STRABISMUS: DIAGNOSIS AND TREATMENT MADE SIMPLE

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Disclosures
- Nothing to disclose

Course Goals
- To improve practitioners’ comfort in examining patients with strabismus
- To learn about the different types of strabismus
- To review the techniques useful in examining patients with strabismus
- To be aware of current treatment options for strabismus
Why is Strabismus Scary?

- Practitioners don’t know what tests to do
- Testing is thought to be too complicated
- Treatment is thought to be too difficult/time consuming
- Practitioners don’t want to miss bigger pathology

Causes of Acute Strabismus

- Head Trauma/CVA
- Diabetes mellitus
- Hypertension
- Multiple Sclerosis
- Myasthenia Gravis
- Chiari I Malformation
- Hydrocephalus
- Meningitis
- Neoplasms

Why Does it Matter?

- 2-6% of the population
- Can result in
  - Amblyopia
  - Poor reading ability
  - Poor fine motor skills
  - Poor or no stereopsis
  - Poor cosmesis
  - Symptoms
    - Double vision, words move on the page, loss of place, headaches, avoidance
Prevalence of Strabismus

- Neurologically normal 3.5%
- Prematurity – 18%
- Cerebral Palsy – 44%
- Down Syndrome – 50%
- Myelomeningocele – 53%
- Hydrocephalus and myelomeningocele 7.4%
- Craniofacial dysgenesis – 90%
- Family history 23-70%

From Harcourt B. Br J. Ophthalmology 58:224;1974

Statistics on Strabismus

- 627 cases of strabismus (10 years)
  - 60% esotropes
  - 33% exotropes
  - 7% hypertropes
- Most common
  - Accommodative esotropia (28%)
  - Intermittent exotropia (17%)
  - Basic esotropia (10%)
  - Esotropia secondary to CNS disorder (7%)
  - Convergence Insufficiency XT (6.4%)


Classification - Distance & Near

<table>
<thead>
<tr>
<th>Direction</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal</td>
<td></td>
</tr>
<tr>
<td>In = Esotropia</td>
<td>□ Constant □ 100% of the time</td>
</tr>
<tr>
<td>Out = Exotropia</td>
<td>□ Intermittent □ 1-99% of the time</td>
</tr>
<tr>
<td>Vertical</td>
<td></td>
</tr>
<tr>
<td>Up = hypertropia</td>
<td>□ Laterality □ Right eye</td>
</tr>
<tr>
<td>Down = hypotropia</td>
<td>□ Left eye</td>
</tr>
<tr>
<td>Torsional*</td>
<td></td>
</tr>
<tr>
<td>Incyclotorsional</td>
<td>□ Alternating</td>
</tr>
<tr>
<td>Excyclotorsional</td>
<td>□</td>
</tr>
</tbody>
</table>

Laterality
- Right eye
- Left eye
- Alternating
### Classification – Distance & Near

<table>
<thead>
<tr>
<th>Magnitude</th>
<th>Comitancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Prism diopters Δ</td>
<td>□ Comitant = Deviation is the same in all position of gaze</td>
</tr>
<tr>
<td>□ Prism bar &amp; cover test</td>
<td>□ Non-comitant = Greater than 5 prism diopter change</td>
</tr>
<tr>
<td>□ Small &lt;10Δ</td>
<td>□ Field of gaze</td>
</tr>
<tr>
<td>□ Medium 11-30Δ</td>
<td>□ Other eye fixating</td>
</tr>
<tr>
<td>□ Large &gt; 30Δ</td>
<td></td>
</tr>
<tr>
<td>□ Degrees</td>
<td></td>
</tr>
<tr>
<td>□ 1Δ = 0.57°</td>
<td></td>
</tr>
</tbody>
</table>

### Recording

- Eye, magnitude and frequency with cover test
- Intermittent - parentheses around the T
  - 35RX(T) = intermittent right exotropia
- Near cover test - apostrophe at the end
  - 20AXT’ = alternating exotropia at near
  - 20AXT = alternating exotropia at distance

