Summary of the USOS VIIP Findings

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The Numbers

- Completed 42 ISS missions
- Sentinel case occurred in 2005 – optic disc edema and a cotton wool spot
- Initiated *some* VIIP related testing in 2008 (Exp 18)
  - Inconsistent testing until Feb 2010 (Exp 23) when Eye MED B 1.10 came into effect
  - Improved imaging hardware (Fundoscope & OCT) flew in 2013
- Clinical Practice Guideline (CPG) approved in 2010
  - Case definition included a classification scheme (0-4)
  - Many issues with this CPG
- New Clinical Care Algorithm in April 2014
  - Case definition no longer classifies – focusses on findings
  - Expands treatment options
USOS Crewmembers

• Individuals that have completed ISS missions
  • 48 US of which 30 have been evaluated for VIIP
  • 13 Int’ls of which 9 have had complete testing

• Repeat 6 (8 if you count previous MIR missions)

• Of crewmembers tested, only 5 had no prior space flight experience.
Findings To Date (ISS/USOS)

• Elevated Intracranial Pressure
  • <20 cm H₂O: 2
  • >20 cm H₂O: 2
  • >25 cm H₂O: 3

• Optic disc edema/papilledema
  • Frisen Grade 1 or higher: 9
  • Subclinical: 5

• Choroidal folds
  • OCT or Fundoscopy: 12

• Cotton wool spot
  • 5*

*1 Roth Spot appeared 193 days post-flight

• Globe flattening

<table>
<thead>
<tr>
<th></th>
<th>U/S</th>
<th>MRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-flight</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Post-flight</td>
<td>14</td>
<td>22</td>
</tr>
</tbody>
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• Optic Nerve Sheath Distention (Diameter):

<table>
<thead>
<tr>
<th></th>
<th>U/S</th>
<th>MRI</th>
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</thead>
<tbody>
<tr>
<td>Pre-flight</td>
<td>0.61</td>
<td>0.64</td>
</tr>
<tr>
<td>Post-flight</td>
<td>0.62</td>
<td>0.65</td>
</tr>
</tbody>
</table>

• Refractive error change – post flight
  • >0.5 Diopter: 9

• Scotoma – in flight
  • 1
Summary Graph

Number of Astronauts

<table>
<thead>
<tr>
<th>VIIP Finding</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>ΔCR ≥ 0.5 Diopeter</td>
<td>48%</td>
</tr>
<tr>
<td>CWS*</td>
<td>8%</td>
</tr>
<tr>
<td>Choroidal Folds</td>
<td>28%</td>
</tr>
<tr>
<td>Flattening</td>
<td>57%</td>
</tr>
<tr>
<td>Distension</td>
<td>36%</td>
</tr>
<tr>
<td>Scotoma</td>
<td>1%</td>
</tr>
<tr>
<td>Disc Edema</td>
<td>15%</td>
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</tbody>
</table>
Figure 1. Distribution of ONSD values in the astronaut cohort (Pre-flight, in 42 pairs). The green area corresponds to the terrestrial published evidence with a “cut-off” value for elevated ICP at 0.59 cm. This value cannot be directly used for the astronaut cohort and is provided as part of background information.
ONSD(U/S) vs Post-flight Disc Edema Diagnosis
AP Diameter(U/S) vs Post-flight Disc Edema Diagnosis

![Graph showing AP Diameter vs Post-flight Disc Edema Diagnosis]
In-flight OCT (n=6)

![Graph showing average global rNFL(µ) across different Relative Flight Days: Preflight, FD30, FD90, R-30, and Postflight.]
Space-flight Naïve: Ultrasound

Note: Scale from 0 to 3 is used (None, Mild, Moderate, Severe) corresponds to vertical axis
Space-flight Naïve: OCT

Total RNFL

![Graph showing Total RNFL](image)

- Preflight
- Postflight
Forward Work

- Continue to update these graphs
- Updates to the MRI/US distributions
- Develop evidence base
- NASA’s Ocular Health Study – PI Christian Otto
### Preflight Exams
- L-21/18 mo
  - Victory Lakes
    - MRI
  - Flt Med Clinic
    - Vision Testing
    - Fundoscopy
    - Refraction
    - Pupil Reflexes
    - Extra-Ocular Muscle Balance
    - IOP (Tonometry)
    - Blood pressure

### In-flight Exams
- FD10
  - Vision Testing
  - IOP (Tonometry)
- FD30
  - Blood pressure
- FD60
  - Fundoscopy
- FD90
  - OCT
- FD120
  - Ocular Ultrasound

### Postflight Exams
- R+1/3
  - Victory Lakes
    - MRI
- R+30
  - Flt Med Clinic
    - Ocular Ultrasound
    - Vision Testing
    - Fundoscopy
    - Refraction
    - Pupil Reflexes
    - Extra-Ocular Muscle Balance
    - IOP (Tonometry)
    - Blood pressure
- R+90
  - Coastal Eye Assoc
    - OCT/A-Scan
    - Biomicroscopy
    - Hi Res Photography
- R+180
  - Bldg. 261
    - Cardiac Ultrasound
    - Blood Pressure
    - Transcranial Doppler
- R+360
  - Bldg. 261
    - Cardiac Ultrasound
    - Blood Pressure
    - Transcranial Doppler

A suite of tests will occur over 5 days at each FD requirement.