

# Adult Diplopia Grand Rounds

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## Financial Disclosures - Dr. Theis

- C. Light Technologies - Chief Medical Officer
- Vision Science Labs - Advisory Board
- Myze - Advisory Board
- Horizon Therapeutics - Advisory Panel
- Oculus - Speakers Board
- MedEvolve - Speakers Board
- Tarsus - Speakers Board
- PER - Speakers Board
- Abbvie - Advisory Panel
- Alcon - Speakers Board, Advisory panel
- Dompe - Speakers Board
- Zeiss - Advisory panel

All risks have been mitigated

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## Why does diplopia scare us?

- Etiology/Vast Differential Diagnosis
  - Benign vs. Life Threatening
  - Rare vs. Common
- Time for a full workup
  - It's not a 20 minute complaint!
- Multidisciplinary
  - Eyes
  - Brain
  - Systemic

Rucker J, Kennard C, Leigh J. The neuro-ophthalmological examination. Handbook of clinical Neurology. 2011; 102:71-94  
Kornel M, Eggensperger S. Diagnosing Diplopia. Eye Net. Nov/Dec 2009; PP33-34

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## Introduction – Questions to ask yourself

- What do you do when an adult patient sits in your chair for a “routine” eye examination and complains of diplopia?
- Where do you start your examination?
- What additional testing do you need to add to your examination?
- When is further labwork and neuroimaging indicated?

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## Objectives

- Give a brief overview of the importance of clinical history taking in diplopia and how it may guide your decision to order ancillary testing
- Outline the ancillary testing that may be required in adult diplopia evaluations
- Review diagnosis and management of adult diplopia using cases including exophoria, esophoria, vertical phoria, and cranial nerve palsies
- Elaborate on some general pearls for prescribing prism

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## Monocular vs. Binocular Diplopia

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    graph TD
      Q1[1) Do you see double with both eyes open?] -- No --> Mono[Monocular]
      Q1 -- Yes --> Q2[2) Cover the right eye, do you still see double?]
      Q2 -- Yes --> Mono
      Q2 -- No --> Q3[3) Cover the left eye, do you still see double?]
      Q3 -- Yes --> Mono
      Q3 -- No --> Bi[Binocular]
  
```

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## Monocular vs. Binocular

<h3>Monocular</h3> <ul style="list-style-type: none"> <li>• Refractive</li> <li>• Ocular Media             <ul style="list-style-type: none"> <li>• Tear film – Dry eye</li> <li>• Cornea – irregular, keratoconus, LASIK, scars</li> <li>• Iris – LPI, damage</li> <li>• Lens – cataract, IOL decentration</li> <li>• Retina – ERM, CNVM, macular disease</li> </ul> </li> <li>• Cerebral cortical dysfunction</li> </ul>	<h3>Binocular</h3> <ul style="list-style-type: none"> <li>• Orbital Disorder             <ul style="list-style-type: none"> <li>– Trauma, Tumor, Thyroid, Infection</li> </ul> </li> <li>• EOM Restriction – Thyroid, Tumor, EOM entrapment, EOM latrogenic injury</li> <li>• EOM Weakness – Myopathy/Dystrophy</li> <li>• Neurological Disorder             <ul style="list-style-type: none"> <li>• Neuromuscular Junction Dysfunction – MG, botulism</li> <li>• CN Palsy – III, IV, VI</li> <li>• Brain stem injury</li> </ul> </li> </ul>
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## Examination

<h3>Monocular Diplopia</h3> <ul style="list-style-type: none"> <li>• Visual acuity</li> <li>• Refraction</li> <li>• Ocular Health             <ul style="list-style-type: none"> <li>• Anterior segment</li> <li>• Posterior segment</li> </ul> </li> </ul>	<h3>Binocular Diplopia</h3> <ul style="list-style-type: none"> <li>• Afferent visual pathway             <ul style="list-style-type: none"> <li>• Visual acuity (BCVA/Pinhole), color vision, visual fields, pupils</li> <li>• Ocular Health</li> </ul> </li> <li>• Efferent visual pathway             <ul style="list-style-type: none"> <li>• Cover test(s)</li> <li>• Ocular Motility</li> </ul> </li> </ul>
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## Rote Approach to Diplopia Chief Complaint

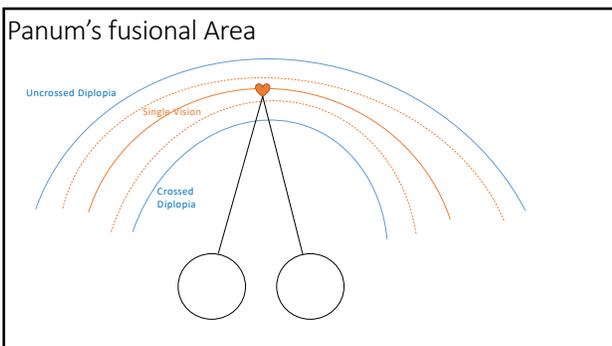
- **Monocular or binocular diplopia?**
- Horizontal, vertical, or diagonal?
- Gaze Dependent? Left vs right? Up vs down? Distance vs near?
- Onset - When did it start?
- Duration - How long does it last? (intermittent, constant)? How often does it happen?
- Frequency – is it getting better, worse, or staying the same since it started?
- Timing
  - When does it occur?
  - What are you doing when it occur(ed)s?
  - Worse at the beginning or end of the day?
- What makes it better?
- What makes it worse?
- Has this ever happened to you before?

