

DRE Update Training: Eye Movements & Pupils

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Chelan, WA
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Introduction

- Goals
 - To understand eye movements and pupil responses in general
 - To understand the various tests of eye movements and pupil responses, and why they work
 - To review other possible causes of abnormal eye movements and pupil responses
 - To prepare you for defense arguments

Introduction

- Aspects of visual function
 - Eye Movements
 - Pupil Responses
 - Visual Acuity
 - Contrast Sensitivity
 - Accommodation
 - Flicker Sensitivity
 - Stereovision
 - Vernier Acuity
 - Motion Sensitivity
 - Color Vision
 - Light Adaptation
 - Dark Adaptation
 - Visual Field

Eye Movements & Driving

Scanning Roadway



Eye Movements & Driving

Viewing in Mirrors



Eye Movements & Driving

Observing Traffic Signs & Signals



Eye Movements & Driving

- Reading Dashboard Indicators



Eye Movements & Driving

- Identifying Peripheral Objects



Eye Movements & Driving

- Dilated Pupils in Daytime



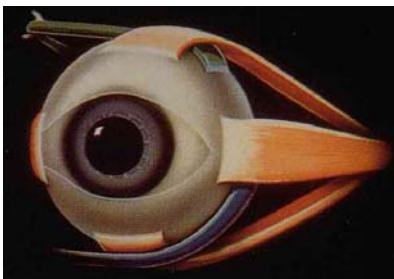
Eye Movements & Driving

- Constricted Pupils at Night



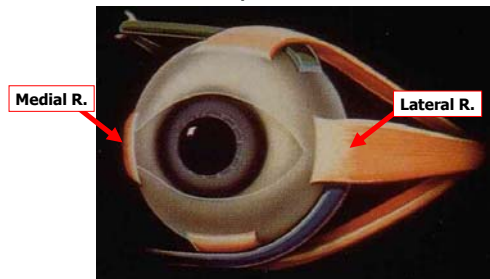
Anatomy & Physiology: The Eye & Related Structures

- Extraocular Muscles



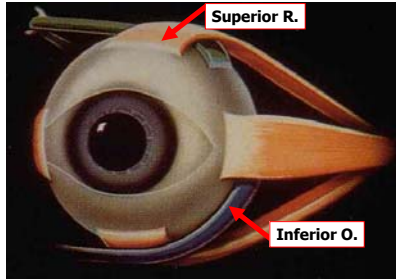
Anatomy & Physiology: The Eye & Related Structures

- Horizontal eye movements – L & R



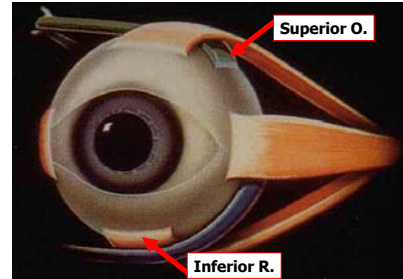
Anatomy & Physiology: The Eye & Related Structures

- Vertical eye movement - Elevation



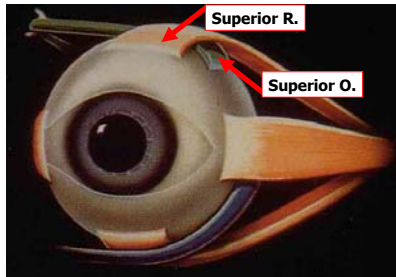
Anatomy & Physiology: The Eye & Related Structures

- Vertical eye movement - Depression



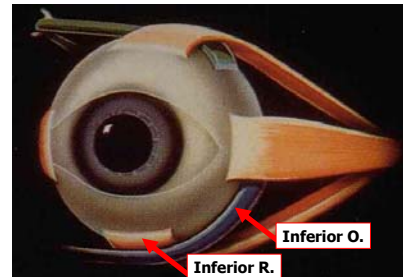
Anatomy & Physiology: The Eye & Related Structures

- Rotation eye movement - Incycloduction



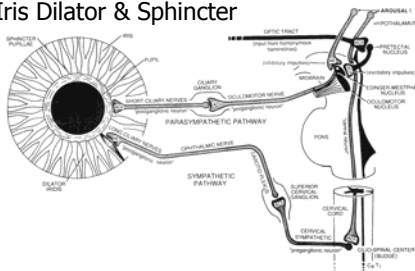
Anatomy & Physiology: The Eye & Related Structures

