



Looking Peripherally: Practice Tips for Optometrists

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Evolution of imaging



Figure 4. The first ophthalmoscope by Coccius, with a plano-mirror and bico for focusing the light.

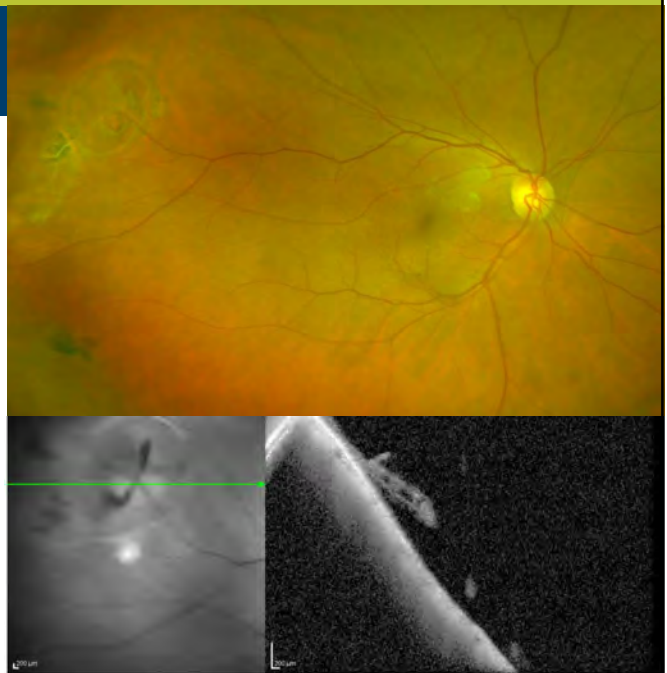


Source: Keeler, Arch O

Aims of the talk

To provide clinically relevant tips on:

- The role of the vitreous in RD formation
- Peripheral retinal degenerations that predispose to RD
- Clinical techniques and advanced imaging for examination of the retinal periphery



64yo Caucasian female

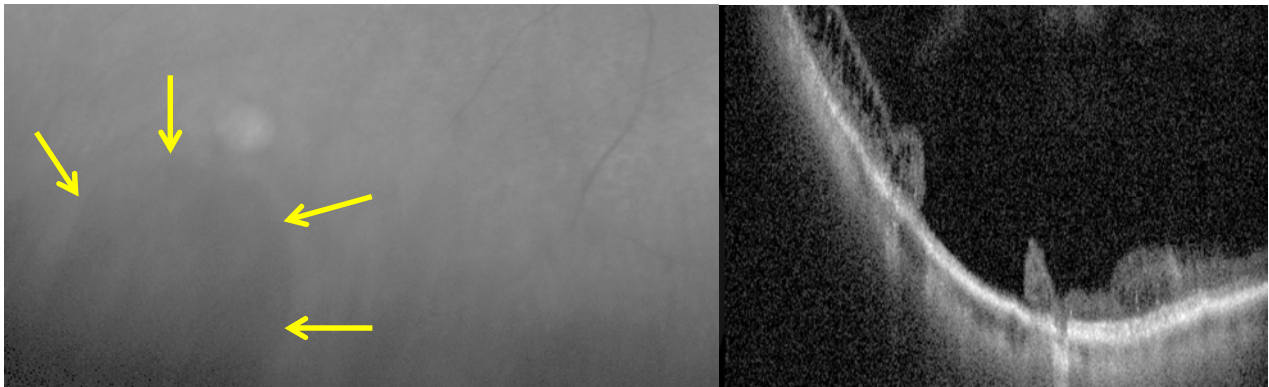
Operculated retinal hole within an area of retinoschisis

- Asymptomatic
- Rx:
 - OD -0.50/-0.75 x I 6/6
 - OS -1.00/-1.00 x I 6/6
- POCHx and
- No Schaeff

Inferior field



Operculated retinal hole within an area of retinoschisis



Clinical examination of the retinal periphery



- Routine pupil dilation is generally well tolerated
- Patient education is vital to acceptance
- Tropicamide + phenylephrine for targeted peripheral retinal examination (unless contraindicated)



Clinical examination of the retinal periphery



Recommended equipment:

- BIO + condensing lens (e.g. 20D or Pan Ret)
- Funduscopy (e.g. 90D lens)
- Gonioscopy (e.g. 3 mirror) for peripheral examination and angles if indicated
- Scleral depressor



Ultrawidefield imaging

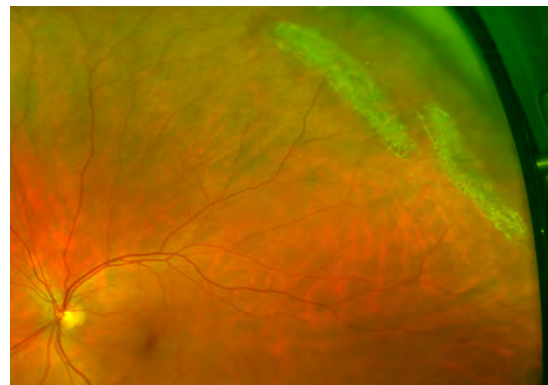
Clinical applications for the peripheral retina



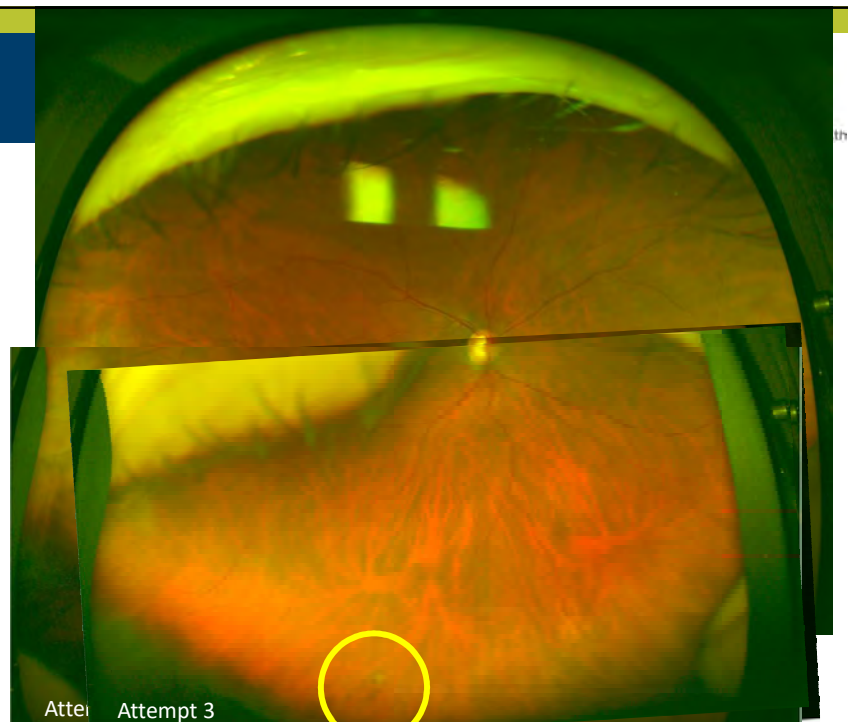
- Several systems available – our experience is using Optos
- Useful in detection and monitoring of peripheral or widespread retinal pathology e.g. RP, DR, retinoschisis, lattice degeneration, pigmented choroidal lesions
- Useful for small pupils/cataract
- Autofluorescence imaging
- Patient education

LIMITATIONS

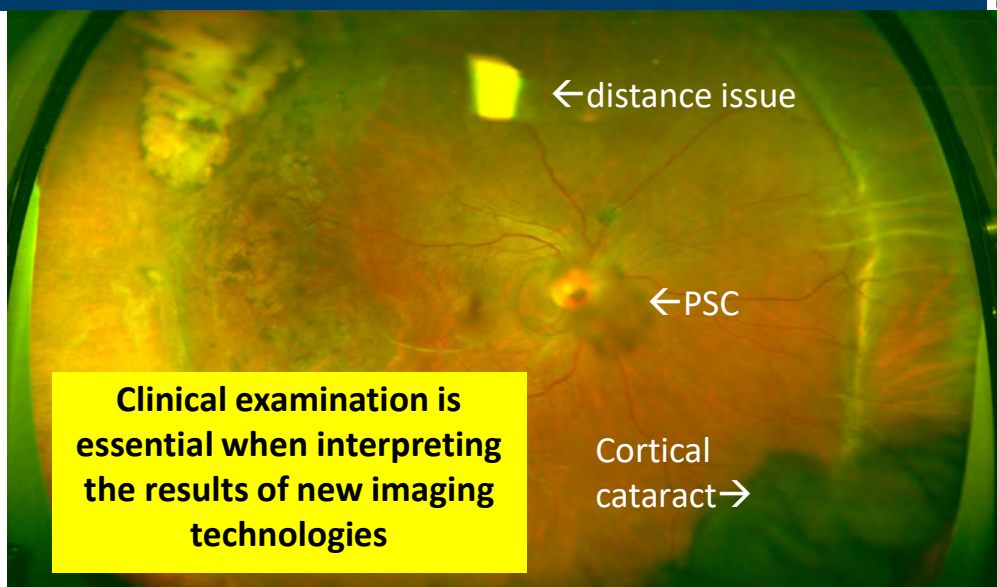
- Adjunct to but does not replace DFE
- Optomap imaging shows variable magnification effects and contrast is uneven across image (Oishi et al. IOVS Apr 2014)



Imaging challenges....



Other artefacts

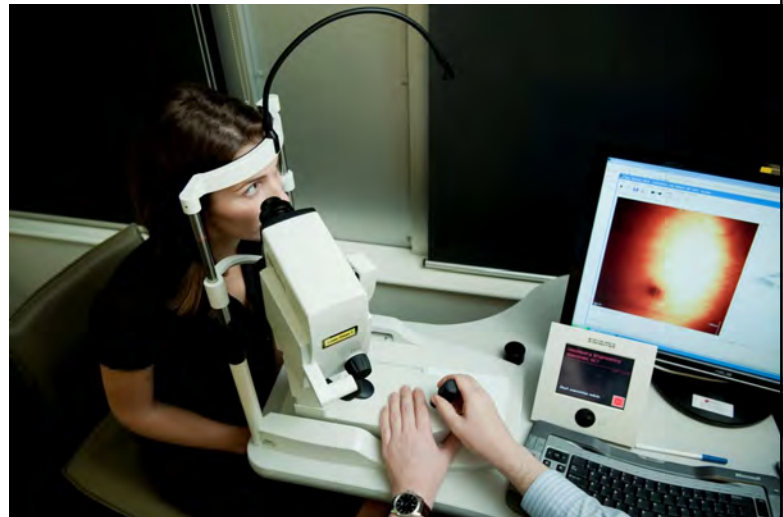


Clinical examination is essential when interpreting the results of new imaging technologies

OCT in the periphery



- Spectralis OCT by Heidelberg Engineering allows for easy scanning of peripheral lesions
- Widefield imaging module (55 degree)

