Objective assessment of optic neuritis using chromatic multifocal pupillometry

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Subjective perimetry

Goldmann

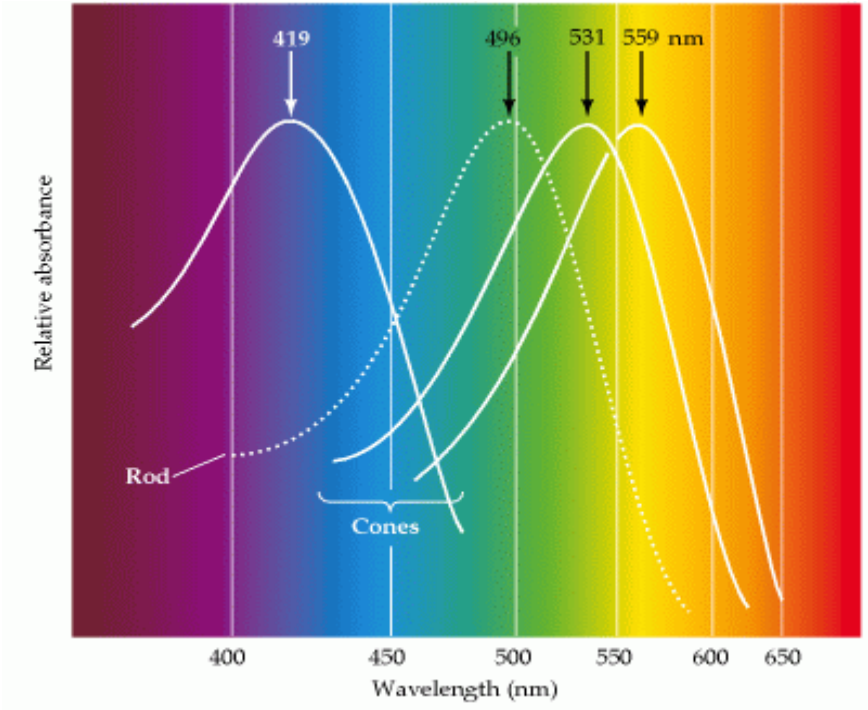
Humphrey

Limitations of subjective perimetry

- Patient cooperation
- More monitoring required
- Cannot distinguish between retina and optic nerve pathologies
- Test-retest variability

Perimetry based on pupillary light reflex to multifocal chromatic stimuli

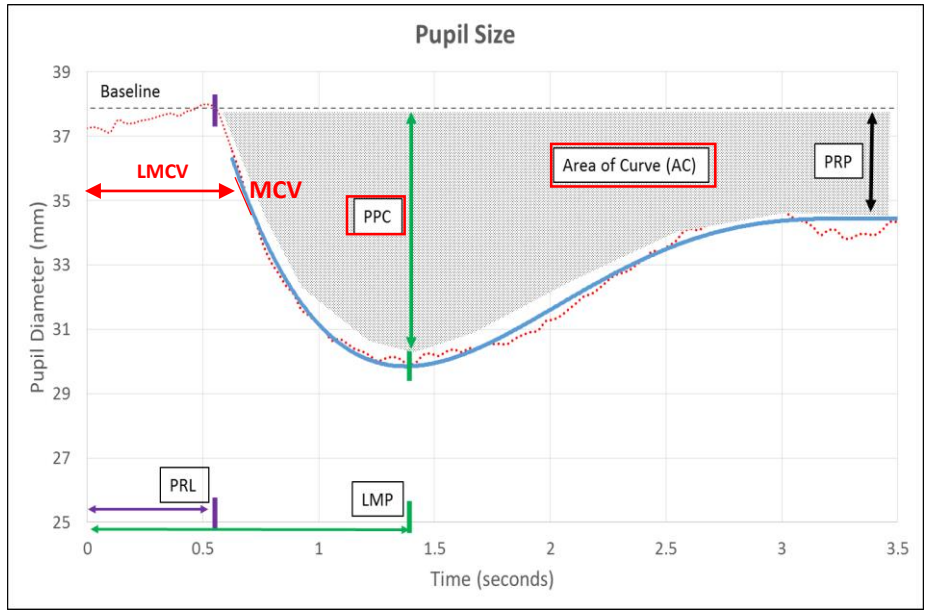
- ✓ Objective
- ✓ More informative
- ✓ Applicable to various pathologies and patients