- Rotation eye movement - Excycloduction



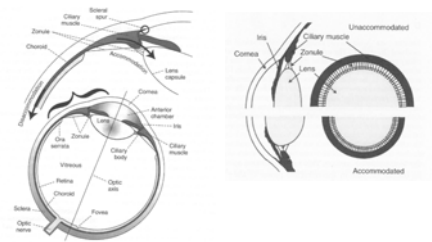
Anatomy & Physiology: The Eye & Related Structures

- Intraocular Muscles – Pupil
 - Iris Dilator & Sphincter



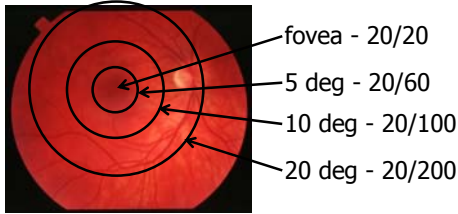
Anatomy & Physiology: The Eye & Related Structures

- Intraocular Muscles – Accommodation
 - Ciliary Muscle (Body)



Anatomy & Physiology: The Eye & Related Structures

- Photoreceptors
 - Location & Visual Acuity



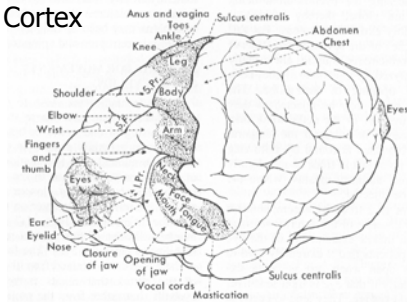
Anatomy & Physiology: Central Nervous System

- Major Components
 - Cortex (Cerebrum)
 - Brainstem
 - Cerebellum
- Cerebrospinal Fluid



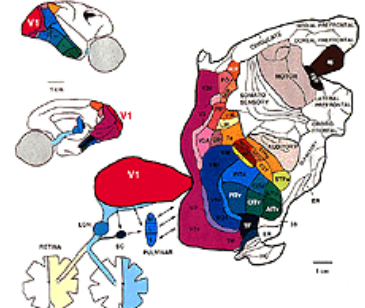
Anatomy & Physiology: Central Nervous System

- Cortex



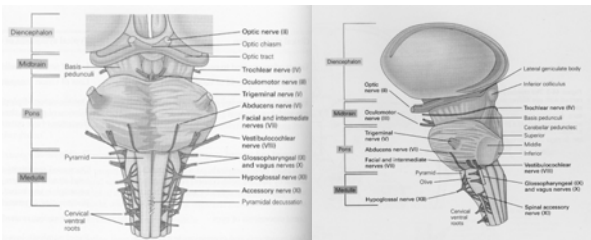
Anatomy & Physiology: Central Nervous System

- Visual Cortex



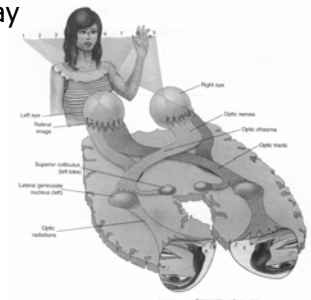
Anatomy & Physiology: Central Nervous System

- Brainstem



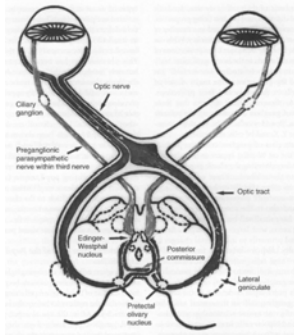
Anatomy & Physiology: Central Nervous System

- Visual Pathway



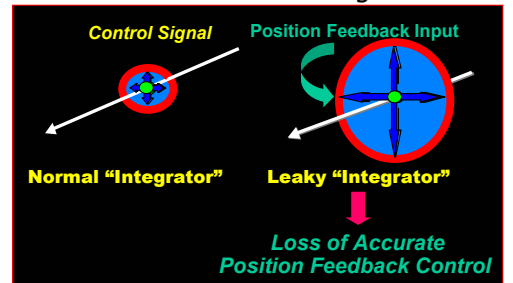
Anatomy & Physiology: Central Nervous System

- Pupillary Light Reflex



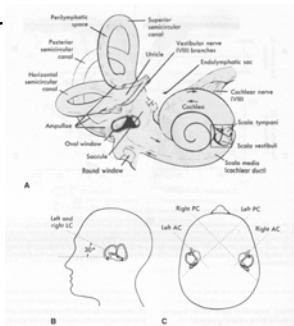
Anatomy & Physiology: Central Nervous System