### Case History

- Age of onset
- Laterality
- Distance noted
- Frequency
- Worsening/Improving
- Associations
  - Head tilt, close eye, clumsy
  - Headache, clumsy, dizziness
- Family history
Exam for Patients With Strabismus

- VA
- Cycloplegic Refraction
- Tests of Motor Fusion
  - Cover Test (or equivalent)
  - Near Point of Convergence
- Tests of sensory fusion
  - Stereopsis
  - Worth 4 Dot
  - Bagolini
- Tests of Correspondence
  - Worth 4 Dot
  - Bagolini
- Visuosity
- Health
  - Pupils
  - VF
  - Dilated exam

Visual Acuity

- No peeking!
- VA chart
  - Allen Pictures
  - Tumbling E
  - Lea Symbols
  - HOTV
  - Snellen
- Amblyopia
  - Constant, unilateral strabismus
  - Amblyogenic refractive error

Potentially Amblyogenic Refractive Error

- Isoametropic
  - Hyperopia: > +5.00
  - Myopia: > -8.00
  - Astigmatism: > 2.50
- Anisometropic
  - Hyperopia: > 1.00
  - Myopia: > -3.00
  - Astigmatism: > 1.50

AOA AAO (ages 2+)

• Hyperopia: > +5.00
• Myopia: > -8.00
• Astigmatism: > 2.50

• Hyperopia: > 1.00
• Myopia: > -3.00
• Astigmatism: > 1.50

Image Courtesy of Marilyn Vicelia, OD
VA Testing in an Infant

- Forced Preferential Looking
- Teller Acuity Cards
  - $-2000
- Cardiff Cards
  - $1470
- Advantages
- Disadvantages

Gross VA Testing in an Infant

- 3 areas
  - Alignment = Central
    - Cover 1 eye is light centered on pupil
  - Absence of nystagmus = Steady
  - Able to maintain fixation = Maintained
    - Does strabismic eye follow target?
- Abbreviated CSM
  - If unable in any area place a “u” in front of the letter

Tests of Fusion

- Motor Fusion
  - Ability to physically move eyes in response to disparate retinal stimuli
  - Corresponding retinal areas pointed at the object of regard
  - Examples: Cover Test, Near Point of Convergence (NPC), Vergence Ranges (Prism Bar)
- Sensory Fusion
  - Using the image from each corresponding retinal area and superimposing them at the level of the occipital cortex
  - Examples: Stereopsis, Worth 4 dot, Bagolini
Cover Test

- Equipment
- Fixation
  - At Distance
  - At Near – accommodative target
- Procedure
  - Unilateral
  - Alternate
  - Unilateral

Cover Test

- Procedure
  - If movement of the eye, place prism on deviating eye (non-strabismic eye fixating – primary deviation) then repeat with strabismic eye fixating (secondary deviation)
  - Comitancy
  - Measure magnitude with prism bar
    - Base in for exo
    - Base out for eso
  - If deviation larger than prism

Comitancy

- Is deviation the same in all fields of gaze?
- 9 positions of gaze or primary v. secondary deviation
  - Cover Test, Maddox Rod
- Difference of 5 prism diopters
- Examples:
  - “A” Pattern Strabismus
    - Eso upgaze > downgaze
  - “V” Pattern Strabismus
    - Exo upgaze > downgaze
Hirschberg

- Transilluminator at 50cm
  - 1mm displacement = 20-25 prism diopters
  - Nasal = exo
  - Temp = eso

Krimsky Test

- Hirschberg with prisms in front of fixating eye to measure magnitude

Ocular Motility Testing

- Ensure no restrictions of gaze
  - Versions & Ductions
  - Check for over or underactions
### Sensory Adaptations to Strabismus

- Suppression
- Diplopia
- Panoramic Viewing – exotropia
- Close one eye - exotropia

### Stereopsis

- Randot Stereopsis
  - Randot Shapes/Lang stereo test
  - Pearls: match shapes
- Wirt Circles
  - Monocular Cues
  - Normal 40" by age 5 (#7 on 10 circles)
- Constant Strabismic
  - Fail Randot
  - Can get up to 70" Local (Wirt)
- Intermittent Strabismic