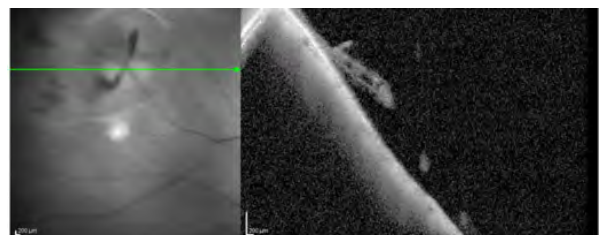


An initiative of Guide Dogs NSW/ACT and The University of New South Wales

OCT of non-macular lesions

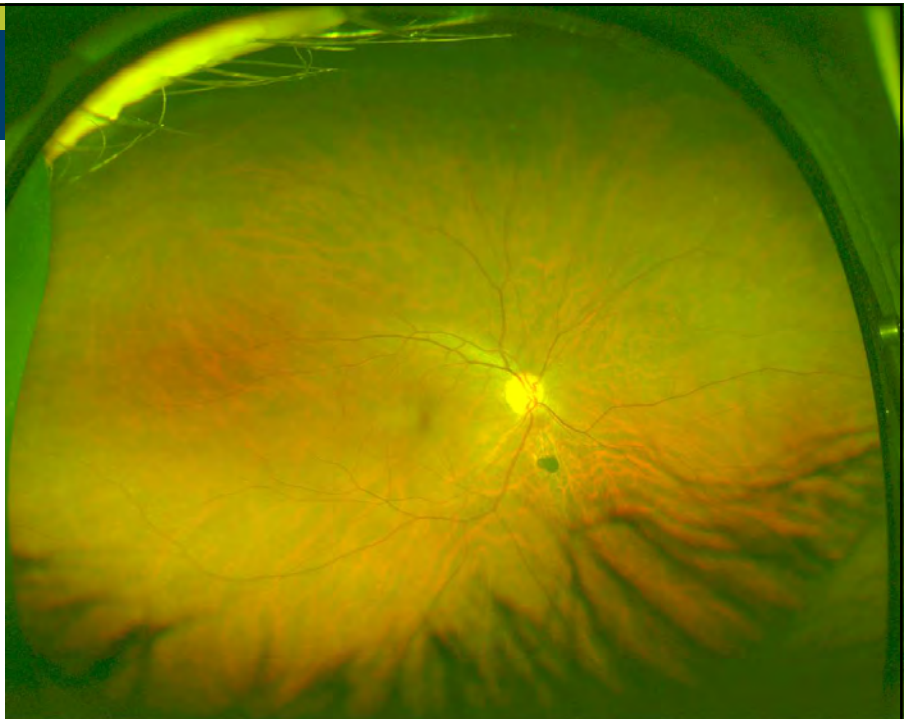
OCT of retinal periphery can be useful for:

- **Pigmented lesions**
 - Choroidal naevus, CHRPE, melanoma
- **Non-pigmented lesions**
 - Amelanotic choroidal naevus, osteoma, metastases
- **Vitreoretinal anomalies**
 - Tufts, lattice degeneration
- Retinal breaks
- Confirming retinoschisis vs detachment



47yo Caucasian female

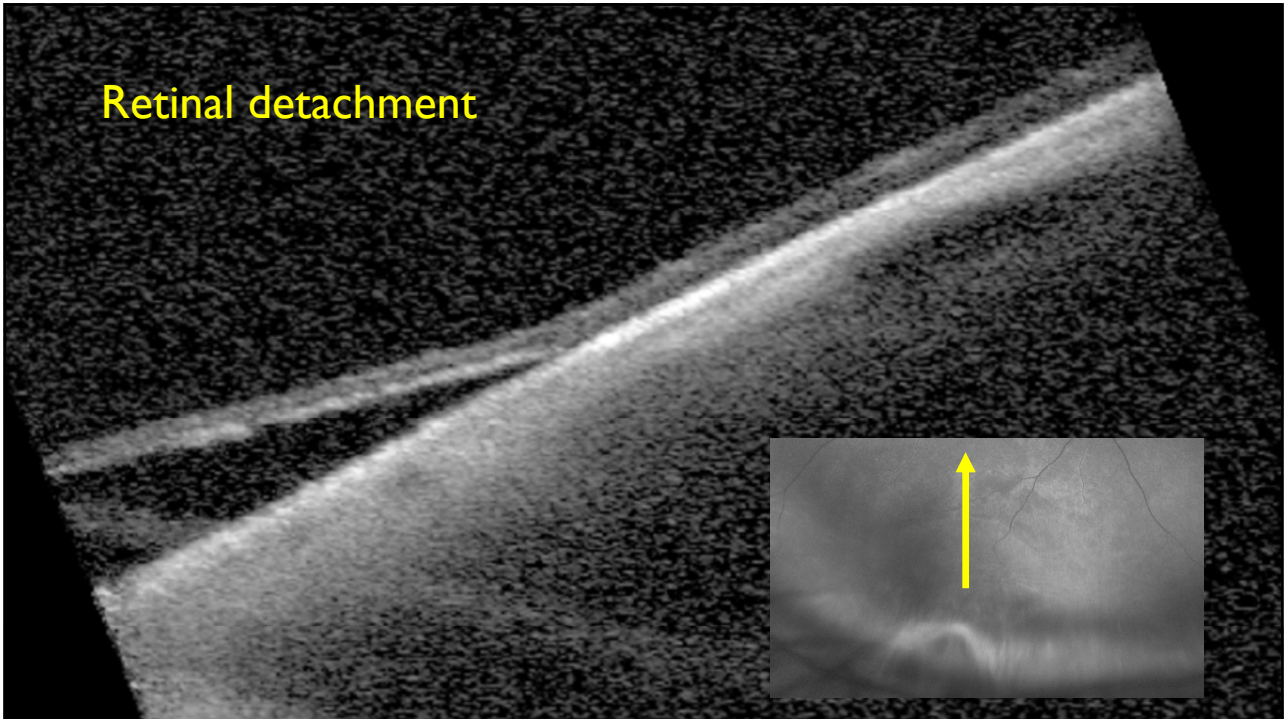
- Referred for assessment of pigmented lesion OD
- No flashes/floaters
- No Schaeffer's sign



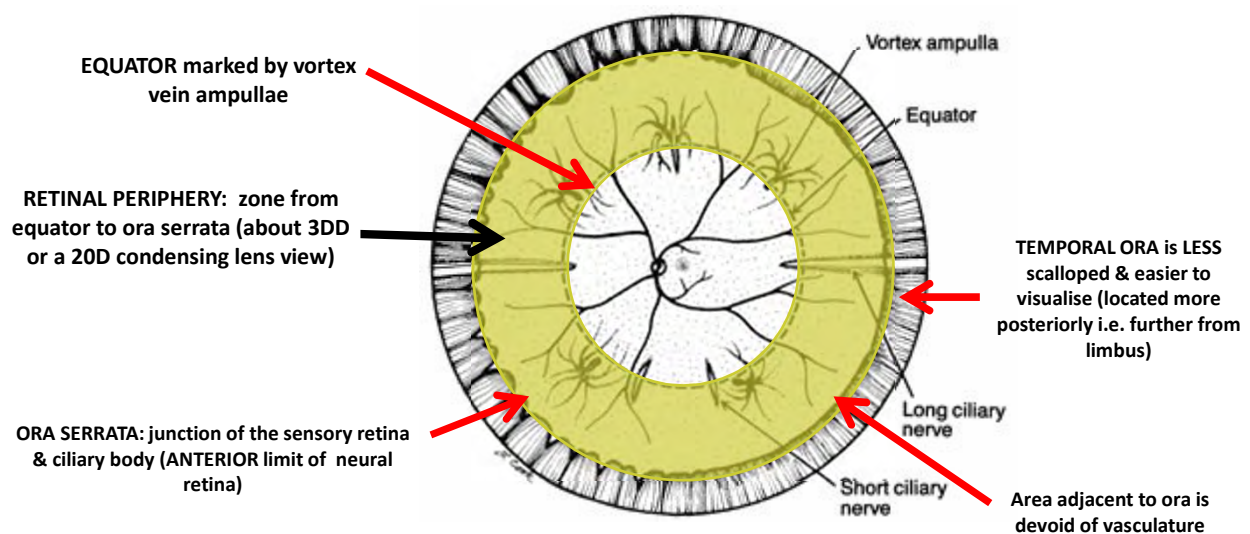
Inferior steering



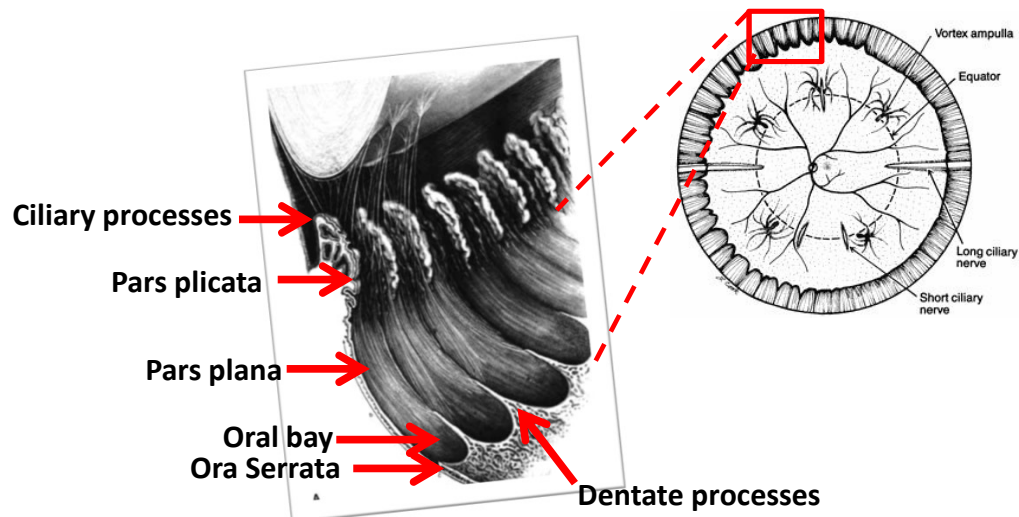
Retinal detachment



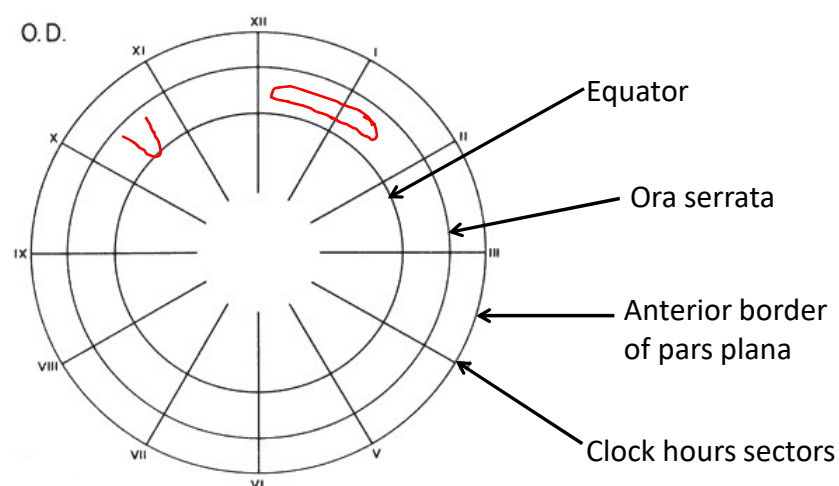
Anatomical characteristics of the peripheral retina



Anatomy of the peripheral retina



Traditional Ocular Fundus Chart



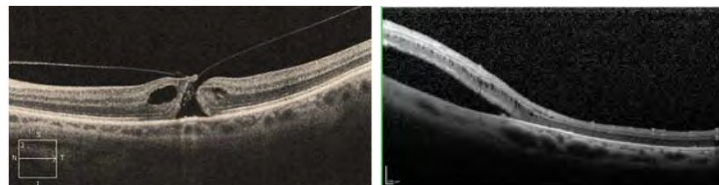
Note – chart misrepresents dimension of peripheral retina (equator > ora serrata)

Vitreous – why is it important?



