan, MRI, IVFA, and FAF

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ONH Drusen



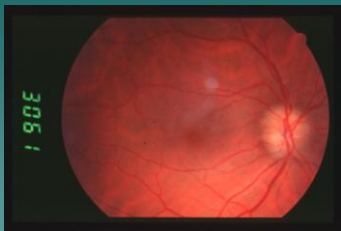
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ONH Drusen



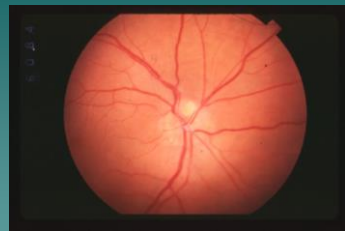
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ONH Drusen



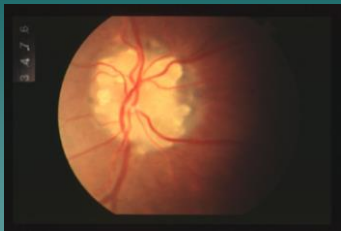
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ONH Drusen



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ONH Drusen



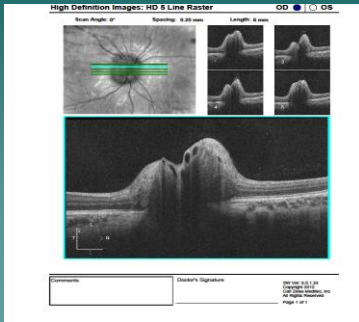
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ONH drusen



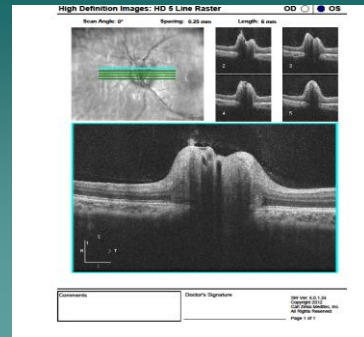
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ONH DRUSEN SD-OCT



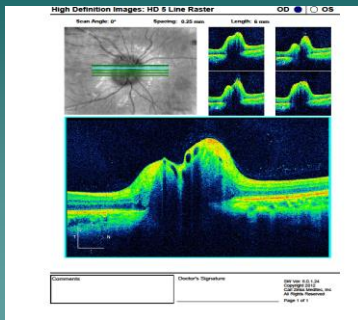
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ONH DRUSEN SD OCT



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Color SD-OCT



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ONH drusen detection with OCT

- ♦ Optic Disc Drusen Consortium Consensus.....
- ♦ Always use EDI
- ♦ Blood vessels are more solid, cast a shadow, and can show as figure 8
- ♦ Drusen always prelaminar
- ♦ Drusen always hyporeflective
- ♦ Drusen often have a hyper-reflective border, especially superiorly

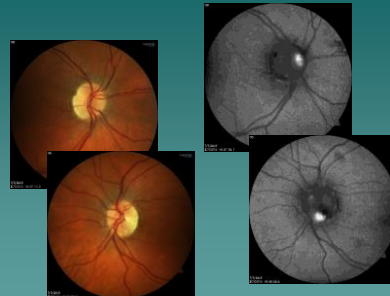
112

ONH drusen detection with OCT

- ♦ Drusen can conglomerate, and these areas can have some internal reflectivity from borders
- ♦ The old concept of a hypo-reflective fluid wedge at the edge of the nerve in true papilledema DOES NOT APPLY with SD-OCT. Was a time domain OCT artifact.

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FAF ONH Drusen



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FAF ONH Drusen



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NFL loss with ONH drusen



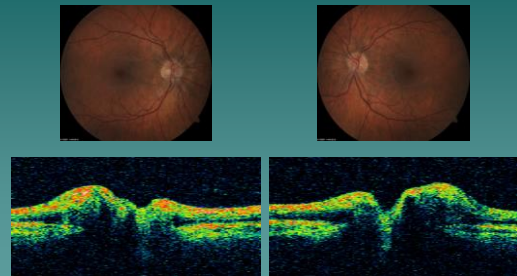
116

What's this? Drusen too!