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## Rote Approach to HPI/ROS related to Diplopia “Weed out the Weird”

<ul style="list-style-type: none"> <li>• New vision changes?             <ul style="list-style-type: none"> <li>• Blur?</li> <li>• Loss of vision?</li> <li>• Dimming of vision?</li> <li>• Visual field changes?</li> </ul> </li> <li>• Pain?             <ul style="list-style-type: none"> <li>• Eye Pain?</li> <li>• Headaches?</li> </ul> </li> <li>• Tingling in the limbs, fingers or toes?</li> <li>• Numbness or weakness in the face, arms or legs?</li> <li>• Nausea or vomiting?</li> <li>• Changes in balance or vertigo?</li> <li>• Photophobia?</li> <li>• Hearing Loss?</li> <li>• Giant Cell Arteritis symptoms (jaw claudication, neck stiffness, temporal artery or forehead pain)?</li> </ul> <p style="text-align: center;">Family History: Eye turn, systemic disease</p>	<ul style="list-style-type: none"> <li>• Recent weight loss or weight gain that was unintentional?</li> <li>• Recent fever?</li> <li>• History of head trauma or motor vehicle accidents?</li> <li>• History of systemic disease?             <ul style="list-style-type: none"> <li>• Hypertension</li> <li>• Diabetes</li> <li>• High Cholesterol</li> <li>• Heart disease</li> <li>• Cancer</li> <li>• Thyroid disease</li> </ul> </li> <li>• History of recent travel?</li> <li>• Medications             <ul style="list-style-type: none"> <li>• Any new medications?</li> <li>• Recently stopped taking medications?</li> <li>• Are you taking medications as they were prescribed for you?</li> </ul> </li> </ul>
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## What does the brain need to combine two images from two eyeballs into one perceived image??

- Location – Projected Images need to be located in relatively the same place in space, in ALL gazes
  - Ocular Posture – strabismus, cranial nerve palsies, etc
- Images need to be of similar clarity
  - Visual Acuity
- Images need to be of similar size
  - Aniseikonia
- Images need to be of similar shape
  - Metamorphopsia

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## Examination: Binocular Diplopia

### To Understand the Diplopia

- Distance Visual Acuity
  - Entering acuity
  - Pinhole Acuity
- Cover Test/Ocular Posture
- Vergence Ranges
- Other ocular motility testing
  - Fixation
  - Versions
  - Ductions
  - Saccades
  - Pursuits

### Ancillary Testing

- Color Vision
  - Ishihara, AOHRR, Red Cap
- Pupils
  - Size in light/dark
  - Reaction to light/dark
  - Near response
  - RAPD?
- Visual Fields
  - Confrontation
  - Amster
  - Automated – FDT/HVF
- Ocular Health – Slit Lamp (with Fluorescein dye) and fundus examination (PHOTO)
- Eyelids (MRD1/MRD2), Levator function
- Orbits (Exophthalmometry, symmetry)
- Optic Nerve Evaluation
- Fundus Evaluation
- Cranial Nerve Evaluation I-XII

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## How To Prescribe Prism

### What the Text Book Says

- Exos
  - Sheard's Criterion
    - 2/3 phoria – 1/3 Break at near
- Esos –
  - Basic/Convergence Excess type - Percivalis
    - 1/3G-2/3L
      - G = greater of the two lateral limits (BI/BO)
      - L = lesser of the two lateral limits (BI/BO)
      - If P > 0 or negative, prism is not indicated
  - Divergence insufficiency type – Saladin 1:1 rule
    - Prism = (Phoria-BI recovery)/2

### What Clinical Wisdom Says

- Exos
  - 1/3 of the deviation
- Esos
  - All of it at distance
- Vertical
  - All of it at distance

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## How to prescribe prism

### What Dr Theis Says...

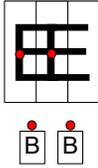
- Use multiple measuring methods to prescribe
  - Cover Test – know your maximum
    - Perform in gaze of complaint
    - Prescribe based on complaint
  - Vergences should be balanced/normalized
  - Clinical/Textbook wisdom
- Prescribe for the "gaze of complaint"
- Caloroso's residual vergence demand
  - Esos 6-20pd, RVDC 4-6pd
  - Exos 20-30pd, RVDC 10-15pd
  - Hyperdev 3-10pd, RVDC 2-4pd
- If you are unsure, prescribe a Fresnel and follow up

### Fusional vergence ranges – Prism Bars are your new best friend

- Video – Cover Test(s)
- Video - Vergences

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## Cover Test - Size Matters

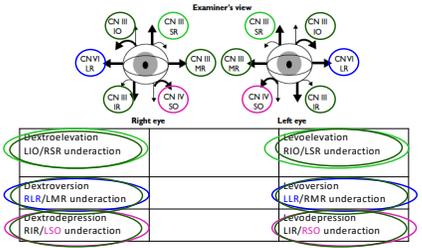


Distance Cover Test Target

- Isolated Supra-threshold Target (2-3 lines above Threshold)

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## Comitancy Quick Review



Right eye	Left eye
Extrolevation LIO/RSR underaction	Extrolevation RIO/LSR underaction
Extroversion RLR/LMR underaction	Extroversion LLR/RMR underaction
Extrodepression RIR/LSO underaction	Extrodepression LIR/RSO underaction

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## Case: Tracy - 47yo female, Vertical Diplopia in Right Gaze



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When to Image a CN Palsy?

- Multiple CN Palsies
- Age <50yo
- No vasculopathic risk factors
- Absence of improvement in 3months for isolated palsy.
- Its atypical

Murphyson AP et al. Neuroimaging and Acute Ocular Motor Mononeuropathies. Arch Ophthalmol. 2011; 129(3):303-305

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Other Cranial Nerve Testing

- **CN1 – Olfactory Nerve**
- CN2 – Optic Nerve
- CN3 – Oculomotor Nerve
- CN4 – Trochlear
- CN5 – Trigeminal
- CN6 – Abducens
- CN7 – Facial Nerve
- CN8 – Acoustic Nerve
- CN9 – Glossopharyngeal Nerve
- CN10 – Vagus Nerve
- CN11 – Accessory Nerve
- CN12 – Hypoglossal Nerve



Casari L, Fingert M, Woodcock HT. Atlas of Primary Eyecare Procedures. McGraw-Hill. 2nd ed.

