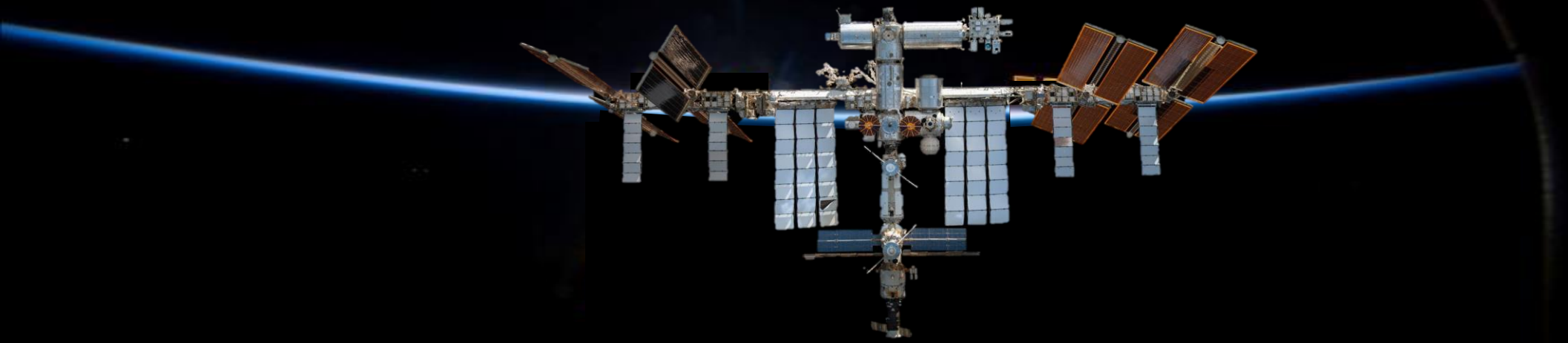
A Journey into Space:
Spaceflight Associated Neuro-ocular Syndrome (SANS)

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SANS Background

- Pre- & postflight eye exams performed by NASA since Gemini era (mid-1960s)
  - Anecdotal reports of astronaut *inflight "vision changes"*



Image credit: NASA

SANS Background

- Pre- & postflight eye exams performed by NASA since Gemini era (mid-1960s)
  - Anecdotal reports of astronaut *inflight "vision changes"*
- Sentinel SANS case discovered in 2005
  - Result: Specialized pre-, in- & postflight eye exams performed since 2010

