Strabismus and Amblyopia
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Anatomy

Tenon's Capsule: Envelope of elastic connective tissue surrounding the eye.
Muscle Sheath: Surrounding fascial sheath of extraocular muscles.
lntermuscular Septum: Extension of muscle sheath between rectus muscles.
Check Ligaments: Fascial extensions between muscle sheath and tenon's capsule.

Origin of Extraocular Muscles:
Four recti muscles originate from annulus of Zinn
Superior oblique originates form orbital apex above annulus of Zinn but has its functional origin (where it acts from) at the trochlea
Inferior oblique originates behind the lacrimal fossa

Tendon Length
MR = 4.5
SR = 6
LR & IR =7

Spiral of Tillaux: Insertions of the rectus muscles are not equidistant from the corneal limbus; they do not lie on a circle concentric with the corneal limbus but lie on a spiral.

Medial Rectus(MR) 5.5mm
Inferior Rectus (IR) 6.5,
Lateral Rectus (LR) 6.9
Superior Rectus (SR) 7.5

Anterior Ciliary Arteries
Muscular branches of ophthalmic artery give rise to 7 anterior ciliary arteries which supply blood to the anterior segment

Lateral muscular branch of ophthalmic artery supplies lateral rectus, superior rectus, superior oblique and levator

Medial muscular branch of ophthalmic artery supplies medial rectus, inferior rectus, inferior oblique

Superior , Inferior, and Medial Recti have 2 anterior ciliary arteries, the Lateral rectus has only one anterior ciliary

Innervation of Extraocular Muscles

3rd Cranial Nerve
- Upper Division
  - -Superior Rectus
  - -Levator
- Lower Division
  - -Medial Rectus
  - -Inferior Rectus
  - -Inferior Oblique
  - -Parasympathetic innervation to pupil travels with inferior oblique branch

4th Cranial Nerve
- -Superior Oblique

6th Cranial Nerve
- -lateral Rectus

Recti Attachments:

Lateral Rectus and Inferior rectus connected to Inferior oblique.
Lockwood's Ligament connects inferior oblique to inferior rectus.

Superior rectus connected to Superior oblique

Medial rectus is only recti not connected to an oblique. Most common muscle "lost " during strabismus surgery.

Capsulopalpebral Fascia - Fascial attachments from the sheath of the inferior rectus to the lower eyelid. Analogous to the levator aponeurosis of the upper lid.
Recession of IR may result in lower lid retraction

Pulley System

There is a pulley system in the orbit for each of the 4 recti muscles. These pulleys contain muscle and may move with rotation of the eye

Primary Position: Eye straight ahead with head straight
Primary Action: Major action of muscle when eye is in primary positions

EOM Obliques

Inferior Oblique
Originates behind the lacrimal fossa
Shortest Tendon - 1mm
Lockwoods ligament
Attachment form capsule of inferior oblique to capsule of inferior rectus

Superior Oblique
Originates orbital apex, functional origin is the Trochlea
Shortest muscle (32mm), longest tendon (26mm)
Becomes tendinous before passing through the trochlea which redirects the tendon inferiorly, posteriorly, and laterally

Vertical Muscles
Elevate Eye: Superior Rectus (SR) and Inferior Oblique (IO)
Depress Eye: Inferior Rectus (IR) and Superior Oblique (SO)

Torsion: Superior muscles intort (SR+SO)
Superior muscles are part of the "in" crowd
Inferior muscles extort (IR+IO)

Horizontal: Vertical recti are Adductors (SR+IR)
Obliques are Abductors (SO+IO)

EXTRAOCULAR Muscles

MUSCLE	LENGTH Of ACTIVE MUSCLE	ORIGINN	ANATOMIC INSERTION	DIRECTION OF PULL	TENDON LENGTH (MM)	ARC Of CONTACT (MM)	ACTION FROM PRIMARY POSITION	INNERVATION **(NERVE)**
Lateral Rectus (LR)	± 40	Annulus of Zinn	6.9mm from Lateral limbus	90*	7	12	Abduction	VI
Medial Rectus (MR)	± 39	Annulus of Zinn	5.5mm from medial limbus	90*	**4.5**	7	Adduction	Lower III
Inferior Rectus (IR)	±40	Annulus of Zinn	6.5mm from inferior limbus	23*	7	6.5	Depression Extorsion adduction	Lower III
Superior Rectus (SR)	±40	Annulus of Zinn	7.5mm from superior limbus	23*	6	6.5	Elevation Intorsion Adduction	Upper III
Levator Palpebri (LP)	—	Orbit apex above annulus of Zinn	—	—	—	—	Lid elevation	Upper III
Inferior Oblique (IO)	± 37	Behind lacrimal fossa	Posterior to equator in temporal-inferior quadrant	51*	1	15	Extorsion Elevation Abduction	Lower III
Superior Oblique (SO)	± 32	Orbit apex above annulus of Zinn (functional origin at the trochlea)	Posterior to equator in temporal-superior quadrant	51*	26	7-8	Intortion Depression Abduction	IV

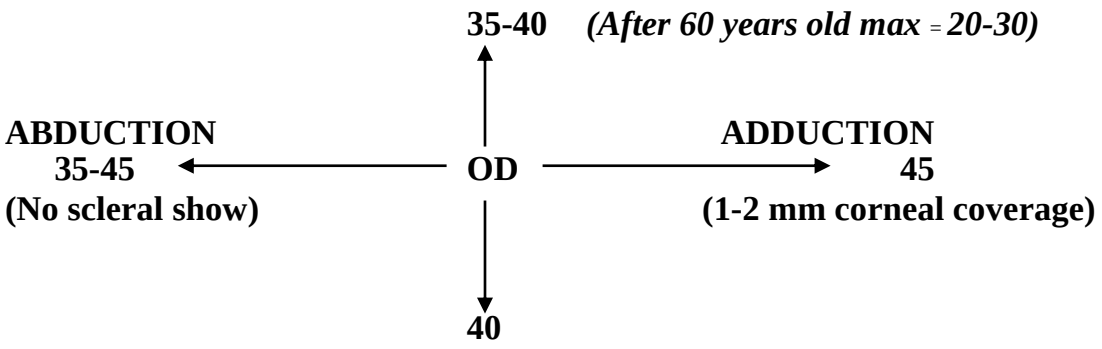
****Relative** to visual axis in the primary position

Definitions

Uniocular Eye Movements (Ductions)

A. **Agonist:** Main muscle active in duction
B. **Synergist:** Another muscle in same eye that acts with agonist to produce a duction.
C. **Antagonist:** Muscle in same eye that acts in opposite direction to agonist

Normal Eye Movement Range

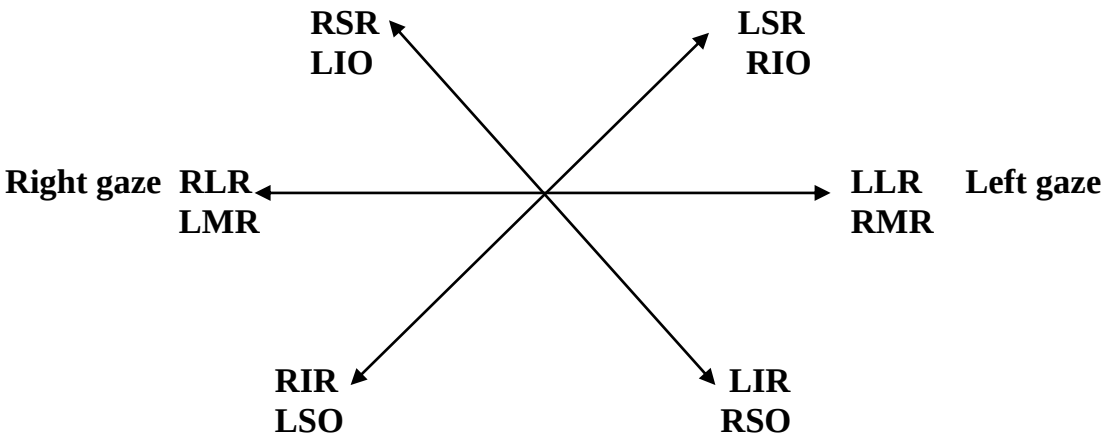


Sherrington's law: As agonist innervation is increased, antagonist innervation is simultaneously decreased.