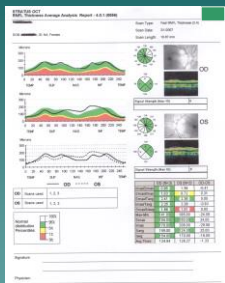
117

IIH with ONHD and papilledema



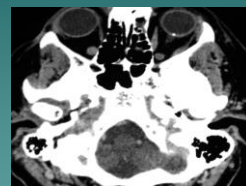
118

IIH with ONHD and papilledema



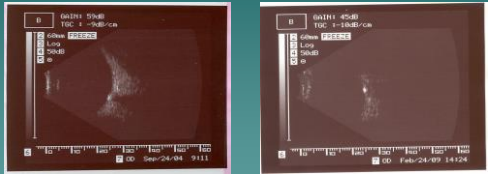
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ONH drusen MRI



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ONH drusen B-scan



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Papillophlebitis (optic disc vasculitis)

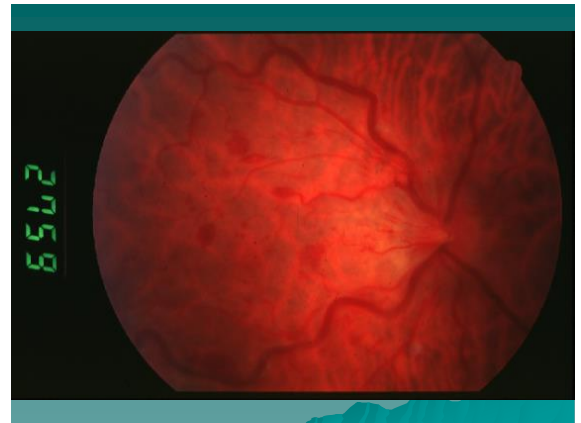
- ◆ An inflammatory variant of CRVO striking otherwise healthy, young adults (f 2x m)
- ◆ Disc edema out of proportion with retinal hemorrhaging
- ◆ Usually mild VA reduction to around the 20/30 level but can be worse

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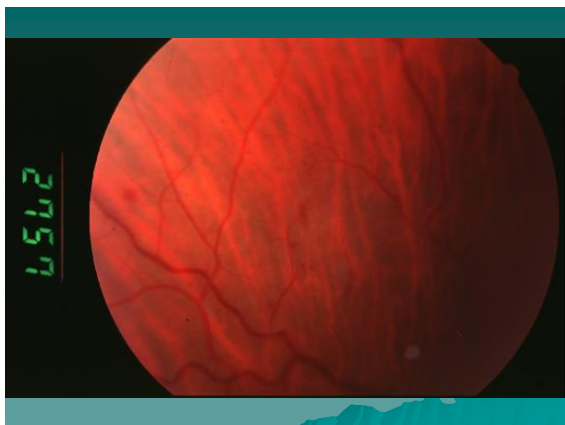
Papillophlebitis

- ◆ Vague prodrome of scintillating, colored lights with visual disturbances
- ◆ Enlarged blind spot on the visual field
- ◆ Dilated and tortuous veins
- ◆ Condition is self limiting over the course of several months and a complete recovery is the norm
- ◆ Separate entity? Systemic work-up? Are we looking for the wrong things? Antiphospholipid antibody syndrome (APA)

