Prospective Observational Study of Ocular Health In ISS Crews: Study Update

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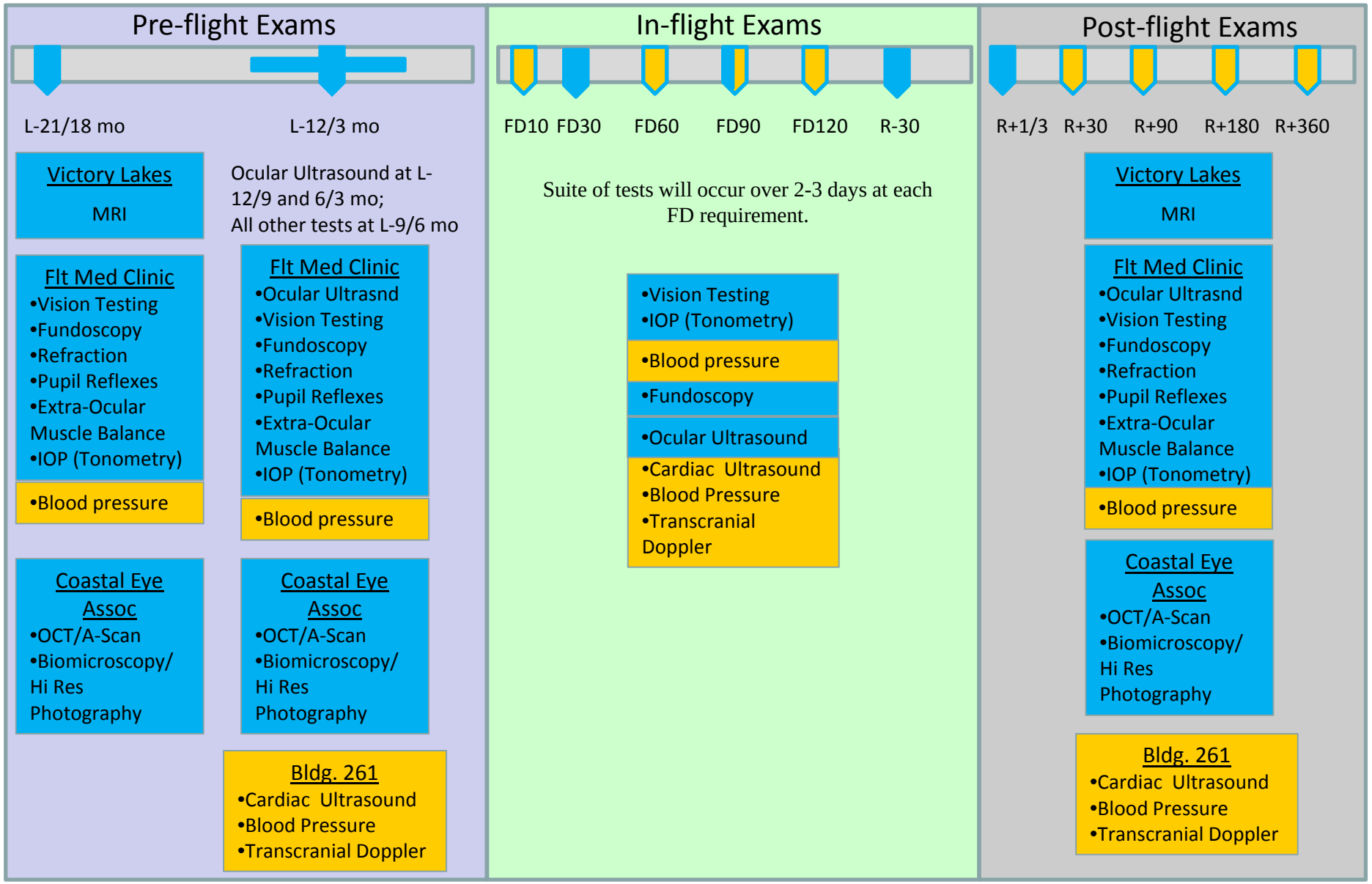
Ocular Health

- Occupational exposure study:
  - Define changes due to ISS environment occurring in:
    - Ocular
    - CNS
    - Cardiovascular
- Mechanistic by observation & measurement
- Limited physiologic manipulation vs FS
  - TCD measurement during tilt testing pre/post
- Recruitment: 9/12 subjects
  - Two subjects have completed preflight and inflight
  - Two additional subjects currently inflight

Ocular Health Study Aims & Rationale:

1. Increased frequency of crew VIIP testing is required to:
   a) Define the temporal sequence for the appearance of signs and symptoms.
   b) Delineate the interaction between duration of weightlessness and severity of symptoms, i.e. the dose-response.
   c) Identify whether VIIP signs and symptoms recover post-flight and determine the impact of prolonged changes on crew health.
   d) Outline the mechanism for the VIIP syndrome to aid in the development of protective countermeasures and treatments.

2. Data from this study will:
   a) Improve the understanding of VIIP incidence, signs, symptoms, susceptibilities, and timeline for development and recovery.
   b) Aid in guiding development of countermeasures and targeted treatments in for the VIIP syndrome and its complications.