<u>Binocular Eye Movements (Versions & Vergences)</u>

<u>Versions:</u> Conjugate Eye Movements, eyes moving in the same direction

Yoke muscles: Muscles in the two eyes that cause the two eyes to move in the same direction.



Hering's law: As a yoked pair of muscles are activated to perform a version eye movement, they received equal innervation to perform the movement

Fixating Eye – In strabismus the fixating eye is the eye that is looking at the target under binocular viewing conditions

Primary deviation (nonparetic eye fixating)
Secondary deviation (paretic eye fixating)
*****The secondary deviation is greater than the primary deviation.***

In a right 6th nerve palsy the deviation will measure greater if the prism is placed over the left eye (the paretic right eye will be fixating, this is the secondary deviation)

Vergence Movements: Movement of the two eyes in opposite direction to ensure and maintain binocular fixation and binocular vision.

Average Normal Fusional Amplitudes

Distance	Convergence	Divergence	Vertical Fusion
Near - 25cm	38 PD	16PD	2.5 PD
Far – 6 meters	14 PD	6 PD	2.5 PD

Types of Convergence Movement

A. Accommodative – Incremental convergence that occurs for each diopter of accommodation.

B. Fusional - Optomotor Reflex which maintains ocular alignment and single binocular vision

C. Tonic - Constant innervational tone to EOMs when an individual is awake and alert

D. Proximal - An induced Convergence movement caused by an awareness of near

Accommodation (A)
A change in the shape of the lens that produces an increase in the dioptic power of the eye to place an image on the retina.

Accommodative Convergence (AC)
Reflex linking convergence automatically to accommodation

AC/A: A measure of the responsiveness of a person's convergence function to a unit of stimulus of accommodation.

Methods for Determining AC/A

AC/A Ratio usually Not measured Estimated as high, low, or normal based upon whether Eso or Exo is greater at near or distance

1) Heterophoria Method

$$\mathbf{AC/A} = \mathbf{P.D.} + \frac{\triangle \mathbf{N} - \triangle \mathbf{d}}{\mathbf{D}}$$

Where……

P.D. = lnterpupillary distance
N = Deviation at Near
d = Deviation at Distance
D = Fixation distance in diopters

Esodeviations are considered to be positive (+) and exodeviations to be negative (-)

Example #1

ET = 30 ET' = 36

P.D.= 6.0 cm
N = 36
d = 30
D = 3

$$\mathbf{AC/A} = \mathbf{6} + \frac{\mathbf{36 - 30}}{\mathbf{3}} = \mathbf{8}$$

Example # 2

XT = 2 XT' = 8

P.D.= 6.0 cm
N = 8
d = 2
D = 3

$$\mathbf{AC/A} = \mathbf{6} + \frac{\mathbf{-8 - (-2)}}{\mathbf{3}} = \mathbf{4}$$

2). Gradient Method

$$\mathbf{AC/A} = \frac{\triangle \mathbf{L} - \triangle \mathbf{O}}{\mathbf{D}}$$

Where……

△ L = Deviation with lens
O = Original deviation
D = Power of lens

A change in the stimulus to accommodation is produced by means of ophthalmic lenses;
minus *lenses* ***increase*** *accommodation*
plus *lenses* ***decrease*** *accommodation.*

Example

△ O= XT = 2
△ L = ET = 8
D = -2

$$\mathbf{AC/A} = \frac{\mathbf{8 - (-2)}}{\mathbf{2}} = \mathbf{5}$$

Normal Binocular Vision

Normal (single) binocular vision (SBV) is the cortical integration of similar images on each retina into a unified perception.

Horopter: Focus of all object points that project onto corresponding retinal points.

Panum's space: Region around the horopter in which objects although imaged on non-corresponding retinal areas, are seen singly. Objects seen outside of Panum's space seem to be coming from 2 different directions resulting in diplopia.

***Three Distinct phenomena comprising* S.B.V.**

1) **Simultaneous perception:** An object projects its image on the retina outside corresponding retinal areas producing physiological diplopia.
2) **Fusion:** Unification of visual excitations from corresponding retinal images into a single visual perception.
3) **Stereopsis:** Relative ordering of objects in depth or in three dimensions

Symptoms of Strabismus

1) Diplopia: One object seen in two places. Simultaneous perception of two images of one object resulting from these similar images projecting onto non-corresponding retinal areas.

Image will appear opposite the deviation
When the eyes are crossed (ET) the images will appear uncrossed
When the eye are uncrossed (XT) the images will appear crossed
When the eye is hypertropic (elevated) the image will be depressed

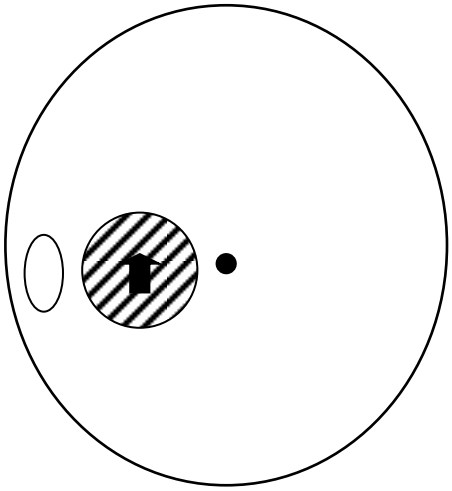
2) Visual Confusion: Two objects seen in one place. Dissimilar images which normally project onto noncorresponding retinal area, project onto corresponding retinal areas.

Sensory Adaptations to Strabismus

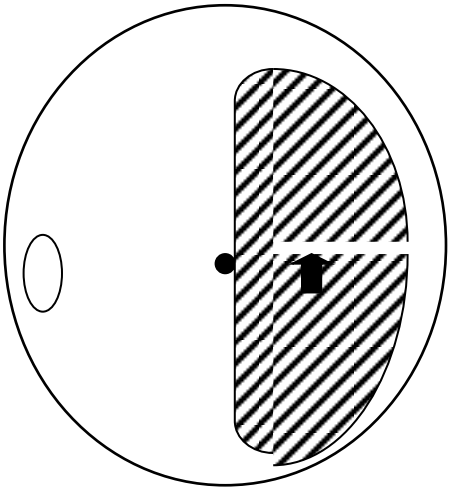
Suppression: Positive inhibitory reflex under binocular conditions which permits the cortex to ignore visual sensations from the retina of the nonfixating eye**.** Prevents diplopia from object of regard.

