EVIDENCE BASED MEDICINE IN SPACE FLIGHT: EVALUATION OF INFLIGHT VISION DATA FOR OPERATIONAL DECISION-MAKING

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Disclosure Information

86th Annual Scientific Meeting

Mary Van Baalen, PhD

I have no financial relationships to disclose.

I will not discuss off-label use and/or investigational use in my presentation

Ophthalmology/Optometry Examinations Requirements

Pre-flight:

AME L-21/18 m
MRI brain and orbits

AME L-21/18 m and AME L-9/6 m
Ocular questionnaire
Visual acuity, distance and near
Refraction – manifest and cycloplegic
Threshold visual fields
Amsler grid
Contrast sensitivity
Pupil reflexes
Extraocular muscle balance
Biomicroscopy (slit lamp)
Dilated fundoscopic examination including video fundoscopy with training
Retinal photography
Tonometry
Optical coherence tomography (high resolution)
Optical biometry

L-9/6 m
2-D imaging ultrasound

In flight:

L+30; L+100; R-30
Ocular questionnaire
Visual acuity distance and near
Amsler grid
Contrast sensitivity
Threshold visual fields

L+30; R-30
Fundoscopy
Tonometry
2-D imaging ultrasound
Optical coherence tomography (high resolution)

Post-flight:

R+1/3
Ocular questionnaire
Visual acuity, distance and near
Refraction – manifest and cycloplegic
Threshold visual fields
Amsler grid
Contrast sensitivity
Pupil reflexes
Extraocular muscle balance
Biomicroscopy (slit lamp)
Dilated fundoscopic examination
including video fundoscopy
Retinal photography
Tonometry
Optical coherence tomography (high resolution)
Optical biometry
2-D imaging ultrasound
MRI brain and orbits

In-flight Tonometry Exam

- Medically required exam conducted 3 times during an increment
- Privatized cabin video and restricted audio utilized during exam
- Remotely Guided exam (Think Telemedicine)
- Operator performs tap technique on eye simulator under direction of a remote guider
- Operator performs exam on Subject
  - Minimum of three data takes per session