Pre-flight Exams
L-21/18 mo
L-12/3 mo
Victory Lakes
MRI
Flt Med Clinic
•Vision Testing
•Fundoscopy
•Refraction
•Pupil Reflexes
•Extra-Ocular Muscle Balance
•IOP (Tonometry)
•Blood pressure
Coastal Eye Assoc
•OCT/A-Scan
•Biomicroscopy/ Hi Res Photography
Ocular Ultrasound at L-12/9 and 6/3 mo;
All other tests at L-9/6 mo
Flt Med Clinic
•Ocular Ultrasnd
•Vision Testing
•Fundoscopy
•Refraction
•Pupil Reflexes
•Extra-Ocular Muscle Balance
•IOP (Tonometry)
•Blood pressure
Coastal Eye Assoc
•OCT/A-Scan
•Biomicroscopy/ Hi Res Photography
Bldg. 261
•Cardiac Ultrasound
•Blood Pressure
•Transcranial Doppler
In-flight Exams
FD10 FD30 FD60 FD90 FD120 R-30
Suite of tests will occur over 2-3 days at each FD requirement.
•Vision Testing
•IOP (Tonometry)
•Blood pressure
•Fundoscopy
•Ocular Ultrasound
•Cardiac Ultrasound
•Blood Pressure
•Transcranial Doppler
Post-flight Exams
R+1/3 R+30 R+90 R+180 R+360
Victory Lakes
MRI
Flt Med Clinic
•Ocular Ultrasnd
•Vision Testing
•Fundoscopy
•Refraction
•Pupil Reflexes
•Extra-Ocular Muscle Balance
•IOP (Tonometry)
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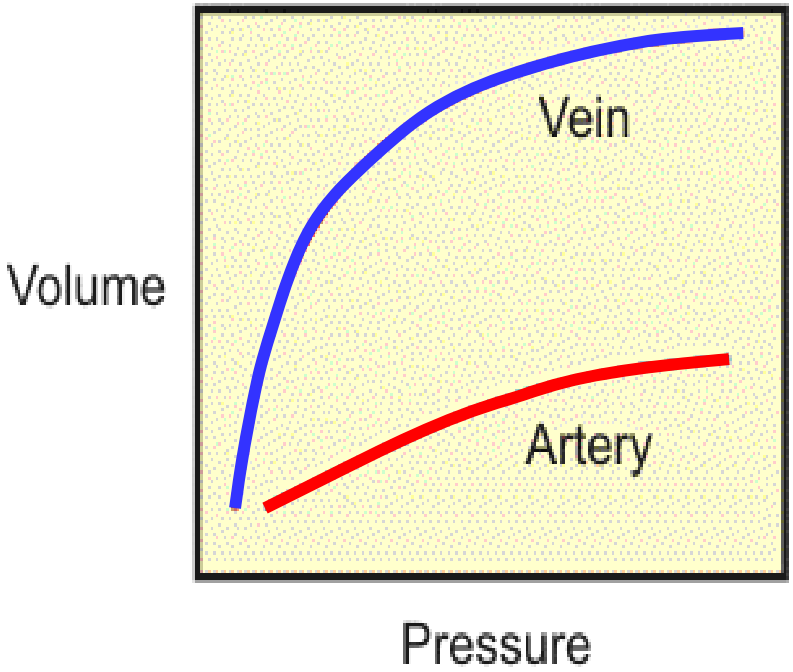
Bldg. 261
•Cardiac Ultrasound
•Blood Pressure
•Transcranial Doppler
Medical Activity
Research Additional Activity
Medical Session
Research Additional Session

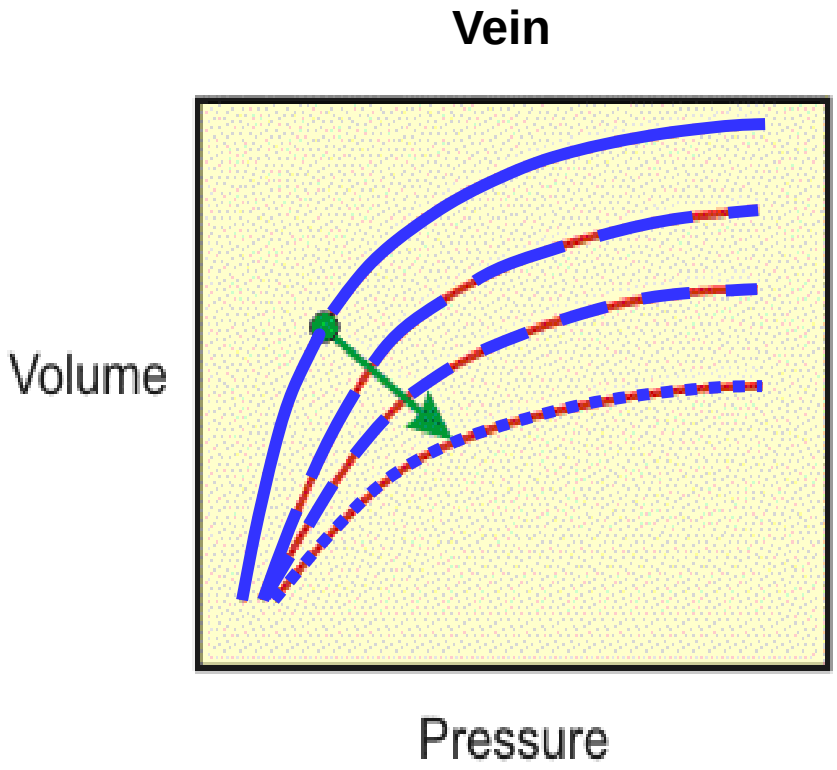
Ocular Health

- Data for two subjects will be presented:
  - Preflight
  - Inflight
  - Early postflight
- Both subjects are non-cases, or VIIP Class “0”