Suppression Scotoma

Esotropia (e.g. OS) 5 degrees



Exotropia (e.g. OS) Hemiretinal



= optic nerve **= true macula (NRC)** **= new ARC macula**

Abnormal Retinal Correspondence (ARC):

A sensory shift in retinal correspondence may develop in young children with long-standing ocular deviations so that retinal areas that receive the same images develop a common visual direction. Such a shift implies a reordering of inputs into the visual cortex. ***Prevents diplopia from objects seen peripherally.*** Occurs with suppression.

Characteristics of ARC and Suppression

1. Adaptation of a visually immature brain to prevent diplopia
2. Requires presence of binocular vision
3. Exists only when viewing binocularly
4. Requires flexibility of sensory system, young flexible brain
5. Lacks a motor component, **No Fusional Vergences**

Duality of Vision

Macular and Extramacular Vision

Levels of Binocular Vision

Bifixation – Using maculas of both eyes, easily lost
Monofixation – Using macula of one eye, extramacular areas of both eyes
Monocular – Eyes are used independently, no binocular vision of any kind

Monofixation Syndrome

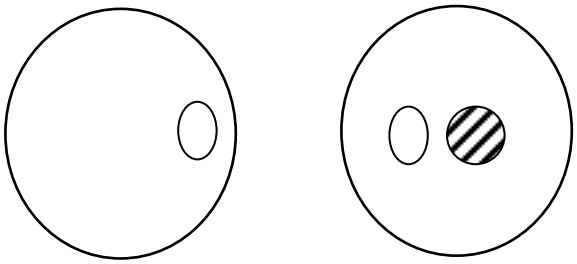
1. Small-angle strabismus (0 to 8 P.D.)

2. Macula Scotoma, Peripheral NRC
   Peripheral fusion in the absence of central fusion
3. Normal Fusional vergences
   Helps to maintain ocular alignement
4. Reduced steroacuity
5. Amblyopia common
   All patients with Amblyopia will have monofixation or be monocular
6. Phoria may be larger than Tropia
   May measure greater than 8 diopters on alternate cover testing
   Will always measure $\underline{<}$ 8 diopters on simultaneous prism cover testing

Causes of Monofixation Syndrome

1. Anisometropia /Amblyopia
2. Treated Strabismus
3. Primary Monofixation Syndrome
4. Organic macula lesion

Macula scotoma of Monofixation



Monofixation Sensory Testing
- Stereo
- Worth 4 light
- Distant Vectograph
- 4 diopter base out test
- Bagolini lenses

Sensory Tests

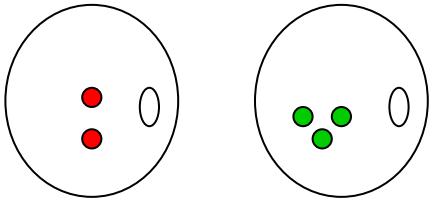
Stereopsis

1. Horizontal separation of objects presented to either eye
   - Polarized or Red Green Glasses
   - Lang stereopsis test embeds the monocular clues in Random dots
2. Separation of figures measured in seconds of arc
3. 40 seconds indicates the presence of Bifixation
4. Monofixation usually with less than 100 seconds
5. Can have fusion without measurable stereopsis

THE WORTH FOUR DOT TEST

1. Four lights are displayed, 2 green, 1 red, 1 white.
2. Red Glass worn in front of one eye, green glass in front of the other eye.
3. The eye behind the red glass can see the can only see the red and white lights.
4. The eye behind the green light can only see green and white lights.

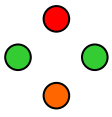
Worth 4 light shown



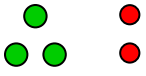
OD FIXATING RESPONSE =

OS FIXATING RESPONSE =

FUSION RESPONSE =

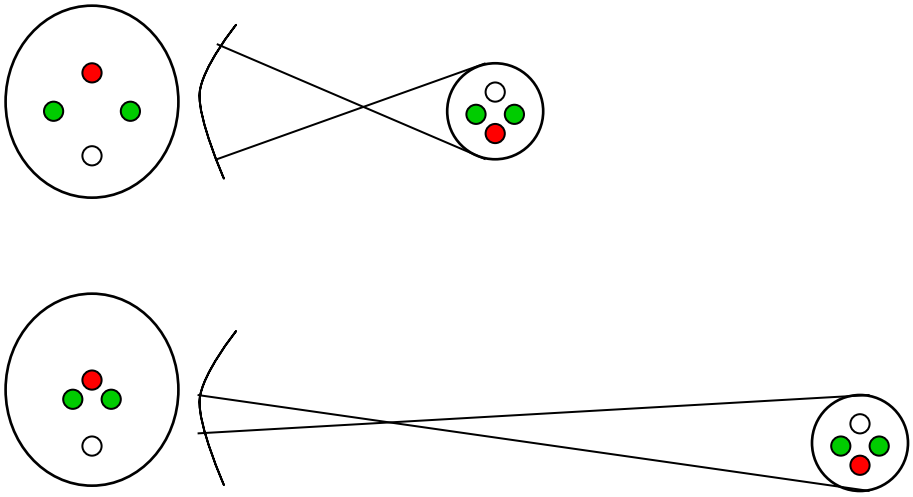


DIPLOPIC RESPONSE =

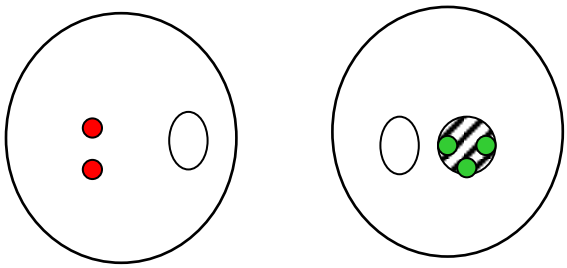


WORTH 4 TESTING DISTANCE AND NEAR

The image projected onto the retina by the Worth 4 light is much greater at near than distance. At 6 meters image is 1.25 degrees, at 0.33 meter the near worth 4 dots project 6 degree angle.

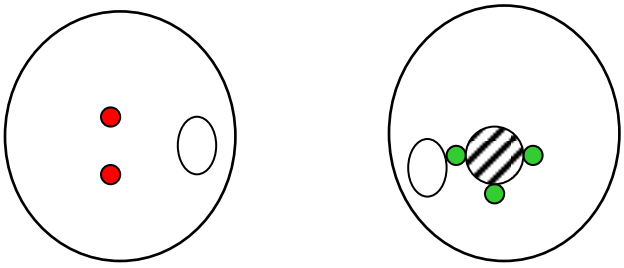


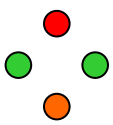
Response to Worth 4 light with Monofixation left eye (macula scotoma OS)
DISTANCE :



RESPONSE =  = SUPPRESSION

NEAR :



RESPONSE = 

WORTH 4 LIGHT

Distance Response

4 Dots = Central fusion (Bifixation)
No need to test near
2 Red or 3 Green = suppression or lack of SBV
5 Dots = No suppression (diplopia) or alternation

Near Response

No Strabismus or Manifest Strabismus < 8 diopters

More dots than distance = peripheral fusion, Monfixation Syndrome
2 Red or 3 Green = No SBV

Manifest Strabismus > 8 diopters

2 Red or 3 Green = suppression or lack of SBV
4 Dots = suppression with ARC
5 Dots = no suppression (diplopia) with NRC

Distance Vectograph

1. Polarized Glasses are worn.
2. Letters are viewed in the distance, letters are polarized so some letters only seen by right eye, some by left eye, some by either eye.
3. Patient is asked to read the letters. If a macular scotoma is present some of the letters will not be seen by that eye.