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CNIX: Accessory Nerve

Casner L, Fingert M, Woodcock HT. Atlas of Primary Eye Care Procedures. McGraw-Hill. 2<sup>nd</sup> ed.

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Other Cranial Nerve Testing

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- **CN12 – Hypoglossal Nerve**



CNIXII: Hypoglossal Nerve

Casner L, Fingert M, Woodcock HT. Atlas of Primary Eye Care Procedures. McGraw-Hill. 2<sup>nd</sup> ed.

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Case 1 – 45year old, Caucasian female

- Chief Complaint: I have double vision
  - Horizontal
  - Intermittent – only occurs at night ~5-6pm
  - At near only, when reading or on phone/computer
  - Started about 1 year ago, but was diagnosed with an eye turn at 10 years old
  - (-) HPI/ROS
  - Uses +1.00 readers, doesn't help
- Differential Diagnosis
  - Decompensated esophoria/exophoria
  - Myasthenia gravis

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What is a “Decompensating” Phoria?

- Phoria – Relative misalignment of eyes when binocular fusion is disrupted
  - Alternating Cover Test
- Tropia – Strabismus, manifest misalignment of eyes relative to one another
  - Unilateral Cover Test
- “Decompensating” – what you use to compensate for your ocular posture) (ie vergences) is not working!
  - Frequency of deviation increases
  - Magnitude stays the same!
  - **Diagnosis of Exclusion!**

Pelak V. Evaluation of Diplopia: An Anatomic and Systemic Approach. Hospital Physician. Mar 2004:17-25

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Case 1 – 45year old, Caucasian female

- Pertinent Exam Findings
  - Refraction
    - OD: Plano 20/20
    - OS: -0.25 20/20
    - Add: +1.00
  - Ocular Health: Normal OU, TBUT 10 sec OU
  - Cover Test:
    - Distance: 14XP
    - Near: 25X(T) - 20% frequency
  - Fusional Vergences (measured sRx at Distance, c+1.00 at Near)
    - BI Distance: x/8/6 BI Near: x/25/20
    - BO Distance: x/16/14 BO Near: x/25/20 (Normal x/16/14)
  - Near Point of Convergence: 10cm, 12cm, 14cm

Questions to ask yourself:  
 1) Why is the patient having symptoms?  
 2) Is this new or longstanding?

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How did I get 25X(T) with 20% frequency at near?

- Intermittent XT at near frequency video
  - Emphasize unilateral CT vs alternating CT

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**Case 1 – 45year old, Caucasian female**

- Pertinent Exam Findings
  - Refraction
    - OD: Plano 20/20
    - OS: +0.25 20/20
    - Add: +1.00
  - Ocular Health: Normal OU, TBUT 10 sec OU
  - Cover Test:
    - Distance: 14XP
    - Near: 25X(T) – 20% frequency
  - Fusional Vergences (measured sRx at Distance, c+1.00 at Near)
    - BI Distance: x/8/6 BI Near: x/25/20
    - BO Distance: x/16/14 BO Near: x/25/20 (Normal x/16/14)
  - Near Point of Convergence: 10cm, 12cm, 14cm
- Diagnosis: Intermittent Exotropia – Convergence insufficiency type
  - Likely decompensation from fatigue

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Why am I not *that* worried in this case?

Duane White Classification

ESOTROPIA	
Basic	DCT=NCT
Convergence Excess	NCT>DCT
Divergence Insufficiency	DCT>NCT
EXOTROPIA	
Basic	DCT=NCT
Convergence Insufficiency	NCT>DCT
Divergence Excess	DCT>NCT

Duane A. A new classification of the motor anomalies of the eye, based upon physiologic principles. Ann Ophthalmol Otol. Part I. 1897, Part II Jan.

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What else could cause X(T)-CI?

- Traumatic brain injury
- Parkinson's disease
- Myasthenia Gravis
- Lyme Disease
- Multiple sclerosis or other demyelinating disease
- Pseudotumor cerebri
- Behavioral medications
- Oculomotor restriction/palsy
  - CN III
  - Duane's syndrome
  - Thyroid eye disease

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**Case 1 – 45year old, Caucasian female**

- Cover Test:
  - Distance: 14XP
  - Near: 25XP
- Fusional Vergences (measured sRx at Distance, c+1.00 at Near)
  - BI Distance: x/8/6 BI Near: x/16/14
  - BO Distance: x/16/14 BO Near: x/25/20 (Normal x/16/14)
- Near Point of Convergence: 10cm, 12cm, 14cm
- Prism Demonstration
  - 4-8pd, patient appreciates 4pd
- Prescribed: 4pd BI Fresnel over non-dominant eye
  - Return in 4 weeks

What are you going to prescribe?

- Nothing
- Sheard's Criterion: 2/3(25) – 1/3(16)
- 16.67-5.33 = 11.34pd
- Clinical Wisdom: 1/3(25) = 8pd

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**Case 1 – 45year old, Caucasian female**

- Why Follow up?