- Cerebellum – Neural Integrator



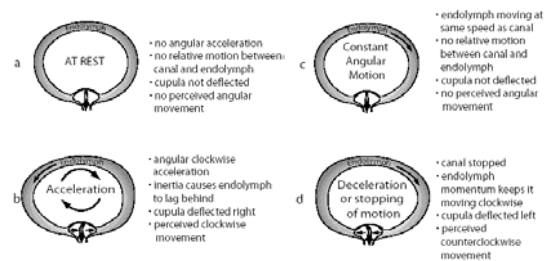
Anatomy & Physiology: Other Sensory Inputs

- Vestibular System



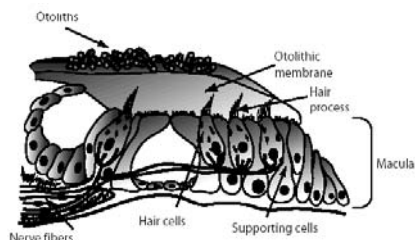
Anatomy & Physiology: Other Sensory Inputs

- Mechanical Action of Semicircular Canals



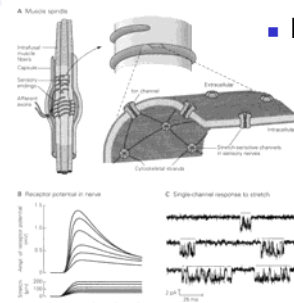
Anatomy & Physiology: Other Sensory Inputs

- Mechanical Action of Otolith Organs



Anatomy & Physiology: Other Sensory Inputs

- Proprioception

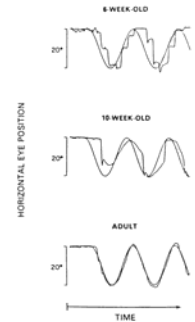


Anatomy & Physiology: Other Sensory Inputs

- Exercise: Vision, Balance & Proprioception
 1. Stand with feet together and fixate a small object or detail across the room
 2. Raise either leg, record time until loss of balance
 3. Construct two narrow tubes using loose pages
 4. Stand with feet together and fixate small object across room while looking through tubes (one in front of each eye)
 5. Raise either leg, record time until loss of balance

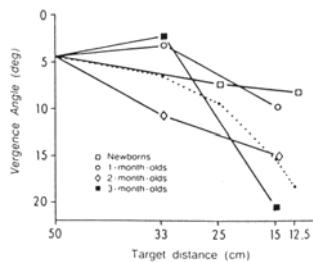
Development & Control of Eye Responses

- Version Eye Movements
 - Saccades
 - Smooth Pursuits



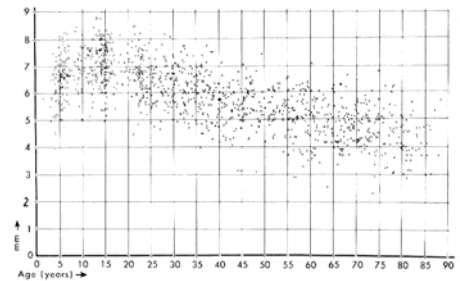
Development & Control of Eye Responses

- Vergence Eye Movements
 - Convergence
 - Divergence



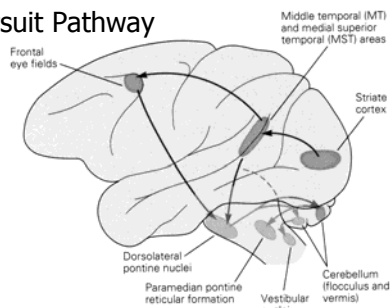
Development & Control of Eye Responses

- Pupil Size & Age



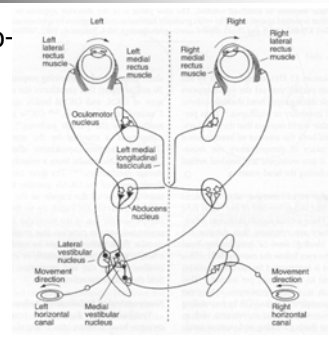
Development & Control of Eye Responses

- Pursuit Pathway



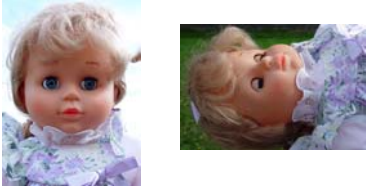
Development & Control of Eye Responses

- Vestibulo-Ocular Reflex (VOR)



Development & Control of Eye Responses

- Doll's-Head Reflex
 - Vertical eye position change with head tilt
 - Mediated (primarily) by otolith organs