### Worth 4 Dot

- Procedure: Red on OD
- Fusion – 4 dots
- OD suppression: 3 green
- OS suppression: 2 red
- Diplopia: 5 dots
  - Eso = uncrossed (BO)
  - Exo = crossed (BI)
- Microtropia: Fusion at near, Suppression at distance
- Malingerer: 8 dots!
Maddox Rod/Red Lens

- Maddox Rod/Red Lens
  - Done in 9 positions of gaze
  - Done the same way as cover test but SUBJECTIVE

Maddox Rod

- Red on Right eye for consistency
- Align with lines Vertical for Vertical diplopia
  - Patient sees Horizontal line
- Align with lines Horizontal for Horizontal diplopia
  - Patient sees Vertical Line

Maddox Rod

- If EXO deviation patient will see the line to the left of the light
  - Crossed diplopia
  - BI prism
- If ESO deviation will see the line to the right of the light
  - Uncrossed diplopia
  - BO prism
Maddox Rod

- For hyper deviations: the hypertropic eye sees the LOWER image
  - BD hyper eye

Correspondence in Strabismus

- Normal Correspondence (NC)
  - Foveae of the 2 eyes have a common cortical visual direction
  - Objective angle of deviation = subjective
- Anomalous Correspondence (AC)
  - Foveae of 2 eyes do not have a common cortical visual direction
  - Objective angle of deviation ≠ subjective
    - There is an eye turn but patient sees target as fused
    - There is an eye turn but prism to cause fusion ≠ eye turn

Assessing Correspondence

- Worth 4 dot
  - 4 dots and no strabismus = NC
  - Diplopia response and magnitude of prism to fusion = magnitude of prism for cover test = NC
  - Fusion but strabismus present = AC
  - Diplopia and magnitude of prism to fusion ≠ magnitude of prism for cover test = AC
- Simple way
  - Patient with constant strabismus, no stereopsis, sees 4 dots = AC
Assessing Correspondence - Bagolini

- Procedure
  - Patient wears lenses OD at 135 degrees
  - Transilluminator at 50 cm
  - Cover each eye
    - OD sees line at 45 degrees
    - OS sees line at 135 degrees
  - Test OU

Assessing Comitancy - Bagolini

- Responses
  - One light in center of X = no suppression
  - NC if no strabismus, AC if strabismus

- Diplopia Responses
  - 2 lights above = esotrope
    - BO prism
    - UCT when light in center = if no movement NC, if movement AC
  - 2 lights below = exotrope
    - BI prism
    - UCT when light in center = if no movement NC, if movement AC

Assessing Correspondence - Bagolini

- Suppression Responses
  - One line with central light
    - Suppression
  - 2 lines, one with central portion missing
    - Small central Suppression
Monocular Fixation Status

- Visuoscropy
- Note if steady, unsteady, central or non-central (nasal, temporal, superior, inferior)
**Esotropia Characteristics**

- More common than exotropia
  - 2-to-4:1
- Onset
  - Ages 1-3 yrs
- Most constant
  - Early accommodative esotropia can be intermittent
- 80% are unilateral
- Larger incidence of hyperopia than in non-strabismic
- 50% can have associated vertical component
- Instability common < 5 years

  Ophthalmology 2008;115:2266-74

**Esotropia**

- Infantile Esotropia (8.1%)
- Accommodative Esotropia
  - Refractive (36.4%)
  - Non-refractive
  - Partially Refractive (10.1%)
- Non Accommodative (16.6%)
  - Early onset
  - Acute onset
    - Comitant
    - Divergence Insufficiency
- Microtropia

Greenberg AE. Ophthalmology 2007;114:170-4
**Infantile Esotropia**

- **Infantile Esotropia** (Congenital Esotropia) (28-54%)
  - Neurologically normal child
  - Develops in first 6 months of life (3-4 months)
  - Stability
  - True congenital “at birth” is rare
  - Magnitude 40-60°
  - Refraction: low to moderate hyperopia (≤+3.00)
  - Amblyopia present

### Motility anomalies
- Cross-fixation
  - OD fixates in left gaze
  - OS fixates in right gaze
- Inferior oblique over-action (IOOA) (78% of cases)
  - Appears as right hypertropia on left gaze and/or left hypertropia on right gaze
  - Unilateral or bilateral