Vitreous ageing changes are central to pathology of common eye conditions:

- Retinal holes and tears
- Rhegmatogenous retinal detachment
- Macular hole
- Epiretinal membrane
- Worsening of PDR and DME



Normal vitreous attachments to retina



■ **STRONG:**

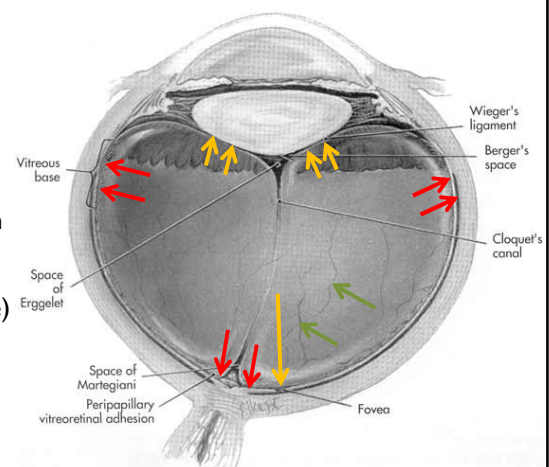
- Vitreous base (strongest)
- Optic disc margins (Base of Gartner)

■ **MODERATE:**

- Macula (central 500µm and at 1500µm) → weakens with age, but stronger in eyes with VM traction
- Posterior lens surface (Weiger's adhesion or Egger's line)

■ **WEAK:**

- Along superficial retinal blood vessels



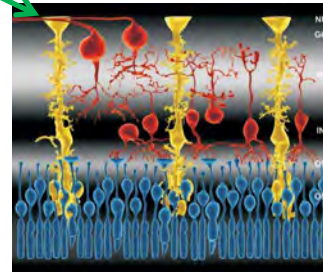
SOURCE:
<http://www.oculist.net/downaton502/prof/eb ook/duanes/pages/v7/ch001/025f.html>

Vitreoretinal adhesion



- The molecular basis of vitreoretinal adhesion is poorly understood
- It is postulated that intermediary molecules may act as “molecular glue” linking cortical vitreous collagen fibrils to the ILM

Muller cells



The ILM is formed by the conical “end feet” of the Muller cells
The Muller cells provide **support** for retinal neurons

<http://www.pnas.org/content/103/47/17759/suppl/DC1>

Orientation of collagen fibrils in vitreous

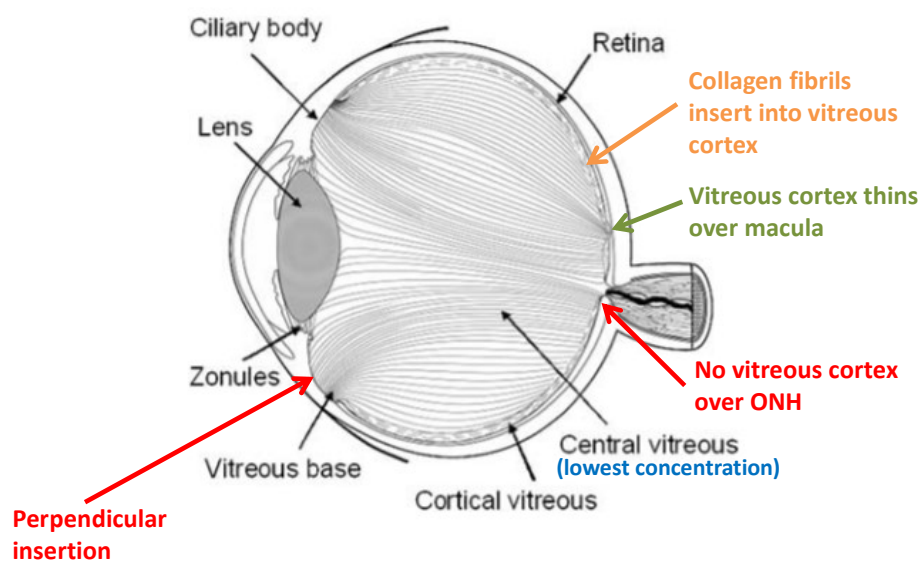


Image Source: Le Goff MM, Bishop PN. Adult vitreous structure and postnatal changes. Eye 2008

Anterior vitreous and vitreous base

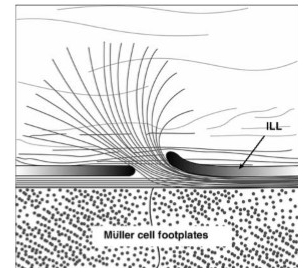
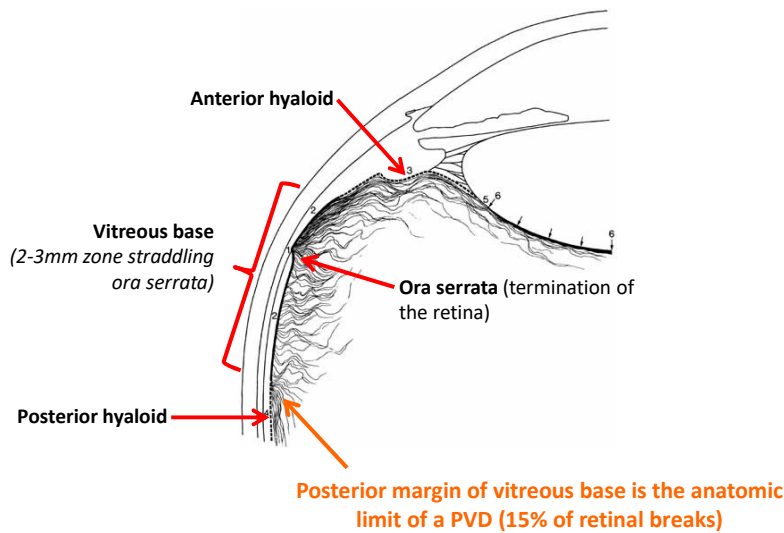


Figure 6 Diagram representing the vitreoretinal junction within the vitreous base. There is a very strong adhesion at the vitreoretinal interface within the vitreous base because vitreous collagen fibrils insert directly into the posterior ciliary body and peripheral retina. The vitreous base extends posteriorly into the peripheral retina with ageing as a result of the adult peripheral retina synthesising new collagen. This new collagen forms a layer on the cellular side of the ILL, but some breaks through defects in the ILL and intertwines with pre-existing cortical vitreous collagen thereby creating new adhesions and extending the vitreous base posteriorly.

Image Source: Le Goff MM, Bishop PN. Adult vitreous structure and postnatal changes. Eye 2008

Vitreous Syneresis



- The vitreous liquefies with age – small pockets that coalesce
- Accompanied by aggregation of the collagen fibrils into bundles that are visible biomicroscopically
- 50% of the gel has liquefied by 70 years of age

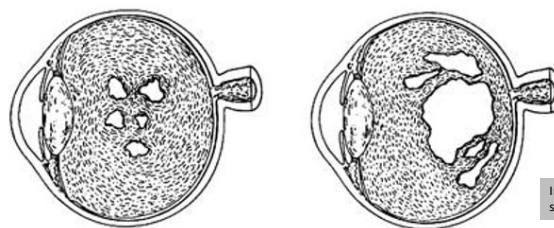
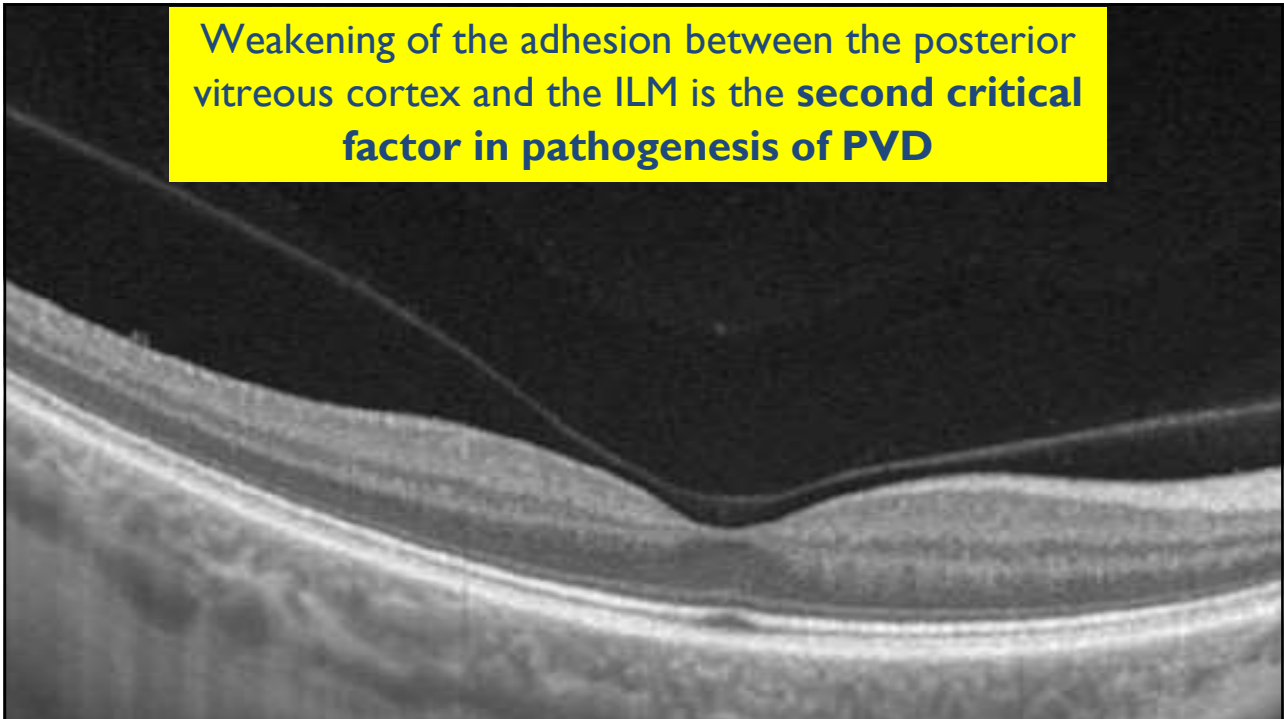


Image Source: Le Goff MM, Bishop PN. Adult vitreous structure and postnatal changes. Eye 2008

The degree of liquefaction is the first critical factor in PVD formation

Weakening of the adhesion between the posterior vitreous cortex and the ILM is the **second critical factor in pathogenesis of PVD**



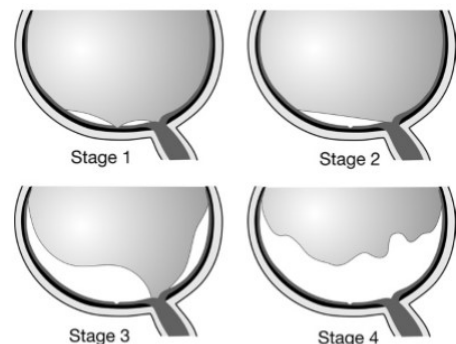
Posterior vitreous detachment



- Separation between the posterior vitreous cortex and the internal limiting membrane (ILM)
- A recent OCT study suggests PVD may extend from perifoveal area to superior and temporal midperiphery before progressing to the fovea
- Progression through stages = months to years
- Stages are usually asymptomatic

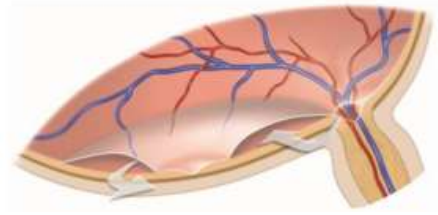
TABLE 1 STAGES* OF POSTERIOR VITREOUS DETACHMENT

Stage 1	Perifoveal separation with adhesion of vitreous to the fovea
Stage 2	Complete separation of vitreous from the macula
Stage 3	Extensive vitreous separation with adhesion of vitreous to the disc
Stage 4	Complete posterior vitreous detachment

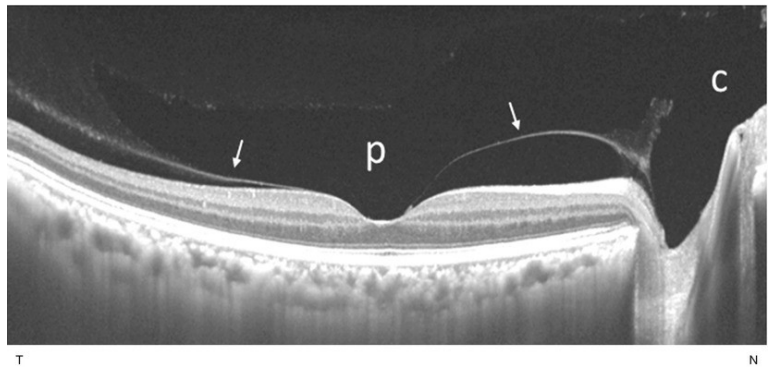


*AAO Preferred Practice Patterns PVD, Retinal Breaks, and Lattice Degeneration
Source of image: Johnson MW. AJO 2010;149:371

Vitreoretinal adhesion (stage I PVD)



- Peri-foveal vitreous separation with remaining attachment to underlying macula **with no distortion of the macular anatomy**
- Thought to be part of the normal aging process



P = precortical pocket (lacunae)

C = Cloquet's canal

Arrows = posterior vitreous cortex

1. Cartoon: Kakahashi et al, Clin Ophthal 2014
2. Sebag J, Niemeyer M, Janusz Koss M. Vitreous: In health and disease (pp.241-263)