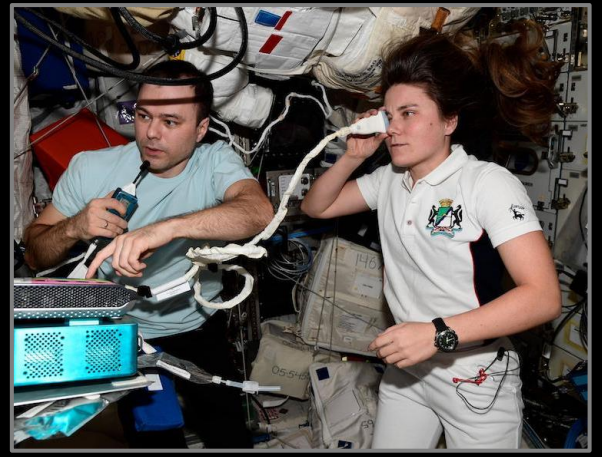





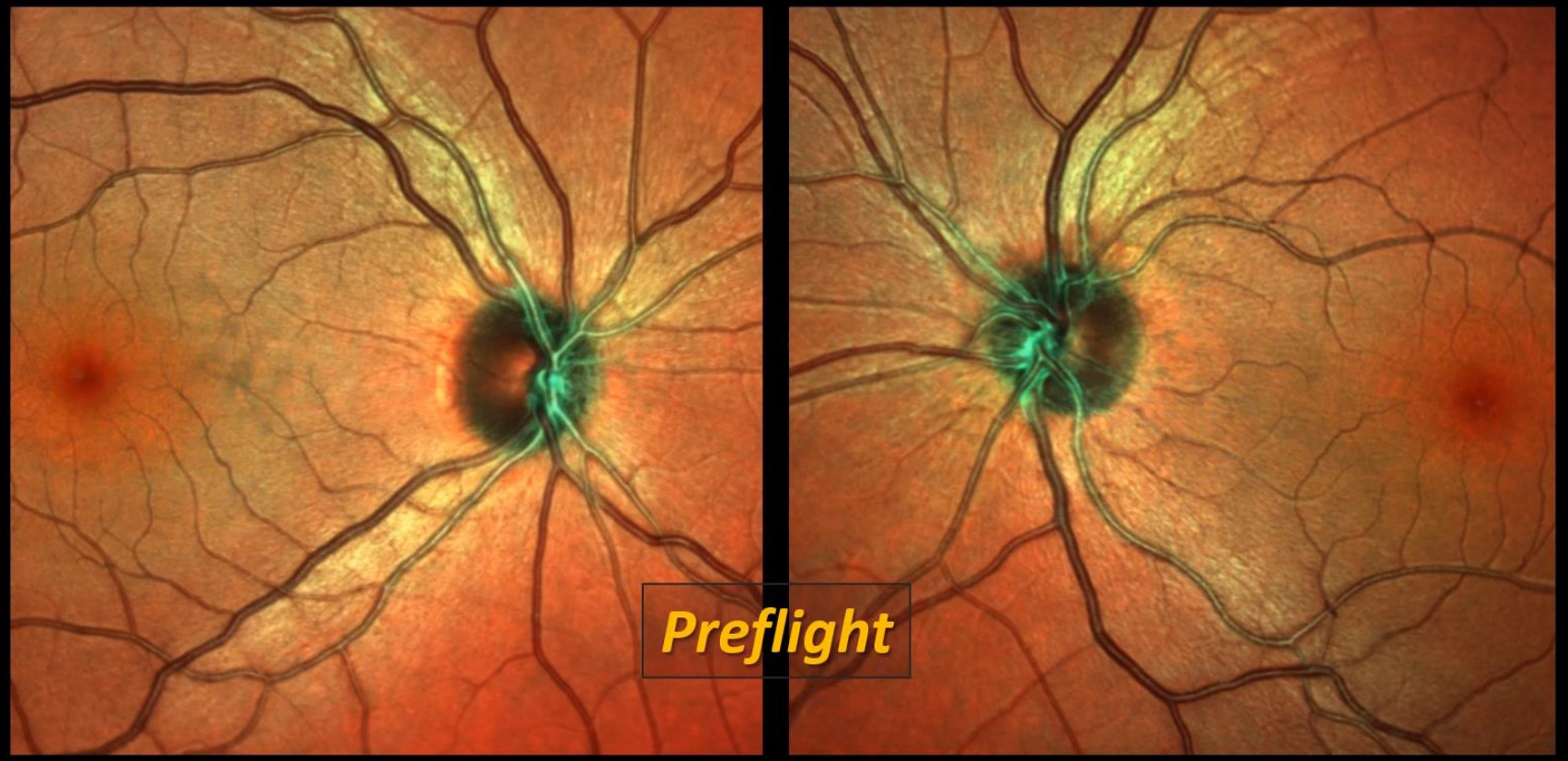
Image credit: NASA

SANS Signs & Symptoms

- Primary signs:
  - Optic disc edema (ODE)
  - Chorioretinal folds
  - Globe flattening
  - Hyperopic RE shift

Primary Risks:
- Enlarged blindspots
- Loss of RNFL – Permanent visual field loss

