

CMV

CONGENITAL CYTOMEGALOVIRUS
PUBLIC HEALTH & POLICY
CONFERENCE



VESTIBULAR AND BALANCE FUNCTION IN CHILDREN WITH CONGENITAL CMV

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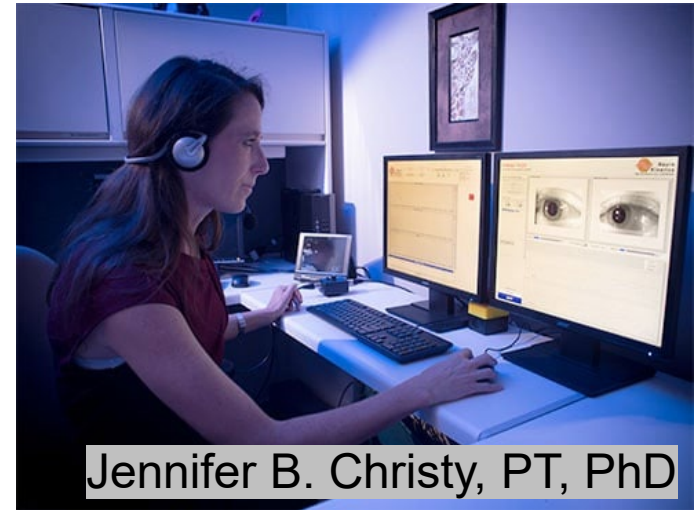
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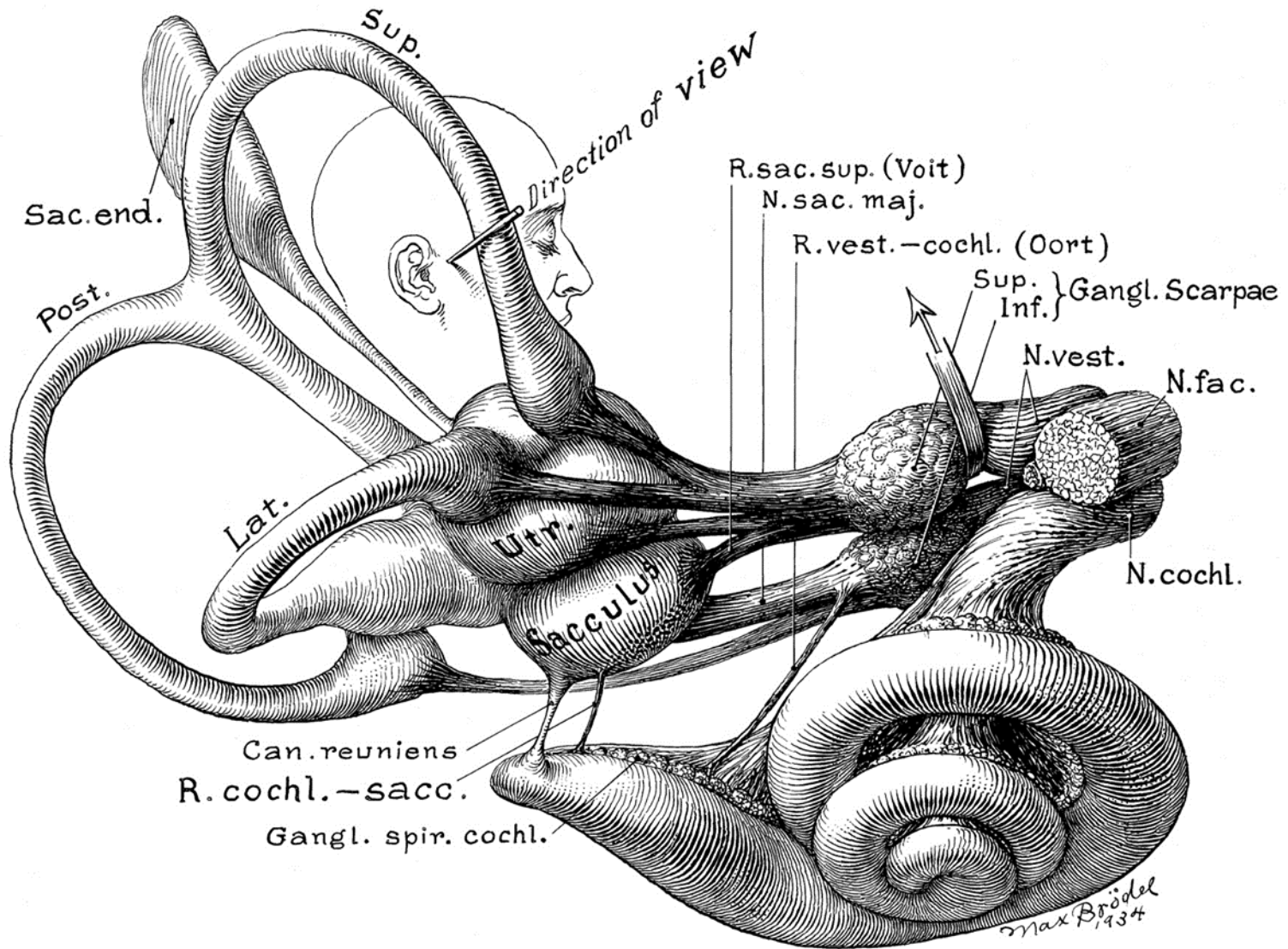
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VESTIBULAR SYSTEM FUNCTION



VESTIBULAR HYPOFUNCTION LEADS TO...

- Progressive Gross Motor Delays (Rine 2004)
- Aberrant use of vision and somatosensory information for postural control (Rine 2006)
- Inability to see clearly when the head is moving (Rine 2004, 2014)

EVIDENCE FOR VESTIBULAR DYSFUNCTION IN CHILDREN WITH CMV

- Review of temporal bone pathology in 9 infants with cCMV who died between 3 weeks and 5 months of age showed evidence of endolabyrinthitis in 5/9 infants (Stagno 1977)
- A histopathologic study of inner ears from fetuses infected with CMV showed frequent involvement of vestibular system with extensive infection of the non-sensory epithelia including the specialized dark cells (Gabrielli, 2013).

EVIDENCE: VESTIBULAR DYSFUNCTION IN CONGENITAL CMV

- In children with symptomatic cCMV who underwent cochlear implantation, balance disturbances and motor delay was found in most (88%) and only one child who underwent testing had normal function (Karlton 2014)
- Retrospective review of clinic patients in France: 92.3% of children with cCMV and hearing loss had vestibular disorders which were progressive in 50% (Bernard 2015)
 - Not related to side of hearing loss (i.e. some of the hearing ears were also damaged)
 - Not all parts of the vestibular system were damaged indicating a need for comprehensive testing
 - Comprehensive standardized balance testing was not done
- **Our hypothesis was that children with asymptomatic cCMV might also exhibit vestibular dysfunction that affects their balance and gaze stability**

HOW MIGHT A CHILD WITH VESTIBULAR DYSFUNCTION PRESENT?

- Late walking, after 15 months
- Inability to navigate compliant surfaces (e.g. sand at the beach, thick carpet, uneven surfaces at the park)
- Gravitational insecurity
 - Poor perception of where they are in space
 - Uneasy with movement (e.g. swings, climbing up a slide ladder)
- Clumsy, falling a lot
- Older kids: Difficulty with high level gross motor skills such as walking on a balance beam, playing eye-hand coordination sports.
- Difficulty reading well
- Poor perception of upright (tilted head or body)

COULD CHILDREN WITH NON-SYMPTOMATIC CMV HAVE VESTIBULAR DYSFUNCTION?

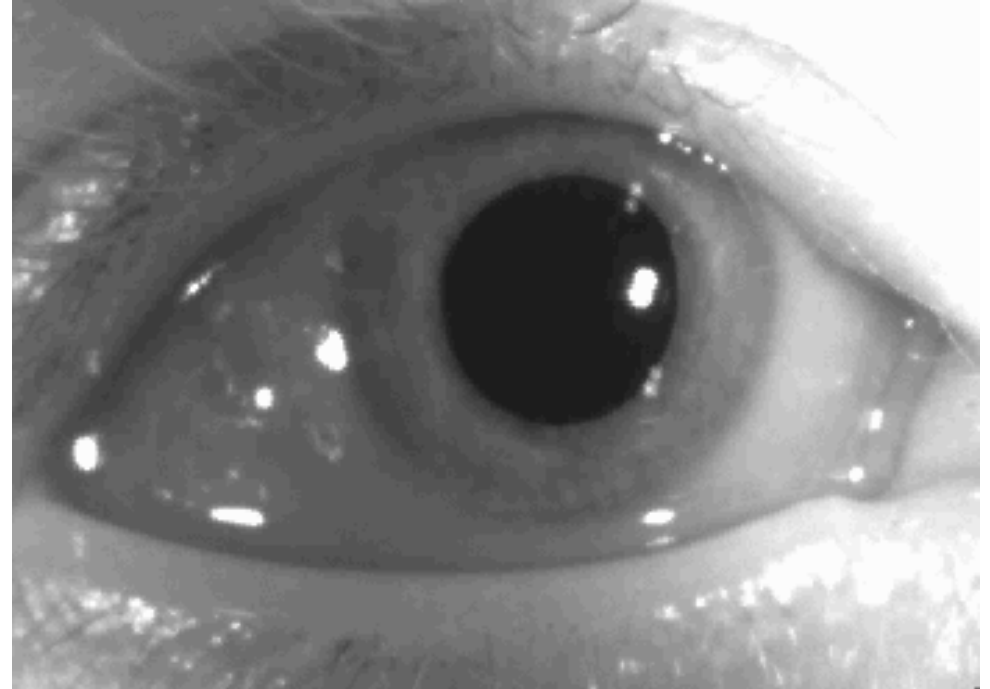
- N=40 children with cCMV, aged 5 to 10 years (mean age= 7.5)
- 20 MALES/ 20 FEMALES
- Recruited from database of children with CMV from the CHIMES study at UAB.
- Only 1 with evidence of hearing loss
- All asymptomatic otherwise
- No evidence of cognitive delay or other neurologic deficits
- None of the children had undergone vestibular function testing or physical therapy evaluation.