Desired Cabin View of Subject during exam

Immobilization during In-flight exam

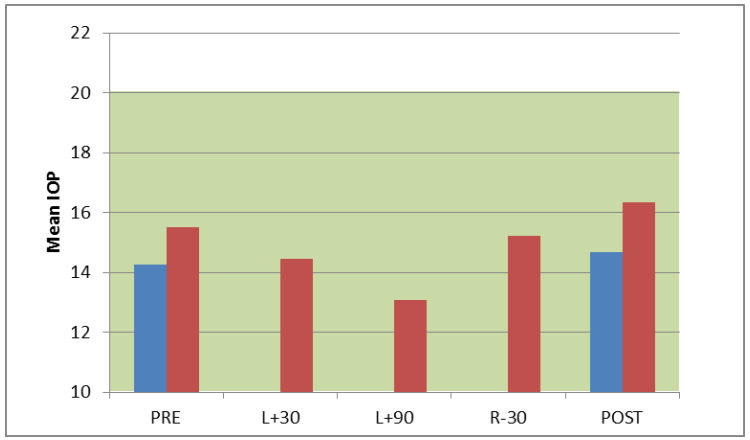
Pooled By VIIP CPG CLASS

TAP

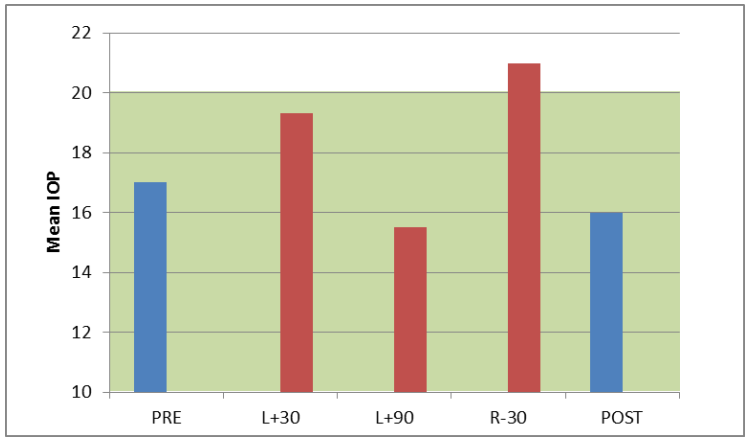
TONO

NORMAL

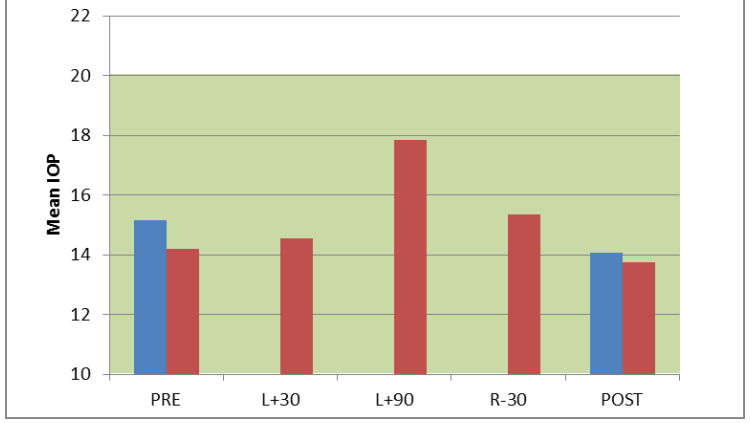
Class 0 (N=4)



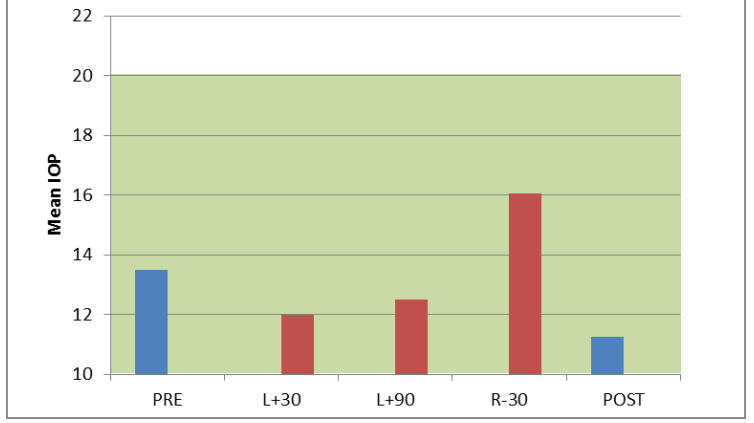
Class 1 (N=1)



Class 2 (N=8)



Class 3 (N=2)



Data Caveats

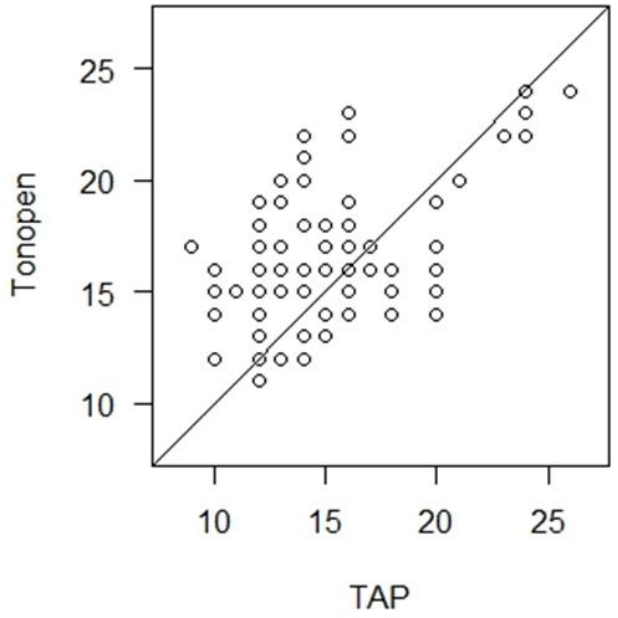
IOP and Outcome

- Not all subjects had measurements at every time point.
- Not all crewmembers who have data for classification have inflight IOP data