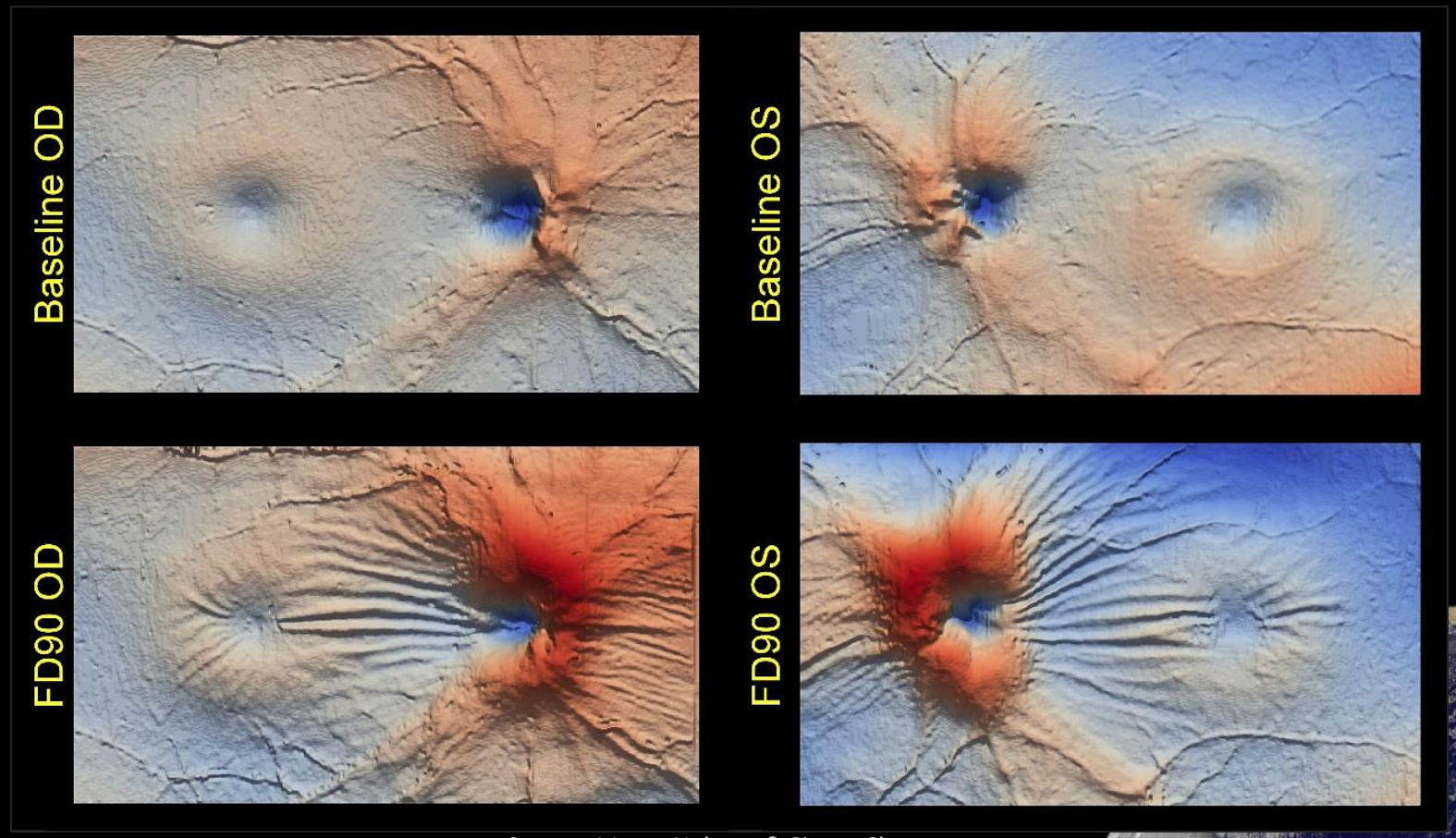
Prevalence:
Earliest indication: 61%
Clinically concerning: 15%



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Retinal Surface (ILM) Topography – Baseline & FD90