### Motor anomalies
- Dissociated vertical deviation (DVD) (50%)
  - Vertical deviation
  - Removal of cover, each eye moves in same direction (down) versus with hypertropia one moves up, one down
- Nystagmus
  - Latent nystagmus (25-50%)
    - Occlusion of one eye
    - DVD
  - Rotary nystagmus (30%)
    - Decreases over 10 years
### Infantile Esotropia

**Spontaneous Resolution of Early Onset Esotropia – Am J. Ophthalmol 2002;133:109-18**

- **170 Infants (4 to <20 weeks)**
  - Family history: 45%
  - Magnitude of deviation: 49% > 40Δ
  - Frequency of deviation:
    - 56% Constant (65% 12 weeks and older)
    - 25% Intermittent (57% under 12 weeks)
    - 19% Variable
  - Refractive error: 23% > +3.00D
  - Motor findings:
    - IOOA 2%
    - DVD 0%
    - Latent nystagmus 1%

### Infantile Esotropia - Resolution

- **27% resolved**
- More likely to resolve
  - Younger age at presentation
  - Intermittent or variable deviation
- Less likely to resolve
  - Constant ET ≥ 40Δ on 2 visits
  - ≤ +3.00

### Infantile Esotropia - Treatment

- **Correction of significant refractive errors**
  - Greater than +2.50 or +3.00D
  - Monitor in 2 months
- Occlusion therapy for amblyopia
  - 1-2 hours a day
- Eye stretches
- Baby eye “ergonomics”
- Surgical correction
  - < 6 months of age v. wait until older
  - “Success” 10Δ or less ET
  - Multiple surgeries common (26-41%)
Accommodative Esotropia

- Due to accommodative demand to obtain a clear retinal image in patients with hyperopia
- Develops later than infantile
  - Onset 6 mos to 8 years (avg 2.5 years)
  - Can start intermittently
- Types
  - Refractive
  - Non-refractive
  - Partially refractive
- Many cases resolve by teenage years
- Motor Anomalies: IOOA 15-17%

Refractive Accommodative Esotropia

- Complete resolution with full hyperopic R
- Magnitude of deviation
  - 70% between 11-45Δ
- Refractive error +2 to +6D
- Motor
  - 35% IOOA
    - Not initially

Refractive Accommodative Esotropia

- Long term treatment results in patients with ET eliminated or decreased to <10 prism diopters
  - Full cycloplegic Rx
  - Followed 10 years
- 79% ortho to ≤10Δ
- 13% XT
- 5% increase ET
- 3% high AC/A

Non-refractive Accommodative Esotropia

- Convergence excess esotropia
- Approximately 5% of all cases
- Magnitude
  - Minimal at distance
  - $10^\text{st}$ at near (usually $30^\text{st}$)
- Refractive error
  - Minimal hyperopia
- Differentials
  - V pattern ET
  - Spasm of near reflex

Partially Accommodative Esotropia

- Incomplete resolution with full hyperopic correction
  - Magnitude of deviation sc and cc yields residual component
  - Usually $10^\Delta$
- Approximately 33% of all patients
- Constant
- Primarily unilateral
- Amblyopia common

Accommodative Esotropia - Treatment

- Prescription
  - Full Cycloplegic v. Minimal Plus to alignment
  - Follow up 2-3 months
- Bifocal consideration
  - If non-refractive or if residual deviation at near
  - Add types
    - $+3.00$ vs. Most plus to alignment
  - Fit
    - Flat top 35, bisect pupil
  - Weaning by teenage years
### Accommodative Esotropia - Treatment

- **Amblyopia Treatment (if indicated)**
  - VA 20/40-20/80 patch 2 hours/day
  - VA 20/100+ patch 4-6 hours/day

- **Prism for residual ET**
  - Generally <15 split between eyes
  - **Adaptation** concern
    - "eat up prism"
    - Sit with prism in office 10-30 minutes, reassess CT, if same deviation = adaptation.
    - Trial Fresnels OU for 1 day – split prism OD/OS