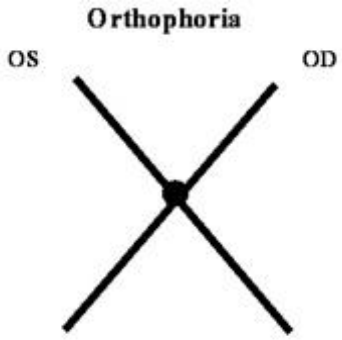
The Four Diopter Base Out Prism Test

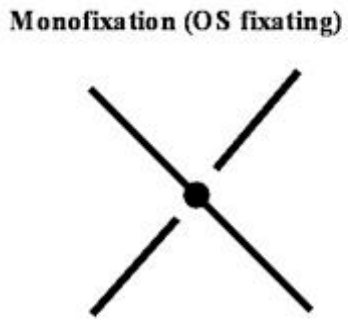
This test is useful to determine whether bifixation or a small suppression scotoma associated with monofixation exists.

1. Four diopters base out prism is quickly placed before one eye.
2. Patient with bifixation shows bilateral movement away from the eye covered by the prism followed by a unilateral convergence movement of the eye not behind the prism.
3. In the presence of a small scotoma in a patient with monfixation syndrome no movement will be seen when the prism is placed before the nonfixating eye. A refixation movement is seen when the prism is placed before the fixating eye, the fusional convergence movement does not occur.
4. **Least Reliable test to detect monofixation**

Bagolini Lenses

1. Striated glasses of no dioptric power cause the light to appear as an elongated streak, like micro-Maddox cylinders.
2. Lenses placed at 135 degrees for right eye and 45 degrees for left eye.
3. Most lifelike testing conditions
4. In Monofixation Syndrome the central Scotoma is perceived as a gap in one of the lines surrounding the fixation light.

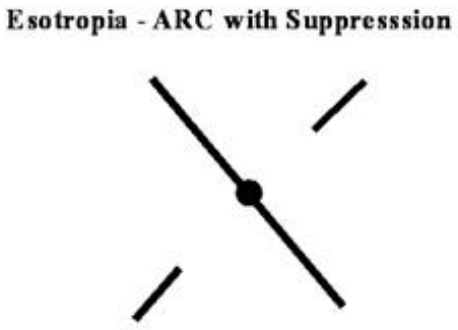




Strabismic Patient with Suppression and ARC (anomalous retinal correspondence)

The lines will appear to cross in the center with a gap seen by the eye with the suppression scotoma

No Diplopia (suppression and ARC eliminates diplopia)



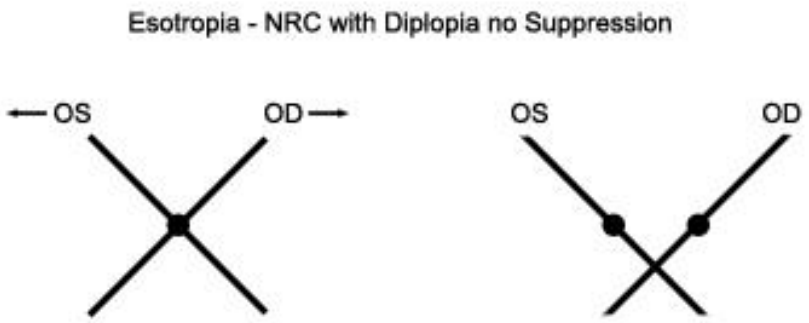
Bagolini Lenses

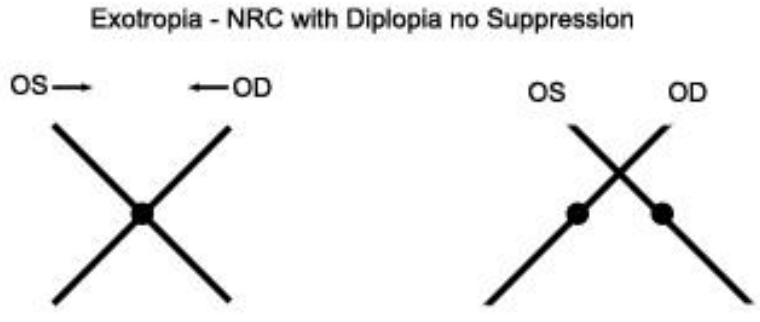
Strabismic patient with Diplopia
NRC (Normal retinal Correspondence) No Suppression

When the eyes are crossed (ET) the images will appear uncrossed
When the eye are uncrossed (XT) the images will appear crossed

Esotropia NRC - OD and OS will be uncrossed or move apart

Exotropia NRC – OD and OS will cross or move towards each other





Bagolini Test Simulator http://eyeontechs.com

THE AFTERIMAGE TEST

Used to determine if a patient has NRC or ARC

A tube of light is flashed into each eye individually, horizontally in one eye and vertically in the other. The center of the light is occluded to allow the fovea to fixate and remain unlabeled. The patient is then asked to draw the perceived afterimages.

The **AFTERIMAGE TEST** differs from other sensory tests in several ways:

1. Only test in which ***each eye is stimulated separately.***
2. Other tests are done binocularly while *the afterimage test is done* ***monocularly.***

In NRC the visual direction of the foveas of both eyes is toward the object of regard. ***In NRC the 2 afterimages will be seen as a cross with a single gap in the center** (the gap corresponds to the fovea in each eye).

In esotropia and ARC - fovea is located temporal to the retinal element which corresponds to the fovea of the dominant eye and the vertical afterimage is therefore displaced nasally (or crossed).

In exotropia and ARC - fovea is located nasal to the retinal element which corresponds to the fovea of the dominant eye and the vertical afterimage is displaced temporally (uncrossed).

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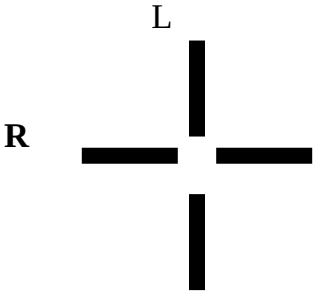
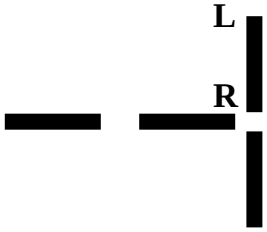
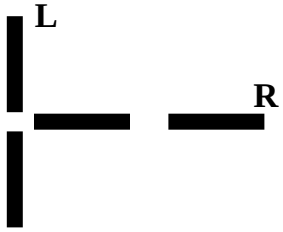


NRC



Esotropia with ARC



Exotropia with ARC

Strabismus Terms

Type of Deviation

Eso	ET	in turning	
Exo	XT	out turning	
Hyper	HT	up turning	(RHT or LHT to designate which eye)
Hypo	HoT	down turning	(RHoT or LHoT to designate which eye)

Fusional Status

Tropia Manifest deviation, fusional status is lost
Esotropia = ET

Phoria Latent deviation in which fusional control is always present
Esophoria = E

Intermittent Tropia Fusional control is present some of the time
Intermittent Esotropia = E(T)

Comitant Does **not** vary in size or direction

Incomitant The deviation varies in size with direction of gaze or fixating eye. Most incomitant strabismus is paralytic or restrictive

For example a right sixth nerve palsy will have an eso deviation that is greatest in gaze right

Measuring Strabismus

Corneal Light Reflex Tests

a. Hirschberg Corneal Reflex Estimate

1 mm = 7 degrees =14 P.D.