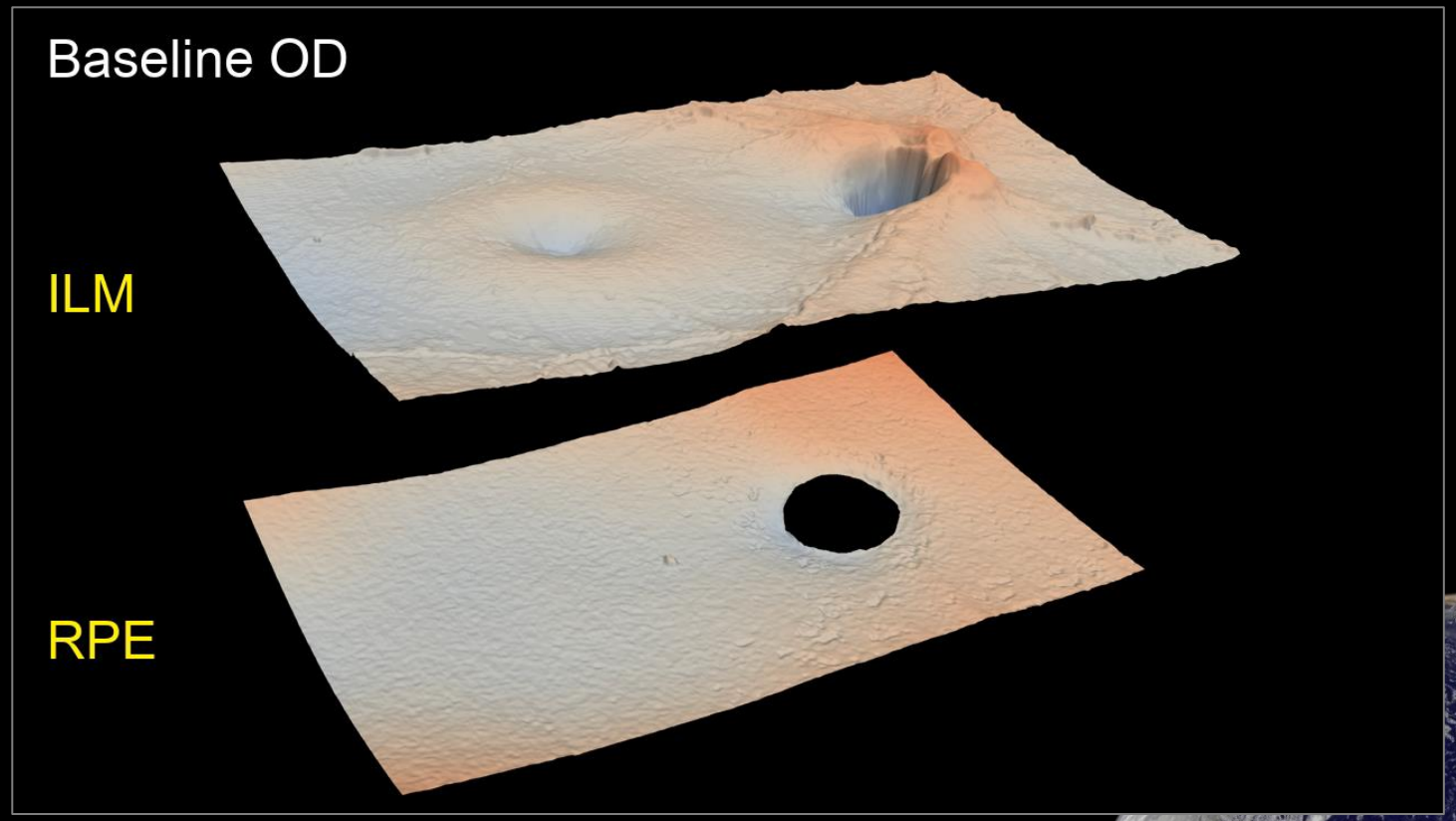
Source: Mayra Nelman & Simon Clemett

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Retinal Surface (ILM; top) & Retinal Pigment Epithelium (Bottom) Topography