VIIP CPG Class	Total	w/ Inflight Tonometry
0	14	4
1	3	1
2	14	8
3	4	2
4	4	**0**

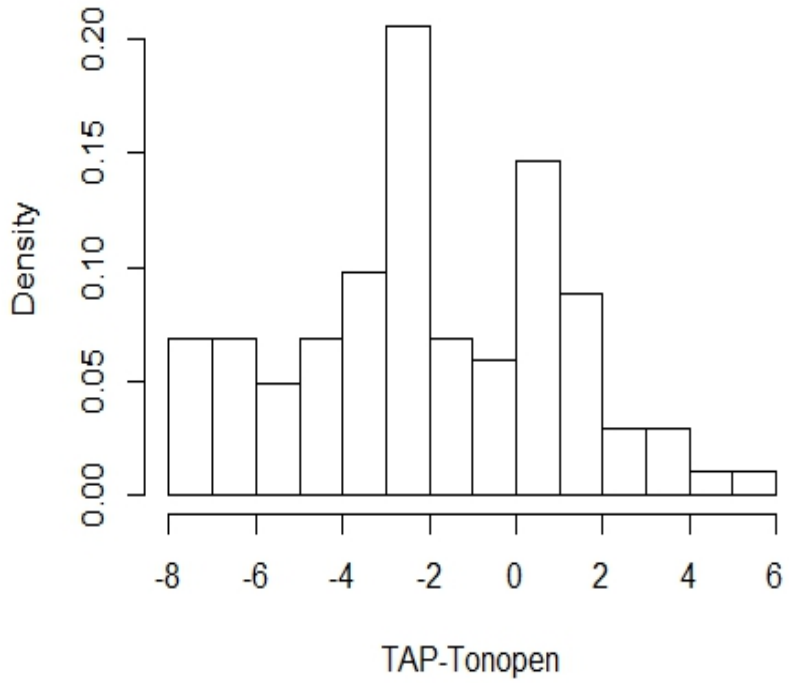
Gold Standard vs Tonopen

- Comparison of the results from Tonometry using Goldmann Applanation (TAP) and Tonopen did not show consistent measurements:
  - Trained Operators (JSC Optometrists)
  - Same visit



Comparison TAP vs Tonopen Terrestrial

- Mean Difference (Tonopen-TAP): 1.67 (95%CI: 1.01, 2.33) p=2.8e-6
- Permutation Test p-value: 2e-6
- Proportion more than 4 units apart: 26.8%