B. Krimsky Prism: Corrected Corneal Reflex Estimate:

Use loose prisms or prism bar to realign reflex of deviated eye to a position similar to undeviated eye

Angle Kappa Estimate (in degrees)

Definition: Visual Axis (Fovea . pupil center.) compared to Pupillary axis (center of. pupil -center of cornea)

Normal = +5 degrees or approx. 1 mm Nasal

Cover tests

1. **Monocular Cover –Uncover test**

   As one eye is covered , the examiner looks for movement in the opposite eye

   Detects manifest strabismus or Tropia

   Differentiates Tropia from Phoria

2. **Alternate Cover test**

   Cover is moved from one eye to another

   Does not differentiate Tropia from Phoria

   Prism + Cover test: Cover is moved form one eye to another, prism is placed over an eye till the movement is neutralized. Measures total deviation

3. **Simultaneous Prism /Cover test**

   Simultaneous Prism /Cover test

   Cover is placed over fixing eye, at the same time prism is placed over deviating eye till movement is neutralized

Strabismus simulator- www.aao.org/interactive-tool/strabismus-simulator

Disimilair Image tests

The images seen in each eye are dissimilar and therefore difficult to fuse.
Measures both phoria and tropia

1. **Maddox Rod**
   A pinpoint of light is created into a line of light 90 degrees to the orientation of the parallel cylinders.
   Image will appear opposite the deviation
   When the eye is hypertropic (elevated) the image will be depressed
   Prism can be placed over an eye till the pinpoint of light sits on the line

2. **Double Maddox Rod test measures *cyclodeviation.*** If the patient reports that the two lines are not parallel, a cyclodeviation exists. The patient rotates the axis of one or both of Maddox rods to make the lines horizontal and parallel to each other. The direction of the deviation (incyclotropia or excyclotropia) is determined by noting the direction the top of the Maddox rod (the 12:00 meridian) is rotated. An inward rotation corresponds with an incyclotropia and an outward rotation with an excyclotropia

3. **Red Glass Test**

   Esotropia - uncrossed diplopia
   Exotropia - crossed diplopia

Special Motor tests

1. Forced ductions
   Forcep is used to move the eye into various positions
   Determines resistance to passive movement

2. Active force generation
   Assess relative strength of a muscle
   Examiner feels the tone as the patient looks in a the field of action of the muscle

3. Saccadic velocity
   Assess speed of eye movement
   Useful to differentiate paralysis from restriction
   A paralyzed muscle generates a reduced saccadic velocity

Esodeviations

Congenital/Infantile Esotropia

1. Present by **6** months of age
3. Not corrected by hyperopic lenses
4. Angle of deviation large and constant
5. Limited Abduction
   - Cross Fixation
   - Ciancia Syndrome
     - Large angle esotropia
     - Restricted Abduction/Tight Medial Rectus
     - Abduction Nystagmus
6. Dissociated Vertical Deviations (DVD) & Inferior Oblique overaction (IOOA)
   Over 50% by 3 to 4 years of age
7. Amblyopia may be present

Differential Diagnosis of Congenital Esotropia

1. Pseudoesotropia
2. Duane's retraction syndrome
3. Moebius syndrome
4. Early onset accomodative esotropia
5. Nystagmus blockage syndrome
6. Congenital sixth nerve palsy
7. Sensory esotropia
8. Esotropia in the neurologically impaired

Management of Congenital Esotropia

1. Non-surgical treatment

a) Occlusion therapy for amblyopia
   - Unoperated infantile ET 10%
   - Operated infantile ET 35%

b) Correct significant hyperopic refractive error (+2.50 diopters or greater)

2. Early surgery

Age of alignment ($\leq$ 8 diopters) is important
Reduced chance of fusion after 2 years of age
Chance of obtaining stereopsis is related to duration of misalignment
Reduced incidence of stereopsis if misaligned > 12 months

Types of surgery to correct congenital esotropia

MR OU recess is the most common procedure
MR OU recess + resect 1 or 2 LR

Goal is alignment within 8 diopters to allow for development of binocular vision. More than one strabismus surgery may be needed

Conditions which may develop after Surgery for congenital esotropia

1. Amblyopia
2. Accommodative Esotropia, requiring glasses
3. Overacting inferior obliques
4. Dissociated vertical deviation
5. Latent Nystagmus

Distinguishing features of I0 (inferior oblique) Overaction and DVD

IO Overaction	**DVD**
1. V-pattern	No pattern
2. Rapid movement	Slow movement
3. RHT on gaze left LHT on gaze right	Constant updrift of eye in all fields **No Hypotropia in fellow eye, violates Hering's law**

Inferior Oblique Weakening Procedure

1. Myotomy
2. Myectomy
3. Recession
4. Anterior Transposition
   Inferior oblique is moved anterior to the axis of rotation of the globe changing its action from elevation to depression

Accommodative ET

1. Develops at an average age of 2 ½ years (range of 6 months to 7 years)
2. Usually intermittent at onset
   Appears when tired or sick
   Can appear acutely
3. Often Hereditary
4. Corrected by hyperopic lenses
5. Diplopia initially, until patient develops suppression scotoma
6. High incidence of Amblyopia (2/3rds)

Refractive (Normal AC/A)
1. Hyperopia range + 3.00 to + 10.00 D (Average +4.75 D)
2. Distance and near deviation similar
3. ET usually 20 to 30 P.D.

Non Refractive (High AC/A)
1. Refractive error normal for age **(Average + 2.25)**
2. ET at near fixation > Distant fixation

Mixed Mechanism or Partially Accomodative Esotropia
1. Esotropia not fully corrected by hyperopic glasses
2. Nonaccomodative component is the portion of the esotropia not corrected by glasses

Accommodative Esotropia Treatment
1. Full cycloplegic refraction
   Bifocals if ET at near with full hyperopic prescription
   Use a +2.50 flat top or executive bifocal

2. Miotics
   Phospholine Iodide 0.125% daily with Neosynephrine 2.5% to prevent iris cysts

3. Treat Amblyopia

4. Surgery for Nonaccommodative Component
   (Mixed Mechanism or Partially Accommodative Esotropia)
   Operate on the amount of esotropia not corrected by the full hyperopic glasses
   Will still require glasses after surgery

Accomodative Esotropia the Older Child

1. 8 yo to puberty - Less + or more -
2. Reduction of AC/A
3. 50% out of bifocals
   50% out of glasses

   Clinical Features Predictive of Successfully Weaning from Spectacles Those children with Accommodative Esotropia: Lambert SRJ AAPOS 2003;7:7-13.
   - –90% if initial RX is <3.00 diopter
   - –20% of initial Rx is ≥ 3.00 diopters
4. Contacts
5. May recurr when Presbyopic

Pseudo Esotropia

Wide nasal bridge creates the appearance of Esotropia while the eyes are actually straight

Pseudo ET - How often are we Wrong?