ROTARY CHAIR TESTING OF THE VOR

- Vestibulo-Ocular Reflex (VOR):
Sinusoidal Harmonic Acceleration (SHA) at slow and fast frequencies;
Step rotation at 100 deg/sec
- Vestibulo-Visual Interaction:
Subjective visual vertical and horizontal (SVV). VOR cancellation and visual enhancement

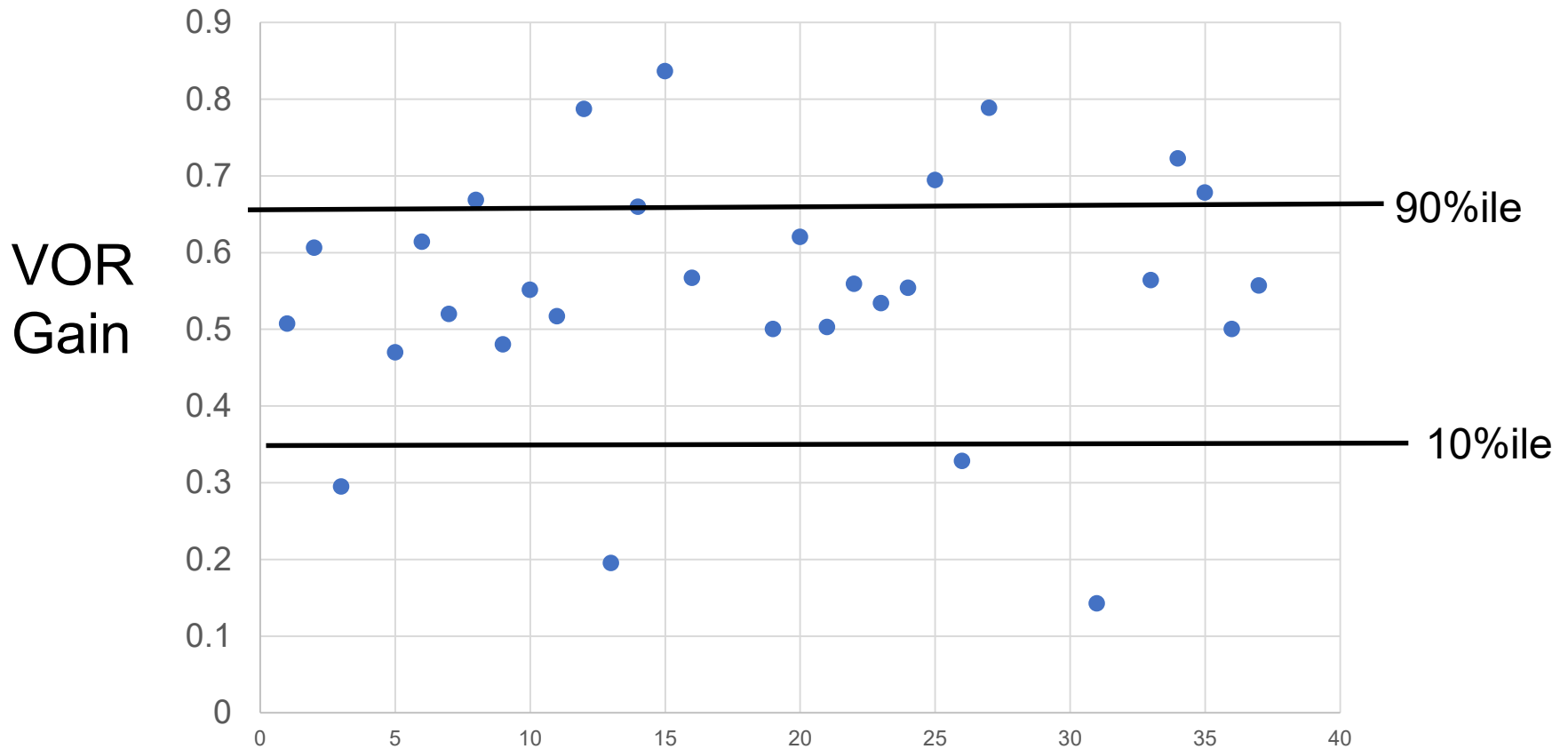


SLOWER SINUSOID (0.04 HZ)

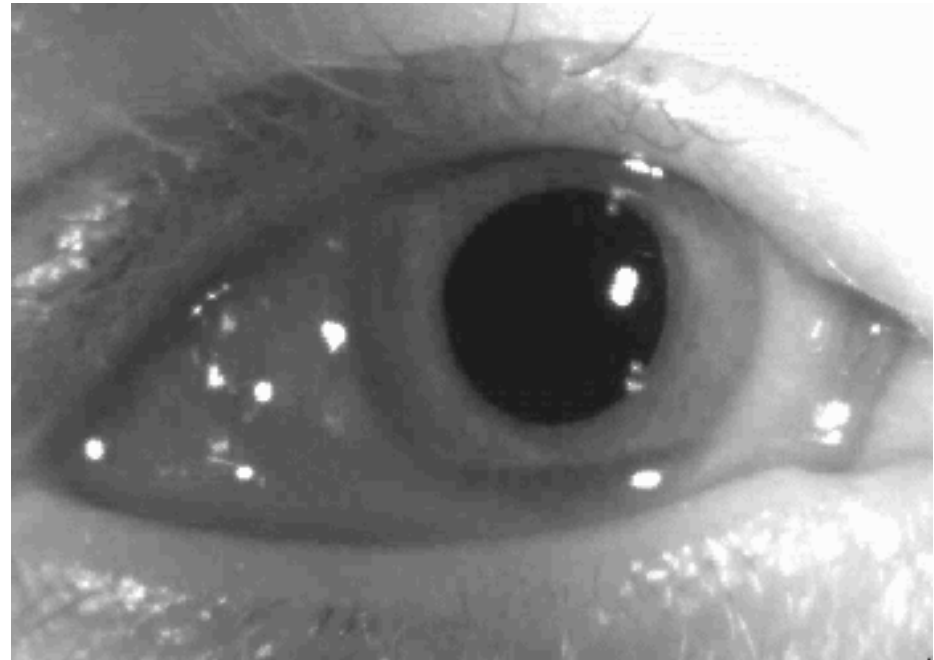


Sinusoidal Harmonic Acceleration (0.02 Hz)

11/30 abnormal (36.67%)