  - Rule out myasthenia gravis
  - Discuss lens options
    - Progressive or SV reading
- Cover Test: *Stable to last exam*
  - Distance: 14XP
  - Near: 25XP
- Fusional Vergences (measured sRx at Distance, c+1.00 at Near and 4BI Fresnel)
  - BI Distance: x/8/6 BI Near: x/14/10
  - BO Distance: x/16/14 BO Near: x/35/30 (Normal x/16/14)
- Near Point of Convergence: 6, 8, 10cm
- Prism Demonstration
  - 4-6pd, patient appreciates 4pd
- Prescribed: BI split prism readers
  - OD: +1.00 2.0BI
  - OS: +1.25 2.0BI

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**Case 1 Learning Pearls**

- Know your normal vs “abnormal” Duane White classifications
- Use your case history to guide the need to rule out secondary causes of convergence insufficiency
- Prism can be an “evening” thing
- Use Fresnel prism trial if you are uncertain about what to prescribe, or if the patient's diplopia complaints occur outside of office hours

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**Case 2 – 55year old, Asian Female**

- Chief Complaint: Eyestrain with glasses – optical department sent me to you because I have had 5 redo's and they said you are really good at refractions
  - Eyestrain when "I put them on"
  - Worse when I try to read something or look at my phone
- Wearing Progressives:
  - OD: +1.00-0.50x180 20/20
  - OS: +1.50-0.75x005 20/20
  - Add: +1.75 20/20
  - Pupil distance measured in lenses: 61
  - Patient pupil distance: 61
  - Add measured at bottom of lenses: +1.75

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**Case 2 – 55year old, Asian Female**

- Cover Test:
  - Distance: 1.5RHyperphoria (primary gaze)
    - Primary gaze = right tilt = left tilt
    - (-) Bielchowsky head tilt test = unlikely CNIV palsy
  - Near: 1.5RHyperphoria (primary gaze)
    - Primary gaze = down gaze = right gaze (comitant in all nine fields of gaze)
    - Unlikely CNIII palsy (also pupils and eyelids are normal)
- Diagnosis: Vertical Phoria

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**How do you do the Bielchowsky Head Tilt Test?**

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**Is this the same as the Maddox Rod Test?**

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**Comitancy**



- Comitancy Strabismus – nonparalytic, deviation remains similar in different gazes and relative to each eye
- Clinical Tests of Comitancy
  - Primary vs. Secondary Angle
  - CT in 9 Fields of Gaze
- Incomitant Strabismus
  - Difference in deviation >5pd
  - Anomalous head posture is not a clinical diagnostic test of comitancy

4LHyper/4Eso	4Eso	Ortho
5LHyper/6Eso	5LHyper/4Eso	3Eso
8LHyper/8Eso	5LHyper/6Eso	6Eso

Ortho ↻ 10LHyper

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**Case 2 – 55year old, Asian Female**

- Cover Test:
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  - Near: 1.5RHyperphoria (primary gaze)
    - Primary gaze = down gaze = right gaze (comitant in all nine fields of gaze)
    - Unlikely CNIII palsy (also pupils and eyelids are normal)
- Diagnosis: Vertical Phoria
- What are you going to prescribe?
  - 0.5BD OD
  - 1.0BD OD
  - 1.5BD OD
  - 2.0BD OD
  - What about BU OS?

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**Vertical Vergence Ranges using a Prism Bar**

- Expanded vs. not expanded
- Norms:  $x/3/2$
- Not Norms:  $>5$

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**Case 2 – 55year old, Asian Female**

- Cover Test:**
  - Distance: 1.5RHyperphoria (primary gaze)
  - Near: 1.5RHyperphoria (primary gaze)
- Vertical Vergences performed over OD (primary gaze distance, downgaze near)**
  - Distance BU: 1/0
  - Distance BD: 4/3
  - Near BU: 1/-1
  - Near BD: 2/1
- Diagnosis: Vertical Phoria**
- Prescribed: compensating prism**
  - OD: +1.00-0.50x180 0.75BD
  - OS: +1.50-0.75x005
  - Add: +1.75

*Clinical Wisdom: 1.5*

**If Prescribe 0.5BD OD**

- Distance BU: 1.5/0.5
- Distance BD: 3.5/2.5
- Near BU: 1.5/0.5
- Near BD: 1.5/0.5

**If Prescribe 1.0BD OD**

- Distance BU: 2/1
- Distance BD: 3/2
- Near BU: 2/0
- Near BD: 1/1

**If Prescribe 1.5BD OD**

- Distance BU: 2.5/1.5
- Distance BD: 2.5/1.5
- Near BU: 2.5/1.5
- Near BD: 0.5/0.5

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**Prescribing Vertical Prism Pearls**

- If prescribing  $<2.0$ pd, put it all in one eye to ensure it is ground in
- If prescribing ground-in prism in one eye only, prescribe it in the BD eye
  - Base down prism has less optical reflections from overhead lighting
- If prescribing Fresnel prism – always prescribe the BD prism unless drastic difference in visual acuity because the reflections from lights will drive them nuts

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**When is a vertical deviation ominous?**

- Developmental vertical phoria = 0-3pd (usually 1-2pd)
- Longstanding deviations will usually have expanded vertical vergences (but not always)
- They will be incomitant (bigger in one field of gaze)
- Differential Diagnosis of vertical misalignment**
  - Myasthenia Gravis
  - Thyroid eye disease
  - CN IV palsy
  - CN III palsy
  - Skew Deviation
    - MS (younger patient)
    - Stroke (older patient)
  - Orbital Mass

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**Case 3 – 60year old, Hispanic Male**

- Chief complaint: I have double vision**
  - Diagonal
  - Constant x 3-4 weeks –started at 10:00am on a Tuesday
  - Has been getting worse since onset
  - Having difficulties walking down stairs, driving, looking to the left
- Pertinent Medical History**
  - Diabetes Type 2, Hypertension, High Cholesterol
  - Taking corresponding medications for aforementioned diseases

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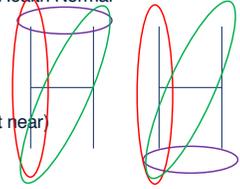
**Case 3 – 60year old, Hispanic Male**

- Entering Acuity: 20/20 OU, Ocular Health Normal**
- Cover Test: (primary gaze)**
  - Distance: 5LHyper, 2Esophoria
    - Right Tilt: 2LHyper
    - Left Tilt: 8LHyper, 4EP
  - Near: 5LHyper, 4exophoria
- Cover Test: Nine Fields of Gaze**

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**Case 3 – 60year old, Hispanic Male**

- Entering Acuity: 20/20 OU, Ocular Health Normal
- Cover Test: (primary gaze)
  - Distance: 5LHyper, 2Esophoria
  - Right Tilt: 2LHyper
  - Left Tilt: 8LHyper, 4EP
- Near: 5LHyper, 4exophoria
- Cover Test: Nine Fields of Gaze (at near)



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**Case 3 – 60year old, Hispanic Male**

- Pertinent Medical History
  - Diabetes Type 2, Hypertension, High Cholesterol
  - Taking corresponding medications for aforementioned diseases
- Diagnosis: Left CNIV Palsy
  - Differential: Most likely ischemic
    - Thyroid: (-) proptosis, dry eye, eyelid retraction, muscle restriction
    - Myasthenia gravis: (-) fatigue/intermittent complaints, (-) ptosis
    - Multiple Sclerosis: (-) numbness/tingling or other neurological signs/symptoms
    - Infectious/Inflammatory/mass: (-) other neurological signs/symptoms
    - Giant Cell Arteritis: (-) GCA symptoms, (+) >55 years old (-) demographics
- Workup
  - Check blood pressure in-office: 140/90
  - Note to PCP to update labs: Fasting glucose, fasting cholesterol, HbA1c, TSH, myasthenia panel, Creatinine with BPH, CBC with differential, ESH, CRP
  - If worried about infection: Lyme titer, HIV, syphilis, HSV/VZV, etc

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**When to Image a CN Palsy?**

- Multiple CN Palsies
- Age <50yo
- No vasculopathic risk factors
- Absence of improvement in 3months for isolated palsy.