### Accommodative Esotropia - Treatment

- **Surgical correction for non-accommodative component**
  - **Magnitude**
    - Generally done binocularly
    - BMR Recession

### Accommodative Esotropia - Treatment

- **Home Therapy**
  - Eye stretches

- **Vision Therapy**
  - Help with alignment and stereopsis
  - Work on suppression
Case

- 3yo 4mo cc: OD intermittently turns in for past 6 mo
- No FEH strabismus
- FT; 8lb 6 oz; no complications
- Normal developmental milestones
- HOTV DVA
  OD 20/200
  OS 20/60+
- 30° Alt ET (OS fixation preferred)
- Dry Ret
  OD +6.50  OS +6.00
- Cyclo Ret
  OD +6.50  OS +7.00
- No stereo

Treatment

- OD +6.00 sph, OS +6.50 sph polycarbonate FT wear
- RTC 8 wks

6 week f/u

- Rx worn FT X 3 wks; patient likes glasses; no eye turn cc
- DVA cc
  OD 20/30-2
  OS 20/30-2
- NVA cc
  OD 20/30
  OS 20/30
- Stereo ? Resp
- DCT ortho
- NCT flick esophoria
- RTC 3 mo
Non-Accommodative Esotropia

- Early Onset
- Acute Onset
  - Comitant
  - Divergence Insufficiency

Early Onset Non-accommodative Esotropia

- Onset 6 mos – 2 years
- Findings similar to infantile esotropia
- Magnitude of deviation: 30-70Δ
- No significant hyperopic refractive error
- Better prognosis for binocular vision development than infantile
- Relationship with ocular disease
  - Retinoblastoma 11%

Acute Comitant Onset Non-Accommodative Esotropia

- Patient with previously normal binocular vision
  - Ages 5+
- Deviation: moderate to large esotropia
- No signs of EOM paresis
- No neurological signs
- Diplopia present
- Causes: decompensated esophoria, illness, injury, stress, prolonged occlusion

Case

- 16 year old F complains of blurry vision OD and diplopia
- LEE 1 year ago
- VA 20/30 OD, 20/20 OS
- DCT 8CRET, NCT 8-10CRET
- EOMs full
- No stereopsis
- Ret +0.50-1.75x180 20/25 OD +0.25 OS

Case – Exam 1 year ago

- Cover test: Ortho distance and near
- Stereopsis 100" sc
- Stereopsis 30" cc

Case

- Order MRI of brain
  - Ovoid Lesion within sella turcica
  - Measures 8x7.4x6.4mm
  - Rathke cleft
Acute Onset Comitant Non-Accommodative Esotropia – Divergence Insufficiency

- Eso distance > near
  - Some say > 10Δ
  - ET at distance and EP' at near
- Normal refractive errors
- Amblyopia uncommon
- Suppression uncommon
- Anomalous correspondence uncommon
- Diplopia at distance, worse towards the affected eye
- THINK NEUROLOGICAL CAUSE!

Divergence Insufficiency v. Paralysis

<table>
<thead>
<tr>
<th>Insufficiency</th>
<th>Paralysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eso distance &gt; near</td>
<td>Eso distance &gt; near</td>
</tr>
<tr>
<td>Comitant</td>
<td>Comitant</td>
</tr>
<tr>
<td>Gradual onset of diplopia (mild)</td>
<td>Sudden onset of diplopia (marked)</td>
</tr>
<tr>
<td>Diplopia worse when tired</td>
<td>Small range of single</td>
</tr>
<tr>
<td>Large range of single</td>
<td>Neurological signs</td>
</tr>
<tr>
<td>Decreased negative fusional vergence</td>
<td>May have “A” pattern: more eso upgaze</td>
</tr>
</tbody>
</table>

Acute Onset Non-Accommodative Esotropia - Treatment

- Hyperopic Rx if no neurological signs
  - Follow up 2 months
- Consider MRI of brain if signs or no improvement
- Prism for fusion – if able
- Vision Therapy
  - Stereopsis
  - Anti-suppression
- Surgery
  - If stable for 6 months
  - Deviation > 15-20Δ
Microtropia