Development & Control of Eye Responses

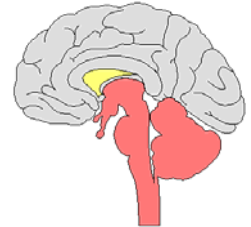
- Near Triad
 - Accommodation – near focus
 - Convergence – single vision
 - Miosis – pupil constriction

Development & Control of Eye Responses

- Demonstration of Eye Movements with IR Head-Mounted Camera

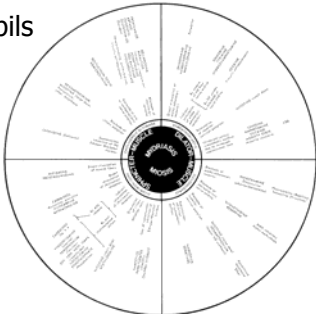
Effects of Drugs on the Eyes

- Eye Movements
 - Saccades & Smooth Pursuits
 - Convergence
 - Nystagmus



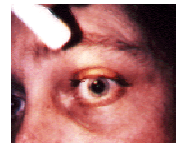
Effects of Drugs on the Eyes

- Pupils



Effects of Drugs on the Eyes

- Conjunctiva
 - Vasoconstriction
 - Vasodilation / Injection / Hyperemia



Effects of Drugs on the Eyes

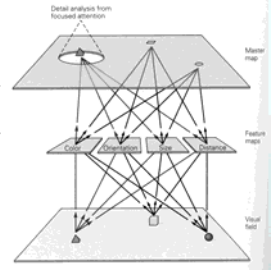
- Eyelids
 - Ptosis (droopy lids)
 - Tremors
 - Retracted lids



- Tears

Effects of Drugs on the Eyes

- Peripheral Vision
 - Loss of Visual Field may be temporary, or due to loss of attention, and may be reversible once therapy is stopped



Effects of Environmental Conditions on the Eyes

- HGN / VGN Stimulus Conditions
 - Size
 - Speed of Movement
 - Distance from Subject
 - Contrast
 - Background
- Pupil Response Conditions
 - Lighting
 - Room Size

Effects of Environmental Conditions on the Eyes

- Subject Posture

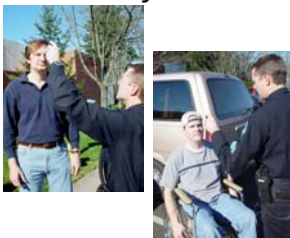


Effects of Environmental Conditions on the Eyes

- Subject Posture

Nystagmus testing in intoxicated individuals

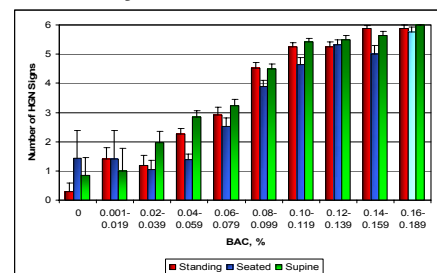
Handwritten text from a document, likely a research paper or report, discussing nystagmus testing. The text is too small to read accurately but appears to be a technical document.



www.ndaa-apri.org

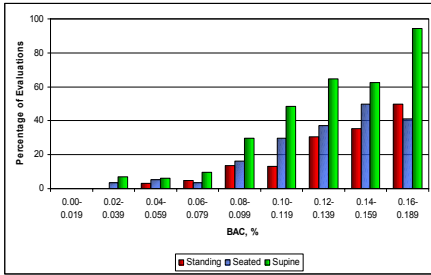
Effects of Environmental Conditions on the Eyes

- HGN Subject Posture



Effects of Environmental Conditions on the Eyes

VGN Subject Posture



Effects of Environmental Conditions on the Eyes

Fatigue – Lack of Sleep

Each position is unique, as an indicator of cultural innovation.

Abstract
Introduction
Method
Results
Discussion
Conclusion

HGN & Fatigue

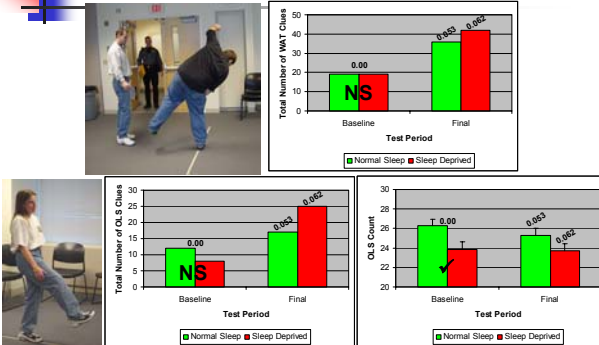
Citek, Arlien, Jons, Krezelok, Neron, Plummer, Tannenbaum (in preparation)