Stage 2 PVD



Arrows = posterior vitreous cortex

Only 10% of eyes with stage 1 or 2 PVD progressed to complete PVD over an average of 30 months*

*Johnson MW. Perifoveal vitreous detachment and its macula complications. Trans Am Ophthalmol Soc 2005;103:537-567

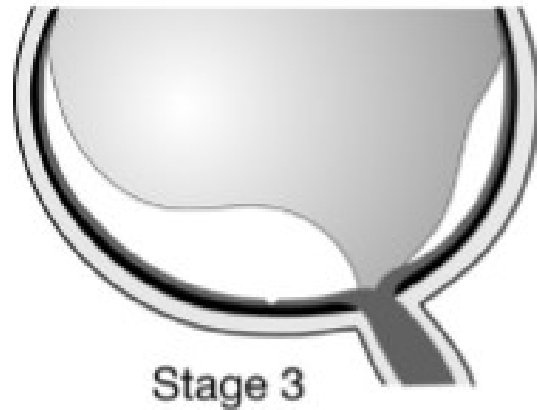
Stage 3 PVD



- Extensive vitreous separation with adhesion of vitreous to the optic disc
- Patients are usually asymptomatic

Clinical Tip

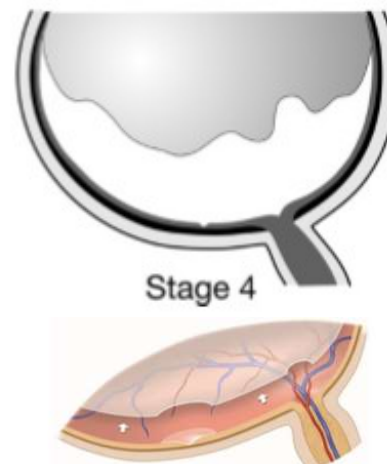
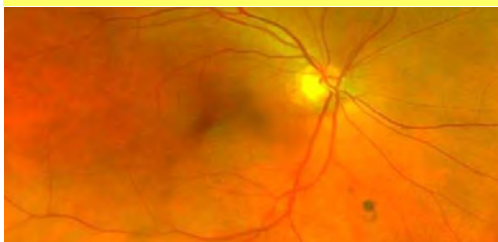
Retinal breaks may occur during Stage 3 PVD due to traction at the vitreous base or where there are abnormal vitreoretinal attachments



“Acute” PVD (uncomplicated)



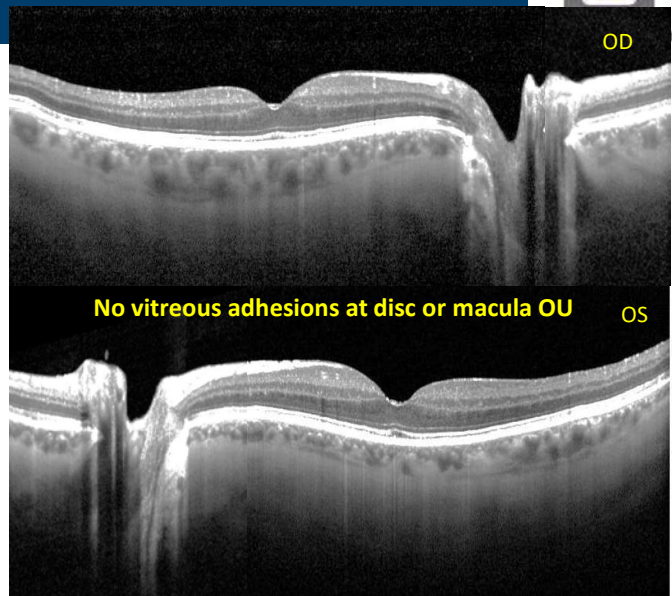
The **acute symptoms of PVD** occur in stage 4 when the vitreous detaches from the ONH causing signs and symptoms of a Weiss Ring



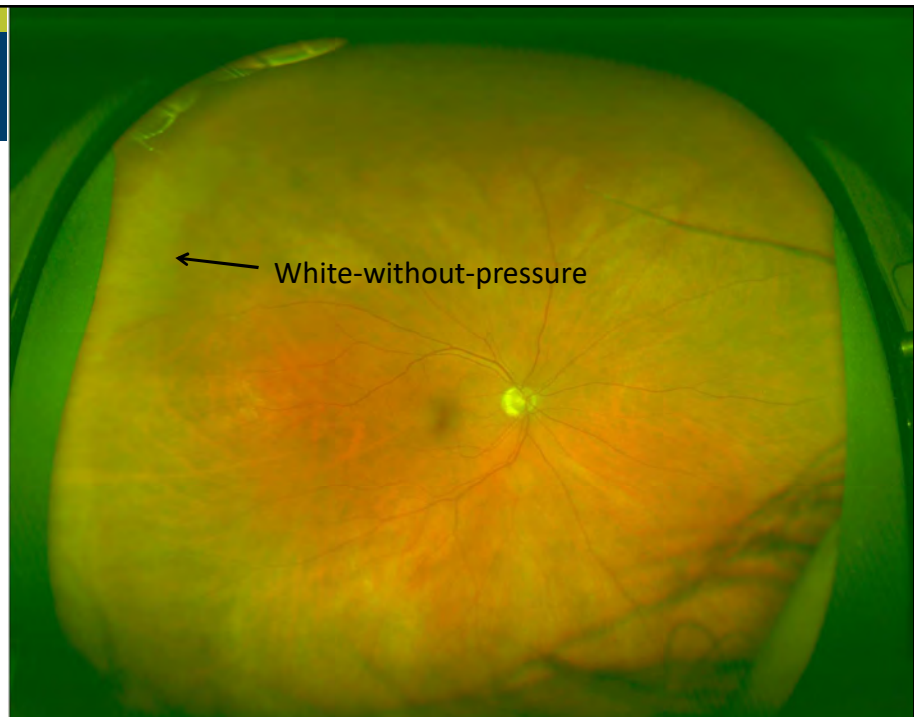
1. Cartoon: Kakahashi et al, Clin Ophthal 2014
2. Sebag J, Niemeyer M, Janusz Koss M. Vitreous: In health and disease (pp.241-263)

73yo Caucasian male

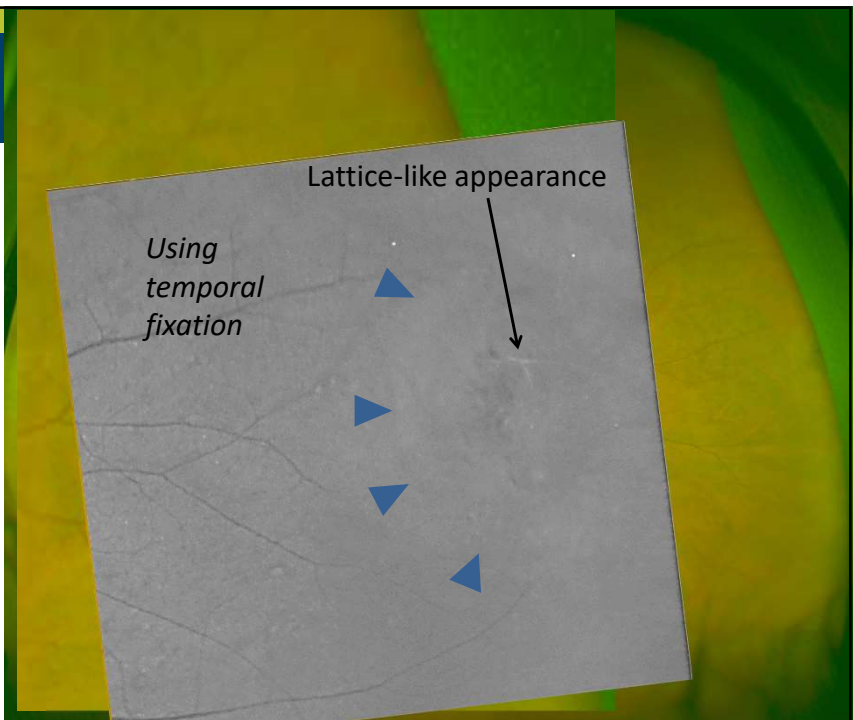
- Sx: notices *flashes and floaters* every few months
 - Unsure which eye
 - Floaters may be longstanding
- VAs (low hyperopic rx):
 - OD 6/6⁻¹ OS 6/6⁻²
- Slit lamp examination
 - No Schaeffer's sign OU



Optomap OD

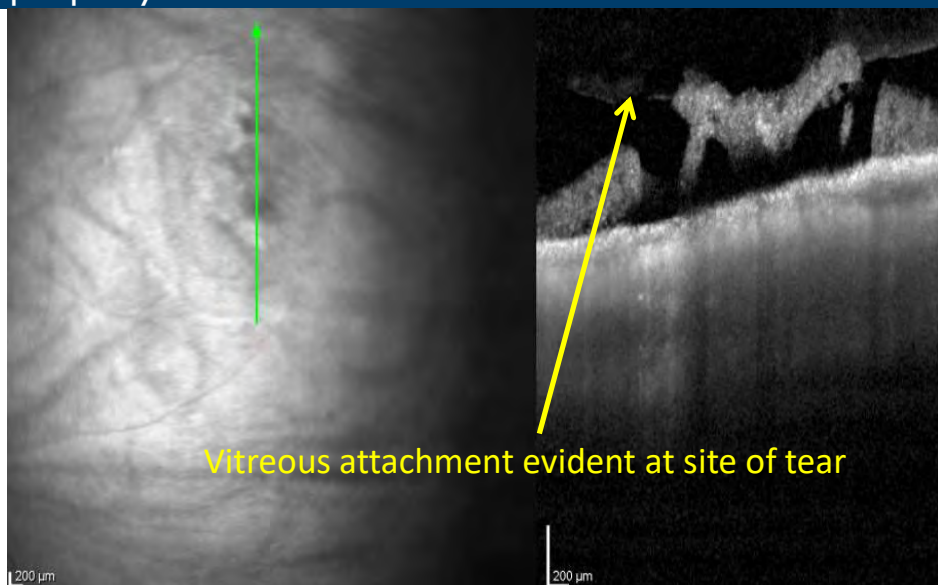


Optomap OS



Spectralis OCT

Temporal periphery OS: vertical scan

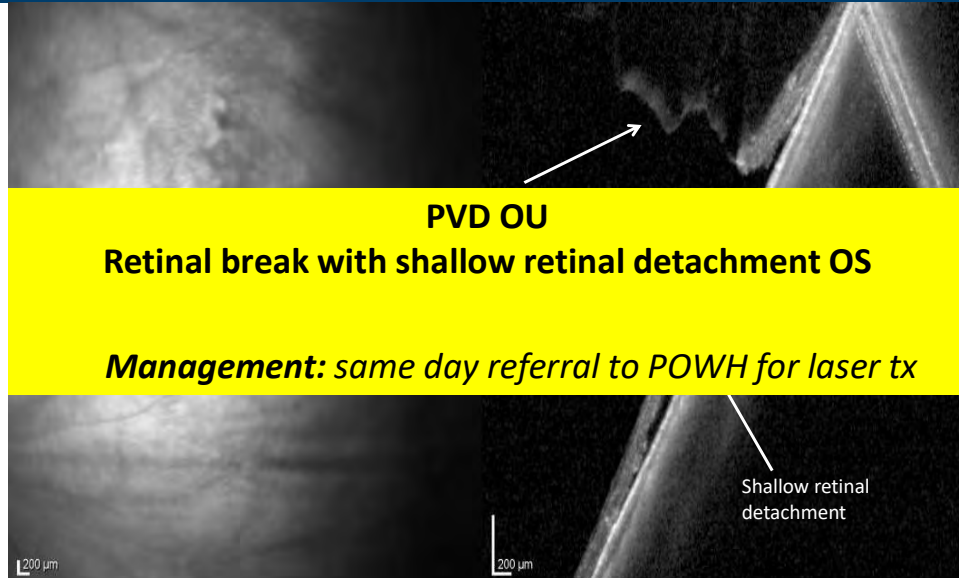


Spectralis OCT

Temporal periphery OS: horizontal scan



Centre for Eye Health



Clinical Tip

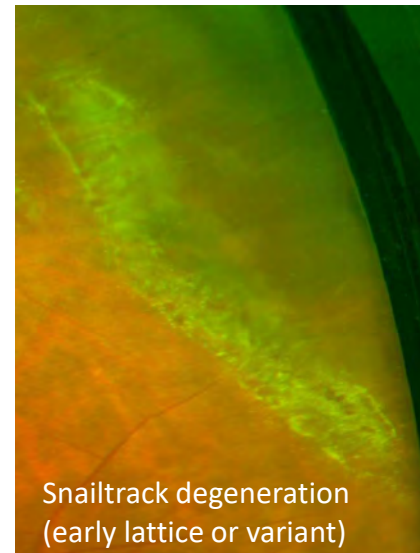
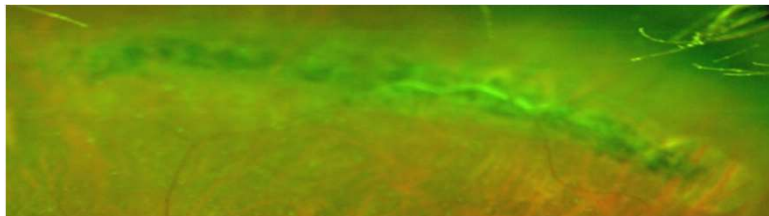
- Lattice degeneration poses a threat for retinal tears following PVD