Silbert AL et al: J AAPOS. 2012 Apr;16(2):118-9

Of children initially diagnosed with pseudoesotropia under age 3 who returned for follow-up, **12%** were later found to have strabismus (10%) or mild refractive amblyopia(2%)

Nystagmus Blockage

1. Nystagmus is damped or blocked by converging the eyes leading to an esodeviation
2. Head turn in direction of fixing eye
3. Will always view with eye held in adduction, right head turn when viewing with right eye and left head turn viewing with left eye

Duane's Retraction Syndrome (DRS)

Clinical Types

1. Type 1 - limited abduction retraction in adduction
   LR fires at the wrong time
   ET with head straight

2. Type 2 - limited adduction retraction in adduction
   LR firing all the time
   XT with head Straight

3. Type 3 - limited abduction and adduction
   LR and MR firing all the time
   XT, ET, or Ortho
   Severe Retraction

Type of Duanes = number of **D**s
   Type 1 - Ab**D**uction deficit
   Type 2 - A**DD**uction deficit
   Type 3 – Ab**D**uction and A**DD**uction deficit

Associated Findings DRS

1. F:M = 3:2
2. OS - 60%, OU - 22%, OD - 18%
3. ET (<30 P.D.) - 60%, XT - 15%**,** Ortho - 25%
4. Amblyopia 10-30% usually attributed to anisometropia
5. Associated malformations Goldenhar's Syndrome, deafness, crocodile tears
6. Autopsy specimens show absence of 6^{th} nerve nucleus, lateral rectus is innervated by branches of 3^{rd} nerve
7. May have upshoot and down shoot in adduction
   Secondary to LR slipping above and/or below equator of globe

Treatment of DRS

1. Correct refractive errors and treat amblyopia
2. Type I DRS with head turn -MR recess, .
   DO NOT RESECT LR will increase retraction
4. Recess LR for Type 2 DRS with XT and face turn
5. Vertical Recti Transposition

Mobius Syndrome

1. Cranial Nerve 6, 7 & 9 palsy
2. ET/ Ortho
   Recess Medial recti if Esotropic
   Associated Adduction Deficit
3. Poor Abduction
4. Hand, limb abnormalities

Sixth Nerve Palsy

1. Usually presents with head turn
2. May be benign and recurrent
3. Surgery is indicated if not resolved in 6 months
   -Recess MR/Resect LR if able to abduct past the midline
   -Transposition of SR and IR to lateral rectus if unable to abduct past midline

Neurologically Impaired

Variable Strabismus

Sensory Deprivation ET

1. Retinoblastoma may present with strabismus
2. Surgery restricted to involved eye

Cyclic Esotropia

1. Incidence - 1:3000 to 1:5000 cases of strabismus
2. Typical cycle 24 hour periods of orthophoria alternating with 24 hour periods of ET.
3. Most cyclic ET becomes constant
4. Acquired ET with onset usually age 3-4 yo
5. Surgery to correct total deviation.

Acquired NonAccommodative Esotropia (ANET)

1. May indicate an underlying neurologic disorder
2. Neurologic evaluation may be indicated
3. May increase in amount over the first few months
4. Responds to strabismus surgery

Divergence Insufficiency / Divergence Paralysis

1. ET greater at distance than near
2. Comitant in all fields
3. Ductions and versions normal
4. Maybe associated with
   a. Pontine Tumors
   b. Head trauma
   c. Other neurologic conditions

Age-Related Distance Esotropia

1. ET greater at distance
2. Older Adults (greater than 60 years old)
3. Treatment is base out prisms, strabismus surgery
4. May be related to anatomic changes that occurred with age
   SR-LR band degeneration
   Sagging Eye Syndrome (SES)
   Inferior displacement of LR seen on orbital MRI/CT

Esotropia Associated with High Myopia
Heavy Eye Syndrome (HES)

1. Displacement of lateral rectus inferiorly and superior rectus medially
   a. Results in esotropia and hypotropia
   b. Degeneration of SR-LR band
2. Surgical treatment – Myopexy (joining) superior and lateral rectus
   A nonabsorbable suture is used to bring the lateral rectus and superior rectus muscles together

Exodeviations

Pseudo Exotropia

1. Positive angle Kappa
2. May be associated with temporal dragging of the macula as can occur in severe Retinopathy of Prematurity

Congenital Exotropia

1. Exotropia occurring under age 6 months of age is rare
2. Angle of deviation large, averaging 35 P.O. or greater
3. Early surgery similar to congenital esotropia

Intermittent Exotropia

1. Onset varies-6 months to 6 years
2. In Children XT usually larger in the distance
3. Control of deviation may be good, fair, or poor

Good Resumes fusion rapidly, without a blink
Fair Resumes fusion only after blinking or refixating
Poor may allow eye to stay for a period of time

PEDIG Intermittent Exotropia Control Scale
5 = Constant exotropia
4 = Exotropia > 50% of the exam before dissociation
3 = Exotropia < 50% of the exam before dissociation
2 = No exotropia unless dissociated, recovers in > 5 seconds
1 = No exotropia unless dissociated, recovers in 1–5 seconds
0 = No exotropia unless dissociated, recovers in < 1 second (phoria)

This scale is applied to each patient for both distance and near fixation which, when combined, yields an overall control score ranging from 0 to 10. Levels 5 to 3 are assessed during an initial 30-second period of observation. Levels 2 to 0 are graded as the worst of three rapidly successive trials. An occluder is placed over the right eye for 10 seconds and then removed, measuring the length of time it takes for fusion to become re-established. The left eye is then occluded for a 10-second period and the time to re-fusion is similarly measured. A third trial of 10-second occlusion is performed, covering the eye that required the longest time to re-fuse. The worse level of control observed following the 3, 10-second periods of occlusion should be recorded for that visit.

4. May be progressive

5. Classification of XT
   Basic XT = XT'
   Divergence Excess XT > XT'
      True
      Simulated
         Resolves after monocular patch for one hour
         Caused by proximal Fusion
   Convergence Insufficiency XT < XT'

Treatment X(T) Nonsurgical

1. Over minus – Induces accommodative convergence
   can give up to –3.00 over Rx, improvement tends to be temporary

2. Part-time patching of preferred eye

PEDIG. A randomized trial comparing part-time patching with observation for intermittent exotropia in children 12 to 35 months of age.
Ophthalmology. Aug 2015;122:1718-25.
Conclusions "Insufficient evidence to recommend part time patching"
"deterioration of previously untreated childhood IXT over a 6-month period is uncommon with or without patching treatment"

3. Orthoptics
4. Base in Prisms – long term can cause reduction of fusional vergence amplitudes

Treatment X(T) Surgical

1. Surgery with increased frequency X(T)
2. Recession of of one or both LR, or
3. Recession of LR with resection of MR

Convergence Insufficiency

1. Exodeviation greater at near than distance fixation
2. Asthenopia symptoms for near work
3. Reduced amplitudes for convergence
4. Uncommon under age 10

Management of Convergency Insufficiency

1. Observe
2. Orthoptic treatment (convergence exercises, vision therapy) can improve fusional amplitudes
3. Base-in prisms
4. Small select group of patients may respond to medial rectus resection

A and V Patterns

1. Manifest by a horizontal change of alignment as the eyes move from the primary position in the midline to upgaze and downgaze.