- A small angle strabismus (<4Δ) without movement on cover test and eccentric fixation
- Etiology
  - Treated strabismus
  - Anisometropia not corrected at early age
- When do you suspect microtropia?
  - No obvious strabismus
  - No amblyogenic refractive error
  - Monocular decreased VA – normally 20/100 or better
  - No Randot Stereopsis

Tests
- Stereopsis – will fail Randot
- Worth 4 Dot
  - Fusion at near
  - Suppression at distance
  - Eye with decreased VA
- Visuscopy – eccentric fixation
- 4 Base out-fail

4 Base Out Test
- Done binocularly
- Place a BO prism before the eye.
- Patients will fail this test if any type of central suppression (macular disease)
**4 Base Out Test – normal**

**Version Eye Movement**

**Vergence Eye Movement**

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**4 Base Out Test – Positive**

**Version Eye Movement**

---

**No Vergence Response**

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**4 Base Out Test – Positive**

**No movement if cover microtropic eye**
A Note On Vision Therapy

- Indications
  - Age of patient
  - Providers
  - Motivation
    - Desire for stereopsis

Esotropia “Mimickers”

- Pseudoesotropia
- Duane’s Retraction Syndrome
- CN VI Palsy

Pseudoesotropia

- Appearance of esotropia when eyes aligned
- Infants
  - Flat nasal bridges
  - Epicanthal folds
- Testings:
  - Hirshberg
- 12% later diagnosed with ET
  - Average 4.5 months (range 1-71 months)
- Recommendation
  - Follow up in 6 months and then annually
Duane's Retraction Syndrome

- Limitation of abduction, adduction or both along with globe retraction and narrowing of palpebral fissure on adduction
- Mostly unilateral
  - OS>OD
- Females > Males
  - 4:1

Duane's Retraction Syndrome

- **Type I** – Limitation of Abduction with narrowing of palpebral fissure on adduction
- **Type II** – Limitation of Adduction with narrowing of palpebral fissure on adduction
- **Type III** – Limitation of Abduction and Adduction with narrowing of palpebral fissure on adduction

CN VI Palsy

- Limitation of abduction
- Check binocularly and monocularly
Etiology of Cranial Nerve VI Palsy

- **Adults**
  - Undetermined: 26-30%
  - Vascular: 13-35%
  - Trauma: 12-17%
  - MS: 4-7%
  - Neoplasm: 5-21%
  - Aneurysm: 2-4%
  - R/O GCA

- **Children**
  - Neoplasm: 19-39%
  - Trauma: 10-34%
  - Congenital: 5-12%
  - Infectious: 6-13%
  - Increased ICP: 2-23%
  - **IIH %**
  - Undetermined: 5-15%

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**Case**

- 16BM referred by primary care doctor for "poor acuity - acute problem left eye (+) nystagmus - gives patient double vision - admits headaches. When I saw him several days ago I thought eyes wiggled and told him to rest his eyes. It helped some"
- Complains of double vision x few weeks, worse at distance. Notes OD turns in. Mild headache x 2 weeks alleviated with ibuprofen

**Case**

- Vision 20/20 each eye
- PERRL (-) RAPD
- Visual fields: Full to finger count
- Motility: bilateral abduction deficit (-1/2)
- Cover Test

![Cover Test Image]
Case

- Stereopsis: All shapes (250")
- Worth 4 Dot: Uncrossed diplopia D & N
- Single Vision
  - Near 18 eso
  - Distance 30 eso
- Refraction
  - -7.00 OU 20/20 OD/OS
- Dilation
  - Healthy optic nerves (+) SVP
- Plan: MRI brain

Case

- Abnormal enhancement of right CNVI suggesting inflammatory neuritis

Case

- Follow up 2 months later
  - VA 20/20 each eye
  - Cover Test
    - Distance RET 35
    - Near RET* 30
  - Stereopsis: none
  - Unable to fuse prism
  - Plan
    - Consult with MD regarding surgery
    - Neurology referral
    - Abduction work & patch when reading
Case

- Follow up 6 months later
  - Did not see neurology
  - Headaches no change
  - No double vision – closes 1 eye when reading
  - VA 20/20 each eye
  - Color 17/17 each eye
  - Cover Test/Maddox Rod