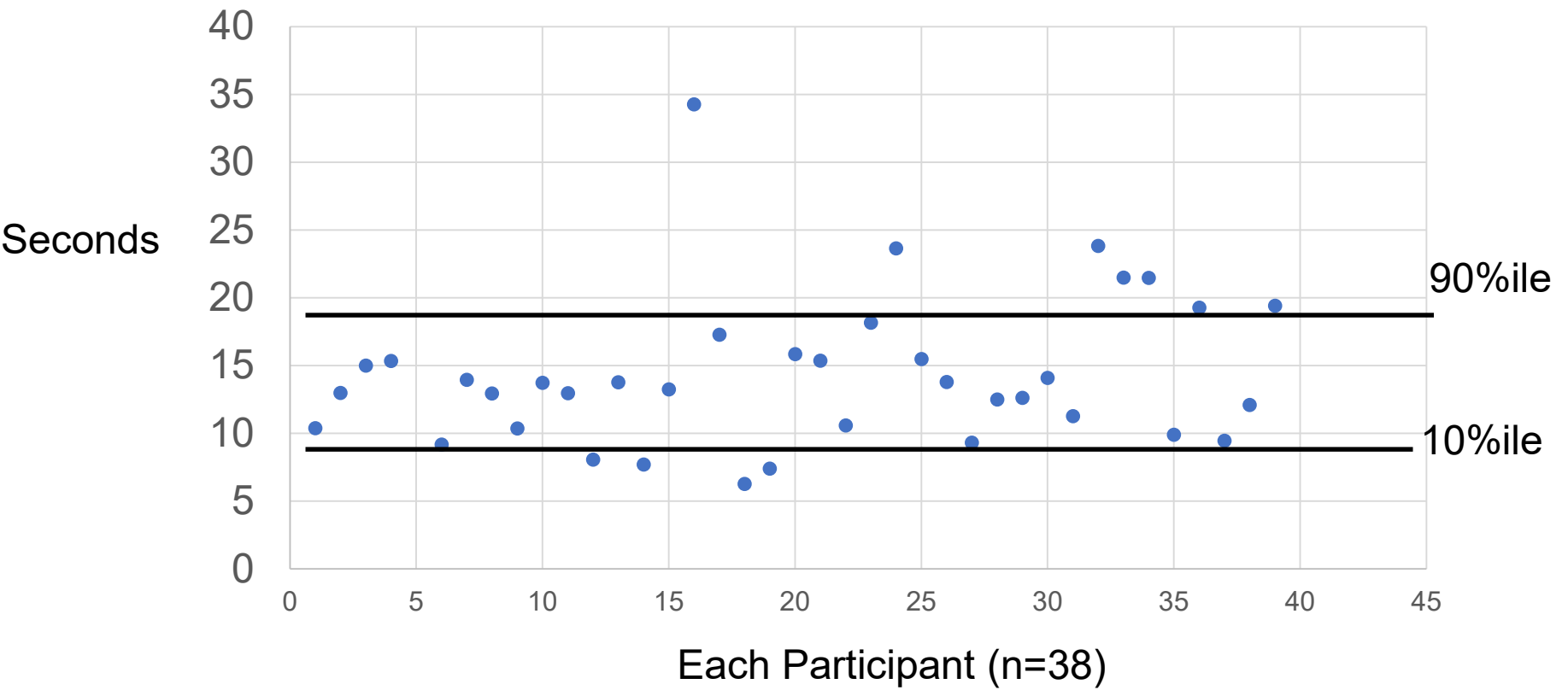


STEP TEST @ 100 DEG/SEC

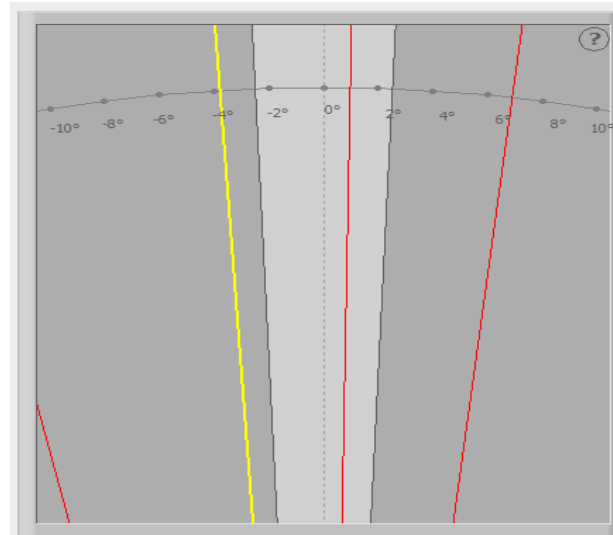
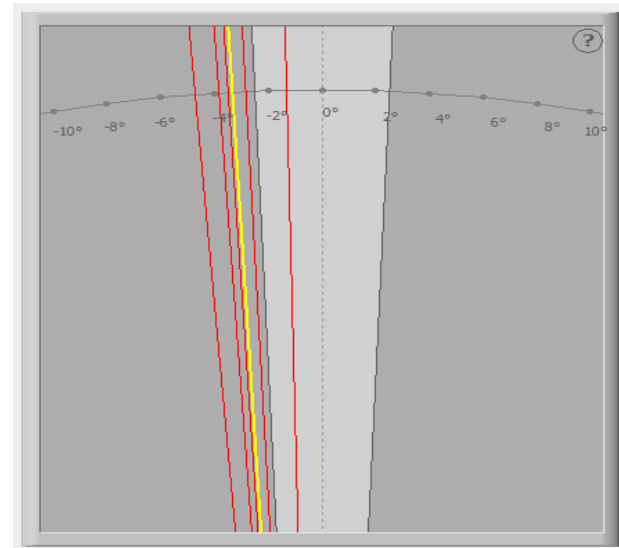


Vestibular Time Constant (100 deg/sec)

10/38 were abnormal (26%)

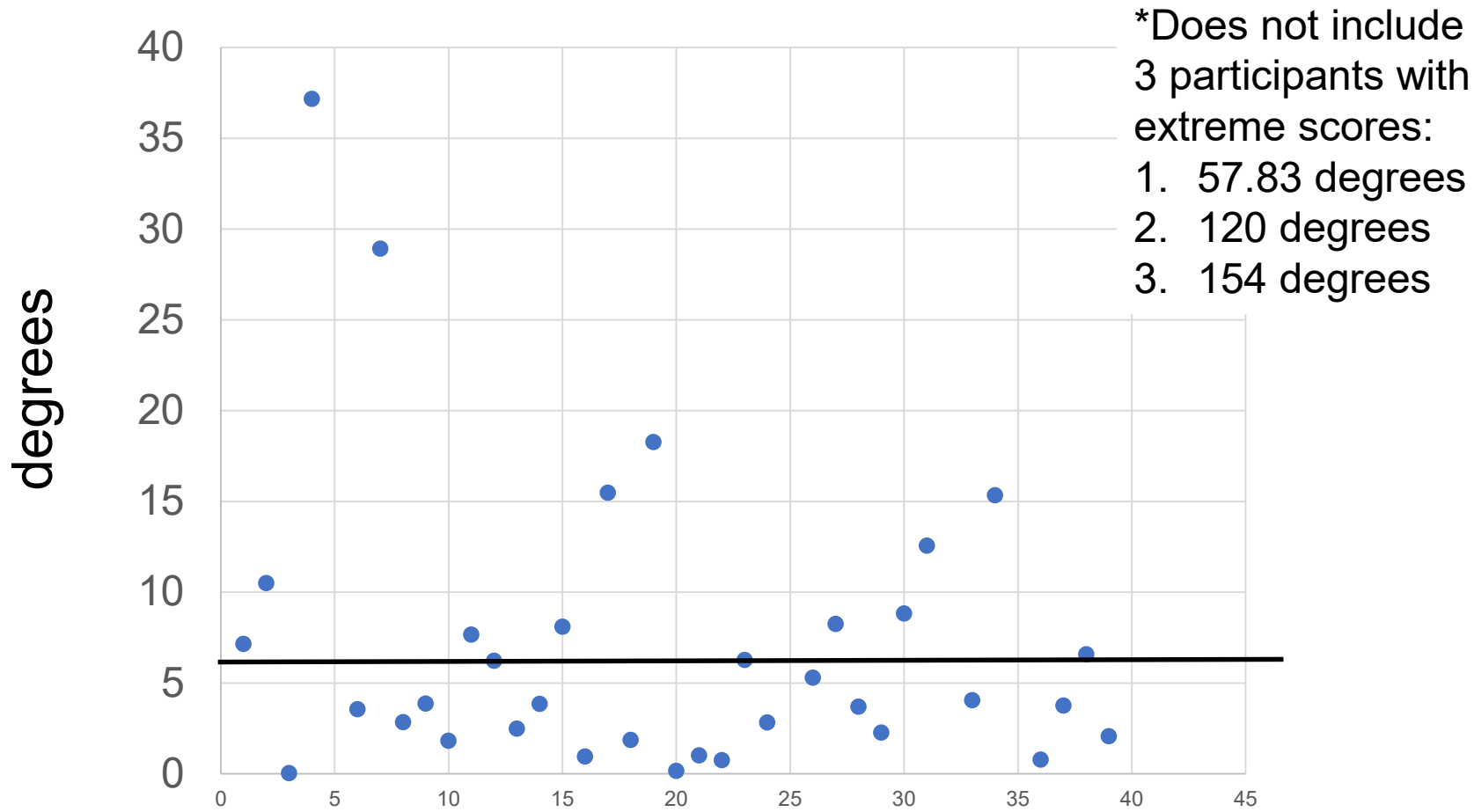


Subjective Visual Vertical (SVV)



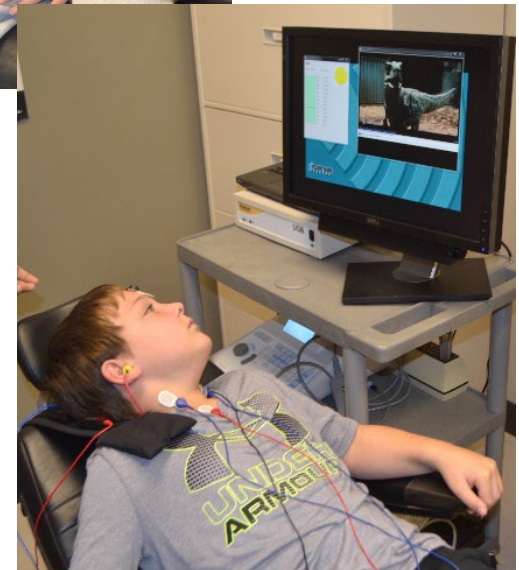
SUBJECTIVE VISUAL VERTICAL VARIANCE

16/35 had abnormal SVV (45.7%)