2. Measure deviation in primary position and with the eyes directed approximately 25 degrees in upgaze and downgaze.

3. Clinically significant if between upgaze and downgaze, a difference of:
   10 prism diopters - A pattern.
   15 prism diopters -V pattern

4. Between 15 and 25% of all strabismus - A or V pattern

5. Possible causes of A and V patterns
   a. Oblique muscle dysfunction
      Obliques are **Abductors** in their field of action
      V pattern in Inferior Oblique overaction
      A Pattern in Superior Oblique overaction

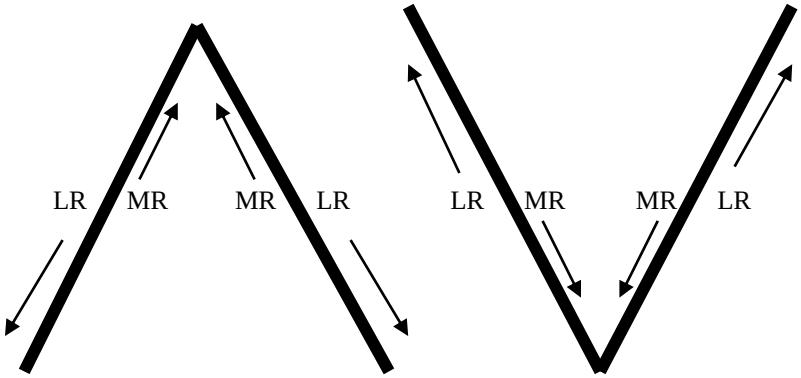
   b) Horizontal rectus muscle dysfunction
      Increased LR tone in upgaze caused **V** pattern

   C) Vertical rectus muscle dysfunction
      IR and SR are **Adductors** in their field of action
      Recessing both IR will result in an **A** pattern

   d) Structural factors
      Excyclorotation of EOM seen in some craniofacial disorders will cause a V pattern
      Abnormal EOM pulley location

6. Treatment
   a. Surgically correct only clinically significant patterns
   b. Weaken Obliques if Overacting
      Weaken IO to treat **V** pattern
      Weaken SO to treat **A** pattern
   c. Weakening the inferior oblique muscles correct about 15 prism diopters in upgaze with no effect on horizontal alignment in primary gaze.
   d. Bilateral superior oblique tenotomies produces about 25 to 45 prism diopters of convergence in downgaze with up to 10 diopters of convergence in primary position

e. Displacement of Horizontal Recti
   Corrects about 15 prism diopters of the A and V pattern
   Medial Recti are moved toward the point of the **A** or **V**
   Lateral recti are moved in the opposite direction



A useful acronym is **MALE**:
   MEDIAL *recti to the* ***APEX***
   LATERAL *recti to the* ***Empty space***

Vertical Deviations

1. Named by the deviation of the nonfixating eye
   Hypertropia nonfixating eye elevated
   Hypotropia nonfixating eye depresses

   RHT = right hypertropia
   RHoT = right hypotropia

2. Superior oblique and Inferior Rectus are depressors

3. Inferior Oblique and Superior Rectus are elevators

4. Most vertical deviations are incomitant at onset
   Inferior oblique overaction – **Hyperdeviaiton** of nasally turned eye, V pattern
   Superior oblique overaction – **Hypodeviation** of nasally turned eye A pattern

Diagnosis of Hypertropia

1. Versions
2. Ductions
3. 3 step test (Parks)
4. Double Maddox Rod
5. Forced Ductions

Diagnosis of cyclo vertical muscle palsy

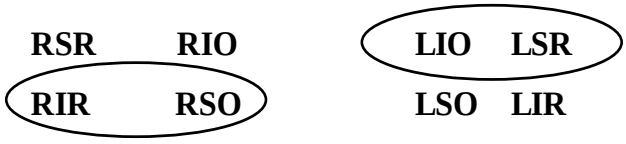
*In order to logically evaluate any isolated cyclo vertical muscle palsy, the **three step test** of Dr. Marshall Parks should be performed. The Double Maddox Rod test should also be performed to detect a torsional component. The three step test is invalid when there is a restriction or multiple muscle palsy.*

Step One

Determine whether there is a RHT or LHT in primary position. *This* eliminates four of the eight cyclovertical muscles as palsied. For example, RHT establishes that there is:

A. Weak left elevator
   1. Left superior rectus
   2. Left inferior oblique

B. Weak right depressor
   1. Right inferior rectus
   2. Right superior oblique



Step Two

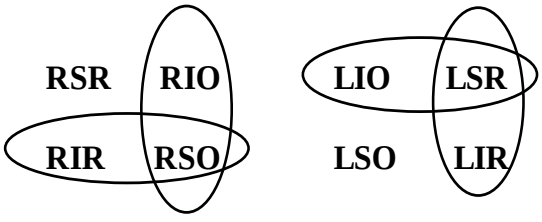
Determine whether the vertical deviation increases on right or left gaze

This eliminates one of the two cyclovertical muscles in each eye.

RHT which increases in left gaze indicates that either:

The right superior oblique is weak

The left superior rectus is weak



At the end of Step Two, the two possible palsied muscles are always either intortors or extortors.

Step Three

The Blelschowsky head tilt test differentiates which of the two muscles from Step Two is palsied. Head tilt test is only Valid when patient is upright. Invalid with multiple muscle palsies or restrictions.

Determine if Vertical Deviation is worse on head tilt right or left.

Head tilt right stimulates:
Intorters right eye RSR, RSO
Extorters left eye: LIR, LIO

Head tilt left stimulates:
Intorters left eye – LSR, LSO
Extorters right eye- RIR, RIO

Worse on head tilt right (improved with head tilt left)
Weak intorters right eye or Weak extorters left eye

Answer - RSO Palsy

Measure Torsion with Double Maddox Rod

Unilateral superior oblique palsy with < 10 degrees of excyclotorsion
Bilateral superior oblique with > 10 degrees of excyclotorsion
Fundus appears extorted on ophthalmoscopy

Bilateral Superior oblique palsy

1. V pattern with esotropia in downgaze
2. Alternating hyper on head tilt test (RHT on head tilt left, LHT on tilt right)
3. Excyclotorsion > 10 degrees

Treatment of Unilateral Superior Oblique palsy

1. Indicated for
   - Abnormal Head position
   - Significant vertical deviation in primary gaze
   - Diplopia

2. Prisms - Small constant deviations without symptomatic torsional component

3. Surgery

Congenital S.O. palsy with significant head tilt S.O. tuck
HT 15P.D. - Recess Ipsilateral. I.O. or contra I.R.
HT 15P.D. - 25 P.D. (gray zone) Recess both or recess either
HT> 25P.D. - Recess both
Recess ipsilateral SR if restricted on forced ductions

Surgery for Bilateral Superior Oblique Palsy

1. Harada-Ito
   - Treats torsion
   - Advancement of Anterior portion of SO tendon

2. Bilateral SO tucks
   - Less commonly done
   - SO tuck may produce Brown's syndrome

Strabismus Syndromes

Brown's Syndrome

1. **Limitation of elevation in adduction**
2. **Forced Duction Positive**
3. Depression (hypotropia) in adduction
4. Normal or near normal elevation in abduction
5. Widening of palpebral fissure on elevation in adduction
6. Exotropia V-pattern in up gaze
7. May have head position with hypotropia in primary position
8. Usually no horizontal strabismus
9. **No overacting SO**
10. Bilateral in 10% of cases
11. May be Congenital or Acquired due to inflammation, trauma or sinus surgery

Differential Diagnosis of Brown's Syndrome

1. Inferior Oblique palsy
2. Double elevator palsy
3. Blow-out fracture with entrapment
4. Thyroid myopathy

Brown's Syndrome - Indications for Treatment

1. An abnormal head position
2. A large hypotropia in primary position
3. Acquired cases should be observed, since spontaneous improvement may occur

Indication for treatment in most incommitant strabismus (Duanes Syndrome, Brown's Syndrome, Superior or Inferior Oblique Palsy, & Monocular Elevation Defecit) is a significant deviation in primary gaze or a significant compensatory head posture

Management of Brown's Syndrome

Weakening procedure (tenotomy, tenectomy) of superior oblique, but prepare for possible superior oblique palsy (Some surgeons will weaken the ipsilateral inferior oblique at the same time)