- Its atypical
- History of cancer

Murchison AP et al. Neuroimaging and Acute Ocular Motor Mononeuropathies. Arch Ophthalmol. 2011. 129(3):301-305

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**Case 3 – 60year old, Hispanic Male**

- Cover Test: (primary gaze)
  - Distance: 5LHyper, 2Esophoria
    - Right Tilt: 2LHyper
    - Left Tilt: 8LHyper, 4EP
  - Near: 5LHyper, 4exophoria
- Vertical Vergences (over OD at distance over 5BD OS)
  - BD 2/1
  - BU 2/1
- Cover Test: Nine Fields of Gaze (at near)

What are you going to prescribe?

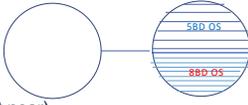
- Nothing
- Patch
- 5BD OS
- 7BD OS
- 10BD OS

4LHyper 2XP	2LHyper 6XP	6XP
7LHyper 2EP	5LHyper 4XP	3LHyper 4XP
12LHyper 2EP	10LHyper	6LHyper 2XP

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**Case 3 – 60year old, Hispanic Male**

- Cover Test: (primary gaze)
  - Distance: 5LHyper, 2Esophoria
    - Right Tilt: 2LHyper
    - Left Tilt: 8LHyper, 4EP
  - Near: 5LHyper, 4exophoria
- Cover Test: Nine Fields of Gaze (at near)



4LHyper 2XP	2LHyper 6XP	6XP
7LHyper 2EP	5LHyper 4XP	3LHyper 4XP
12LHyper 2EP	10LHyper	6LHyper 2XP

Prescribed:  
5BD OS Fresnel Distance Segment  
8BD OS Fresnel Near Segment

Follow up: 4-6 weeks

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**Case 3 – 60year old, Hispanic Male**

- Follow Up 4-6 weeks later
- Cover Test: (primary gaze)
  - Distance: ortho
  - Near: 4exophoria
- Cover Test: Nine Fields of Gaze (at near)

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### Case 3 Pearls

- Use Fresnel Prisms in ischemic CN palsies
  - Reduce fall risk from diplopia/patching
- Check ischemic CN palsies monthly for resolution and to confirm diagnosis
  - If no resolution within 3 months of onset – need to neuro-image
- Segment Fresnel prism can be a game changer

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### Case 4 – 80year old, Caucasian Male

- Chief complaint: Intermittent vertical double vision x 6 months
  - Vertical, binocular
  - Started 6 months ago intermittently 1-2x/week, gradually getting worse/more frequent
  - Currently occurs every day intermittently for a few seconds 0-60 when he is reading or going down the stairs (has to tilt his head down to walk down the stairs)
    - Reading: newspaper, or ticker on the News
    - Denies right/left gaze diplopia
  - Vision isn't as crisp as it used to be, but feels he sees just fine
  - (-) ROS/HPI
- Pertinent Medical History
  - Hypertension, High Cholesterol – well medically controlled with atorvastatin and compliant with meds. Denies any changes to his medications
- Last Eye Exam: 1 year ago
  - BCVA 20/25 OU
  - 1+ NS cataracts

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### Case 4 – 80year old, Caucasian Male

Diagnosis: Right CNIV Palsy – likely longstanding, likely decompensating from cataracts

- Best Corrected Visual Acuity
  - OD: +1.00-0.50x175 20/30 PAF 20/20
  - OS: +1.50-0.75x005 20/20 PAF 20/20
- Cover Test: (primary gaze)
  - Distance: 15RHyper
  - Right Tit: 15RHyper
  - Left Tit: 15RHyper
  - Near: 15RHyper, 4exophoria
- Vertical Vergences (over OD at distance)
  - BD 20/18
  - BU 5/4
- Cover Test: Nine Fields of Gaze (at near)

10RHyper 6XP	10RHyper 6XP	10RHyper 6XP
15RHyper 4XP	15RHyper 4XP	15RHyper 4XP
15RRHyper	20RHyper	20RHyper

Bielchowsky/Parks 3 step: Inconclusive

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### Case 4 – 80year old, Caucasian Male

- Cover Test: (primary gaze)
  - Distance: 15RHyper
  - Right Tit: 15RHyper
  - Left Tit: 15RHyper
  - Near: 15RHyper, 4exophoria
- Vertical Vergences (over OD at distance)
  - BD 20/18
  - BU 5/4
- Cover Test: Nine Fields of Gaze (at near)

What are you going to prescribe?