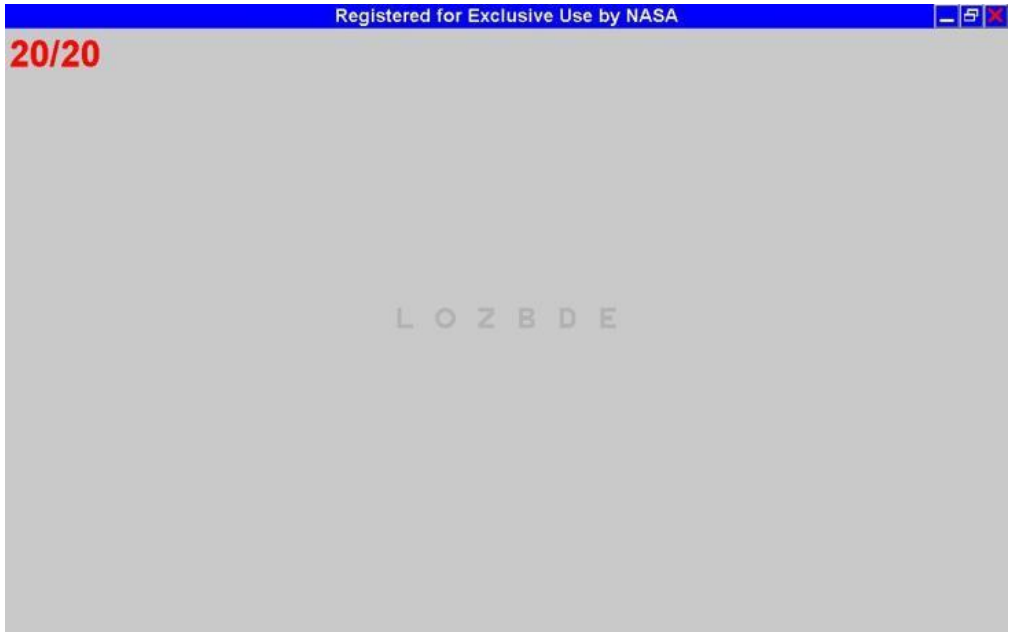


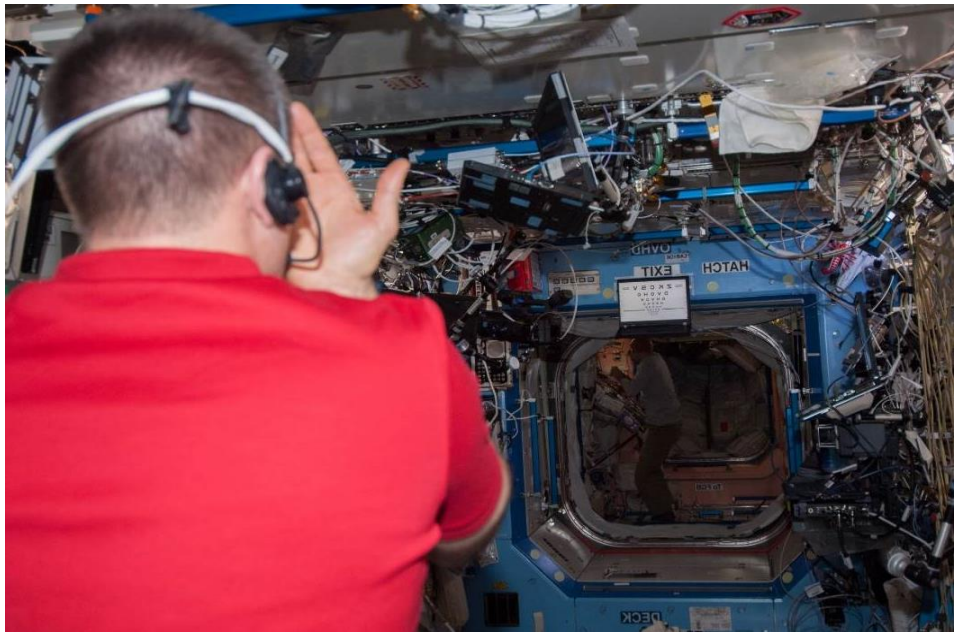
Contrast Sensitivity Ground Training

- No ground training provided to crew
- Exposed to software and testing flow during pre-flight Baseline Data Collection exam