Lattice Degeneration

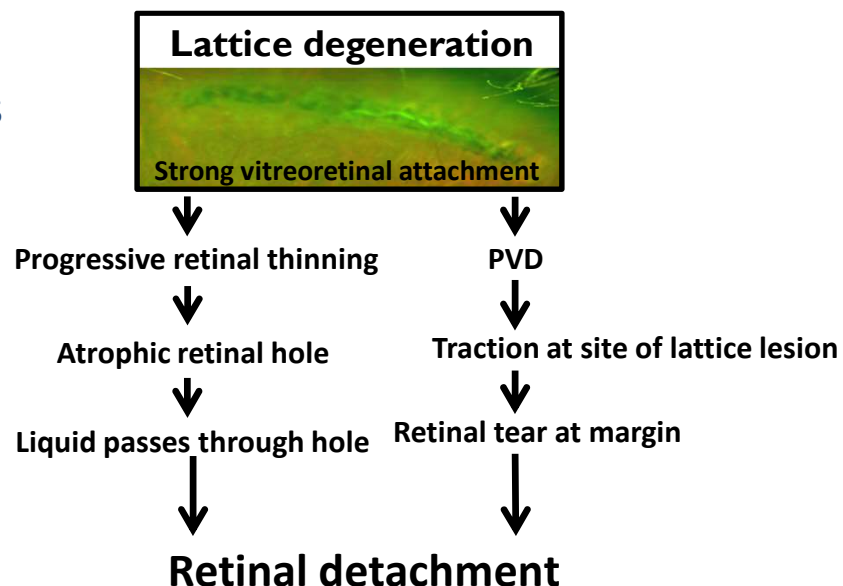


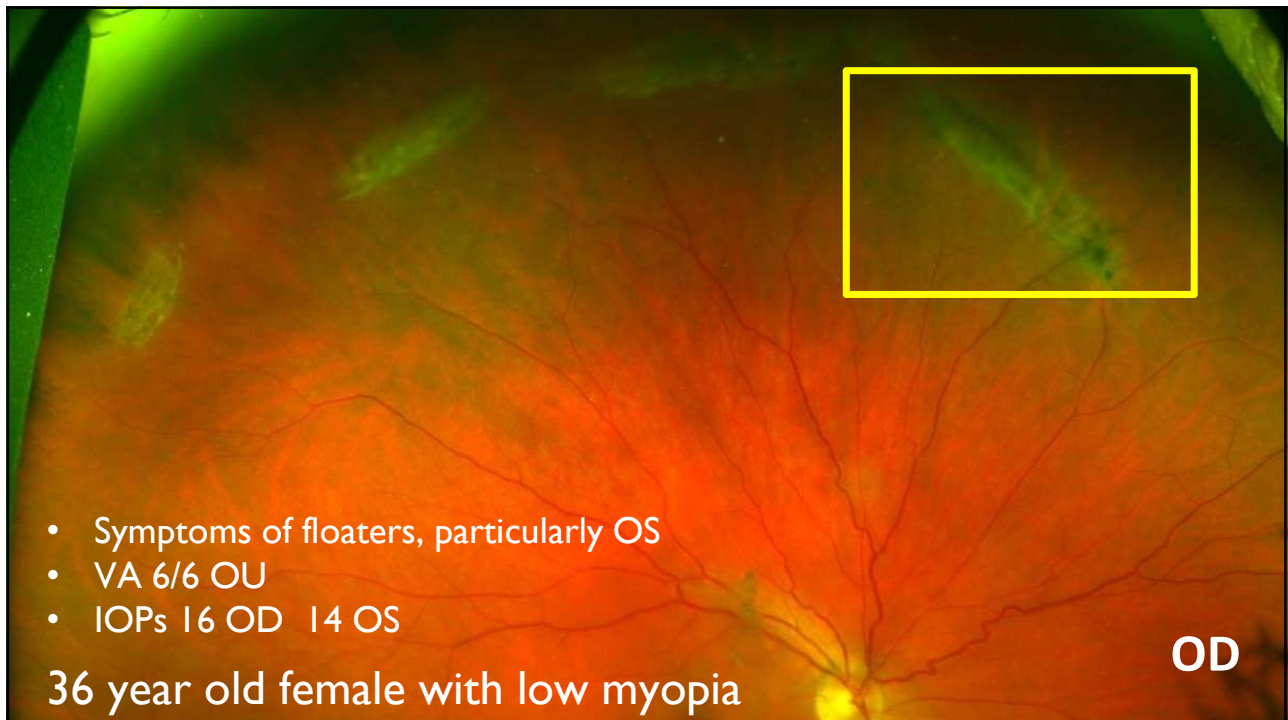
Accounts for 40% eyes with RRD following PVD

- 6 to 10% of normal population
- Elongated, round or oval lesions
- Usually parallel to ora serrata between equator and vitreous base



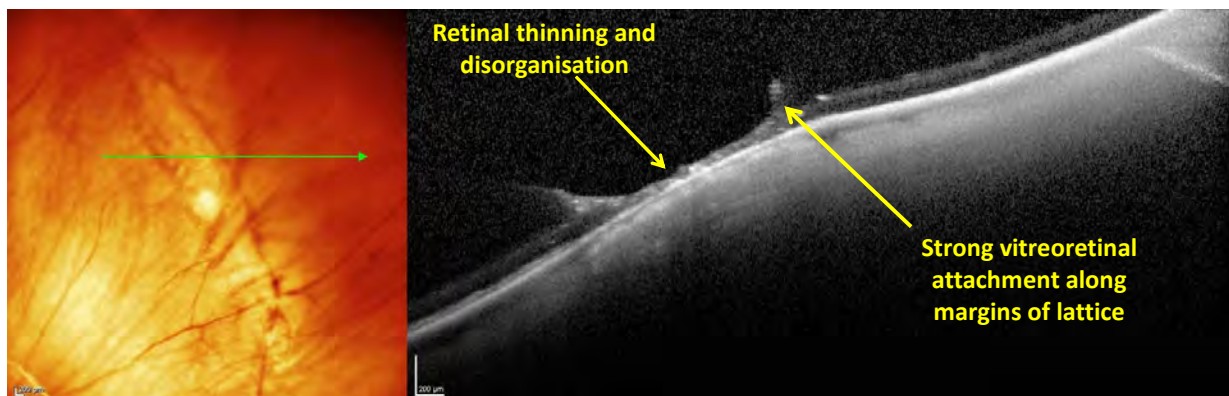
Two main
mechanisms
contributing
to RD:





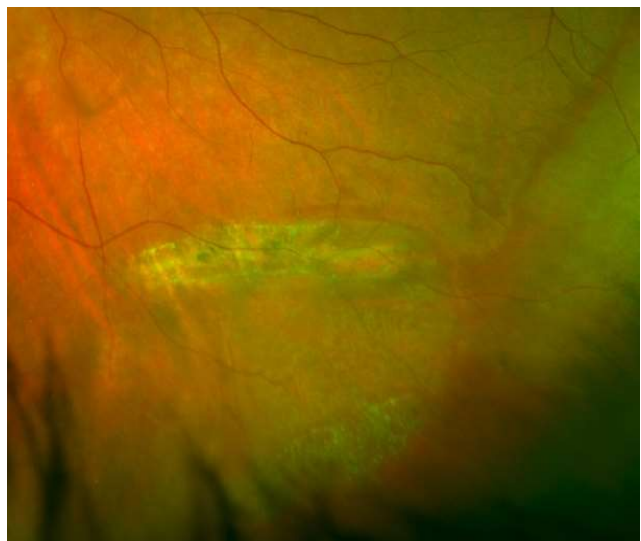
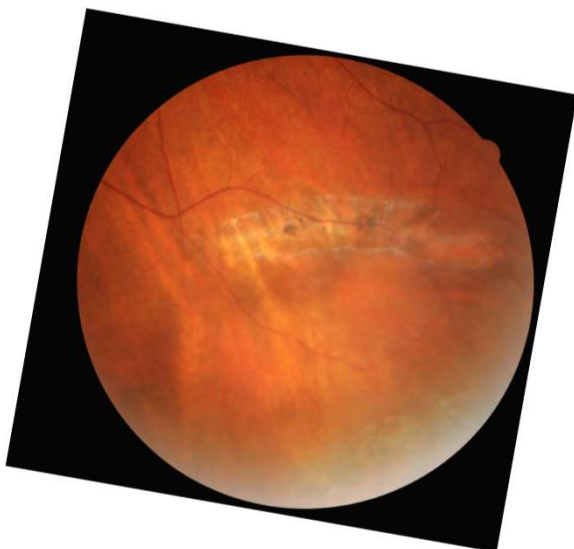
Spectralis OCT

OD superonasal periphery

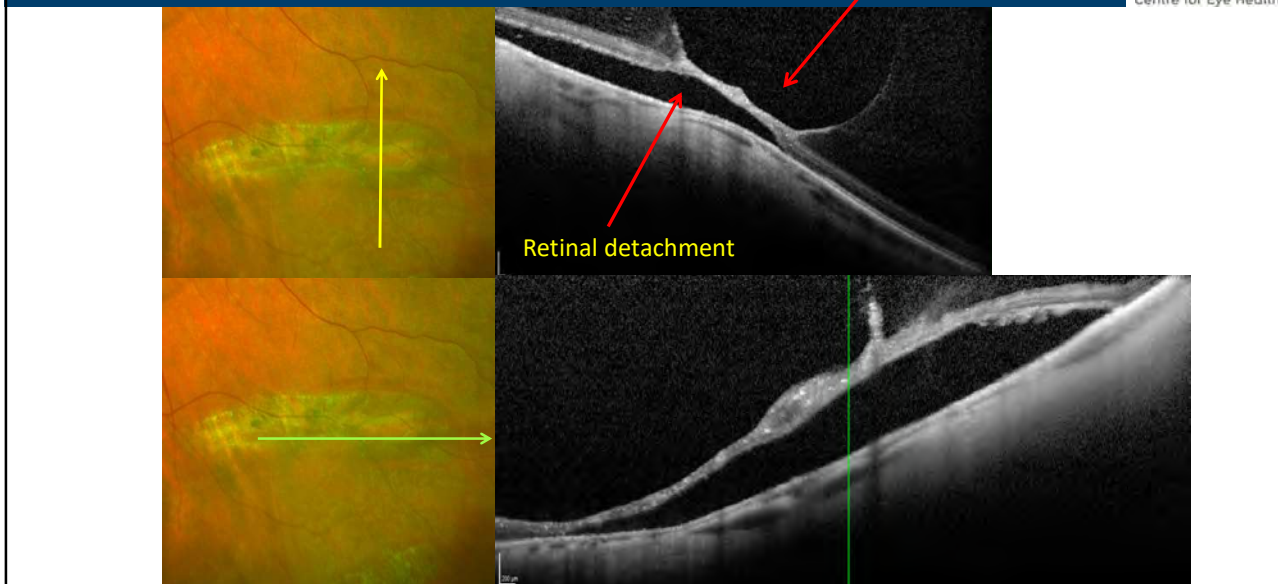




Photography vs Optomap – inferior OS



OCT inferior periphery OS



Clinical Tip

- **Shallow retinal detachments** often occur at the border of lattice lesions
- They can be very difficult to appreciate clinically
- Scleral indentation can enhance visibility