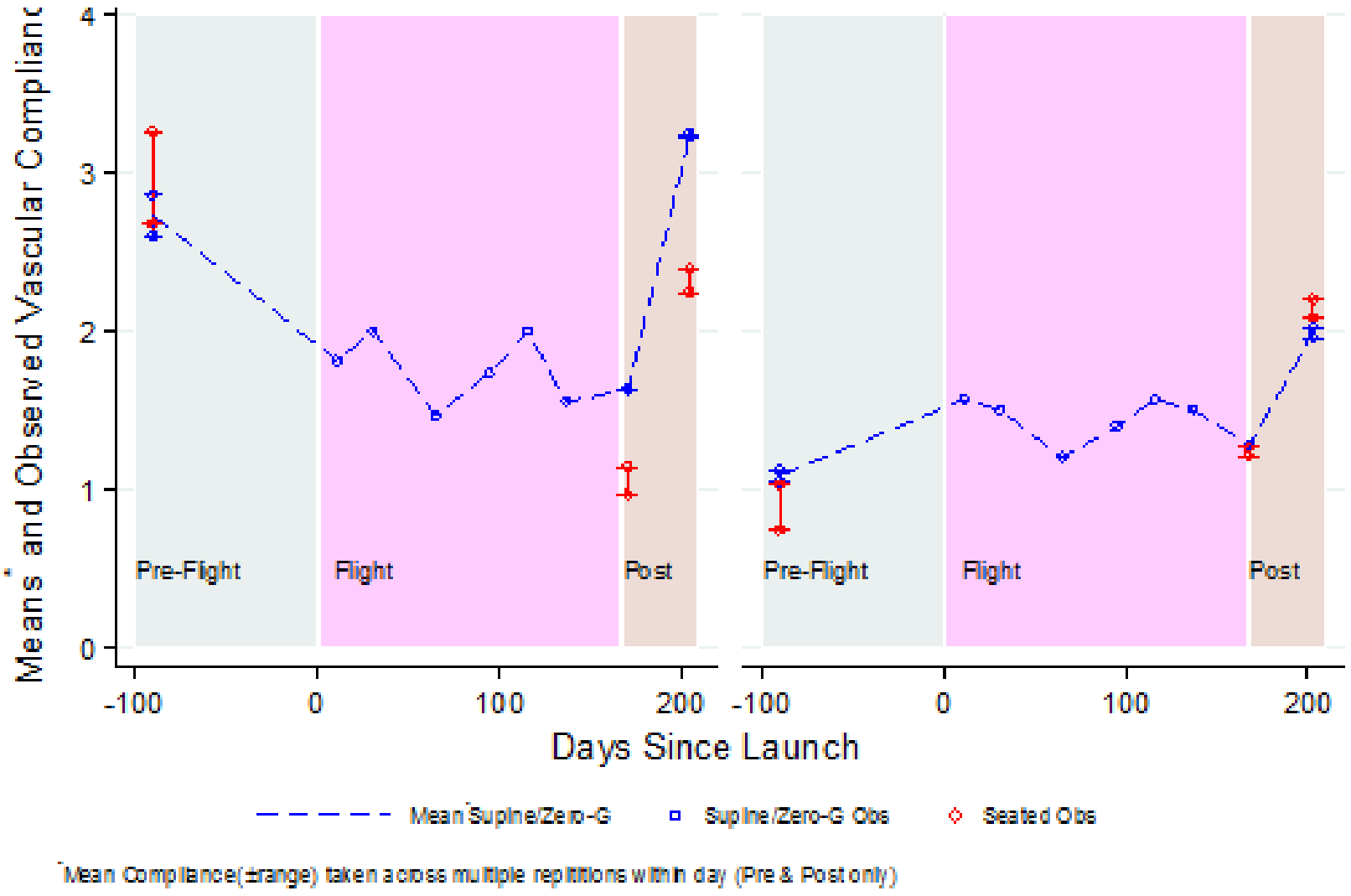
Venous Compliance

$$C = \frac{\Delta V}{\Delta P}$$



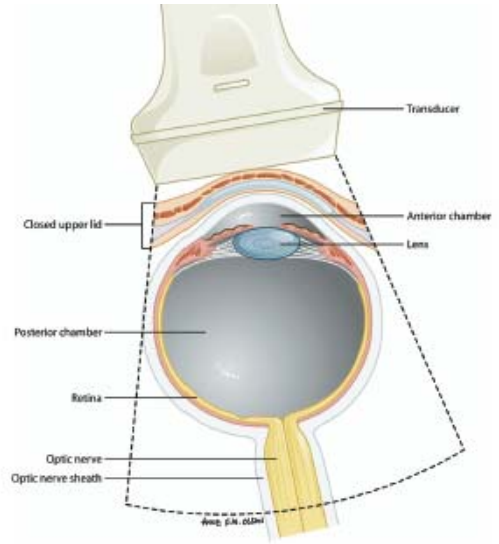


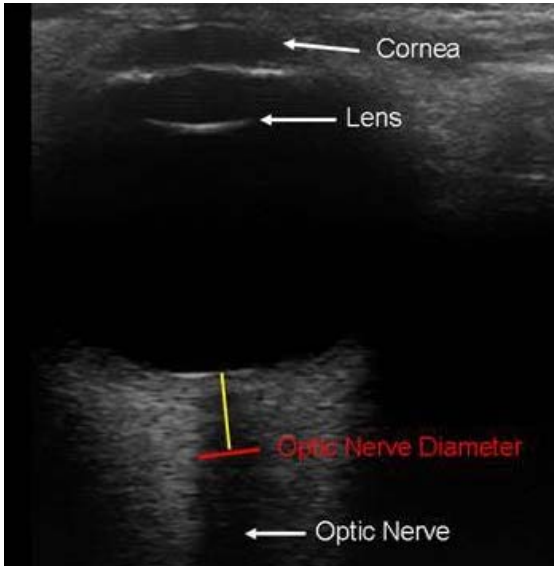
Compliance Crewmember A & B



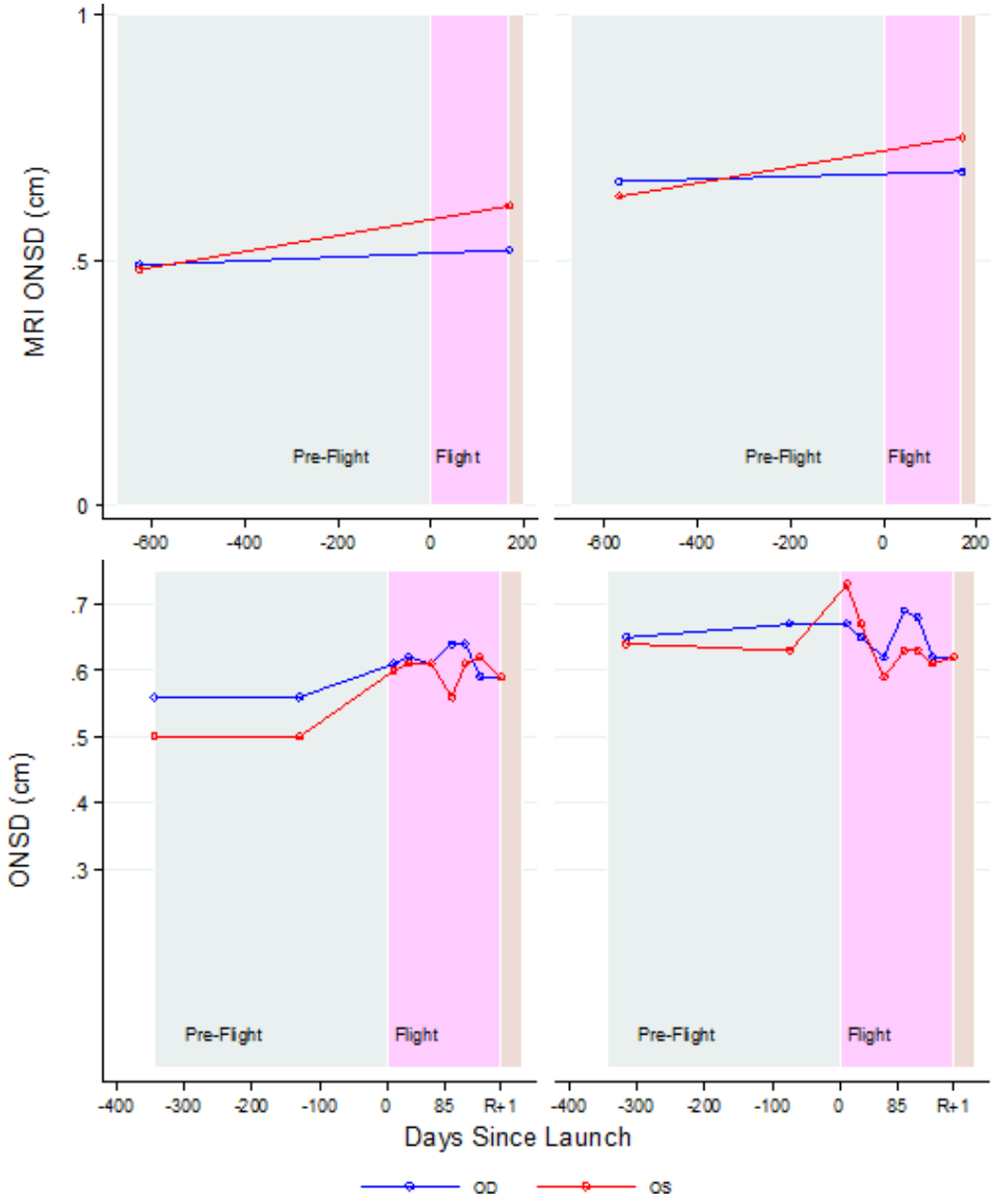
Mean Compliance(±range) taken across multiple repititions within day (Pre & Post only)