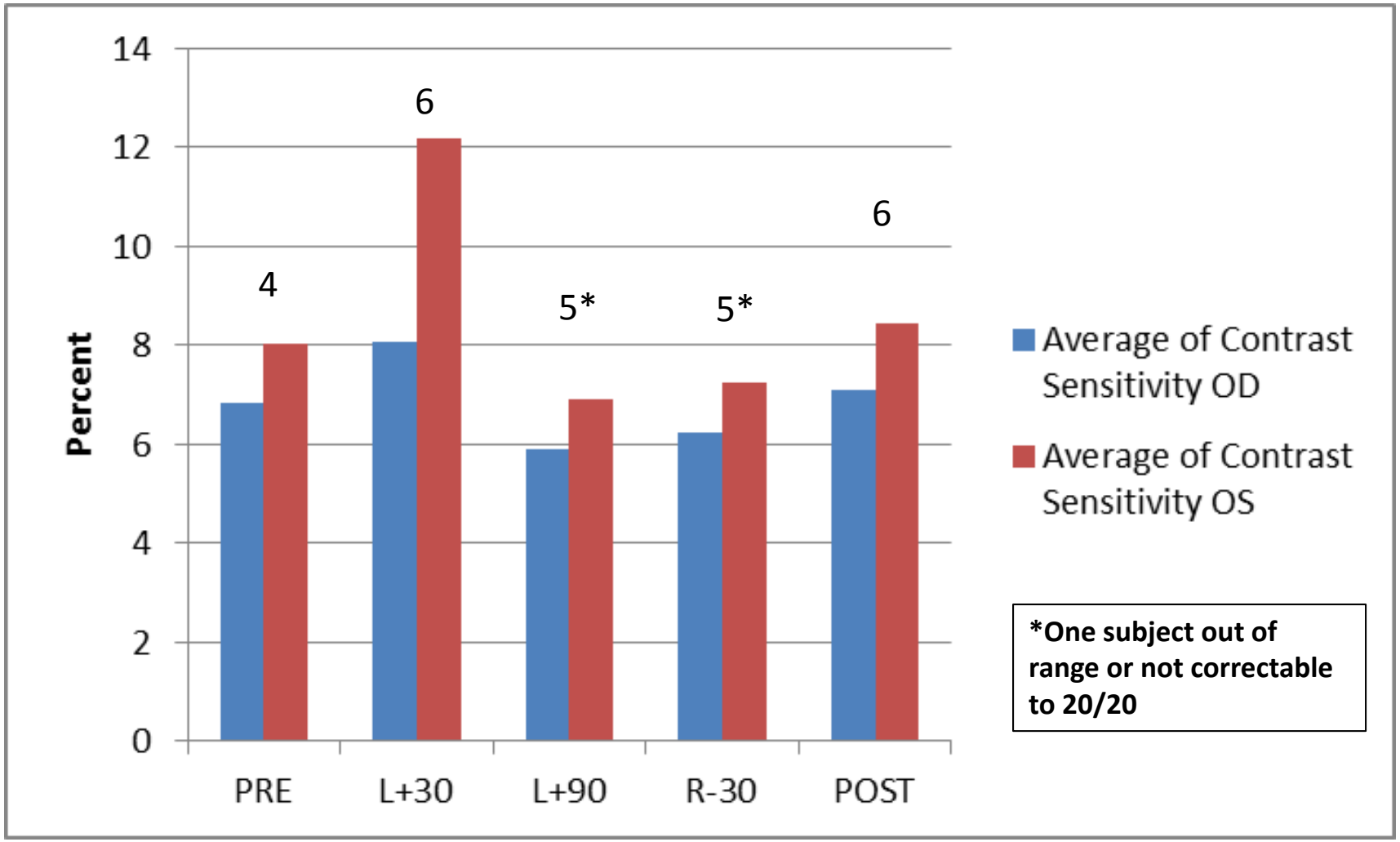
In-flight Contrast Sensitivity

- Medically required exam conducted 3 times during an increment
  - One of four exams in the Visual Acuity suite
- Remotely Guided exam (Think Telemedicine)
- Restricted audio only utilized during exam
- RG commands laptop while crew reads eye charts per direction
- Performed at a distance of 15 feet from the laptop (same as distance acuity testing)