Cell Type	Stimulus
Cones	Low-intensity red (624nm)
Rods	Low-intensity blue (485 nm)
ipRGCs	**High intensity blue (485 nm)**

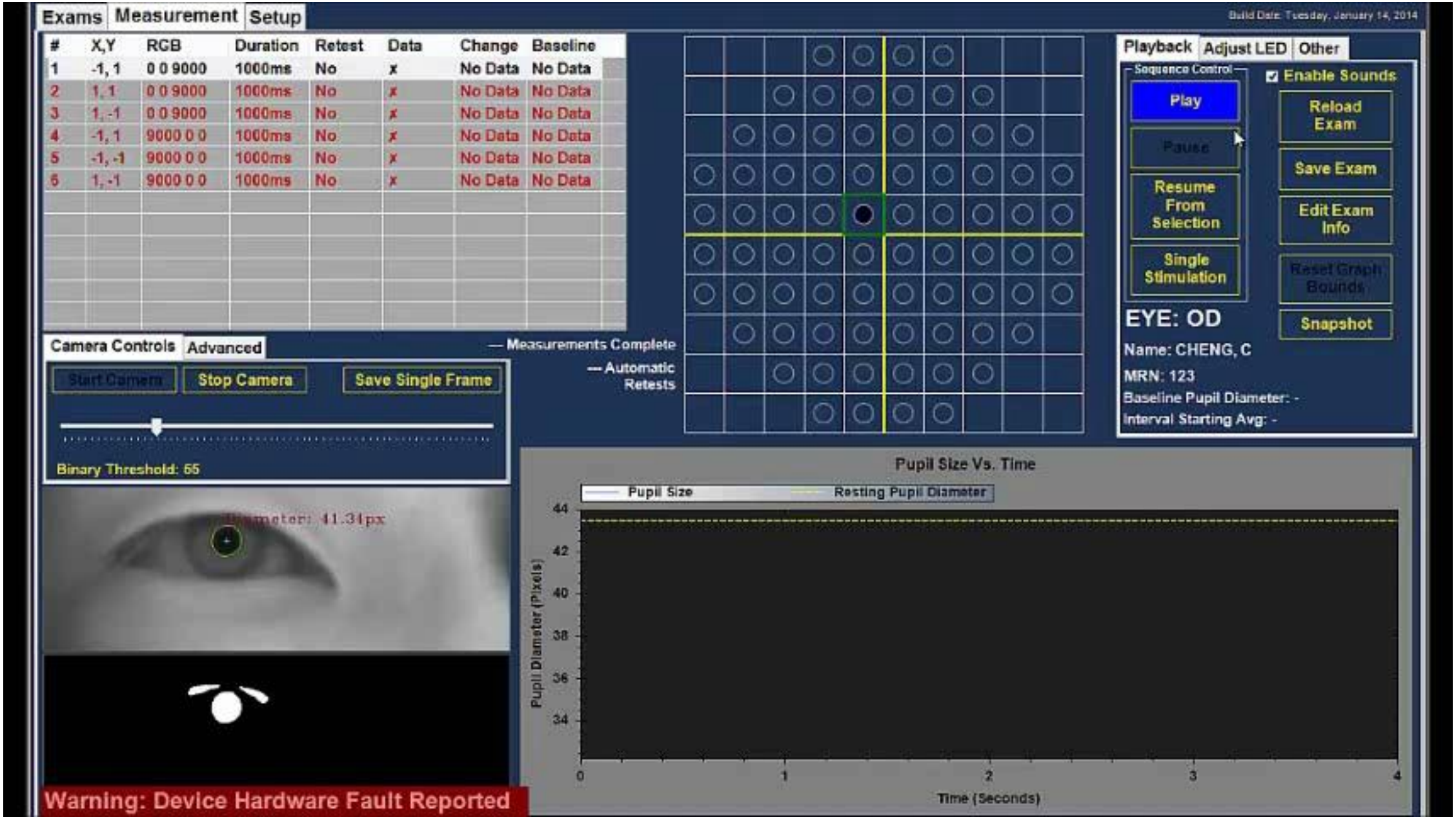
Objective Multifocal Chromatic Pupillometry (OMCP)