Exotropia Characteristics

- Less common than esotropia
  - In Children: 1 case for every 3-5 cases of esotropia
- Gender
  - Females > Males
- Onset
  - 35-70% begin within first 2 years of life
  - 85% Intermittent
  - 16-52% can have associated vertical component

Exotropia Classifications

- Divergence Excess (5-17%)
- Basic (50%)
- Convergence Insufficiency (33%)
  - More common in older patients
- Consecutive
Divergence Excess Exotropia

- Distance > near (10 Δ)
  - Average distance deviation 29 Δ
  - Average near deviation 9 Δ
- Pearl: may need to have patient view farther than end of exam room

True vs. Pseudo Divergence Excess

- Prevalence of True DE overestimated due to robust accommodation-convergence in children (80%)
  - May cause near deviation to be measured as less exo than distance deviation
- Testing
  - Prolonged occlusion (30 minutes) of 1 eye
    - Remove patch (eyes covered) and IMMEDIATELY measure near cover test
  - +3.00 lens OU at near
    - If no change with +3.00 = true
    - If increases with +3.00 = pseudo

Basic Exotropia

- Deviation is within 10 Δ at distance and near
Convergence Insufficiency Exotropia
- Deviation at near is greater than distance (10∆)

Consecutive Exotropia
- Preceded by esotropia
- After surgical correction or spectacle correction of esotropia
  - 4-25% of patients after ET surgery
  - 10-20% of esotropic patients treated with hyperopic Rx
  - Risk factor +4.50 or greater without good stereopsis
- Treatment
  - Decrease plus in glasses

Sensory Adaptations
- Suppression
- Panoramic viewing
- Close one eye in sunlight
Panoramic Viewing

- Binocularity

Strabismus Referral

- 15 year old F referred for VT for strabismus
  - OD turns out
  - Ret
    - OD -1.25  20/30-
    - OS plano  20/20
  - Cover Test
    - Distance  6XP
    - Near 8 RX(T)
  - Stereopsis
    - 1/6 Randot shapes
Strabismus Referral

- Dx: Pars Planitis OU, 9RD IT OS
- 5 years later
  - S/P steroid injections x 2 OD, x 1 OS
  - S/P Subtenon kenalog plaque placement OD
  - S/P Retinal tear repair OS
  - S/P Cataract with Phaco and PCIOL O YAG
  - S/P Aqueous shunt OD for subsequent glaucoma

Treatment of Exotropias

- Course of Intermittent Exotropia
  - Does not always progress & may improve
    - Rutstein RP. OVS 2003;80:644-9
  - Findings can be variable
    - IX(T) Studies
### Treatment of Exotropias

- **Correct refractive error**
  - Even full plus or astigmatism may help alignment
  - Kassem IS. JAAPOS 2012;16:437-40

- **Overminus lenses - 28% success**
  - 1-3 D over distance refractive error (up to 6.50)
  - Not for CI type

- **Alternate occlusion - 37% success**
  - Alternately occlude OD/OS daily to eliminate or prevent suppression

- **Prisms – 28% success**

- **Surgical Treatment – 61/43% success**
  - Bilateral Lateral Rectus Recessions (BLR Recess)
  - > 20 Δ
  - Indications
    - Non-surgical treatment unsuccessful
    - Decreasing Stereopsis (Wirt)
    - Frequency of deviation (> 50%)
    - 45-50% multiple surgeries


- **Vision Therapy/Orthoptics – 59% success**
  - Develop Convergence
  - Brock String
  - Computer Orthoptics
  - Polarized Vectograms

Available from bernell.com
Exotropia Mimickers

- Pseudoexotropia
- CN III Palsy

Pseudoexotropia

- Less common than pseudoesotropia
- Due to a wide PD

CN III Palsy

- Horizontal and Vertical diplopia
  - Distance and near
- Ptosis (no diplopia)
- Dilated fixed pupil
  - Aneurysm
- Limitation of mobility
  - Abduction Intact
- Possible Neurological Signs
  - Contralateral hemiparesis
  - Contralateral hyperkinesia
  - Ataxia
Cranial Nerve III Palsy