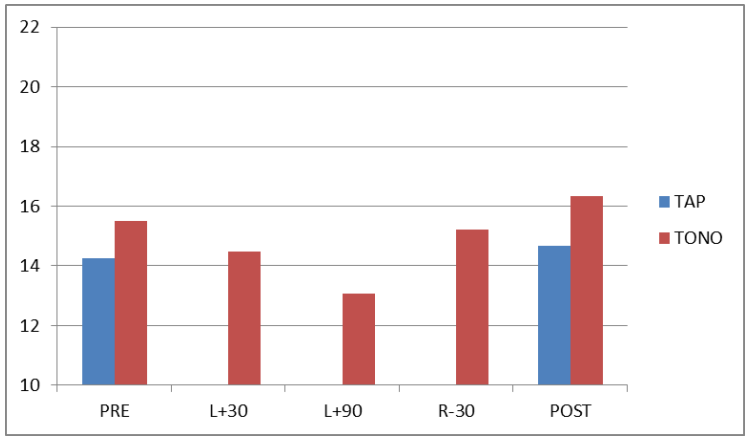


Pooled Data

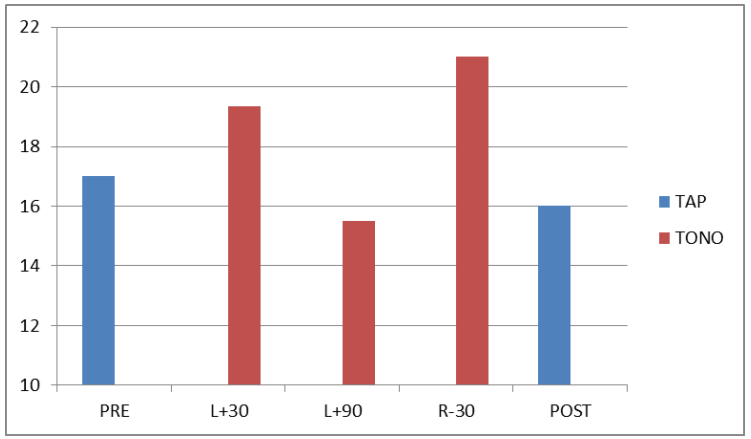

14
12
10
8
6
4
2
0
Percent
6
4
5*
5*
6
PRE
L+30
L+90
R-30
POST
Average of Contrast Sensitivity OD
Average of Contrast Sensitivity OS
*One subject out of range or not correctable to 20/20

Pooled By VIIP CPG CLASS*

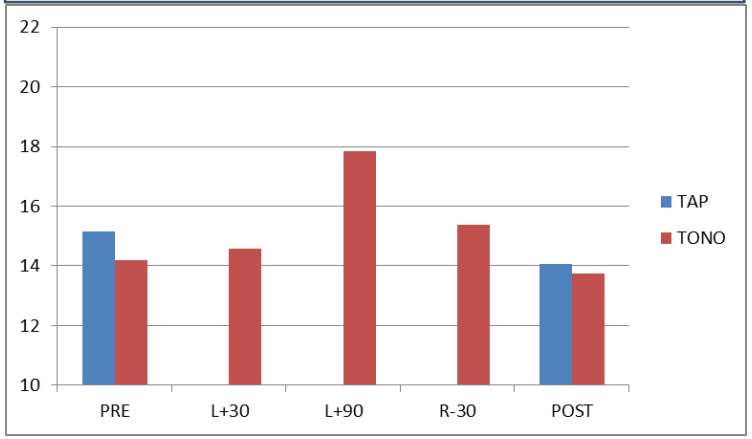
Class 0 (N=4)



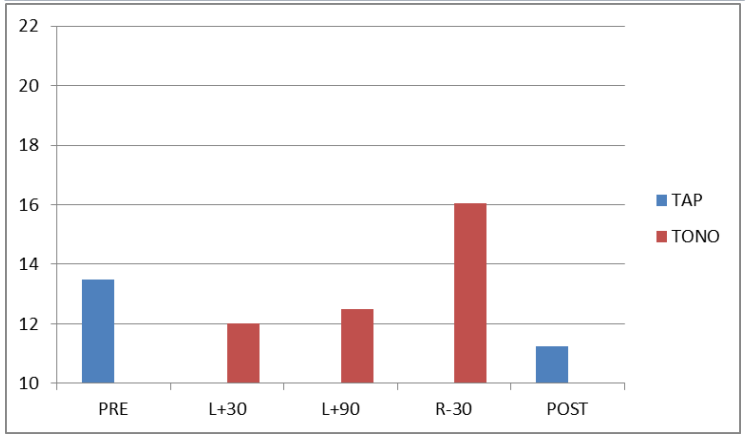
Class 1 (N=1)