- Nothing
- Patch
- 5BD OD
- 10BD OD
- 15BD OD

10RHyper 6XP	10RHyper 6XP	10RHyper 6XP
15RHyper 4XP	15RHyper 4XP	15RHyper 4XP
15RRHyper	20RHyper	20RHyper

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### Case 4 – 80year old, Caucasian Male

- Cover Test: (primary gaze)
  - Distance: 15RHyper
  - Right Tit: 15RHyper
  - Left Tit: 15RHyper
  - Near: 15RHyper, 4exophoria
- Vertical Vergences (over OD at distance)
  - BD 20/18
  - BU 5/4
- Cover Test: Nine Fields of Gaze (at near)

What are you going to prescribe?

- Nothing
- Patch
- 5BD OD
- 10BD OD
- 15BD OD

Prescribed:  
5BD OD Full segment  
\*If you don't like it take it off

10RHyper 6XP	10RHyper 6XP	10RHyper 6XP
15RHyper 4XP	15RHyper 4XP	15RHyper 4XP
15RRHyper	20RHyper	20RHyper

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### Congenital ocular motor cranial nerve palsy

- Congenital CN III
  - Often noted soon after birth due to obvious nature/presentation
- Congenital CN VI
  - Not always noted until child begins to track, has anomalous head posture - turn
  - Rare without concomitant Duane syndrome or Mobius Syndrome
- Congenital CN IV
  - Not always noted until child begins to track, has anomalous head posture – tilt
  - Relatively common

Pineles SL, Velez FG. Isolated Ocular Motor Nerve Palsies. J Binocul Vis and Ocular Motil. 2018;68(3):70-77

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### Review of Isolated CN Palsy in Adults

Cranial Nerve	Oculomotor (III)	Trochlear (IV)	Abducens (VI)
Etiology	Microvascular ischemia Stroke Aneurysm Traumatic Demyelination, trauma, tumors, increased intracranial pressure	Congenital Trauma Microvascular ischemia Stroke Demyelination, trauma, tumors, increased intracranial pressure	Neoplasm Trauma Microvascular ischemia Stroke Demyelination, trauma, tumors, increased intracranial pressure
Suggested workup	Rule out undiagnosed vascular risk factors MRI brain+orbits with contrast MRA or CTA of brain If imaging normal, consider lumbar puncture Rule out MG/thyroid/GCA	Rule out undiagnosed vascular risk factors* MRI brain+orbits with contrast Lumbar puncture if sx of meningitis Rule out MG/thyroid/GCA	Rule out undiagnosed vascular risk factors MRI brain+orbits with contrast Lumbar puncture if sx of meningitis Lab: syphilis, lyme Rule out MG/thyroid/GCA

\*if elderly and + vascular risk factors, it is reasonable to observe for resolution

Pineles SL, Velazquez FG. Isolated Ocular Motor Nerve Palsies. *J Binocular Vis and Ocular Motil.* 2018;68(3):70-77

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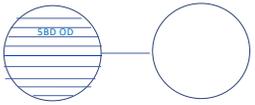
### Should we neuro-image and/or further workup?

- What we know
  - Vasculopath – hypertension and high cholesterol
  - Onset 6 months ago, more frequent/worsening
  - Isolated CN IV Palsy
    - All other CN I – XII are intact
    - Normal afferent visual pathway (red cap, visual fields, PAP visual acuity, ocular health – aside from cataracts)
    - Expanded vertical vergences
    - No head tilt
    - Intermittent diplopia with prolonged gaze/task/lighting specific
- Plan
  - Consulted PCP, ran labs/minimize vasculopathic risk factors, ruled out mimickers (GCA, thyroid, MG)

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### Case 4 – 80year old, Caucasian Male

- 4 week follow up: Patient is happy with prism, no episodes of diplopia
- Visual Acuity: stable 20/30 OU
- Cover Test: (primary gaze) with 5 BD OD Fresnel glasses
  - Distance: 10RHyper
  - Right Tilt: 10RHyper
  - Left Tilt: 10RHyper
  - Near: 10RHHyper, 4exophoria
- Vertical Vergences (over OD at distance)
  - BD 20/18
  - BU 10/4
- Cover Test: Nine Fields of Gaze (at near): **STABLE to previous**



Prescribed:  
5BD OD Full segment  
\*If you don't like it take it off

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### Case 4 – 80year old, Caucasian Male

- 6 month follow up: prism isn't working, having trouble seeing especially at night or in bright light
- Visual Acuity: **worse 20/50 OU BCVA, 20/80 glare acuity, PAP 20/20**
- Cover Test: (primary gaze) with 5BD OD Fresnel glasses
  - Distance: 10RHyper
  - Right Tilt: 10RHyper
  - Left Tilt: 10RHHyper
  - Near: 10RHHyper, 4exophoria
- Vertical Vergences (over OD): **Unable to fuse with any prism**
- Cover Test: Nine Fields of Gaze (at near): **STABLE to PREVIOUS**
- What has changed??
  - Cataracts! Vision!
    - Remember: To see single you need the images
      - In the same location
      - The same shape/size
      - The same clarity
- Plan: Refer for cataract surgery

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### Case 4 – 80year old, Caucasian Male

- Post OP follow up: Patient is happy with vision, still gets occasional double vision if reading for prolonged periods of time >2 hours
- Visual Acuity: 20/20 sRx OD/OS
- Ocular Health: PCIOL OU
- Cover Test: (primary gaze) **STABLE to previous**
  - Distance: 15RHHyper (primary = right tilt = left tilt)
  - Near: 15RHHyper, 4exophoria
- Vertical Vergences (over OD at distance)
  - BD 20/18
  - BU 8/4 (Better than at his initial 4 week follow up WITHOUT compensating prism!)