In Flight B-scan Ultrasound

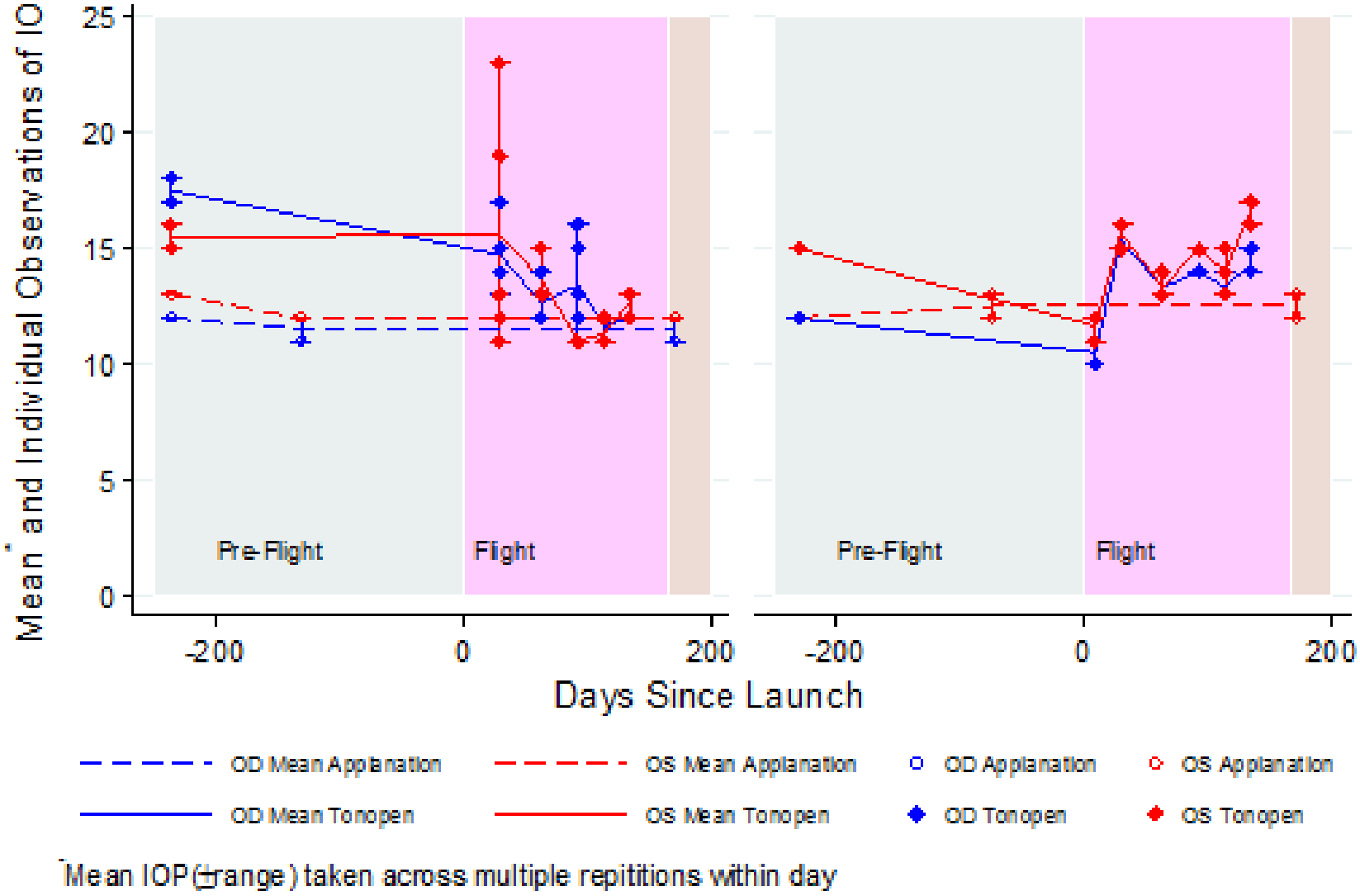




Optic Nerve Sheath Diameter, Crewmember A & B
MRI & US

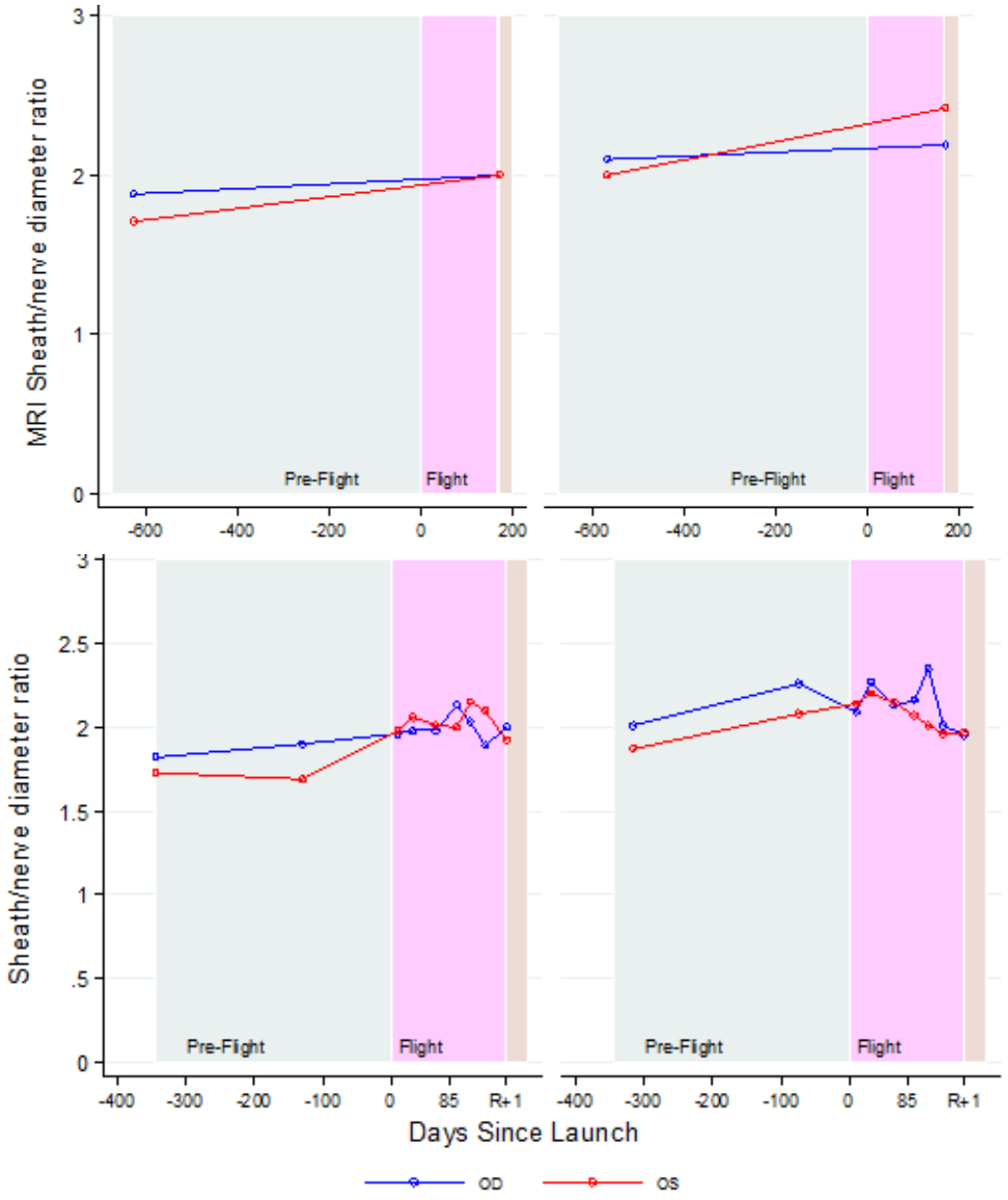