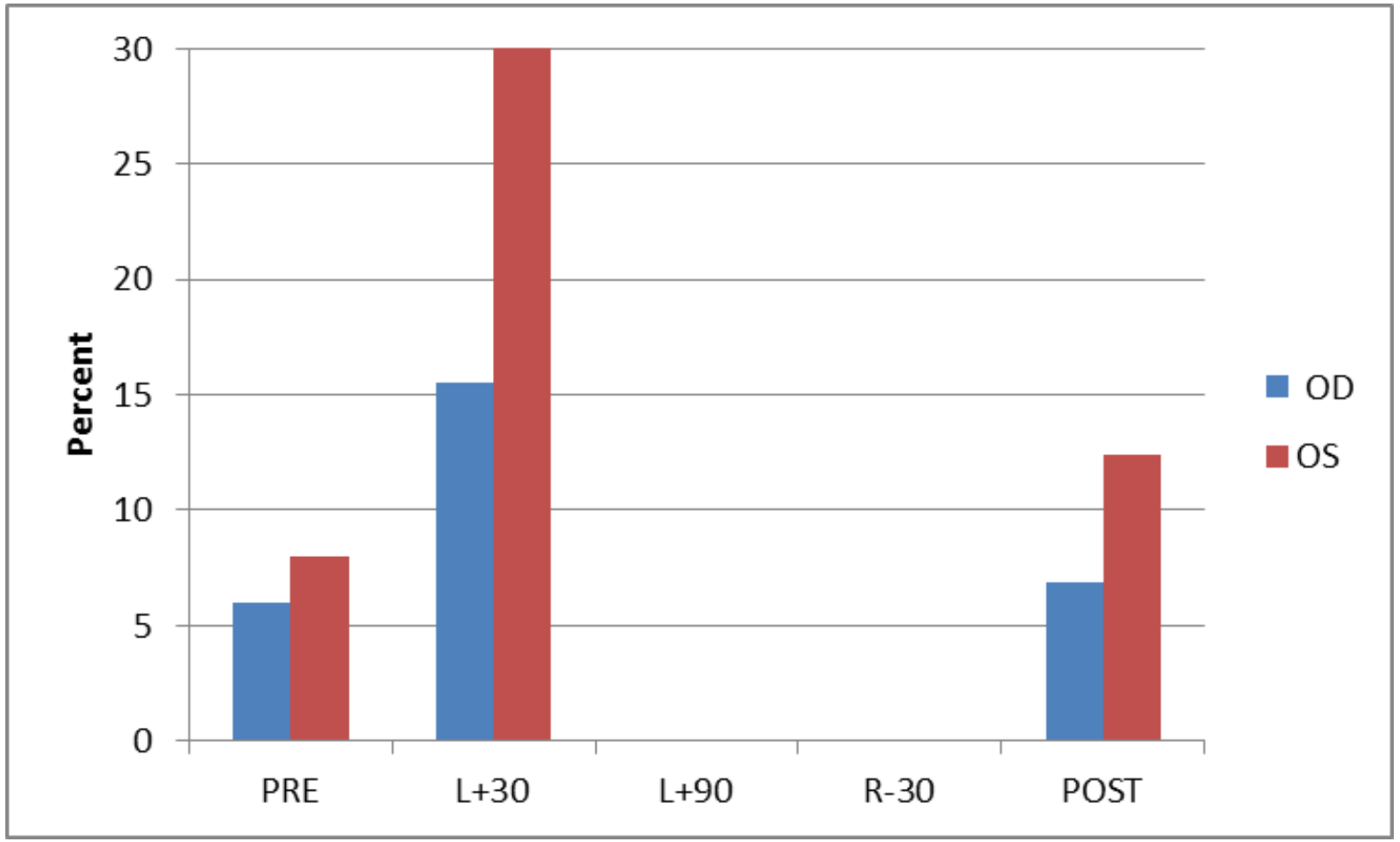
Class 2 (N=8)



Class 3 (N=2)



Subject 1



Rationale for Removal

- Anatomical changes associated with contrast sensitivity issues occur late in the pathological process, often outside of 6-month mission timeframe.
- Precursors to these anatomical changes can be identified by OCT scans and Fundocsopic imaging.
- VIIP Research & Clinical Advisory Panel (RCAP) agreed in-flight contrast sensitivity testing would be better suited ‘as clinically indicated’ to assess a crewmember as required.
- No change is being requested to the pre- or post-flight testing requirements.
- Performing contrast sensitivity on-orbit has technical challenges that translate into extensive crew time.

Outcomes

- Expedition 40 NASA discontinued routine in-flight tonometry and contrast testing as part of the medical requirement,
- Although these capabilities will continue to be available as needed for clinical care.
- Future evaluation of routine on-orbit ultrasound, OCT, and fundoscopy testing is planned in order to maximize medical resources and crew time.