15 parameters



ACCUTOME® A HALMA COMPANY

PPC - % pupil contraction
LMCV – Latency of maximal contraction velocity
MCV - Maximal contraction velocity


Exams
Measurement
Setup
Build Date: Tuesday, January 14, 2014
X,Y RGB Duration Retest Data Change Baseline
1 -1, 1 0 0 9000 1000ms No x No Data No Data
2 1, 1 0 0 9000 1000ms No x No Data No Data
3 1, -1 0 0 9000 1000ms No x No Data No Data
4 -1, 1 9000 0 0 1000ms No x No Data No Data
5 -1, -1 9000 0 0 1000ms No x No Data No Data
6 1, -1 9000 0 0 1000ms No x No Data No Data
Playback
Adjust LED
Other
Sequence Control
Play
Pause
Resume From Selection
Single Stimulation
Enable Sounds
Reload Exam
Save Exam
Edit Exam Info
Reset Graph Bounds
Snapshot
EYE: OD
Name: CHENG, C
MRN: 123
Baseline Pupil Diameter: -
Interval Starting Avg: -
Camera Controls
Advanced
Start Camera
Stop Camera
Save Single Frame
Binary Threshold: 65
— Measurements Complete
— Automatic Retests
Pupil Size Vs. Time
Pupil Size
Resting Pupil Diameter
Pupil Diameter (Pixels)
Time (Seconds)
Warning: Device Hardware Fault Reported

OMCP research

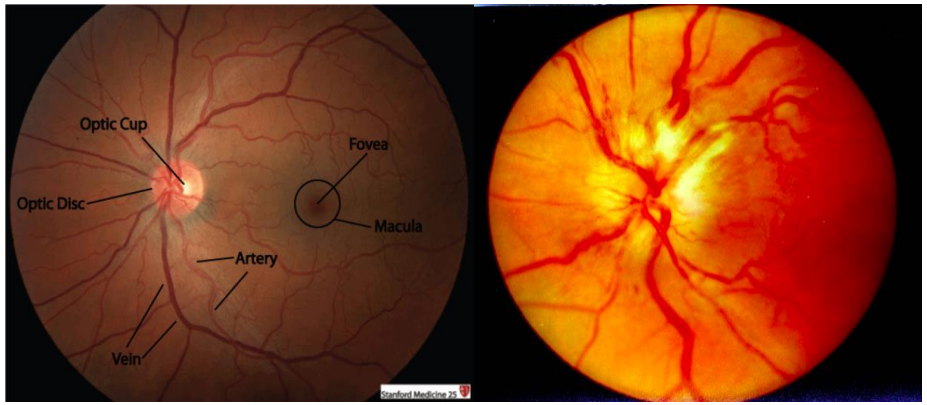
- Previous studies have demonstrated proof of concept for detection of VF defects in patients with:
    - Retinal degeneration
    - Macular dystrophies
    - Glaucoma

- Can OMCP also be effective for detecting optic neuritis?

Optic neuritis

- Unilateral acute inflammation of the optic nerve
- Manifestation of multiple sclerosis
  - Sudden painful vision loss

http://psych.ucalgary.ca/PACE/VA-Lab/Brian/acquired.htm



https://stanfordmedicine25.stanford.edu/the25/fundoscopic.html

Study goal

Utilizing OMCP to assess pupillary responses and identify subtle changes that characterize optic neuritis in the acute phase and during recovery

Study design

- Open, prospective
- 30 acute optic neuritis patients
- 30 MS patients with a history of optic neuritis
- 30 healthy age matched controls