Intraocular Pressure: Crewmember A & B

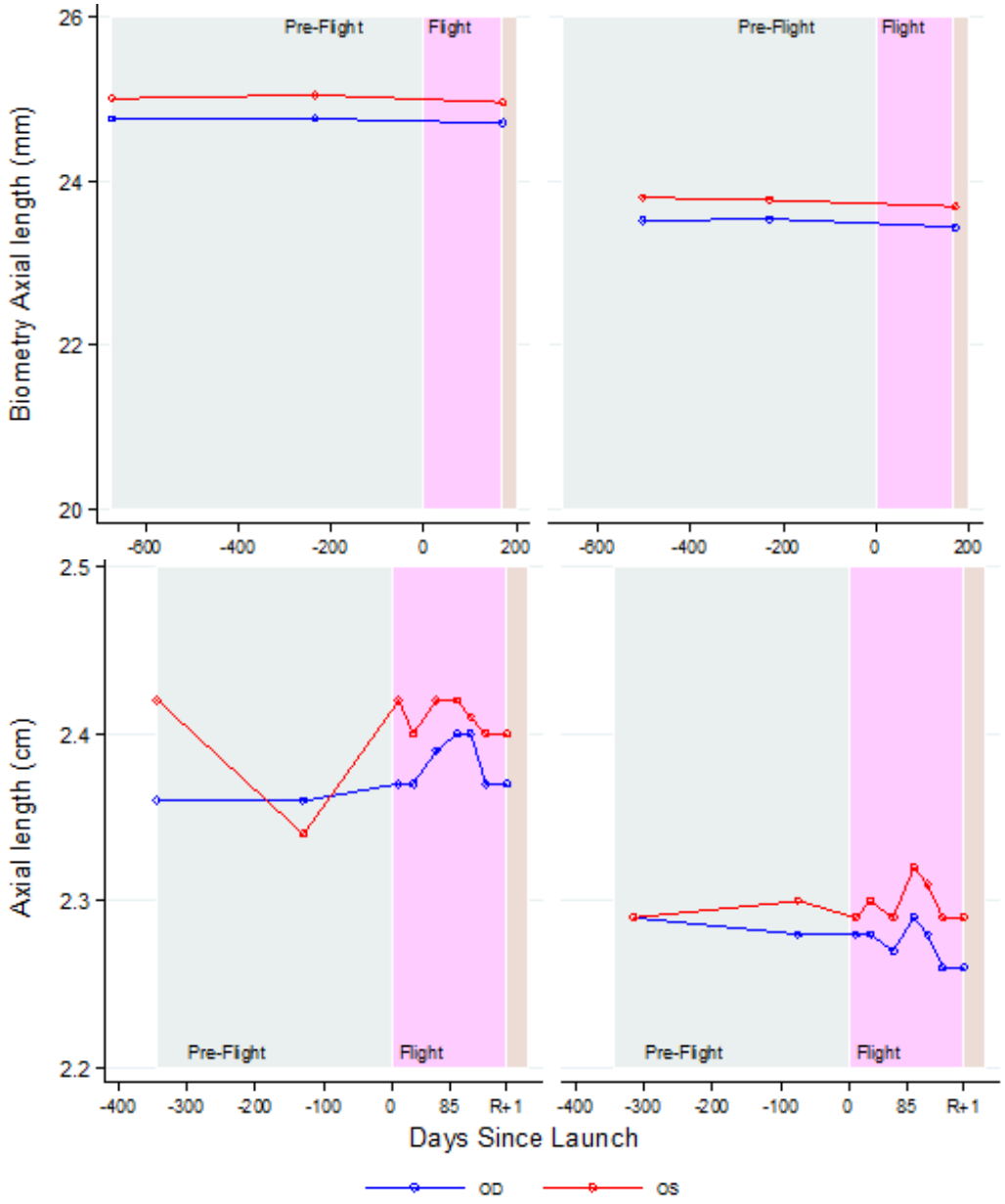


*Mean IOP (±range) taken across multiple repititions within day

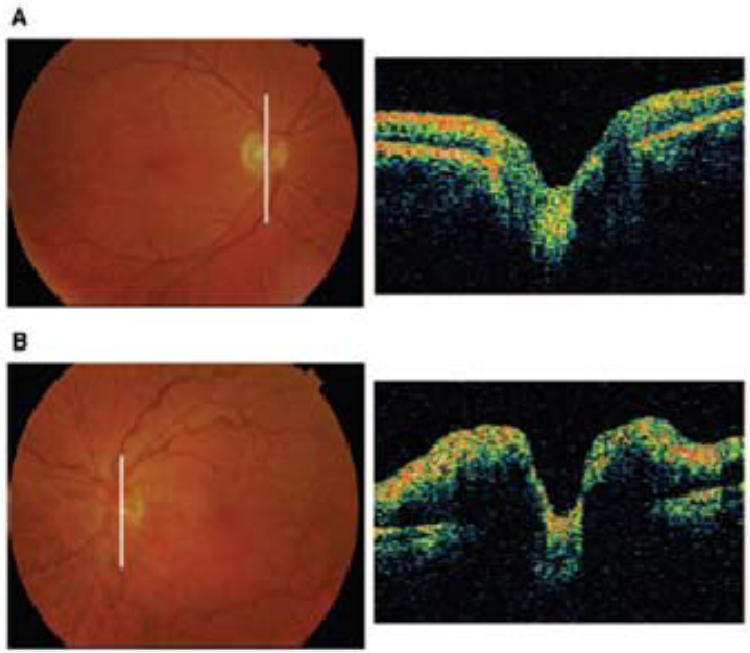