Etiology

- **Adults**
  - Undetermined 25%
  - Vascular 20%
  - Aneurysm 16-20%
  - Trauma 15%
  - Neoplasm 12-15%

- **Children**
  - Congenital 18-47%
  - Trauma 13-53%
  - Neoplasm 2-26%
  - Aneurysm 1-6%
  - Inflammatory/ Infectious 3-21%

Sensory Strabismus

- Vision loss or chronic poor vision in one eye
  - Retinal scar
  - Cataract
  - Corneal opacity
- If develops before age 5-6 equal chance to be ET or XT
- If develops past age 6, exotropia more common
### Sensory Strabismus

<table>
<thead>
<tr>
<th>Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreased VA</td>
</tr>
<tr>
<td>Fixation difficult</td>
</tr>
<tr>
<td>Hirschberg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treat underlying condition if able</td>
</tr>
<tr>
<td>Polycarbonate for protection</td>
</tr>
<tr>
<td>Surgery results variable</td>
</tr>
<tr>
<td>No fusion after surgery</td>
</tr>
</tbody>
</table>

### Vertical Strabismus

<table>
<thead>
<tr>
<th>Less Common than Horizontal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most commonly associated with horizontal</td>
</tr>
<tr>
<td>Traditionally describe hypertropic eye - now describe actual position</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Etiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNV Palsy</td>
</tr>
<tr>
<td>DVD</td>
</tr>
<tr>
<td>SR overaction</td>
</tr>
<tr>
<td>IR Restriction</td>
</tr>
<tr>
<td>SR or IR palsy</td>
</tr>
<tr>
<td>Prior surgery</td>
</tr>
<tr>
<td>Brown Syndrome</td>
</tr>
<tr>
<td>Orbital Floor Fracture</td>
</tr>
</tbody>
</table>

### Vertical Strabismus

<table>
<thead>
<tr>
<th>Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observe habitual head posture</td>
</tr>
<tr>
<td>Cover Test with head aligned</td>
</tr>
</tbody>
</table>
CN IV Testing

- Parks 3 Step
  - What eye hyper in primary gaze?
  - What eye hyper in right or left head gaze?
  - What eye hyper with right or left head tilt?
- Cover Test/Maddox Rod/Red Lens

CN IV Palsy

- Hyperdeviation greater on contralateral gaze and ipsilateral head tilt
- Patient will tilt head to contralateral side
- Excyclotorsion
- Complaint
- Congenital
  - Photo review
  - Increased vertical fusion ranges (10-15 prism diopters)

Case

- 3.5 year old Black Male
- Droopy left eye with head tilt x 10 days
- Mom noted droopy right eye lid 3 months ago
  - Evaluation by pediatrician
Exam

- VA 20/30 each eye (Pics)
- Cyclo Ret: +1.50-1.00x180 OU
- 10 prism diopter right hyper
  - Worse in left gaze
  - Worse with right head tilt
- 5 mm left ptosis
- Dilation unremarkable

Parks 3 Step

Differentials

- Congenital CN IV Palsy?
- Acquired CN IV Palsy?
  - If lesion at brainstem; can get SO palsy with contralateral Horner’s
  - Testing
    - MRI
    - No lesions found
Differentials

- Myasthenia Gravis
  - Variable ptosis
  - Strabismus
- Ice Pack Test
  - Improvement in Ptosis

Etiology of Cranial Nerve IV

- Adults
  - Congenital 38%
  - Trauma 29-35%
  - Idiopathic 8-32%
  - Vasculopathic 18-23%
  - Neoplasm 5%
  - Aneurysm 1%
- Children
  - Congenital 65-84%
  - Trauma 8-30%
  - Other 8%

Treatment of Vertical Deviations

- Prism
  - Base down on hyper eye
  - 10 or less
  - Split between eyes
- Surgery
- Vision Therapy
Summary

- Patients with strabismus require accurate measurement of the deviation and evaluation of sensory status
- Correction of refractive error can help with alignment
- Working on ocular motilities, vergence and tasks requiring depth can be helpful
- In patients who present with neurological signs especially if sudden onset strabismus, imaging should be ordered or neurological referral made

Thank You