Valuable resource – scleral indentation



Retina Image Bank

A project from the American Society of Retina Specialists

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lattice degeneration

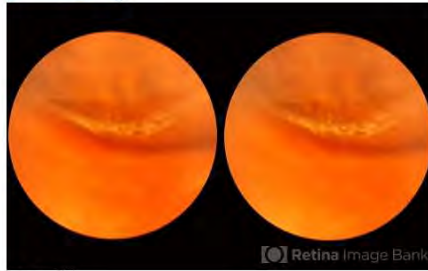
DISCOVER

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Lattice Lesion

DOWNLOAD (195 KB)



File number: 2002

Comments

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By Norman Byer
From Dr. Norman E. Byer's "The Peripheral Retina in Profile"
Uploaded on Nov 9, 2012
Last modified by Suber S. Huang, MD, MBA on Feb 10, 2013
Reviewed by Chayal Patel

Rating

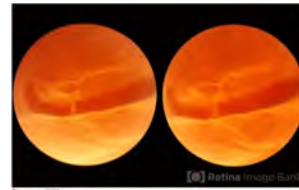
Appears in
Miscellaneous

Condition/keywords

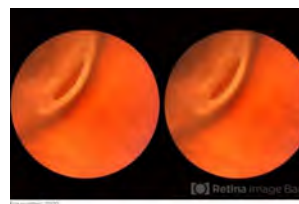
[lattice lesion](#) [scleral indentation](#)
[liquefied vitreous](#) [reddish crater](#)
[lattice degeneration](#) [snail track](#)

Description

This lattice lesion in a 30-year-old woman also shows combined features with a reddish crater above and a parallel snailtrack appearance just below it. Please note especially another interesting feature: From the left end of the lesion, there is a faint thin yellow line slanting down toward the right just below the shadow of



File number: 2002



File number: 2002

By Norman Byer
From Dr. Norman E. Byer's "The Peripheral Retina in Profile"
Uploaded on Nov 9, 2012
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Miscellaneous

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[lattice lesion](#) [scleral indentation](#)
[liquefied vitreous](#) [reddish crater](#)
[lattice degeneration](#) [snail track](#)

Description

This 54-year-old woman has lattice degeneration and also this large oval retinal hole with a surrounding transtrophic zone of subretinal fluid.

Rating

Appears in
Miscellaneous

Condition/keywords

[lattice lesion](#) [scleral indentation](#)
[liquefied vitreous](#) [reddish crater](#)
[lattice degeneration](#) [snail track](#)

Description

This 54-year-old woman has lattice degeneration and also this large oval retinal hole with a surrounding transtrophic zone of subretinal fluid.

CFEH Chairside reference: Peripheral Retina

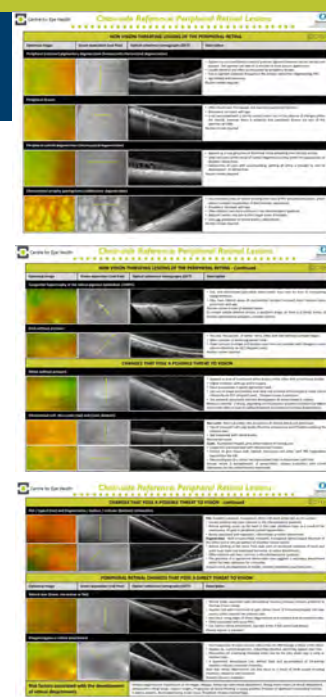
https://centreforeyehealth.com.au/wp-content/uploads/2016/09/chairside_reference_peripheral-retina.pdf

Centre for Eye Health

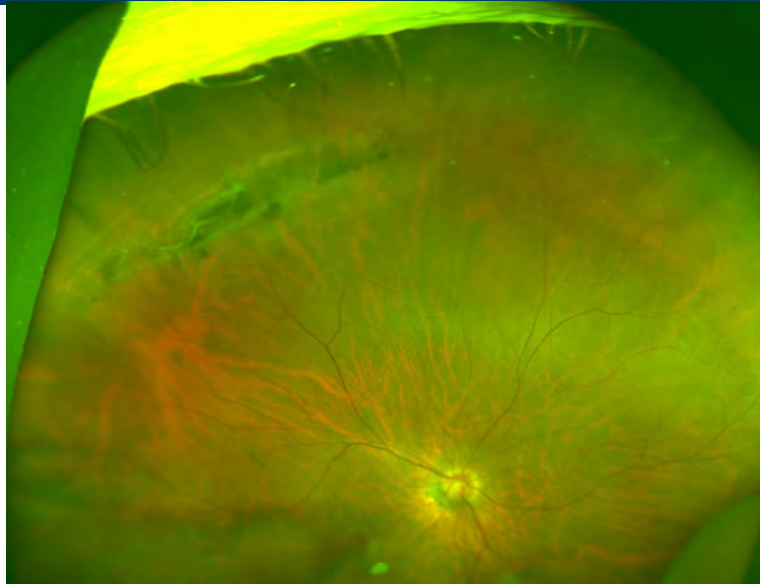
Chair-side Reference: Peripheral Retinal Lesions

Optometry
Australia's Eye Health Experts

CHANGES THAT POSE A POSSIBLE THREAT TO VISION - continued				© CCF
Optomap Image	Green separation (red-free)	Optical coherence tomography (OCT)	Description	
Lattice (top) and snailtrack (bottom) degenerations				
			<p>Lattice: Band of retinal thinning with abnormal vitreoretinal attachments at the margins.</p> <ul style="list-style-type: none">• Associated with RPE hyperplasia, yellow/glistening flecks, sclerotic vessel formation and atrophic holes.• Most common in the superior and inferior retina and usually in a circumferential orientation around the eye. <p>Snailtrack: A variant of lattice degeneration.</p> <ul style="list-style-type: none">• Shiny bands of retina due to numerous glistening yellow-white dots on the inner retinal surface.• Associated with atrophic holes are often found within lesions.• Most common in inferotemporal quadrant. <p>Annual review is required.</p> <p><i>If symptomatic (flashes and floaters), scleral indentation is mandatory with more regular subsequent reviews. Also consider other risk factors for development of retinal detachment.</i></p>	
Operculated retinal hole				
			<ul style="list-style-type: none">• Round red hole with an overlying floating fragment of tissue which often appears smaller than the hole due to tissue atrophy.• Results from focal vitreoretinal traction which pulls a "plug" of retinal tissue (operculum) away from the surrounding tissue.• May have associated localized subclinical retinal detachment (fluid cuff) and/or surrounding RPE hyperplasia. <p>Asymptomatic cases with <100 radius fluid cuff: 6-12 month review or refer for retinal specialist opinion, particularly if located superiorly.</p> <p><i>In cases of fluid cuff >100 radius, symptomatic lesions or in the case of additional risk factors for retinal detachment, referral is indicated.</i></p>	
Atrophic retinal hole				
			<ul style="list-style-type: none">• Red, round lesion, pinpoint to 20D.• Often with surrounding whitish subclinical retinal detachment (fluid cuff) and/or RPE hyperplasia.• Results from retinal thinning and can occur within lattice or snailtrack degeneration or otherwise apparently normal retina. <p>Represent full thickness retinal break, unrelated to vitreoretinal traction.</p> <p>Isolated, asymptomatic cases and those with RPE hyperplasia: annual review. In case of fluid cuff that is <100 in radius, review in 6 months or refer for retinal specialist opinion, particularly if located superiorly.</p> <p><i>In case of fluid cuff >100 radius or symptomatic cases, referral is indicated.</i></p>	



55yo Asian male with symptoms of floaters OD>OS



OD -9.50/-0.75 x 165 (6/6)

OS -7.00/-0.75 x 50 (6/6)

Symptoms of floaters onset 3 years ago with no change

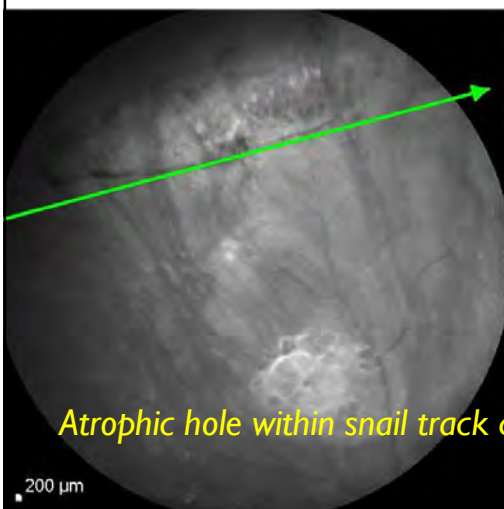
P&FOcHx: unremarkable

GH: smoking (3-4x daily)

Slit lamp examination

(-) Schaeffer's sign OU

Spectralis OCT scans through lattice degeneration



Atrophic hole within snail track degeneration



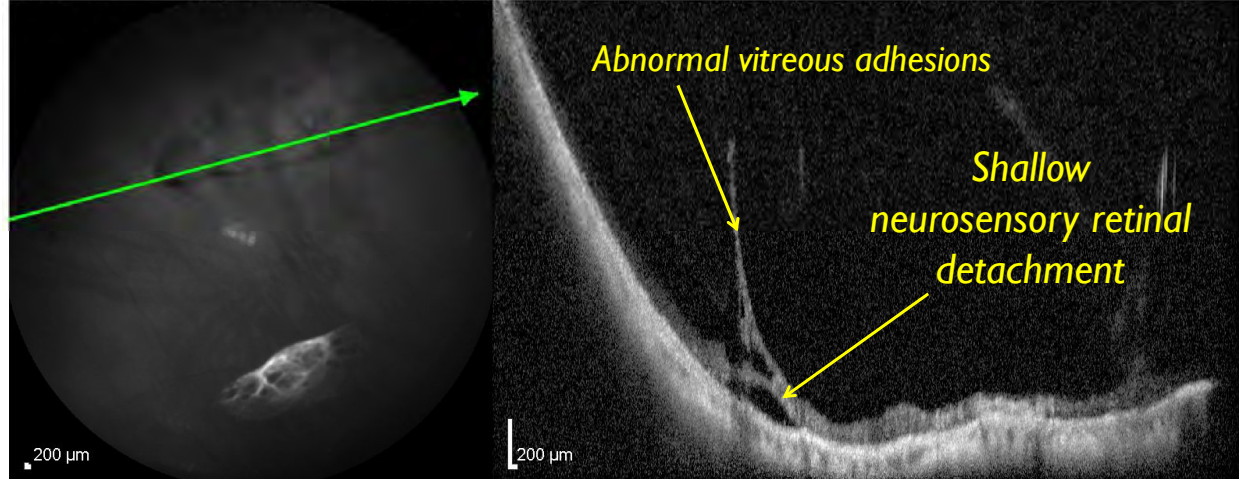
retros?