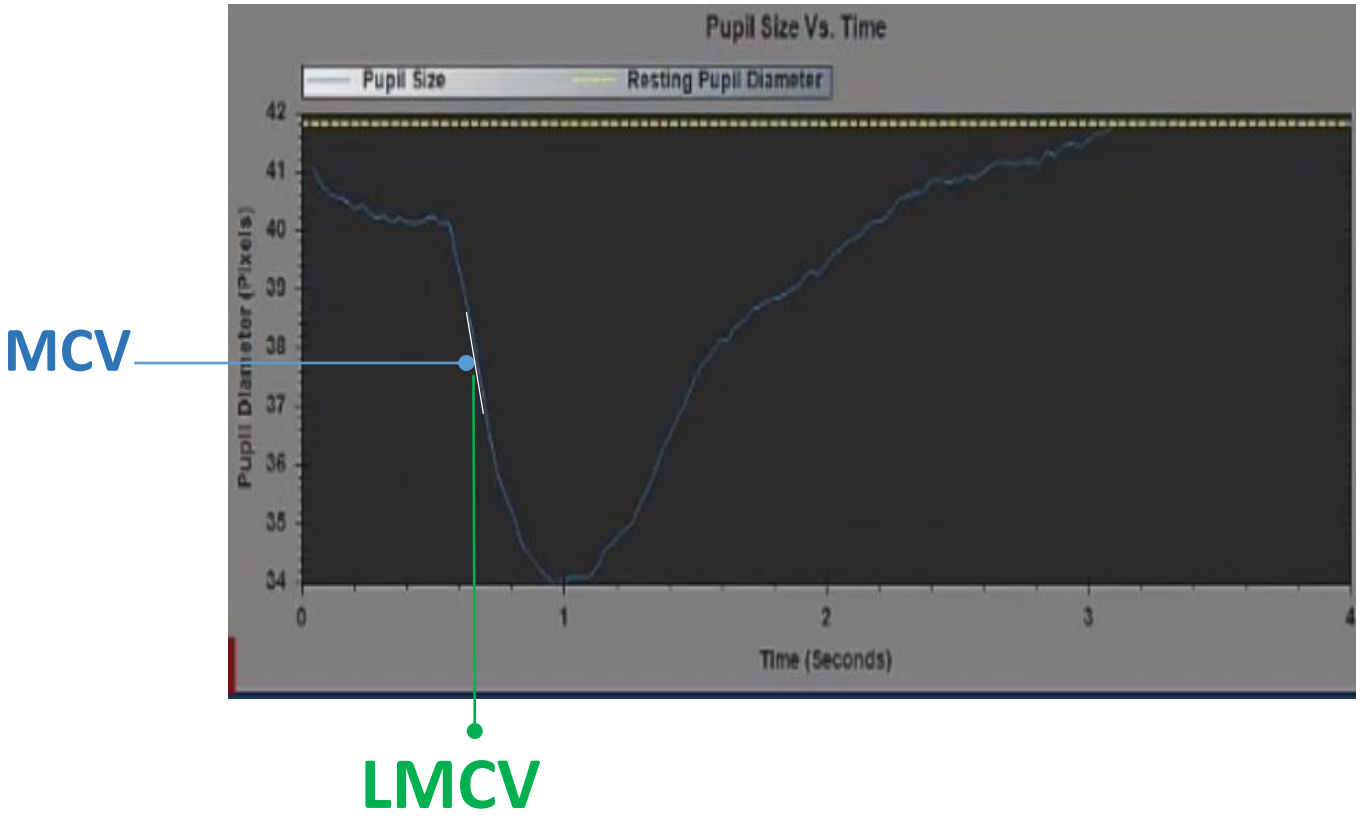
Current enrollment

- 3 acute optic neuritis patients
  - 30 to 38 years old
  - No color vision deficiencies
  - BCVA: 20/30 or better