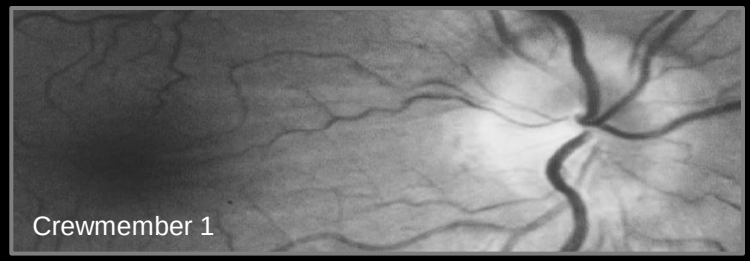
Preflight thru R-30d

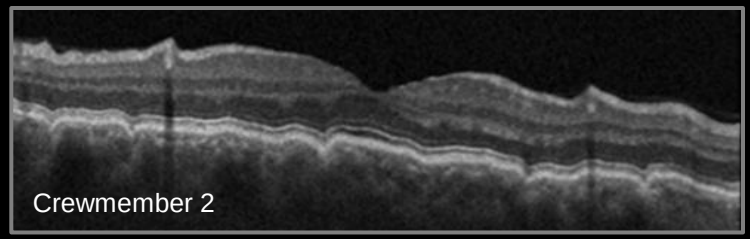


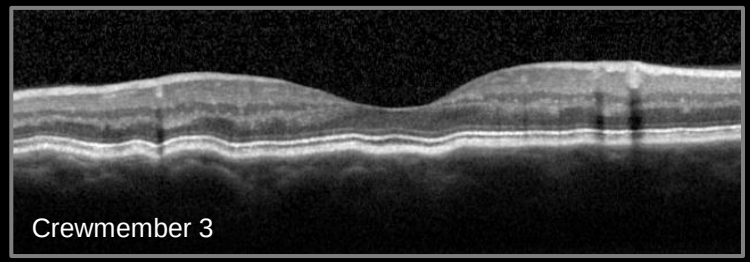
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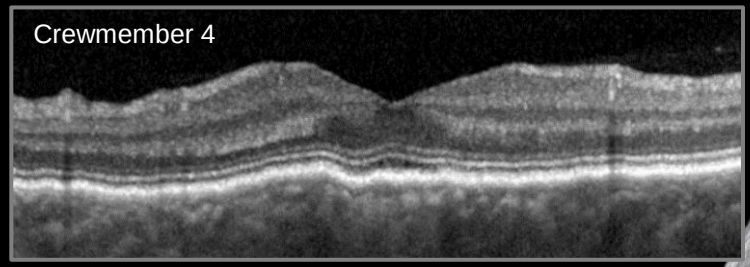
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Prevalence:

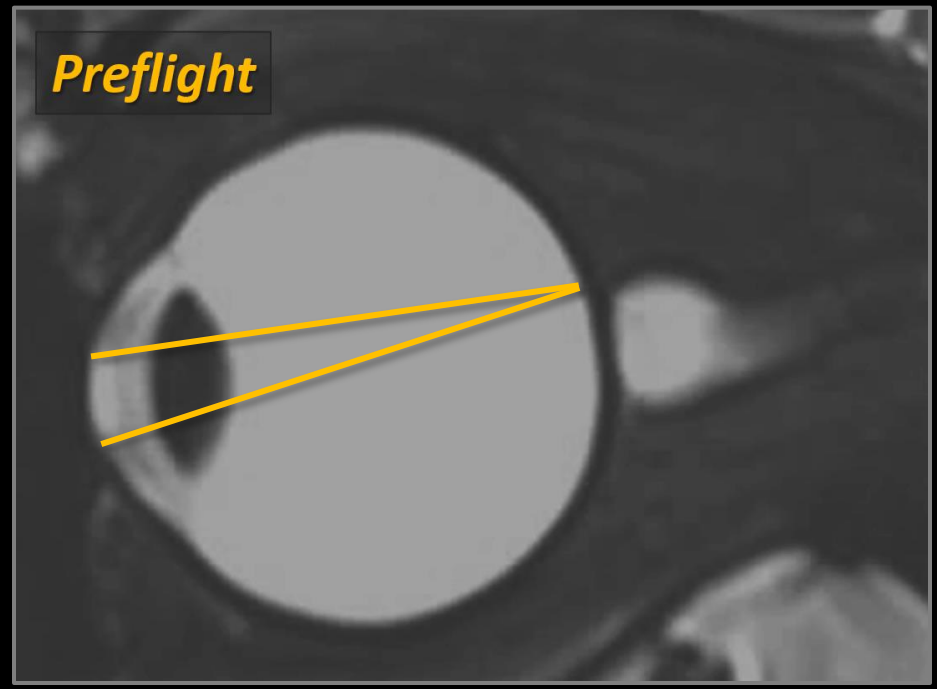
Presence of folds: 16%
Folds encroaching macula: 4%

