What is an Orthoptist?

• Many are COTs, or COMTs

• Specifically trained to evaluate strabismus, diplopia, amblyopia and complex optical dilemmas.

• Work in close association with ophthalmologists, usually in a hospital based setting.

• Involved in many areas of care:
  - Pediatrics
  - Neurology
  - Community services, rehabilitation
  - Geriatrics, neonatology
Ophthalmic technology

- Involved in Resident education, training new orthoptists

Strabismus - Definition

- From the Greek “strabismos”
  - to squint
- It means ocular misalignment
  - Abnormality of binocular vision
  - Abnormalities of neuro-muscular control of ocular motility
- One fovea is not directed at the same object as the other.
- Only 30% of newborns have straight eyes
  - But should be straight by 2 months of age....

NOT ONE YEAR!!!!

Symptoms of Strabismus

- Double Vision
- Blurred VA
- Squinting
- Headache - PM onset

Diplopia

- What are the Symptoms?
  - True double vision, blurred vision or aesthenopia?
  - Binocular or Monocular?
- Binocular resolves by closing one eye!
- Monocular that resolves w/ pinhole is almost always refractive!

- Unusual in children!
  - Implies an acquired strabismus
  - More extensive workup?

- Children under 4-5 turn off the double vision
  - Suppression
  - Occurs in the cerebral cortex

**The 6 Extra-Ocular Muscles**

Later Rectus  
Medial Rectus  
Superior Rectus  
Inferior Rectus  
Superior Oblique  
Inferior Oblique

**Basic Terminology**

- Ipsilateral - Same side
- Contralateral - Opposite side
- Antagonist - Muscle who's action opposes that of the contracting muscle (agonist) moving the eye
- Yoke - One of two muscles that move the eyes in a similar direction

**Basic Ocular Movements**

- Ductions - The movements of *one* eye
- Versions - Synchronized binocular movements in which *both* eyes move symmetrically in the same direction
- Vergences - Disjunctive movement of each eye in opposite directions to obtain or maintain SBV. e.g., divergence, convergence
Ductions - The Movements of One Eye

- ABduction - Movement away from the nose
- ADduction - Movement toward the nose
- Elevation - Movement upward
- Depression - Movement downward

Versions - Driven by Yoke Muscles

Principles

Hering’s Law - A bilatera l phenomenon.
- Equal innervation to synergistic yokes:
- Innervation to one extra-ocular muscle (EOM) to contract generates equal innervation to contract it’s yoke muscle.

Sherrington’s Law - A unilateral phenomenon.
- As one EOM receives an impulse to contract, it’s ipsilateral antagonist receives an impulse to relax.

Innervation of the EOMs

- CN III SR, IR, IO, MR, Lids, Pupils
- CN IV SO
- CN VI LR

- Origin in the brainstem:
  “The Rule of Fours”
  - CN I-IV: Midbrain
  - CN V-VIII: Pons
  - CN IX-XII: Brainstem
Basic Types of Strabismus

- ORTHO - “Straight”

- Horizontal
  - ESO: Eye deviated In
  - EXO: Eye deviated Out

- Vertical
  - HYPER: Eye deviated Up
  - HYPO: Eye deviated Down

Cyclo-Rotation: The Primary Function of Oblique Muscles

Strabismus Concepts

- Comitant Deviation - Same amount of misalignment in all directions of gaze, or distance compared to near

- Incomitant Deviation - Different amounts of misalignment in different positions of gaze
  - Helps us differentiate between long-standing and more recently acquired strabismus
  - Important in planning surgery

Describing Fusion Status

- Phoria - A “latent” tendency for the eyes to deviate; controlled by fusion. Normally, they are straight.

- Tropia - Greek for “turn in,” a manifest deviation exceeding fusional control. The misalignment is visible.

- Intermittent - Fusional control sometimes present
Age of Onset

- Congenital - Onset early in infancy (birth to within 1st year)
  - “Infantile” more appropriately used now

- Acquired - Later onset, after a period of apparently normal visual development
  - May require further medical and/or neurological workup.

Measuring Strabismus

Assessing Fusion
Measuring Alignment

The W4D - Assessing Gross Fusion

- Convention:
  - Red lens on Right

- Do at distance and near

- Comes in pediatric flavors too!

- Responses:
  - Fusion
    - 4 lights seen
  
  - Suppression
    - Only one color seen

  - Diplopia
    - 5 lights seen
Why? Related to Retinal Projection

The Stereo Test – Assessing Fine Fusion

- Titmus or Randot stereo tests
- The wings of the fly are the most disparate and easily perceived (3000 seconds of arc)
- Typically use the animals only for young children
- The circles correspond to progressively less disparate or increasingly fine stereo images
- The more circles that are seen, the finer the stereoacuity (25 seconds of arc)
Stereopsis - Required Visual Acuity
Both eyes must see well to have good stereo acuity

Measuring Alignment
In Children, You Need Interesting Toys!