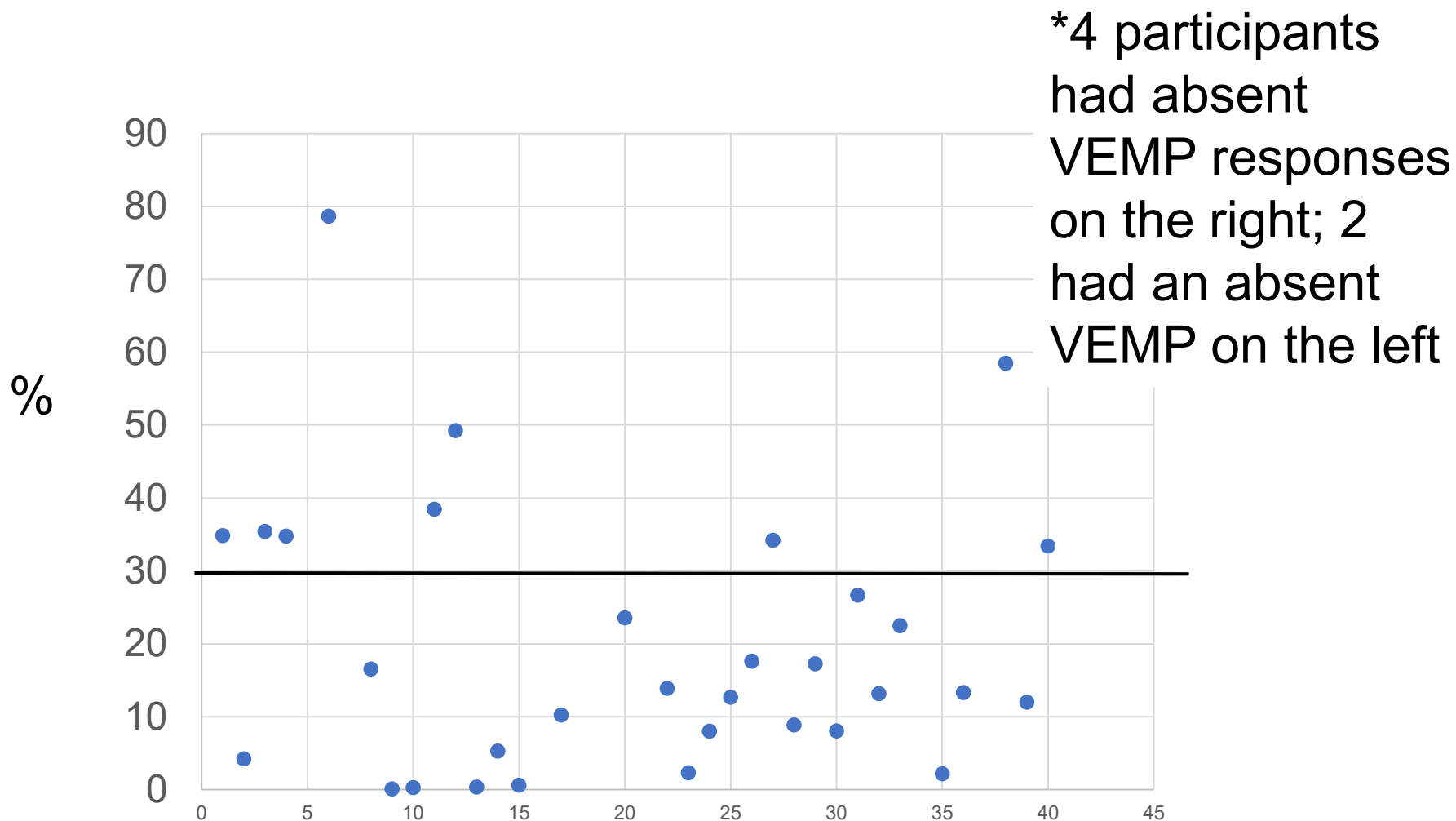


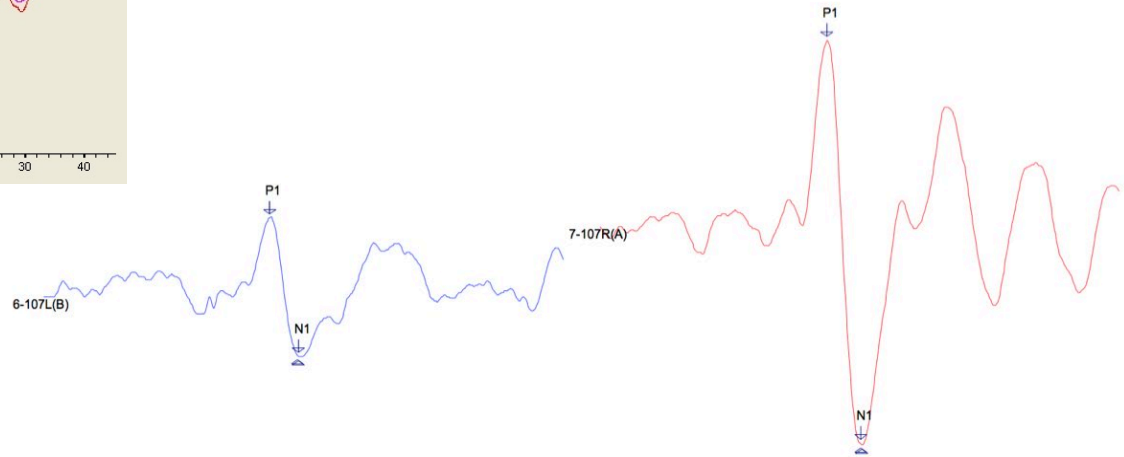
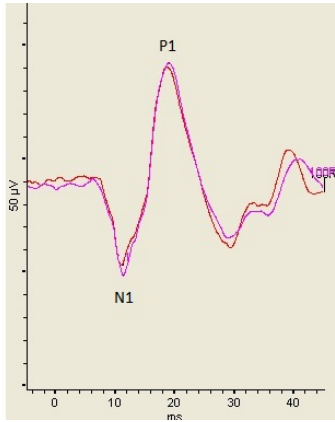
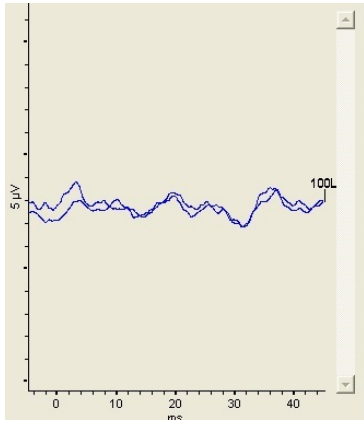
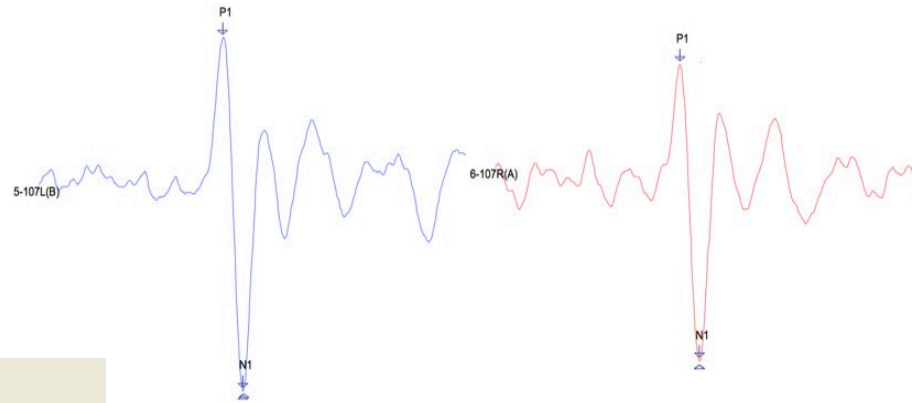
Methods: Cervical Vestibular Evoked Myogenic Potential (C-VEMP)

- A neurophysiological assessment technique used to determine the function of the otolith organs (i.e. saccule) of the inner ear.
- The participant's SCM muscle was recorded using EMG while pure tone bursts via an earphone to the ear ipsilateral to the SCM being activated.