Primary Risks:

- Distorted central vision
- Outer retinal atrophy
- Choroidal neovascularization

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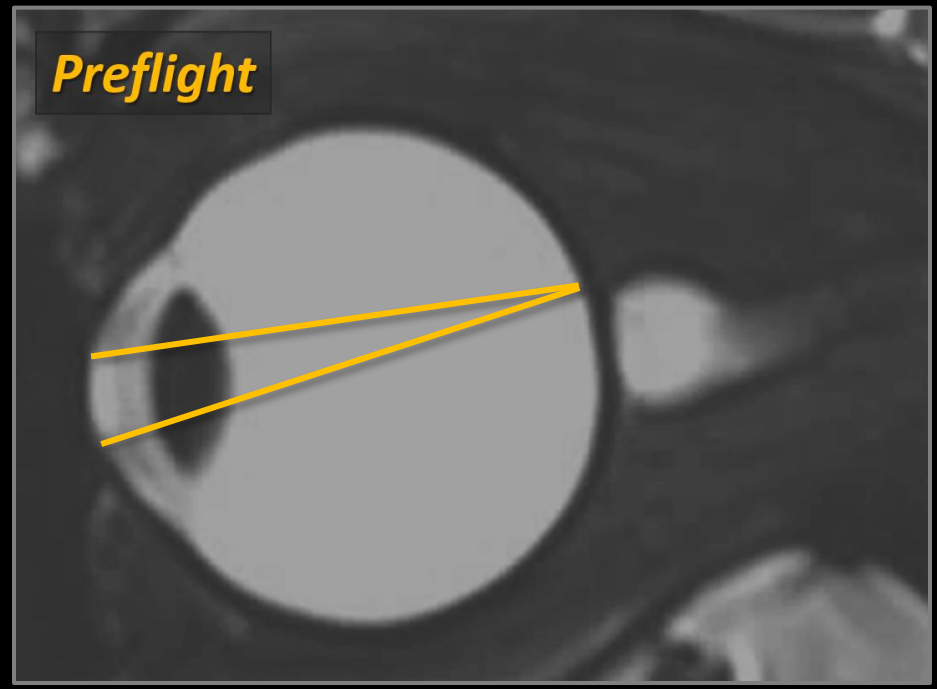


Prevalence:
≥ Mild: 23%
≥ Moderate: 12%

Primary Risk:
- Hyperopic shifts in refractive error

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Prevalence:

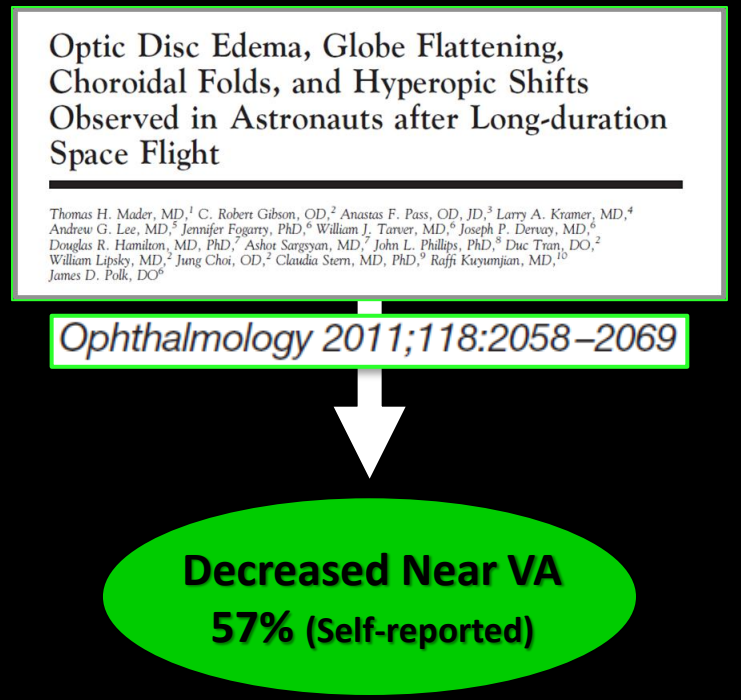
> +0.50D: 14%
≥ +1.50D: 5%

Primary Risk:

- Shift may surpass power of available "Space Anticipation Glasses"

SANS Signs & Symptoms

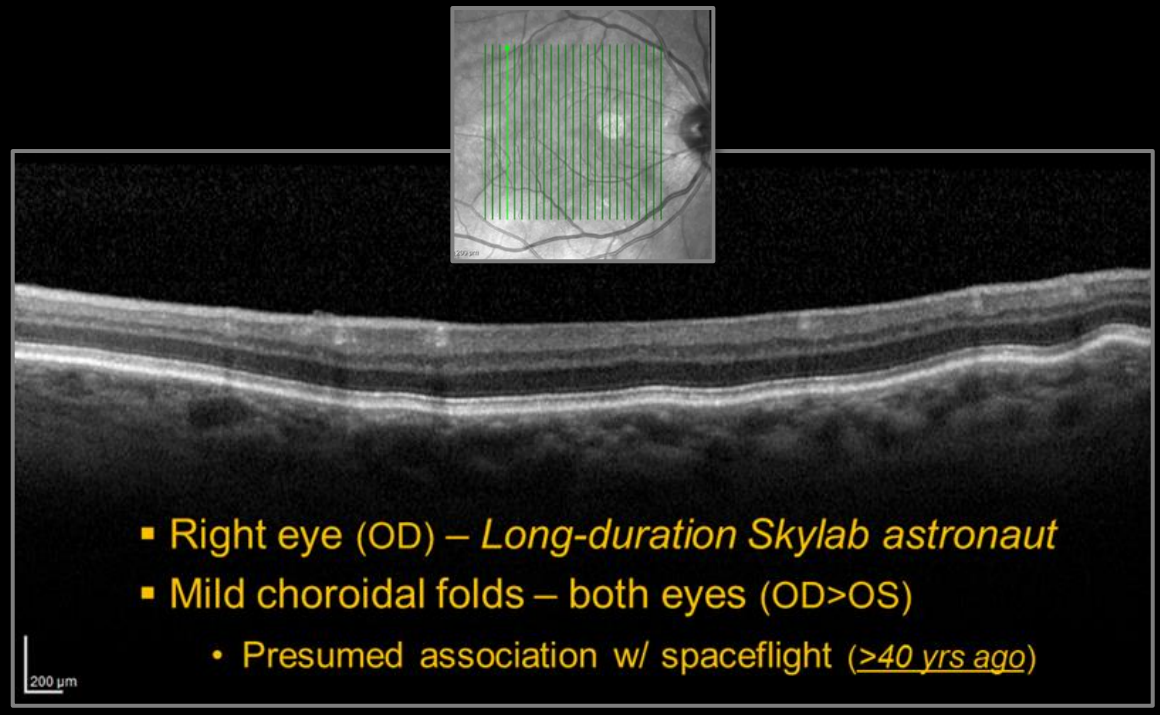
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Decreased Near VA
57% (Self-reported)