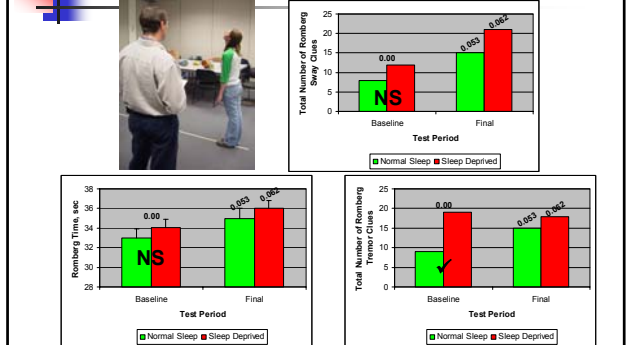
Pacific Lack of Sleep Study

- 29 healthy adult subjects
 - 14 females, 15 males
 - Average age 26.3 years, range 21-52
 - Average BMI 23.7, range 19-40
 - 9 Specs, 9 CLs, 11 No Rx
- 2 alcohol workshops each
 - Normal sleep: awake 4.1 hrs, range 1.5-8
 - Sleep deprived: awake 29.8 hrs, range 24-32
 - Max BAC: 0.115%
- 4 test periods: Baseline, 1 hr, 2 hrs, 1 hr post

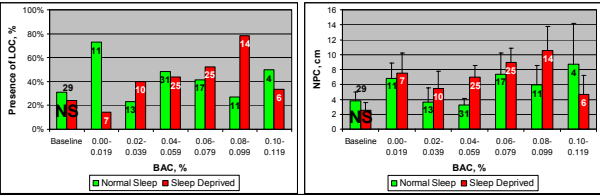
Pacific Lack of Sleep Study



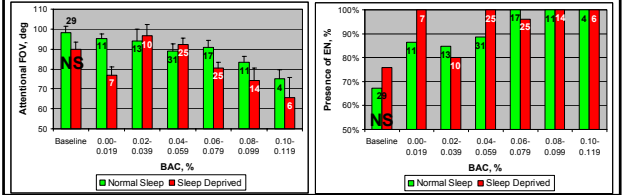
Pacific Lack of Sleep Study



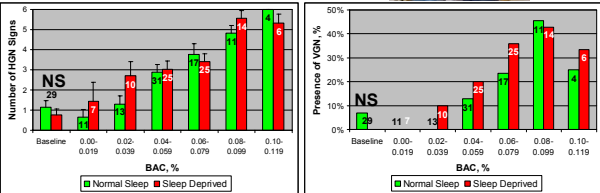
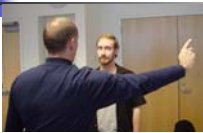
Pacific Lack of Sleep Study



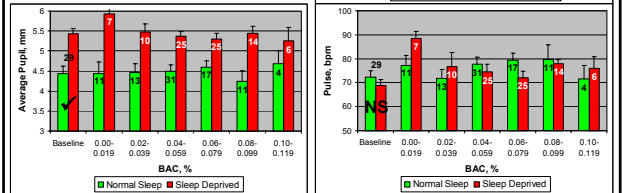
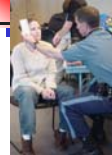
Pacific Lack of Sleep Study



Pacific Lack of Sleep Study



Pacific Lack of Sleep Study



Pacific Lack of Sleep Study

Summary

- Sleep deprivation does NOT affect HGN, VGN, LOC, FOV, EN, WAT, OLS clues, Romberg sway & time estimate, BP, and Pulse regardless of level of intoxication
- Sleep deprivation may affect OLS count, Romberg tremor, and Pupil size in sober individuals
- BOTTOM LINE: Sleep deprivation will NOT be confused for intoxication by police officers!

Effects of Environmental Conditions on the Eyes

Nystagmus

- Voluntary
- Rotatory
- Rotational / Post-rotational
- Caloric
 - Horizontal – COWS
 - Vertical – CUWD
- Fatigue
- Optokinetic

Effects of Environmental Conditions on the Eyes

- Nystagmus
 - Positional Alcohol Nystagmus (PAN)
 - PAN I – rising BAC; endolymph ETOH concentration *lower* than BAC
 - Intermediate – endolymph ETOH concentration *equals* BAC
 - PAN II – falling BAC; endolymph ETOH concentration *higher* than BAC; may sustain for 6-10 hours after BAC returns to zero

THANK YOU!!



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