Sheath to OND Diameter Ratio Crewmember A & B

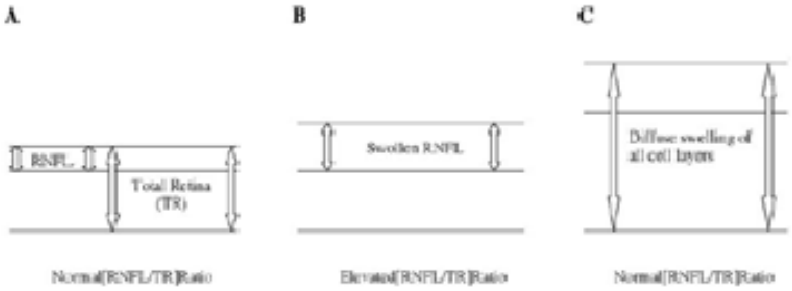


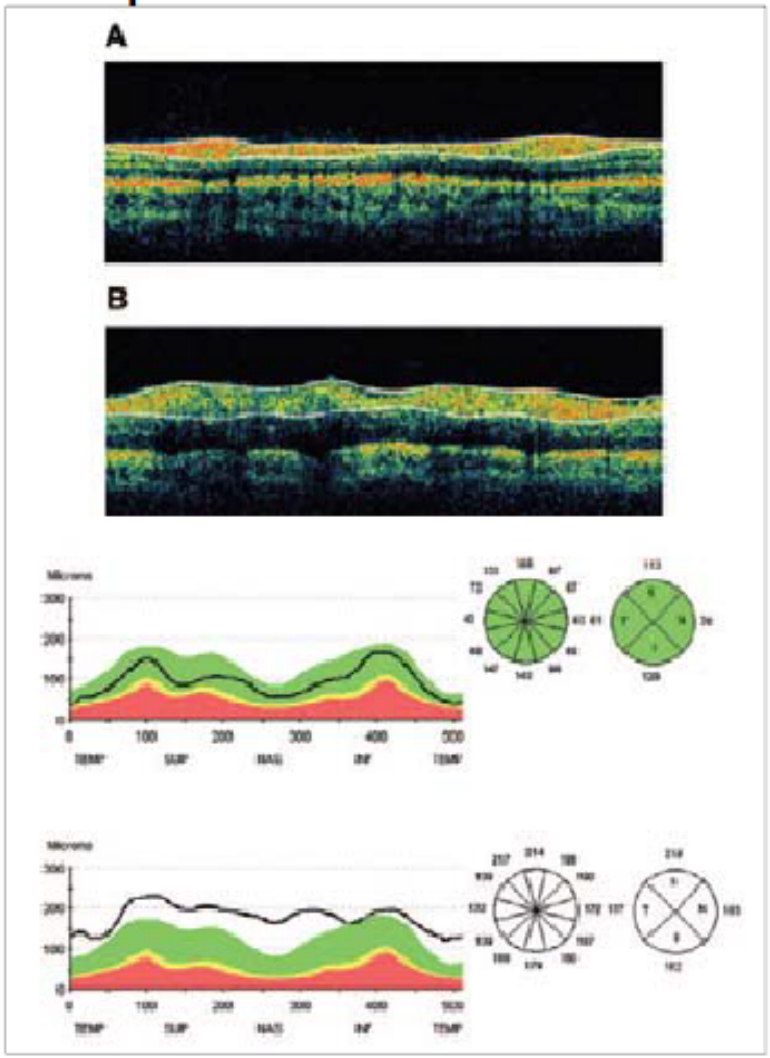
Globe Axial Length, Biometry & US: Crewmember A & B