C-VEMP CORRECTED ASYMMETRY RATIO: 15/32 WERE ABNORMAL (47%)



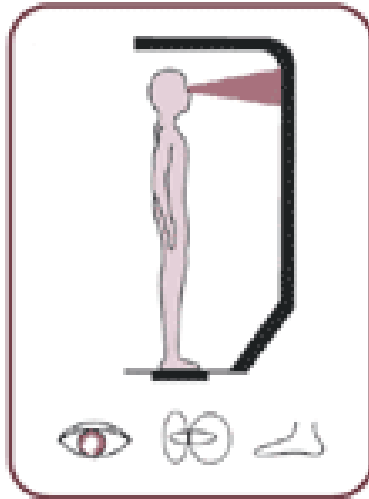


Methods: Sensory Organization Test (SOT)

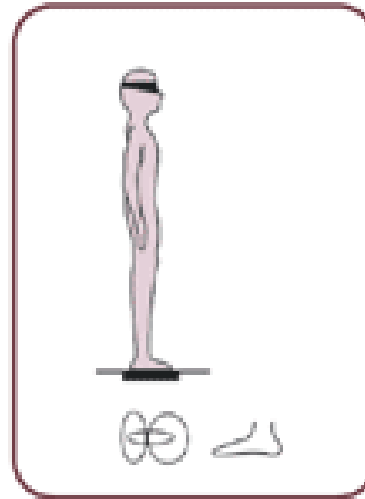
- SMART EquiTest (Natus Medical, Inc). The participants were tested on 6 conditions.
- Effectiveness ratios were calculated & compared to published norms*
 - Visual ratio: condition 4/1
 - Somatosensory ratio: condition 2/1
 - Vestibular ratio: condition 5/1



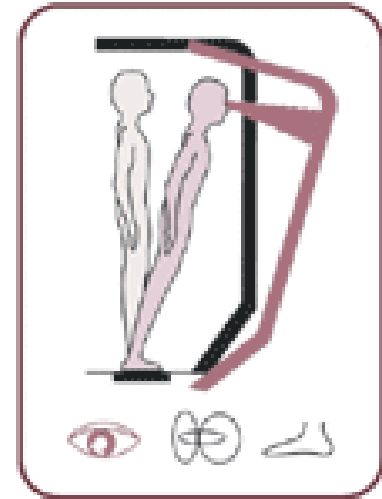
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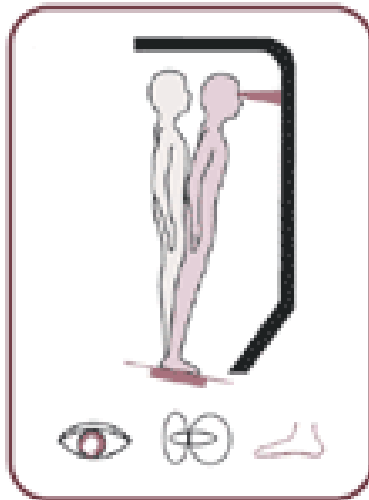
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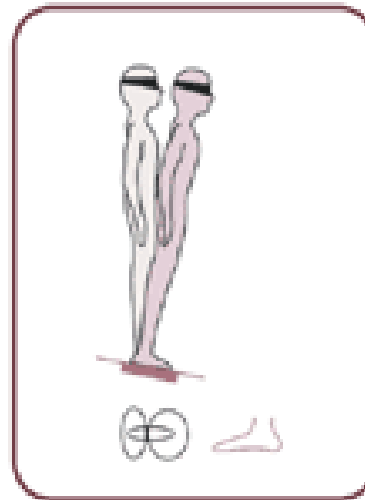
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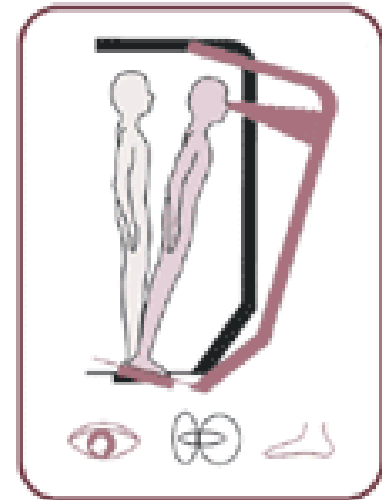
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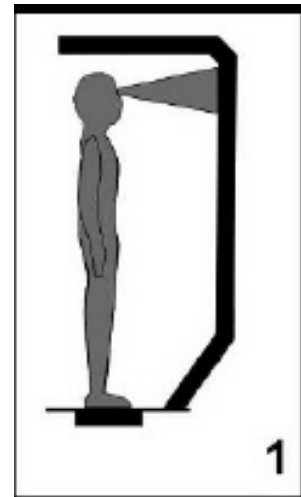
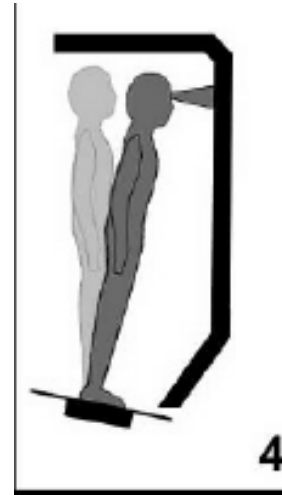


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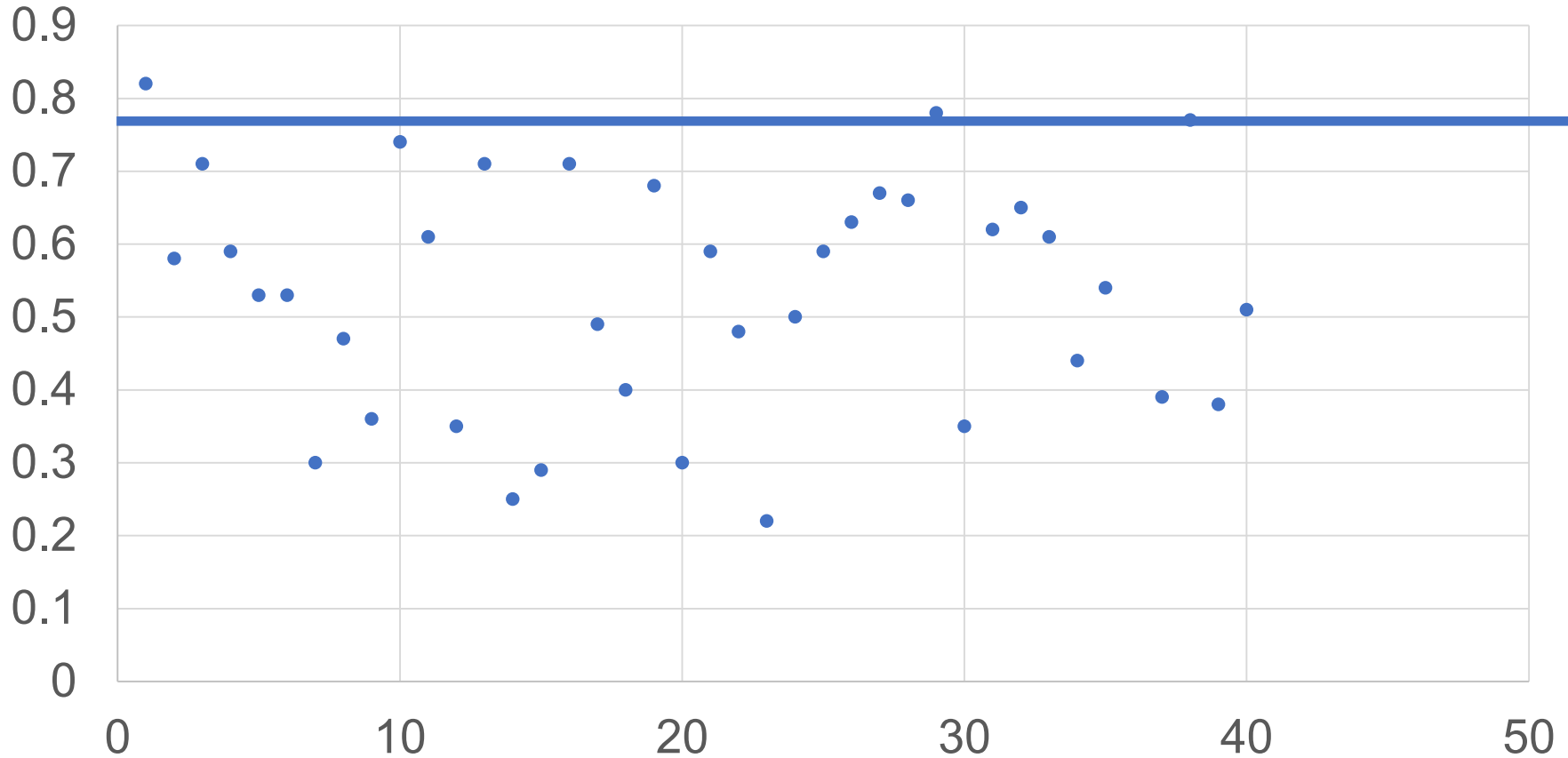
Sensory Organization Test

POSTURAL CONTROL: VISUAL RATIO

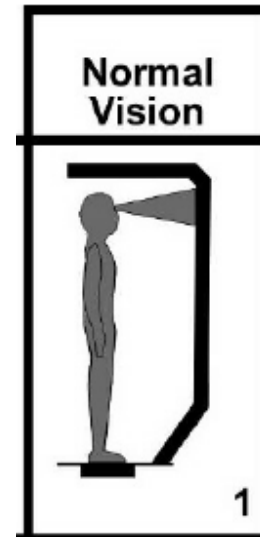
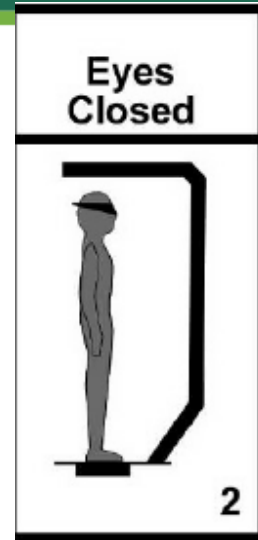