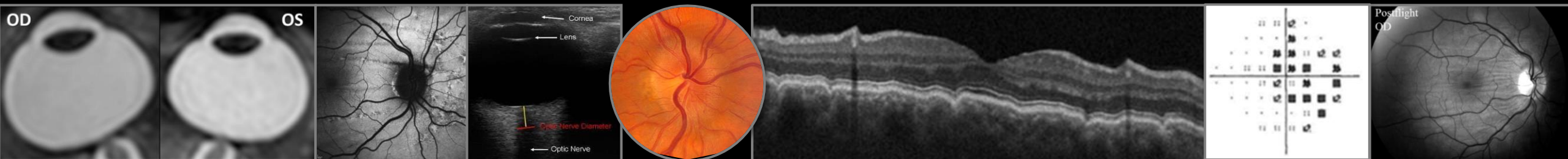
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- Symptoms:
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- Persistence:
  - To date, ODE has resolved in 1g
  - Moderate-to-severe choroidal folds, globe flattening, and hyperopic shifts can persist indefinitely



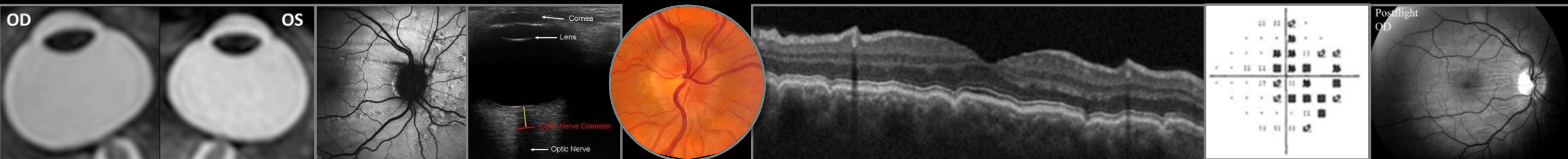
Take-Home Messages

- Currently, *no evidence* of spaceflight-associated cognitive impairment or permanent vision loss in *any* astronauts
- 71% of ISS crewmembers diagnosed w/ SANS, while *16% develop clinically-concerning SANS*
- SANS severity related to mission duration
  - "Green risk" for short-duration missions (≤ 30d)
  - "Yellow risk" for long-duration missions
  - "Red risk" for Mars missions
- SANS efforts will benefit terrestrial medicine (e.g., advanced analytics; miniaturized & semi-autonomous diagnostic devices; new objective-based definitions of ONH disease; telemedicine technology & techniques; etc.)



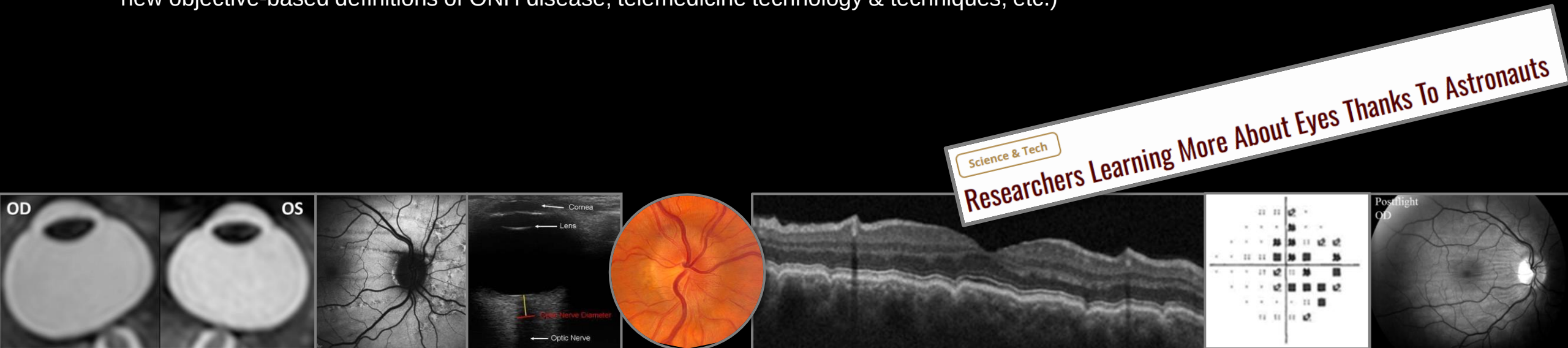
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Thank you!

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