- Cover Test: Nine Fields of Gaze (at near): **STABLE to previous**

Prescribed: 3BD OD Fresnel Segment

10RHyper EXP	10RHHyper EXP	10RHHyper EXP
15RHHyper 4XP	15RHHyper 4XP	15RHHyper 4XP
15RHHyper	20RHHyper	20RHHyper

\*Called patient in 2-4 weeks, he loved it so prescribed ground in prism readers:  
OD: +2.50 1.5BD  
OS: +2.50 1.5BU

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### Case 4 – 80year old, Caucasian Male

- 1 Year follow up: Patient is happy, except gets intermittent blurry and double vision even with prism readers after 10-15 minutes of prolonged reading and/or watching television, at night only (okay during the day)
- Visual Acuity: 20/20- sRx OD/OS
- Ocular Health: PCIOL OU, **TBUT 0-2 sec, 2+ scurf**
- Cover Test: (primary gaze) **STABLE to previous**
  - Distance: 15RHHyper (primary = right tilt = left tilt)
  - Near: 15RHHyper, 4exophoria
- Vertical Vergences (over OD at distance) ) **STABLE to previous**
- Cover Test: Nine Fields of Gaze (at near): **STABLE to previous**
- What has changed?
  - Dry Eye! Visual Clarity
  - Plan: Warm compresses/lid scrubs BID, artificial tears QID, Recheck in 4-6 weeks

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**Case 4 Pearls**

- Know how to differentiate between acquired vs. congenital CN palsy
  - HPI/ROS, previous pictures
  - When/if in doubt, neuro-image
- Use vertical vergences to confirm suspicions of acquired vs. congenital CN palsy as well as aid in prescribing prism
  - You may not need full vertical prism to correct congenital CN palsies
- Congenital CN palsies may decompensate in adults as they acquire changes to their visual clarity (cataracts, dry eye)
- You don't always have to fix double vision with prism glasses, you need to fix what is causing the double vision (which is sometimes cataracts and dry eye!)

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**Case 5 – 65 year old, Caucasian Female**

- Chief Complaint: Intermittent diagonal double vision at distance more than near
  - Started 2 years ago
  - Occurs more towards the end of the day
  - Goes away after reading for 30 minutes, but see it mostly at distance now
- Pertinent ocular history:
  - Mild left upper eyelid ptosis diagnosed 5 years ago
    - Presumed to be due to RGP overwear



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**Case 5 – 65 year old, Caucasian Female**

- OS Ptosis – Pertinent Exam History
  - 5 years ago
    - Ortho in primary gaze
    - Mild Giant papillary conjunctivitis
    - Hertel Base 92, 14mm OD, 16mm OS
    - PAS: 10mm OD, 8mm OS
  - 2 years ago
    - PAS 11mm OD, 9mm OS
- Vertical Diplopia – Pertinent Exam History
  - 2 years ago
    - Cover test: Ortho
    - Accepts 1.5BU OS
  - 1 year ago
    - Cover test: 0.5-1LHypo
    - Accepts 2.0BU OS

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**Case 5 – 65 year old, Caucasian Female**

- Entering Acuity: 20/20 OU, Ocular Health Normal
- Cover Test: (primary gaze) - **WORSE**
  - Distance: 5LHypotropia
    - Right Tilt Left Tilt OD = OS Fixating
    - Near: 5LHyp(1), 23x0p10019
- Cover Test: Nine Fields of Gaze unable due to mild abduction restriction OS
- Vertical Vergences from fusion point (4BU over OS)
  - BU 4/0
  - BD 3/1
- OS Ptosis: PAS 12mm OD, 10mm OS – **STABLE difference**
- OS Proptosis: Hertel Base 92, 14mm OD, 21mm OS- **WORSE OS**
- Mild retroptosis of globe with pressure OS>OD
- Plan?

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Diagnosis: Primary Lacrimal Gland Tumor

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Management: Refer to Oculoplastics for removal, return if diplopia remains post-op

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**Orbital Tumors**

- Symptoms
  - Persistent/progressive swelling of outer third of eyelid
  - Pain
  - Double vision
- Signs
  - Chronic eyelid swelling
  - +/- Proptosis
  - +/- Globe displacement
  - Extraocular motility restrictions
  - Palpable Mass

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**Orbital Tumor**

- Etiology/Differential Diagnosis
  - Sarcoidosis
  - Orbital Inflammatory Pseudotumor
  - Infectious
  - Benign mixed epithelial tumor
  - Dermoid cyst
  - Lymphoid Tumor
  - Adenoid Cystic Carcinoma
  - Malignant mixed epithelial tumor
  - Lacrimal gland cyst

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**Differential Diagnosis**

- Ptosis
  - Myogenic
    - Congenital muscular dystrophy, chronic progressive external ophthalmoplegia
  - Aponeurotic
    - Aging (levator dehiscence), eye rubbing, RGP use
  - Neurogenic
    - CN III palsy
    - Horner syndrome
    - Myasthenia gravis
    - Marcus Gunn jaw-winking syndrome
  - Mechanical
    - Retained CL
    - Upper eyelid inflammation (GPC, chalazion)
    - Neoplasm
  - Traumatic
    - Pseudoptosis (contralateral eyelid retraction)
- Proptosis
  - Mass effect
    - Inflammation – thyroid, idiopathic, sarcoidosis, sinusitis, Wegener granulomatosis, etc
    - Infectious – orbital cellulitis, subperiosteal abscess, mucormycosis
    - Neoplastic
  - Trauma
    - Retrobulbar hemorrhage
    - Carotid-cavernous fistula
  - Malformation
    - Skeletal
    - Genetic/congenital
    - Enlarged globe (myopia)
  - Vascular
    - Carotid-cavernous fistula
    - Lymphangioma

Bagheri N, Wajda BN, The Wills Eye Manual 7<sup>th</sup> ed. 2017: Wolters Kluwer, China

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**Case 5 Pearls**

- Know the differential diagnosis of ptosis and proptosis
- Don't forget to measure the orbit!