200 μm

Spectralis OCT scans through lattice degeneration



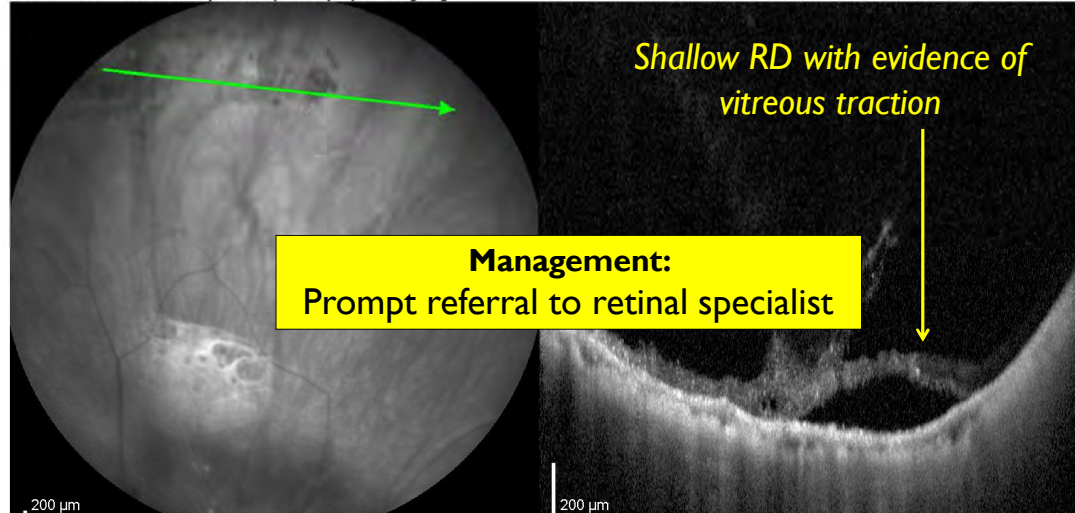
IR 55° ART + OCT 55° (14.3 mm) ART (9) Q: 28 [HR]



Spectralis OCT scans through lattice degeneration



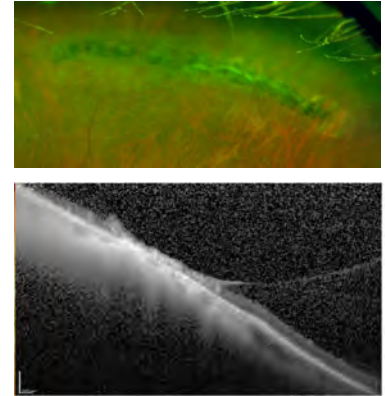
IR 55° ART + OCT 36.7° (9.5 mm) ART (23) Q: 33 [HR]



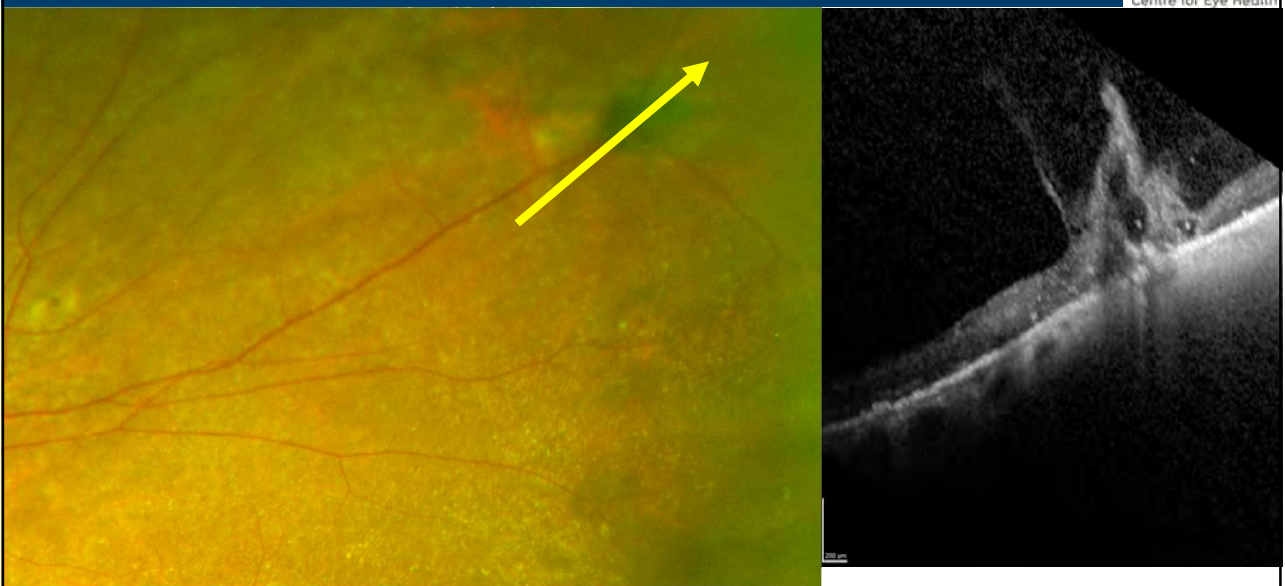
Lattice Degeneration MANAGEMENT



- Annual DFE
- Consider scleral indentation or 3 mirror evaluation
- Referral indicated if associated with symptoms of flashes or floaters or suspected breaks or detachments
 - *Laser may be indicated*
- Consider photo-documentation/imaging
- Patient education



72 year old Caucasian female – asymptomatic



Clinical Tip

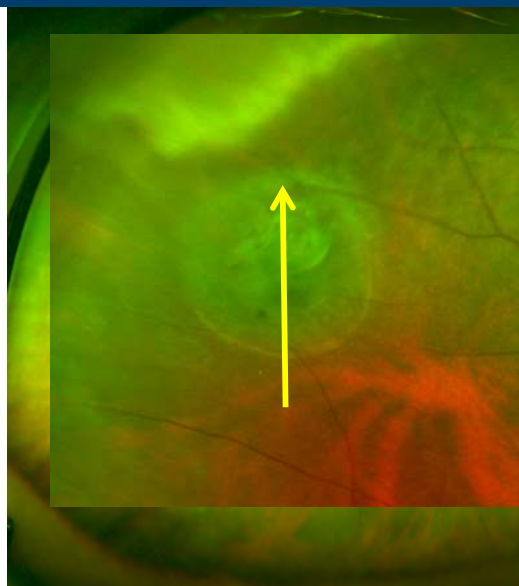
Isolated hyper-pigmented lesions with irregular borders in the retinal periphery are often **cystic vitreoretinal tufts**

50 yo Asian female with symptoms of photopsia



-4.75/-0.25 x 90 (6/6)
-5.00/-1.50 x 160 (6/6)

Previous laser OS



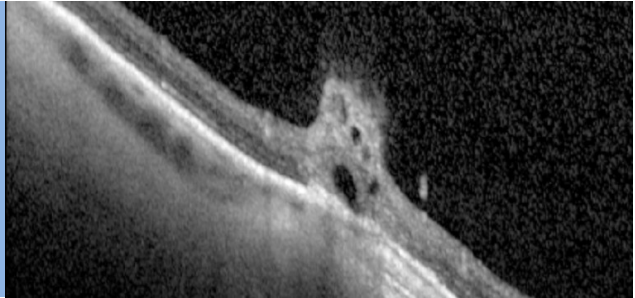
**Tuft with
tractional RD**



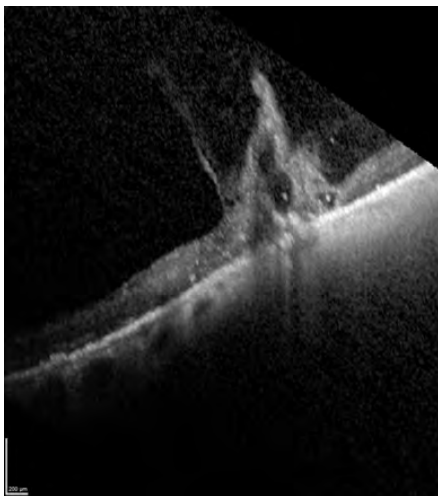
Clinical Pearl



It is estimated that 10% of RD is causally related to cystic retinal tufts



Cystic Vitreoretinal Tufts

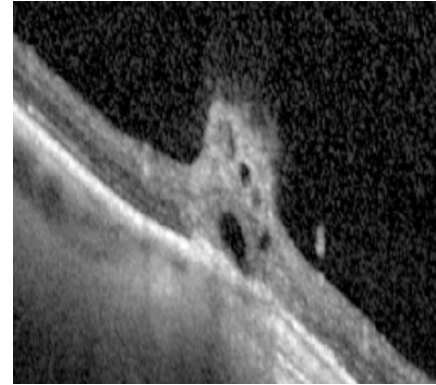


- Gray or white nodules of varying size posterior to the vitreous base
- Site of dense vitreoretinal adhesion
- RPE hyperplasia may develop around base
- Histologically, accumulations of glial tissue that form nodules on the retinal surface (projecting into vitreous)

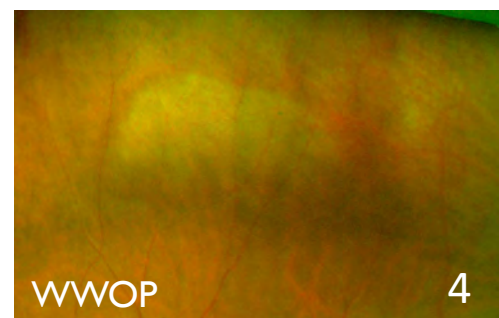
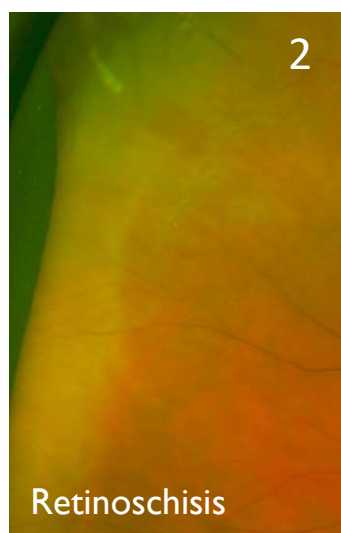
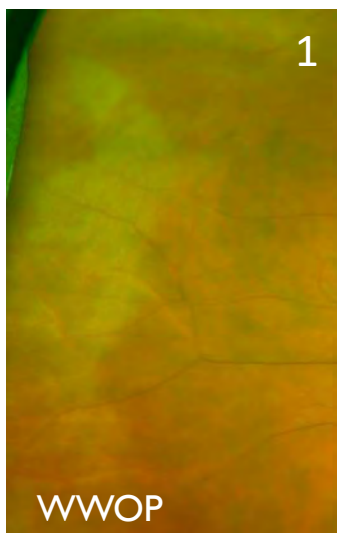
Cystic Vitreoretinal Tufts



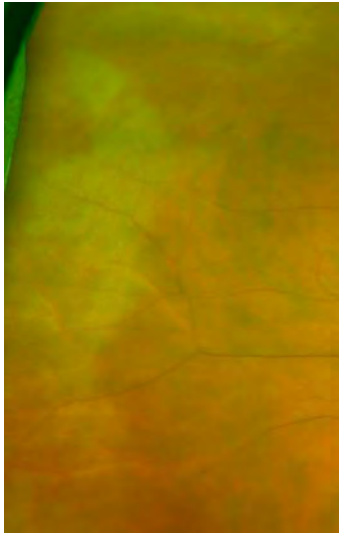
- 5-7% of population
- Congenital abnormality present at birth
- Tufts subjected to traction with vitreous syneresis
- Common site of retinal tears (flap) or holes (operculated) particularly after PVD
- **Annual DFE and patient education**
- **Refer if symptomatic or evidence of associated retinal breaks or detachment**



WWOP or retinoschisis?



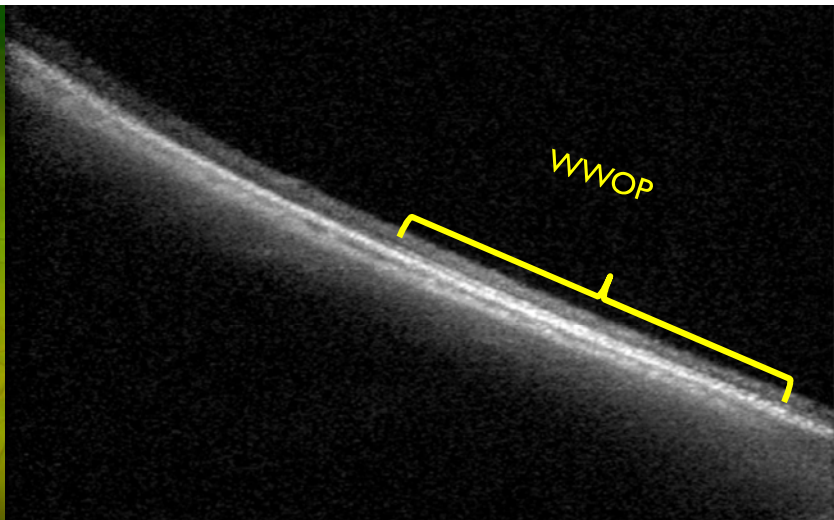
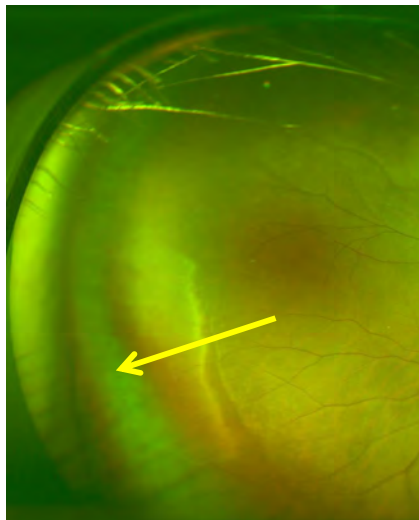
What is WWOP?