VISUAL RATIO: CUT-OFF IS <math><0.76</math>; 92.3% ABNORMAL. 7 PARTICIPANTS STEPPED

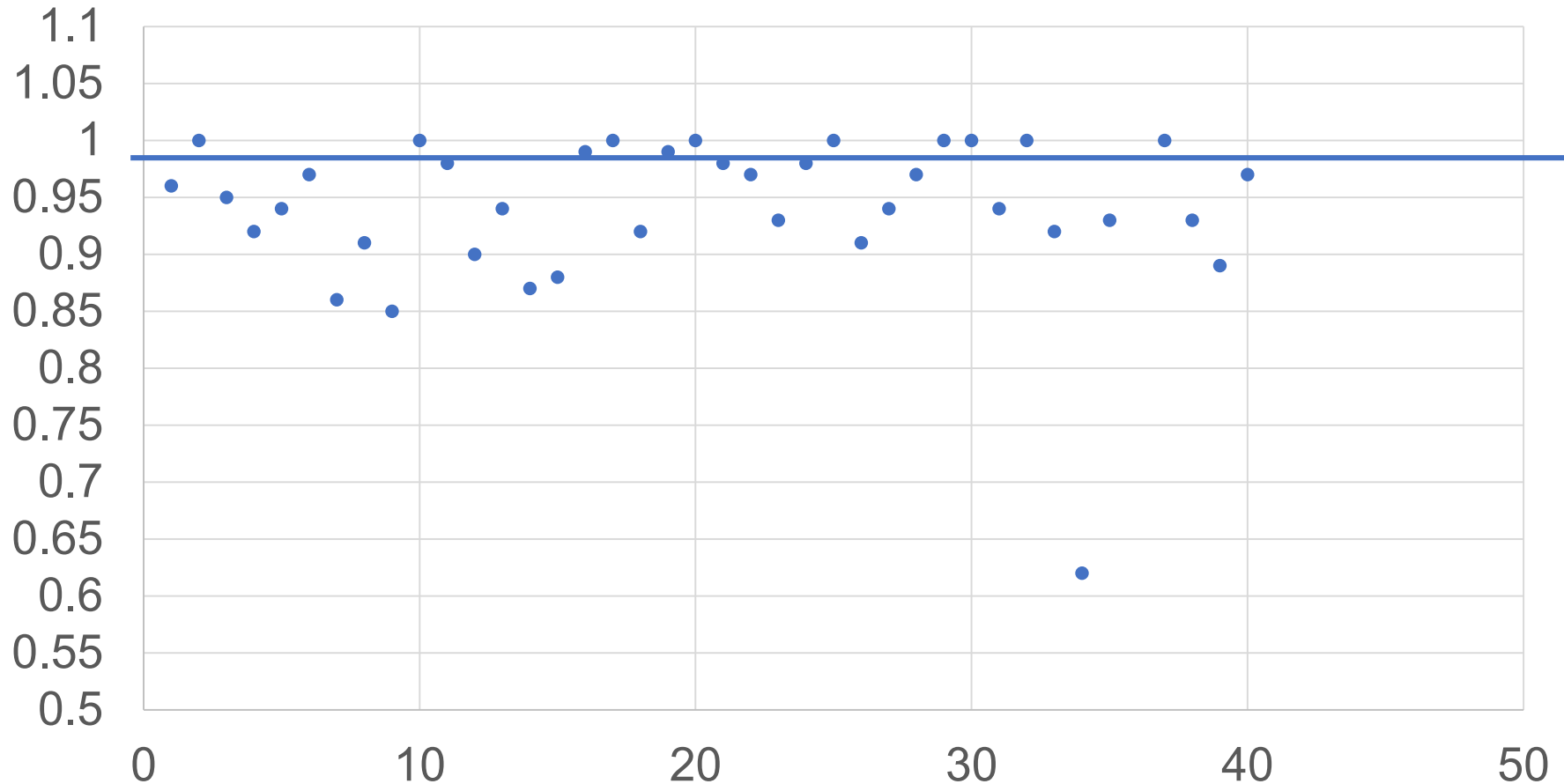
VISUAL RATIO



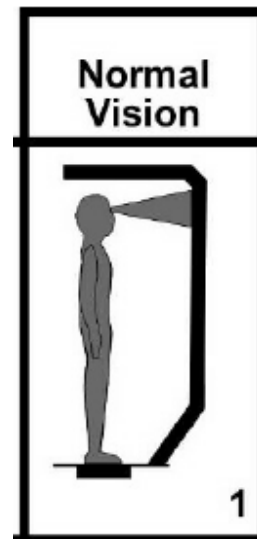
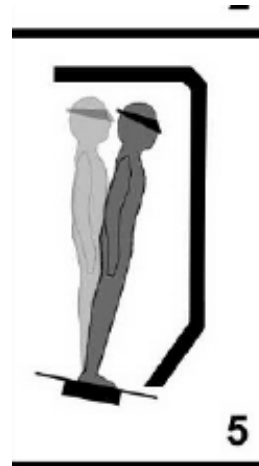
SOMATOSENSORY RATIO: CUT-OFF IS <math><0.98</math>