OCT and the Swollen Optic Nerve Head





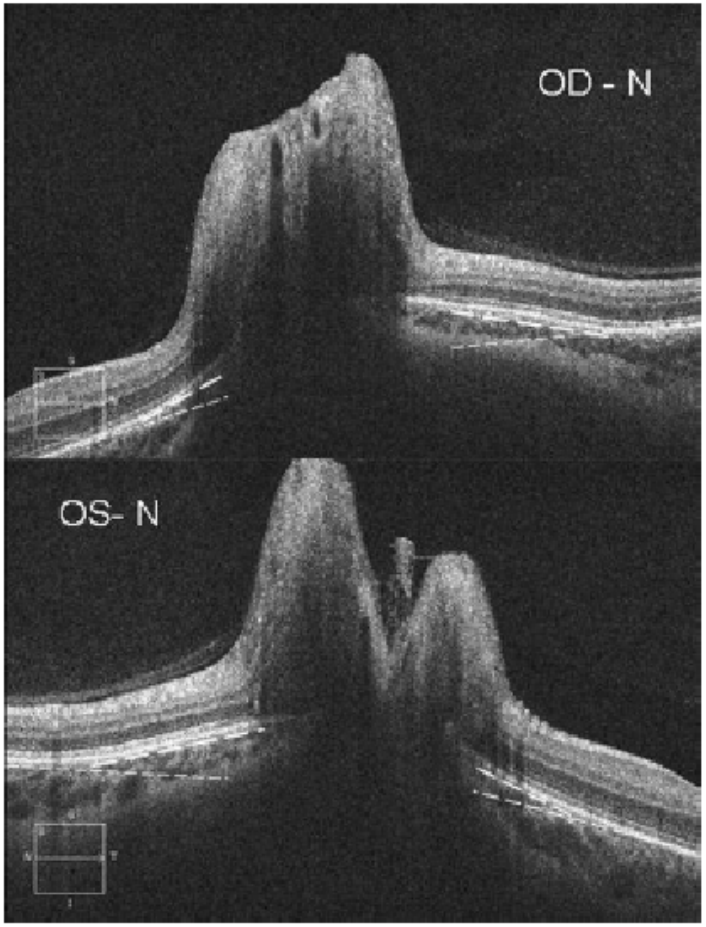


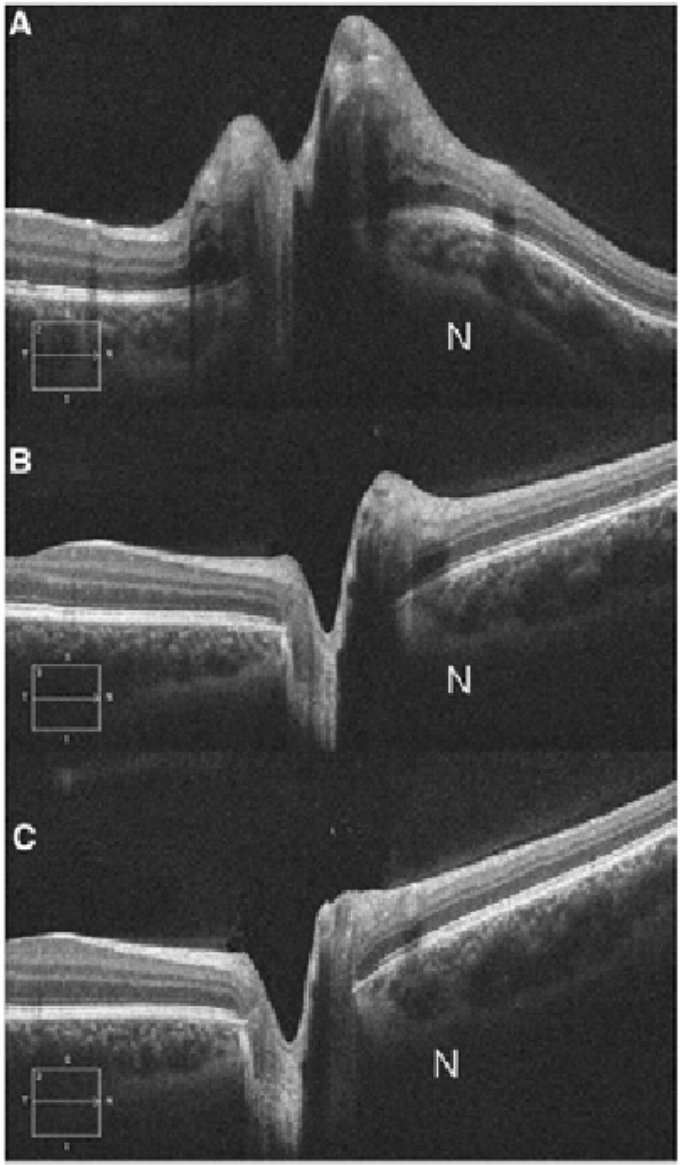
Finding:

Instrument derived RNFL thickness is increased in inflammatory optic neuropathies and with inflammatory retinal disease. The total retinal thickness minus RNFL is not significantly different in optic neuropathies.

Menke MN, et al. OCT Measurements in Patient with Optic Disc Edema. IOVS 2005;46(10):3807-3811.

OCT and the Swollen Optic Nerve Head





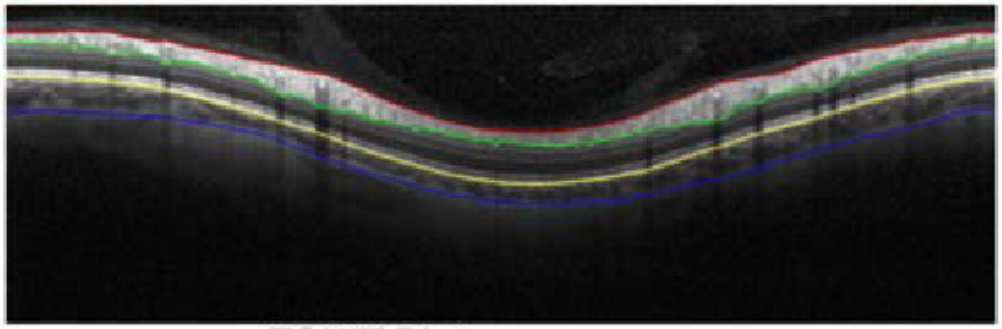
Finding:

Optic nerve head (ONH) 'deflection', can be quantified using the RPE-angle. This angle is increased in papilledema associated with increased ICP.