Assessing Strabismus - Basically 3 Ways:

• Prism & Cover Test
• Estimating Techniques
  – Hirschberg
  – Krimsky
• Maddox Rods (rarely used)

Prism and Cover Test

• The ‘gold standard’
  - Distinguishing between phorias and tropias
  - Cover-uncover: Looking for tropias
    • Fusion maintained
  - Alternate cover: Looking for phorias
    • Fusion disrupted

Cover / Uncover - Will Reveal a Tropia
Alternate Cover - Will Reveal a Phoria
Assessing the Deviation

• What tools do we need?
  – Bar or loose prisms
  – Occluder

• How to hold the prisms:
  – Plastic prism in FRONTAL position
  – Glass prism in the PRENTICE position

Measure the Deviation

• How to measure the deviation:
  – Bar or loose prism on the deviating or non-preferred eye
  – Prism apex points toward deviation
  – Begin alternate cover, and increase prism power until no shift in either eye
  – Measure at both distance (6M) and near (1/3M) fixation

• Works for Eso, Exo, Hyper and Hypo deviations

• Works for combined horizontal and vertical deviation
  – Just start to neutralize one deviation until left with only the other

Measuring the Distance Deviation in 9 Diagnostic Positions

• Determines Incomitance

• Measure degree of paresis in CN palsies

• Establishing what muscle(s) are involved in paralysis

Notation in the Chart
Estimating Strabismus

Estimating Strabismus – Corneal Reflex tests

• Hirshberg
  - Edge of pupil: 15 degrees / 30 PD
  - Mid Iris: 30 degrees / 60 PD
  - Limbus: 45 degrees / 90 PD

• Krimsky – Add Prism to Hirshberg Estimate to Confirm
  - Apply prism over the non-deviating eye
  - Center the corneal reflex of the deviating eye

Common Forms of Strabismus in Children and Adults
Esotropia: (ET)

• Non-paretic
  - Benign, early-childhood

• Paretic
  - Neuro, 6th Nerve Palsy

• Restrictive
  - Trauma
  - Thyroid Eye Disease
  - High Myopia
Non-Paretic: Esotropia (ET)

- Constant, \textit{large-angle} esotropia present from within first 12 months of life
- Look for alternating fixation
- Implies qual acuity / no amblyopia
- Surgery between 1-2 yrs

Partially - Accommodative Esotropia

- Residual ET despite hyperopic glasses
- Usually full Cycloplegic Refraction

Pseudo - Esotropia

- Occurs in pts w/flat broad or wide nasal bridge and
- Prominent epicanthal folds
- Corneal Reflex test differentiates it from true ET
- Gradually disappears / improves with age
- Ask family if the crossing is getting better, worse, or staying the same.
  - Many times they will say it’s getting better.
  - Generally not true of pathological strabismus

Intermittent Exotropia – XT

- May be more common than ET.
- Can progress from phoria to intermittent, to constant
- Possibly hereditary

Types:
  - Basic XT: D=N
  - Divergence Excess D>N
  - Convergence Insufficiency N>D

Non-Paretic: Exotropia (XT)

- Convergence Insufficiency (CI)
  - N > D
  - Aesthenopia
  - Headaches
  - Poor readers
Cranial Nerve Palsies

Third Nerve Palsy

• Results from damage to the Oculomotor Nerve:
  • Levator, pupillary sphincter & ciliary body, MR, IR, SR, IO muscles
  • Sudden-onset diplopia - horizontal, vertical, torsional components
  • “Down & Out” (exotropia & hypotropia) strabismus: unopposed LR & SO muscles
    - Ptosis
    - Pupil involvement

• Typical Causes:
  - Vascular problems
    • Uncontrolled diabetes or hypertension
  - Aneurysm
    - A pupil-involving III rd nerve palsy is an ICA or PCA aneurysm until proven otherwise by MRI / MRA

• Resolution / improvement in 3-6 months
  - If pupil-sparing and no cardiovascular Hx

• Optical / prisms of little benefit
  - Horizontal (MR)
  - Vertical (IO, SR, IR)
  - Torsional (IO)

• Usually, we just patch or use scotch ‘satin’ tape

Fourth Nerve Palsy

• Results from injury to the Trochlear Nerve:

• The most common cause of vertical diplopia
• Innervates *only* the SO muscle

• Paresis results in unopposed *antagonist* IO and a hyper-deviation

• Unilateral or bilateral, congenital or acquired

• Torticollis
  - Away from the affected eye

• Opposite head tilt reveals the hypertropia
  - Positive head-tilt test

  • R hyper worse in Left gaze and Right Tilt
  • L hyper worse in Right gaze and Left Tilt

• Congenital Etiology:
  - Long-standing head tilt
  - Possible facial asymmetry
    • affected side fuller
  
  - Sx: intermittent diplopia, aesthenopia, neck pain with reading
  - Large vertical fusional amplitudes
  - Decompensates at later age

• Acquired etiology
  - Trauma, CVA, sinusitis, tumor
  - c/o “tilting” objects
  - In older patients, ischemia

**Sixth Nerve Palsy**

• Results from trauma to the Abducens Nerve:

• Unique intra-cranial course through Dorello’s canal

• Binocular horizontal diplopia
  from Esotropia D > N

• Clinically, abduction deficit, typically less than midline

• Etiology in Adults:
- Vascular infarct
  - Poorly controlled diabetes and/or hypertension
- Trauma, or iatrogenic - improves with time
- Demyelinating disease (MS)

• Etiology in Children:
  - Viral syndrome
  - Lyme’s disease
  - After a recent immunization
  - Trauma
  - Occasional tumor / increased ICP
  - Congenital, idiopathic - improves with time

• Prognosis for full recovery
  - Good in adults w/vascular disease
  - Allow 6-12 months
  - Manage the diplopia
  - Strabismus surgery or Botox

**Pseudo-Sixth Nerve Palsy**

• Acquired esotropia in the context of high axial myopia

• Unilateral or bilateral abduction defecits

• Healthy patient

• No other neurological signs

• MRI reveals normal brain

• Displacement of MR & LR muscle

**Blowout Orbital Floor Fracture**

• Diplopia following blunt trauma
  - Inferior orbital rim
  - Orbital floor and medial wall weakest parts

• Herniation of orbital contents into the maxillary sinus

• Entrapment of IR, IO in the fracture
• CT vs MRI

• Hypo in primary
  - Increases upgaze

• Hyper in downgaze

• SX:
  - Double vision (occasionally painful)
  - Facial numbness (Hypesthesia)
    • Injury to V2

• Clinical signs:
  - Ecchymosis (bruising), enophthalmos, limited elevation and depression, positive forced ductions

• Treatment:
  - Repair fracture first
  - Then strabismus surgery to free the restriction

**Thyroid Eye Disease (TED)**

• Most common glandular dysfunction after diabetes

• An auto-immune problem
  - Abs attack thyroid, EOMs, and extraocular tissues

• Can be hyperthyroid, hypothyroid, or euthyroid

• Effects women > men

• Progressive thickening and fibrosis of the EOMs

• Diagnose with orbital ultrasound

• Symptoms
  - Lid retraction
  - Marked proptosis
  - Diplopia, usually vertical
  - (remember “IMSLO”)

• ON compression - sight threatening!
  - Check pupils and color vision on all Grave’s patients
• Dry eyes / exposure keratopathy secondary to abnormal blink

• Smoking exacerbates the Sx, advise your patients to cut back or quit

**Convergence Insufficiency (CI)**

• The inability to obtain and/or maintain sufficient binocular convergence without undue effort

• Most common causes of ocular discomfort and eyestrain (asthenopia)

• Evaluate CI by assessing
  - NPC
  - Fusional convergence amplitudes

**Convergence Insufficiency - NPC**

• People without CI can easily converge to the nose

• People with CI have a tough time

• Near Point of Convergence (NPC)

**Convergence Insufficiency - Treatment**

• Computer Orthoptics

• Orthoptic exercises
  - Pencil pushups
  - Prism reading

• Vision therapy
Clinical Treatment of Strabismus and Diplopia

Several Options

• Correct refractive error:
  – Hyperopic lenses can improve ET
  – Myopic lenses can improve XT

• Optical:
  – Press-on (Fresnel) prism
  – Ground-in spectacle prism

• Occlusion
  – Patching
  – Scotch ‘Satin’ Tape

• Medical:
  – Botulinum Toxin (Botox)
  – Mestinon (Prostigmine)

• Surgical:
  – Weakening - recession
  – Strengthening - resection
  – Transposition

Post-Operative Care

• Close follow-up is important

• Many possible complications:
  – Diplopia
  – Scleral perforation with surgical needle - endophthalmitis
  – Lost and slipped muscles
  – Changes in eyelid position
  – Nausea, vomiting
Thank You!

For your interest in my course – Please do not hesitate to contact me by email if you have further questions, or you were too shy to ask in class. Put “Your JCAHPO Demystifying Strabismus Course” in the Subject Box or else I might think it is SPAM!

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