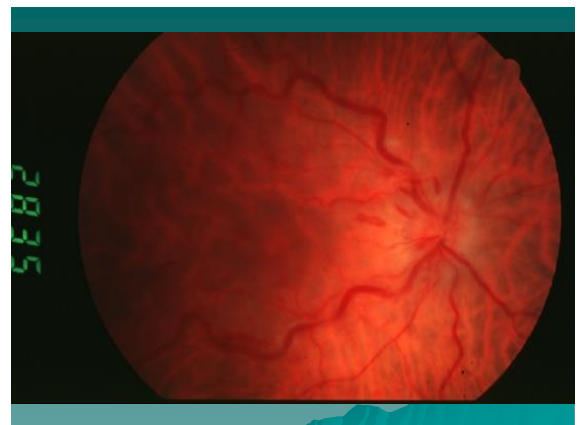
123



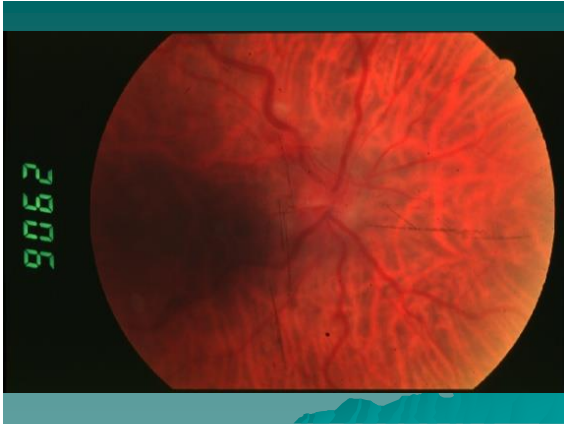
124



125



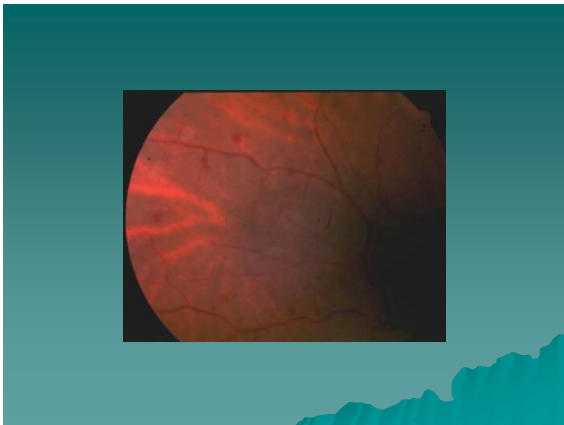
126



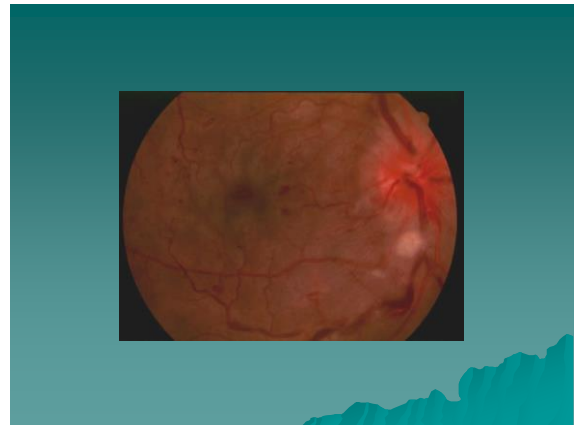
127



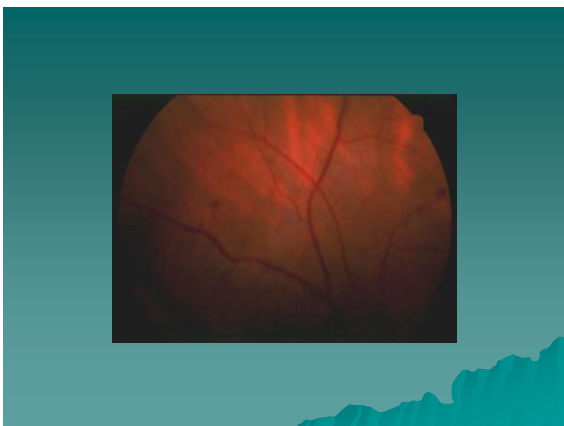
128



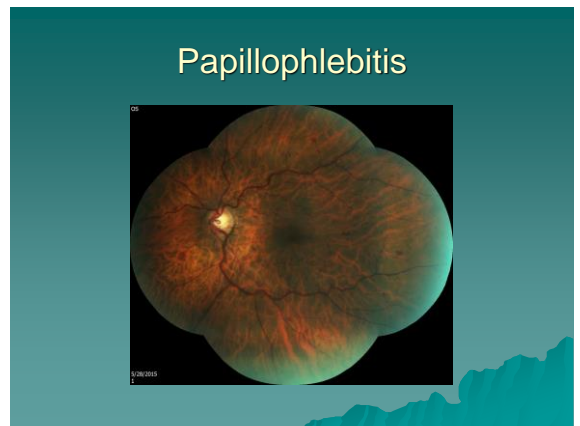
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Papillophlebitis



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Diabetic Papillitis

- ◆ More common in young, type I diabetics but can also be seen in adults with type II
- ◆ Diffuse ONH edema that may be unilateral or bilateral
- ◆ Relatively mild vision loss
- ◆ No altitudinal defect on VF; various patterns of mild loss seen

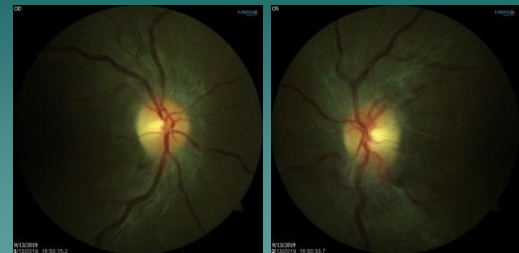
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Diabetic Papillitis

- ◆ Slow resolution of ONH edema but complete or nearly complete recovery of vision is the norm
- ◆ Like NAION, more prominent in nerves with small cups
- ◆ Is it real.....or just a variant of NAION?

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Diabetic Papillitis



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Grave's disease

- ◆ Remember No SPECS.....
- ◆ Soft tissue edema
- ◆ Proptosis
- ◆ EOM involvement
- ◆ Corneal involvement from exposure
- ◆ Sight threatening complications
- ◆ Hyper (most common), hypo, or euthyroid



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Grave's disease

- ◆ The sight threatening complication is optic neuropathy from compression at the muscle cone
- ◆ Requires oral steroids and / or orbital decompression
- ◆ Type II Grave's patients
- ◆ 75-80% of Grave's patients are smokers!

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The end!



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