- Previously thought to be due to vitreoretinal interface abnormalities
- OCT imaging shows changes to the outer retina: increased hyper-reflectivity at the ellipsoid zone (at the level of the photoreceptors)

An initiative of Guide Dogs NSW/ACT and The University of New South Wales

WWOP on OCT

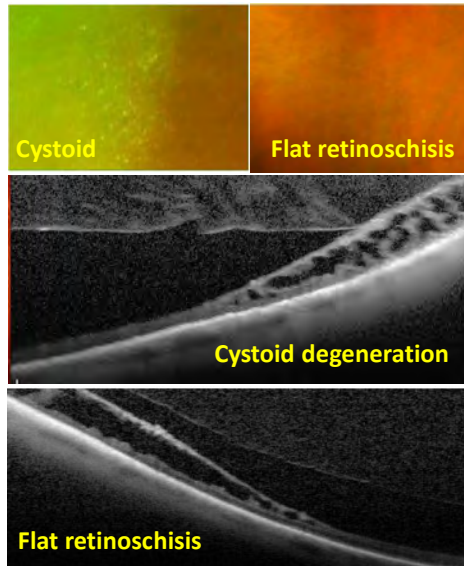


An initiative of Guide Dogs NSW/ACT and The University of New South Wales

Retinoschisis: Flat



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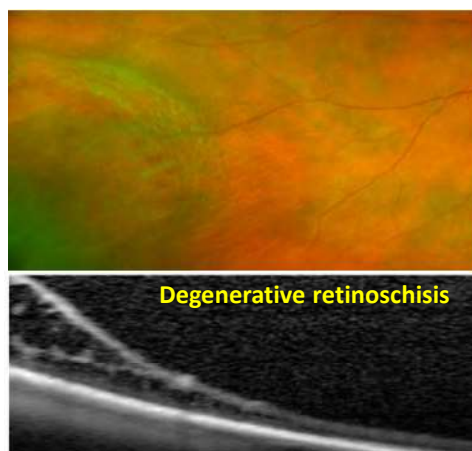


- Smoothly elevated, transparent
- Often with small white dots on the surface
- Splitting at level of OPL due to coalescence of cysts in peripheral cystoid degeneration
- Usually bilateral, inferotemporal quadrant
- Rarely associated with retinal holes, detachment or expansion

Retinoschisis: Degenerative

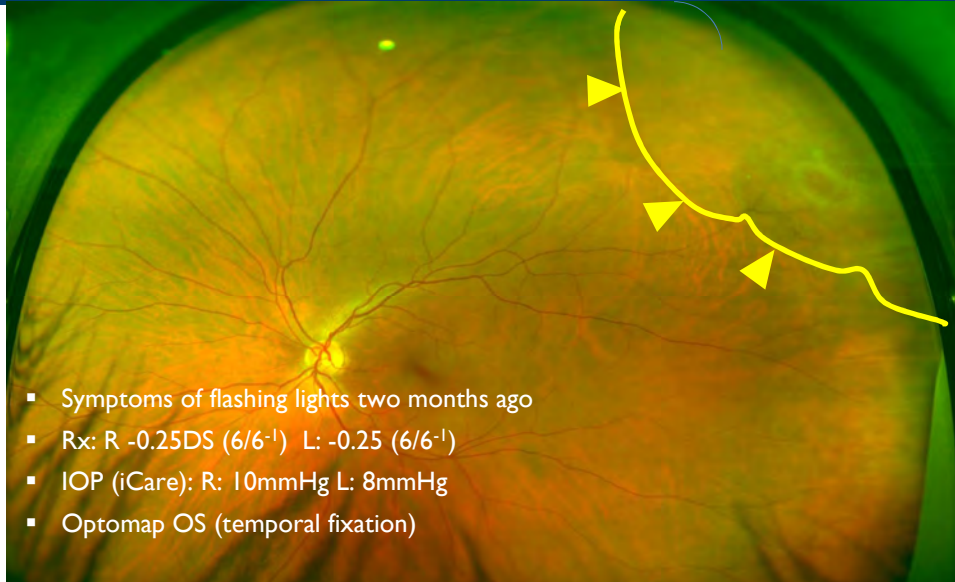


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- Well circumscribed, immobile, transparent
- Often has dome shaped elevation with reticular pattern of sheathed retinal vessels
- Bilateral, most commonly in inferotemporal quadrant
- At risk of inner and outer layer holes and associated RD formation
- Presence of pigmented demarcation line suggests secondary RD, stationary for at least 3 months
- Refer where breaks or RD detected

47 year old Caucasian male

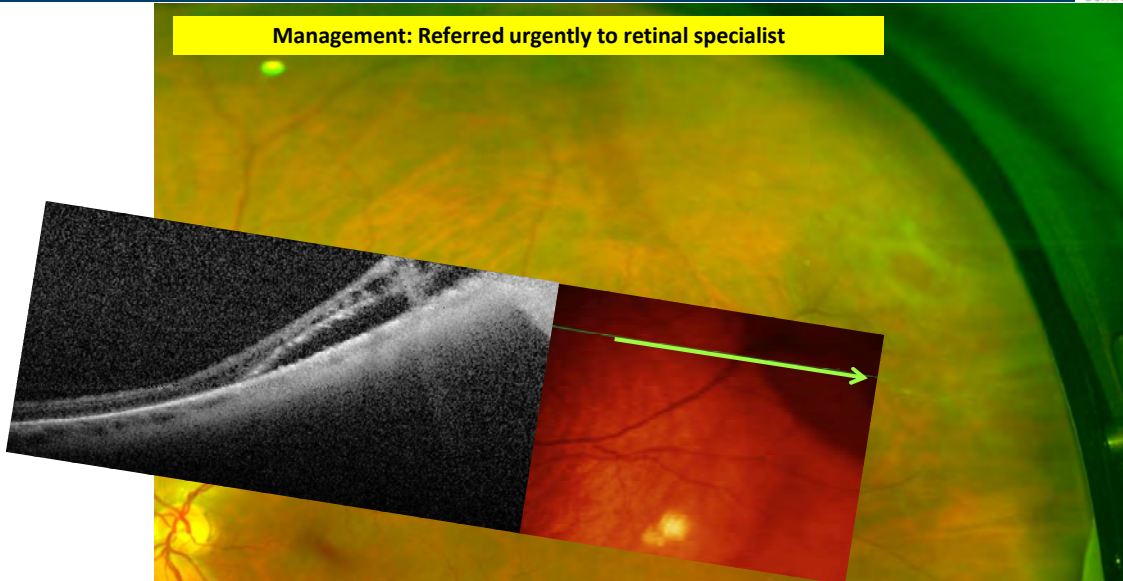


- Symptoms of flashing lights two months ago
- Rx: R -0.25DS (6/6-1) L: -0.25 (6/6-1)
- IOP (iCare): R: 10mmHg L: 8mmHg
- Optomap OS (temporal fixation)

Case #2: Optomap OS Temporal



Management: Referred urgently to retinal specialist





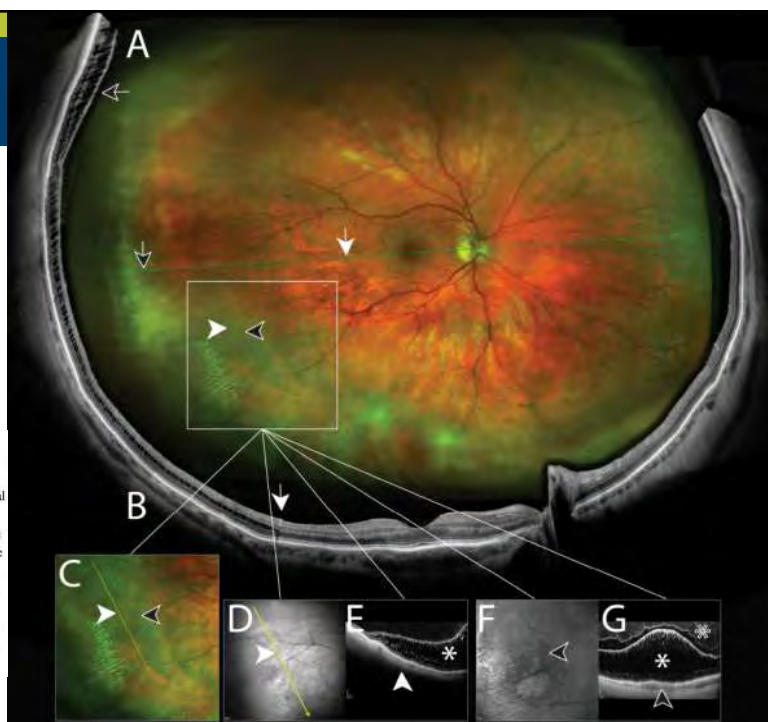
The future

Ophthalmology. 2016 June ; 123(6): 1368-1374. doi:10.1016/j.ophtha.2016.01.045.

Ultra-Widefield Steering-Based SD-OCT Imaging of the Retinal Periphery

Netan Choudhry, M.D., FRCS(O)^{1,*}, John Golding, B.A.¹, Matthew W. Manry, M.D.², and Rajesh C. Rao, M.D.^{2,3,*}

Figure 3. UWF montage of typical degenerative senile retinoschisis with outer retinal hole (A) UWF color image of typical degenerative senile retinoschisis. The junction of non-schitic and schitic retina is outlined by the white inset. (B) A montage UWF SD-OCT cross-section from nasal periphery, through the optic nerve and fovea, to the schitic temporal periphery is registered by the green arrow on the corresponding UWF color image (A). Schisis of the retina at the inner nuclear and outer plexiform layers is seen posteriorly in the temporal macula (B, white arrow) and proceeds all the way to the periphery, with the degree of intraretinal splitting progressively widening posteriorly (white arrowhead) to anteriorly (B, black arrow). (C) Color and (D, F) NIR-SLO images with overlaid raster scans (yellow and green arrows) register the position of additional peripheral SD-OCT cross sections (E, G). An inferotemporal portion of the retina (A, inset; C, D, F, arrowheads) is also analyzed by peripheral SD-OCT, which reveals splitting along the inner nuclear and outer plexiform layers (E, G, white asterisks), and highlights the vitreous interface (G, black asterisk).

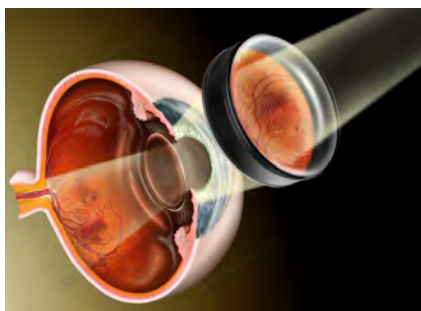


Take Home Points



- Vitreous-retina connections play a major role in the genesis of retinal detachment
- **Retinoschisis, lattice and vitreoretinal tufts** can be
 - detected through routine dilated eye exams
 - are often present in young patients

Take Home Points



- New imaging technologies can enhance our ability to detect and diagnose pathology
- Value of photodocumentation in monitoring
- Don't give up your BIO/funduscopy just yet!
 - Clinical examination is essential when interpreting imaging results



Centre for Eye Health
Education

Thank you

Any questions or comments?
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