  - Exophthalmometry
  - Palpebral aperture size, MRD1/2
- Documentation is important to observe for change over time
- Digital retropulsion test can feel for a mass in the eyelid

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**BONUS Case: 52yo African American Male Referred for Post-Concussion Diplopia**

- Chief Complaint: Diplopia
  - Started 4 weeks earlier when he was in a MVA
  - Constant
  - At all distances but variable in direction/magnitude
  - Mostly vertical
  - Image tilted in the left eye

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Initial Differential	Diagnosis
<p><b>Traumatic CN IV Palsy</b></p> <p>Presentation – Vertical worse in <b>down gaze</b></p> <ul style="list-style-type: none"> <li>• Superior Oblique – depressor, incyclotorsion</li> <li>• <b>HYPER, EXOCYCLOTORSION</b></li> </ul> <p>Pathophysiology</p> <ul style="list-style-type: none"> <li>• Longest course from CNS to target muscle – more prone to trauma than III and VI</li> <li>• Decompensated congenital CNIV palsy has abnormally large vertical deviation vs acquired</li> <li>• Traumatic origin not uncommon</li> <li>• CNIV&gt;CNIII&gt;CNVI</li> </ul> <p><small>Kim JH, Choi HY, Jeon H. Clinical Characteristics for Predicting Recovery of Acquired Fourth Cranial Nerve Palsy. J Neuroophthalmol. 2022 Jun 1;42(2):234-236.</small></p>	<p><b>Traumatic CN III Palsy</b></p> <p>Presentation – Vertical worse in upgaze</p> <ul style="list-style-type: none"> <li>• Superior Division: Superior Rectus – elevator, Levator – Eyelid elevation                             <ul style="list-style-type: none"> <li>• HYPO, PTOSIS</li> </ul> </li> <li>• Inferior Division: Medial Rectus – Adduction, Inferior Oblique – Elevator, exocyclotorsion, Inferior rectus – Depressor, Parasympathetic Pupillary innervation                             <ul style="list-style-type: none"> <li>• EXO, HYPO, +/- MYDRIASIS</li> </ul> </li> </ul> <p>Pathophysiology</p> <ul style="list-style-type: none"> <li>• Trauma: Rootlet avulsion, distal fascicular damage, stretching of nerve, decreased blood supply, uncal herniation (mass effects cause crowding/traps CNIII against the sharp edge of the tentorium) -&gt; frontal lobe injury</li> <li>• RARE to have isolated CNIII palsy with normal neuro-imaging (moderate+ TBI)</li> </ul> <p><small>Kim T, Nam K, Hyun SS. Isolated Oculomotor Nerve Palsy in Mild Traumatic Brain Injury. Am J Phys Med Rehabil. 2020 May;99(5):430-435.</small></p>

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### Comitancy

Clinical Tests of Comitancy

- Primary vs. Secondary Angle
- CT in 9 Fields of Gaze

Findings

- Left Hyper → Left CNIV Palsy
- Right Hyper → Right CNIV Palsy
- V Pattern Eso → Bilateral CNIV OR Partial CNVI palsy

OD Fixating: 10LHyper  
OS Fixating: 2LHyper

8LHyper/3Eso   3LHyper/4Eso   3RHyper  
6LHyper/12Eso   3RHyper/10Eso   5RHyper/4Eso  
6LHyper/25Eso   30Eso   10RHyper/20Eso

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### Ancillary Testing

- Pupils: PERRL (-) APD
- Ocular Health: Normal OU
- Exophthalmometry: 16mmHg OD/OS
- Eyelids : Mild Ptosis OS
  - MRD1 3mm OD, 1mm OS
  - MRD2 5mm OD, 5mm OS
  - Levator Function – 10mm OD/OS

### Other CN Testing

- CNI – Normal
- CNII – Normal VA, VF, Color, Pupils, Ocular Health
- CNV – Partial numbness on lower left side of face
- CNVII – Brow ptosis/facial ptosis
- CNVIII through CNVII – Normal

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### Signs of Neuro-Ophthalmological Emergencies

- Optic nerve edema or pallor
- Extraocular/intraocular abnormality
  - Multiple cranial nerve palsies
  - Pupil-involving CN III Palsy
- Anisocoria
- Ptosis

PEARL for Concern: if you have more than one of the following

- Pupil abnormality
- Eyelid abnormality
- EDM abnormality

Karnel M. Eggenberger E. Deciphering Diploia. Eye Net. Nov/Dec 2009. PP31-34

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### Management

- ER (Called ahead – got ER physician on the phone)
- Diagnosis: CSF leak at the base of his skull
- Referred to Neurosurgery
- Sees me q4-6weeks for stability check

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### Signs and Symptoms of CSF Leak

- Low pressure (orthostatic) headache – 92%
- Nausea – 54%
- Neck pain – 43%
- Loss of smell or taste
- Tinnitus
- Otorrhea
- Rhinorrhea
- Oculorhea extremely rare

Most common cause – craniofacial trauma

- Skull base fractures occur in 4% of head injury that present to the ED ~21% of all skull fractures
- Predominantly in males (75%) with mean age 49

Taylor CA, Bell JM, Brading MJ, Xu L. Traumatic Brain Injury-Related Emergency Department Visits, Hospitalizations, and Deaths - United States, 2007 and 2013. MMWR. Weekly Report 2017 Mar 10;66(10):1-6.  
Kofsky K, Schenkendorfer M, Sisk R, Fitzgerald M. Delayed onset sequential bilateral abducens nerve palsy secondary to traumatic CSF leak. Trauma case report. 2022;38  
Speranza M, Schiavone CC, Zampieri MC, Giamberini MC. Craniofacial Fractures. (Updated 2022 Mar 6). In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK528157/>

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