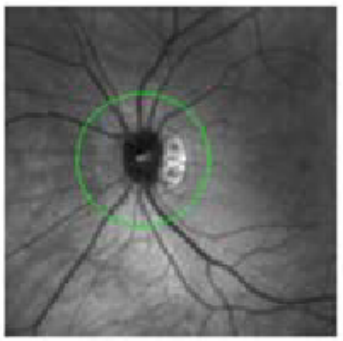
Kupersmith MJ, et al. Optical Coherence Tomography of the Swollen Optic Nerve Head: Deformation of the Peripapillary Retinal Pigment Epithelium Layer in Papilledema. IOVS 2011;52(9):6558-6564.

ISS Scans – OS

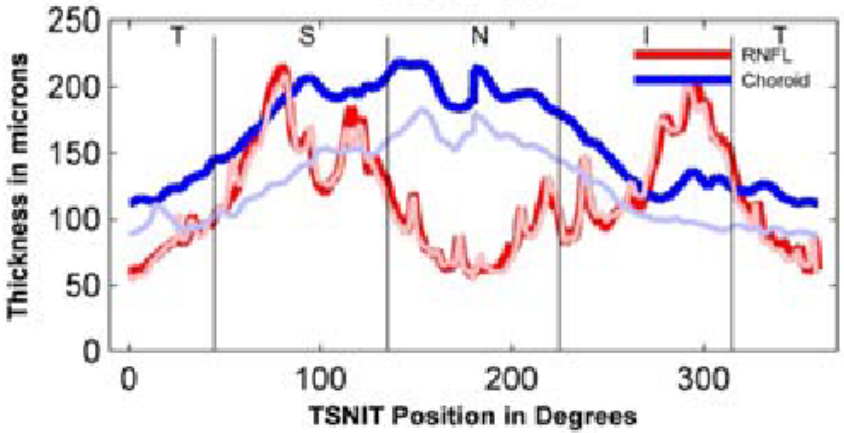
RNFL B-Scan



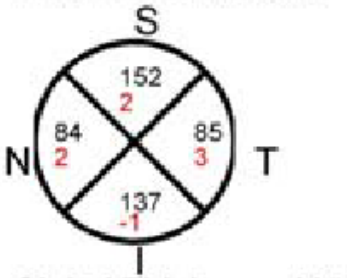
Scan Path



TSNIT Plot

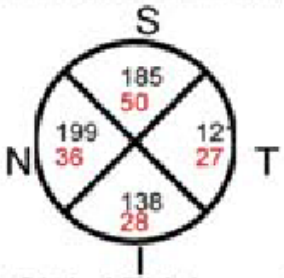


RNFL Thickness



Global Thickness 115
2

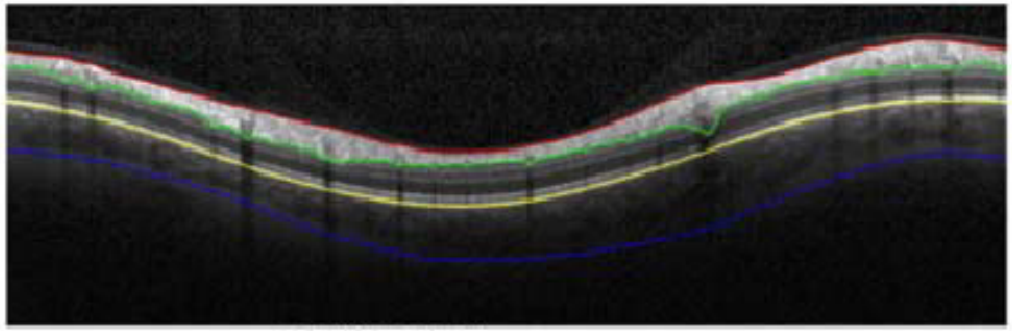
Choroid Thickness



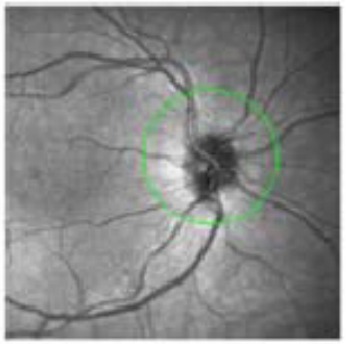
Global Thickness 161
35

ISS Scans – OD

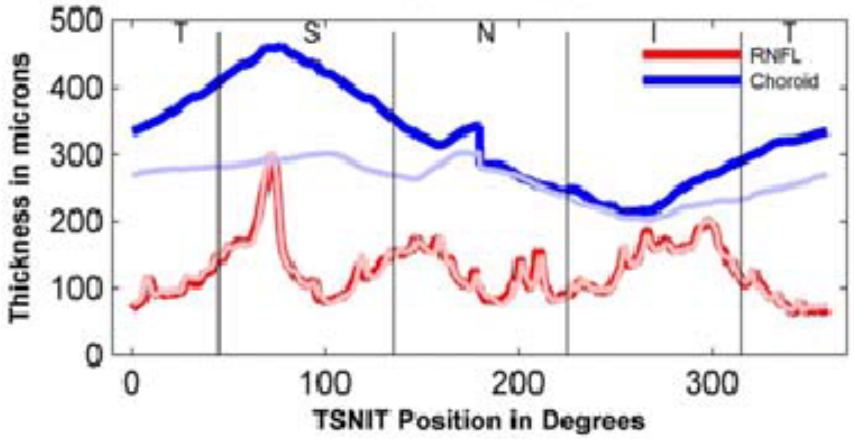
RNFL B-Scan



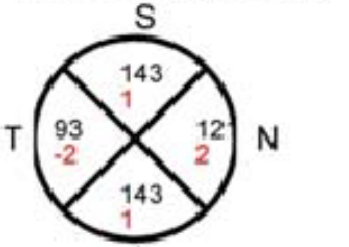
Scan Path



TSNIT Plot

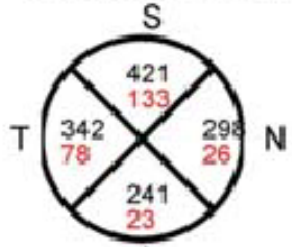


RNFL Thickness



Global Thickness 125
0

Choroid Thickness



Global Thickness 325
65

Summary

- Difference in compliance
  - Compliance changes occurred
- Optic Nerve sheath diameter
  - Increased from pre to post
- IOP increased for crew A, decreased for crew B
- Sheath to OND ratio increased for crewmember A & B
- No change in globe axial length
- OCT: choroidal thickness increased for crew A & B
  - RNFL increased for crew A & B