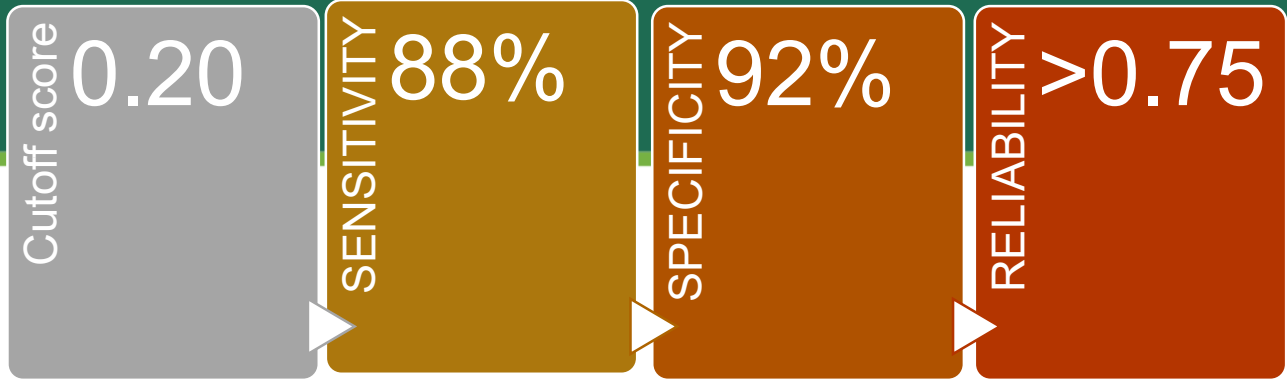


SOMATOSENSORY RATIO. CUT-OFF <0.98. 64% WERE ABNORMAL

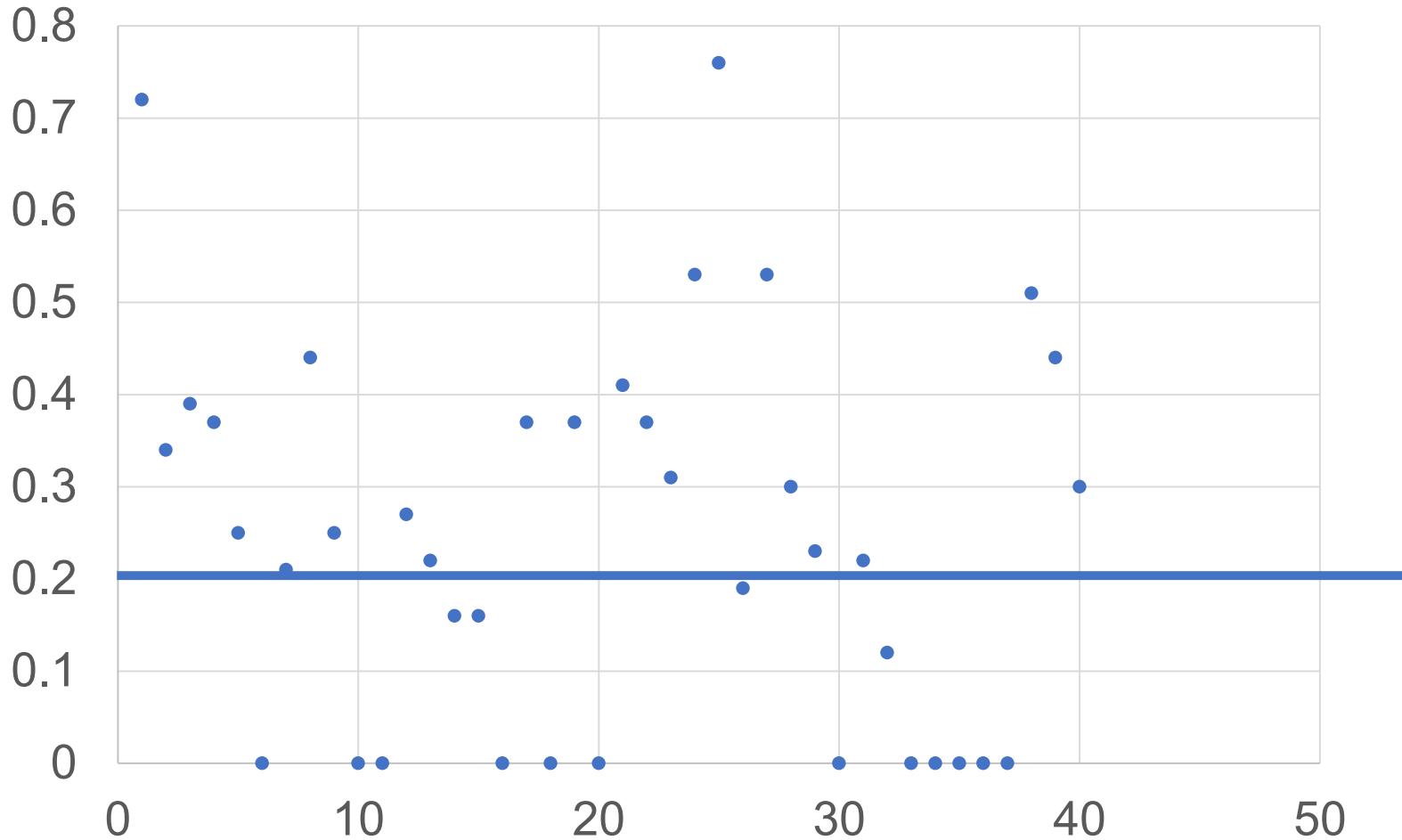


VESTIBULAR RATIO. CUT-OFF IS < 0.20



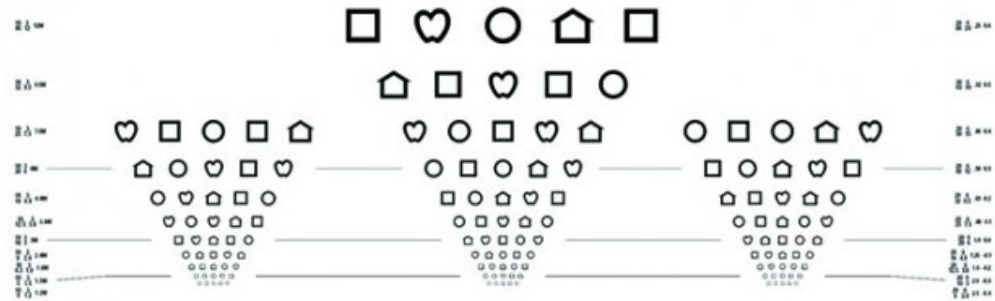


VESTIBULAR RATIO: 38.5% ABNORMAL. 25 STEPPED OR FELL



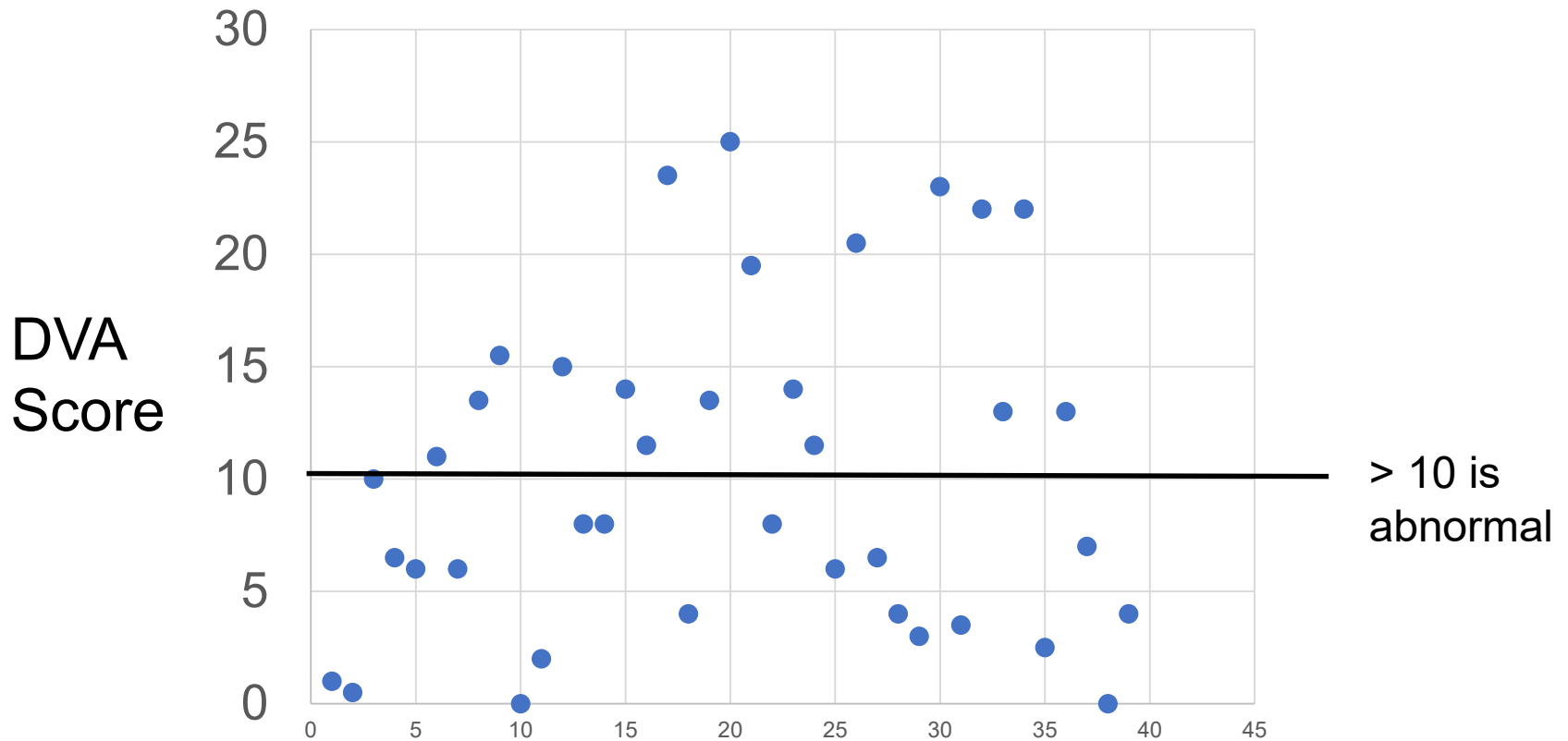
Clinical Dynamic Visual Acuity test (DVA)

- Tests the ability to use the vestibulo-ocular reflex (VOR) in a functional way.
- The difference in optotypes viewed during static visual acuity and visual acuity during 2 Hz passive head movement in yaw plane was measured.



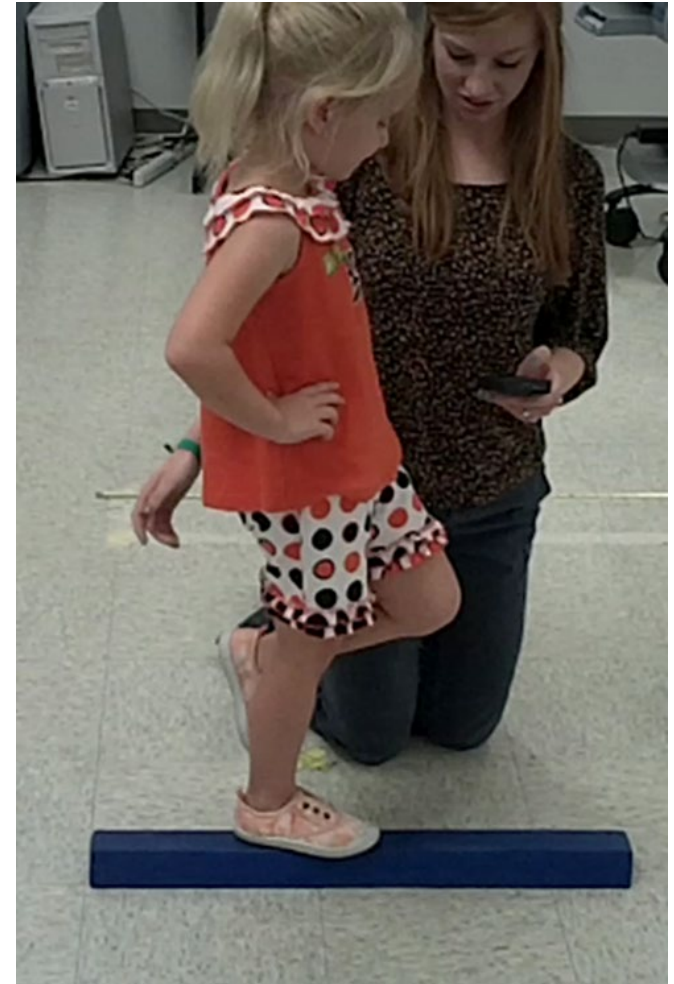
CLINICAL DYNAMIC VISUAL ACUITY

18/39 Abnormal (46%)