- 6 healthy age-matched volunteers

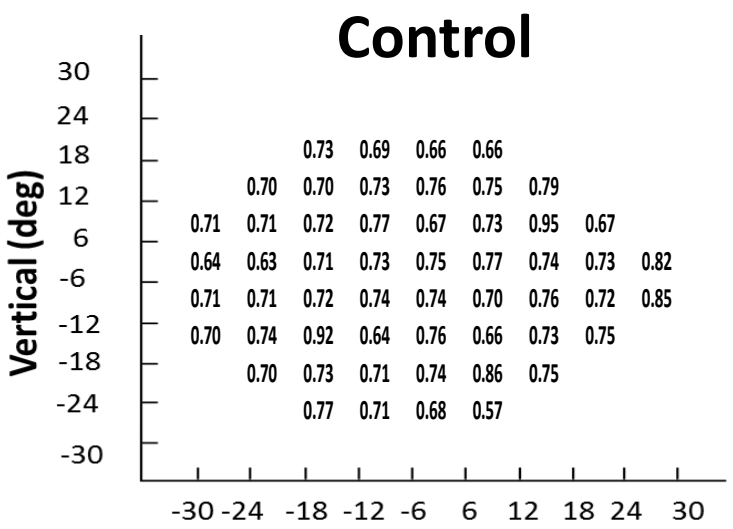
- Data collection
  - Within 24 hours of acute ON symptoms
  - After one week of steroid treatment

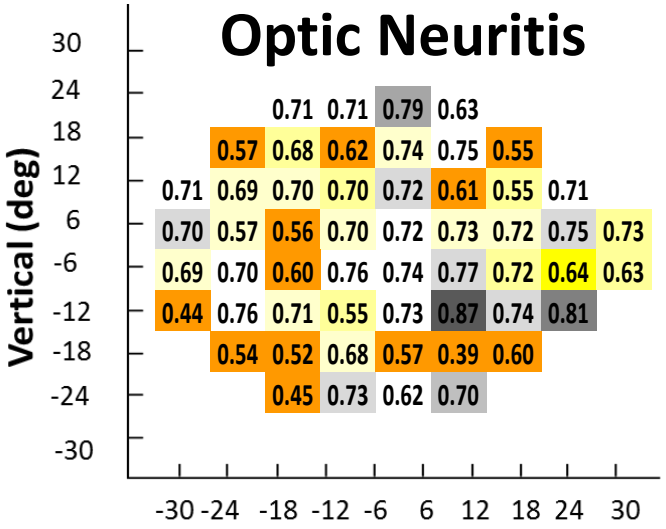
LMCV - Latency of maximal contraction velocity



Subjects with optic neuritis presented a significantly shorter LMCV in response to red (mean=0.667 sec, SE=0.013) compared with controls at baseline (mean=0.728 sec, SE=0.009, p<.0001) (OS)