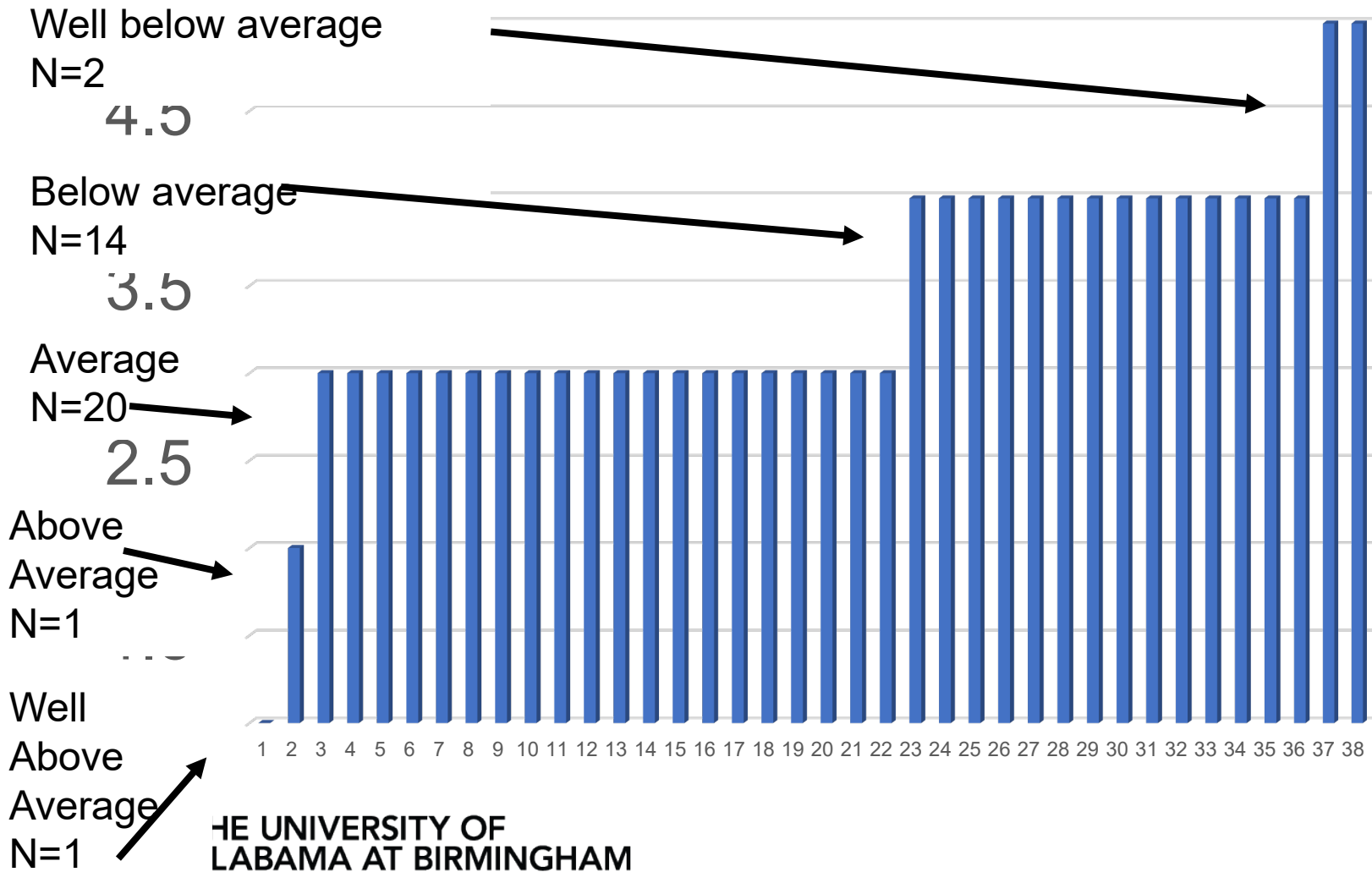
BRUININKS-OSERETSKY TEST OF MOTOR PROFICIENCY

- Standardized test for children ages 4-21 years
- Balance subscale (10 items):
 - Standing with feet apart on line with eyes opened and closed
 - Walking forward on a line
 - Standing on 1 leg on a line with eyes opened and closed
 - Walking tandem on a line
 - Standing on 1 leg on a balance beam with eyes opened and closed
 - Standing tandem on a balance beam with eyes opened and closed



BOT-2 Balance Subscale Standard Scores

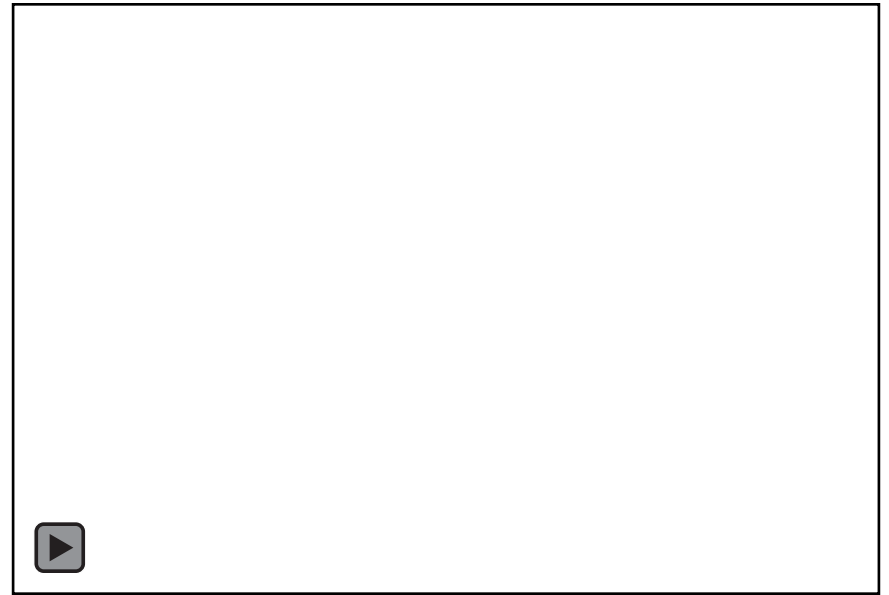
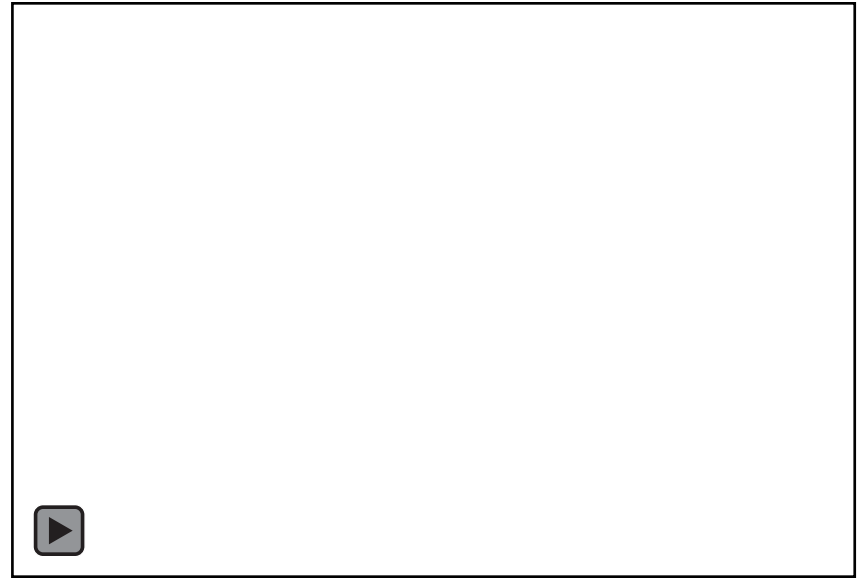
N= 16/38 (42%) scored below or well below average



CONCLUSIONS AND CLINICAL IMPLICATIONS

- Although children with cCMV may be asymptomatic, they should be monitored for vestibular related impairments
- It is recommended that children with cCMV receive vestibular function testing and referred for a physical therapy evaluation when the child has:
 - Delay of walking > 15 months of age
 - Clumsiness or frequent falling
 - Complaints of blurry vision, not explained by visual acuity
 - Balance problems, especially when in the dark and/or on compliant surfaces
 - Poor tolerance of movement (e.g. motion sensitivity)
 - CMV related sensorineural hearing loss

VESTIBULAR REHABILITATION: BALANCE TRAINING



VOR TRAINING: READING WHILE BOUNCING



VOR TRAINING: IDENTIFY PICTURES WHILE JUMPING




NET SWING TO GET HEAD MOVEMENT



VOR TRAINING: TURN THE HEAD AS THE CHILD READS WORDS USING POWERPOINT



- 
- Discounted Registration Rate for Parents
 - cCMV Focused Program April 7 – 9, 2019
 - National CMV Foundation Presentation during Opening Session on Sunday April 7, 2019

CMV2019

Birmingham, Alabama
07-11 April 2019

7th International Congenital CMV Conference &
17th International CMV Workshop

Important Dates

Monday, 01 October 2018: Registration and Abstract Submission Sites Open
Friday, 30 November 2018: Early Registration & Abstract Submission Deadline
Friday, 11 January 2019: Abstract Disposition Notices Sent
Friday, 22 February 2019: Standard Registration & Cancellation Deadline
Sunday, 07 April 2019: See you in Birmingham!

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