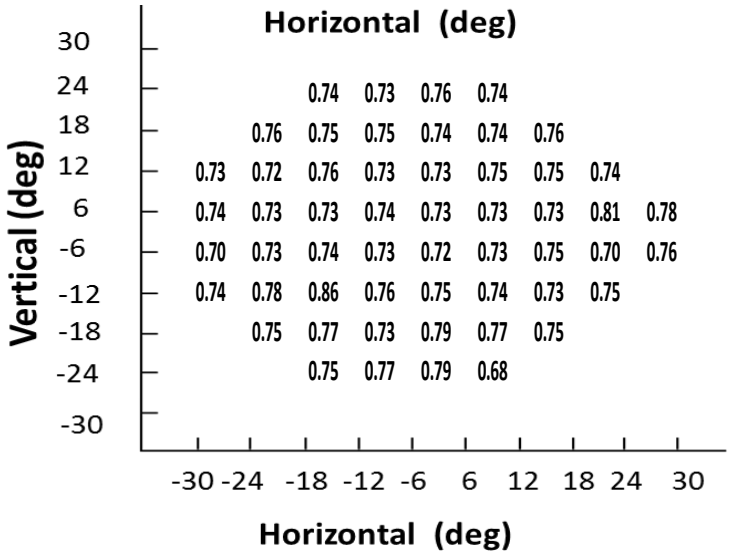
RED

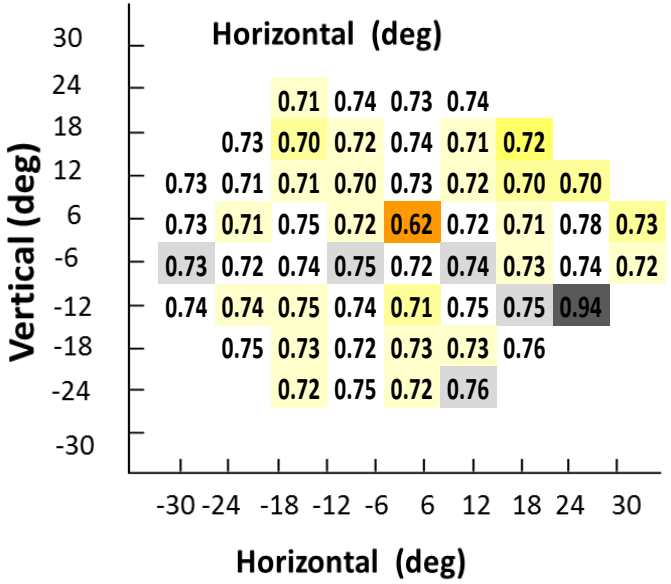




<1SE	<1SE
1SE-2SE	1SE-2SE
2SE-3SE	2SE-3SE
3SE-4SE	3SE-4SE
4SE-5SE	4SE-5SE
>5SE	>5SE

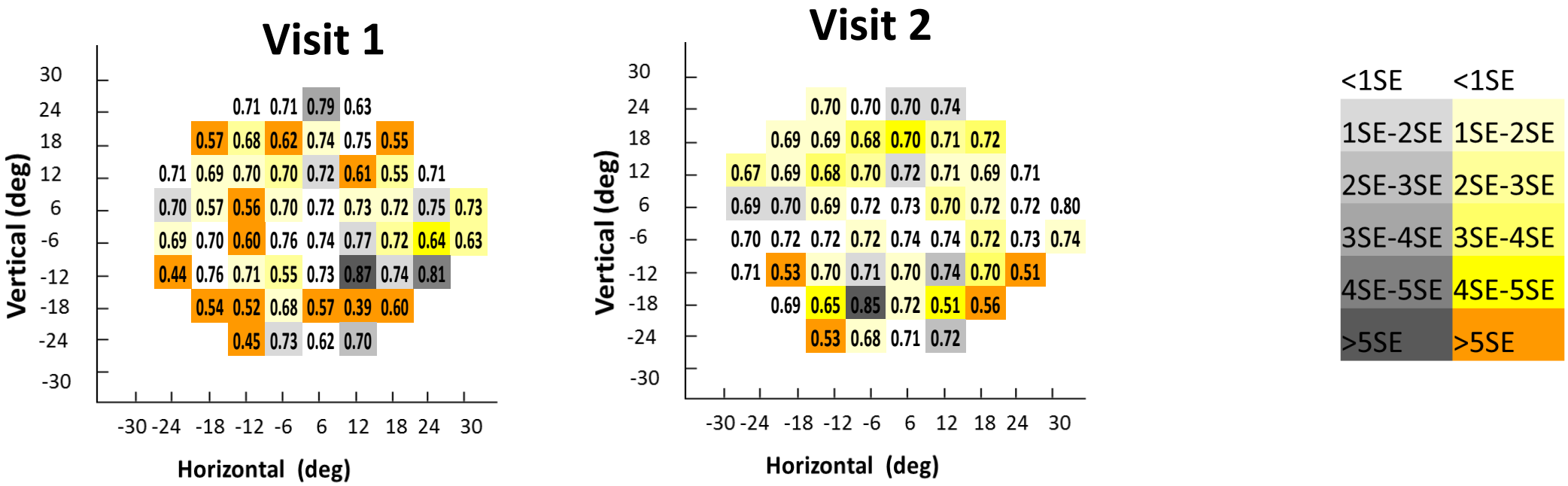
BLUE





After 1 week of steroid treatment: subjects with optic neuritis presented a significantly shorter LMCV in response to red (mean=0.694 sec, SE=0.012 p=0.01) compared with controls (OS)

RED



Summary

- This preliminary analysis demonstrates that ON patients present with significantly different pupil response kinetics to chromatic light stimuli

- Suggesting that the chromatic multifocal pupillometer may present a novel objective functional test for assessing ON patients

Future directions

- Complete enrollment and analysis of acute ON patients, MS patients and age-matched controls
- Examine the correlation with subjective visual field and optical coherence tomography (OCT) findings
- Determine the sensitivity and specificity of this novel objective visual field testing method for assessing ON disease.

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