Inferior Oblique Palsy

1. Deficiency of elevation in adduction
2. A-pattern
3. Superior oblique over action
4. Fulfills the 3-step criteria for the diagnosis of an isolated cyclovertical muscle palsy
5. Forced ductions - normal

Indications for treatment

1) Abnormal head position
2) Vertical deviations in primary position
3) Diplopia

Management of I.O. Palsy

1) Superior oblique weakening procedure (tenotomy/tenectomy/tendon expander)
2) Recess contralateral superior rectus

IO palsy verus Brown Syndrome

Both cause an elevation deficit in adduction

Brown Syndrome	IO Palsy
V pattern	A pattern
Forced duction positive	Forced duction normal
No SO overaction	SO overaction

Monocular Elevation Deficiency (Double Elevator Palsy)

1. **Limitation of elevation in all horizontal orientations**(straight up, right, left)
2. Large hypotropia in primary position that increases in upgaze
3. Combination of ptosis and pseudo-ptosis is often present in primary position
4. Chin up position - fusing in down gaze,
   Straight head, not fusing risk of - amblyopia in hypotropia eye
5. *Two types of Monocular elevation deficiency:*

   Inferior Rectus Muscle Restriction
   Positive forced ductions
   Extra or deep eyelid fold on affected side
   Absent or very poor Bell's Phenomenon

   Elevator Weakness
   Free forced ductions
   Reduced forced generation and Saccadic velocities
   Bell's Phenomenon Preserved

   Can have a combination of the above 2

Indications for treatment

1. Large vertical deviation with ptosis - Primary position
2. Abnormal head position - chin up

Management of Monocular Elevation Deficiency (MOD)

1. If the forced duction is positive then the Inferior rectus is restricted - recess inferior rectus
2. No inferior rectus restriction - Transpose MR and LR towards SR (KNAPP procedure)

Congenital Fibrosis Syndrome (CFEOM)

1. Replacement of EOM by fibrous tissue
2. Restricted movement
3. Positive forced duction
4. Varying involvement of EOM
   Generalized, unilateral or bilateral
   May affect Inferior rectus alone
   May be associated with ptosis
5. Treatment
   Frontalis Suspension for ptosis
   Large recession of IR (both IR if bilateral)
   Other strabismus surgery may be needed to maintain alignment in primary gaze

Chronic Progressive External Ophthalmoplegia (CPEO)

1. Begins in childhood with ptosis and slowly progresses to paralysis of EOM and lids
2. Sporadic or familial
3. Kearns Sayre syndrome (Triad)
    CPEO
    Retinopathy
    Cardiomyopathy

Congenital Ocular Motor Apraxia

1. Inability to generate normal horizontal saccades
2. Changes fixation with head thrusts
3. May present as an infant who does not appear to see until the child gains head control and begins using head thrusts to generate eye movements

Strabismus Surgery

Recti

Recession – Standard Weakening Procedure
Resection - Standard Strengthening Procedure
Transposition – Moving muscles out of their original planes of action

Inferior Oblique

Weakening – Recession, myotomy, anterior transposition

Superior Oblique

Weakening – Tenotomy, Tenectomy, Tendon expander, Recession
Stengthening – Tendon Tuck, Advancement

Complications of Strabismus Surgery

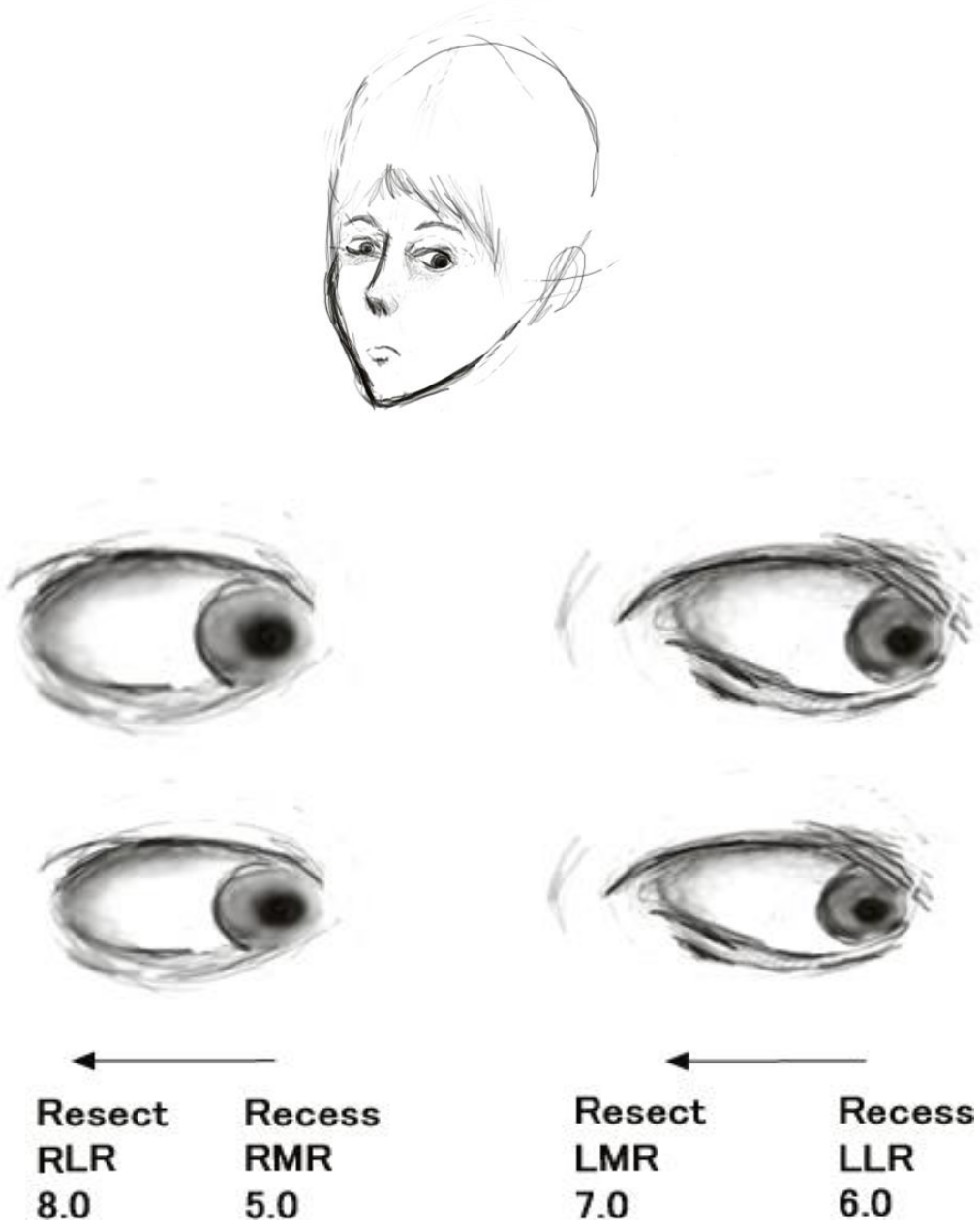
1. Lost muscle – Connection lost to globe
2. Slipped Muscle – Slipped within the sheath
3. Scleral Perforation
4. Orbital Cellulitis
    2-3 days after surgery
    1:1500
5. Endophthalmitis
6. Anterior Segment Ischemia
    Corneal Epithelial Edema, Decemet's folds
    Low IOP
7. Adherence Syndrome
8. Dellen
9. Change in lid position

Surgery for Head Turn Associated with Nystagmus

Null Point - Gaze point where the nystagmus is minimal

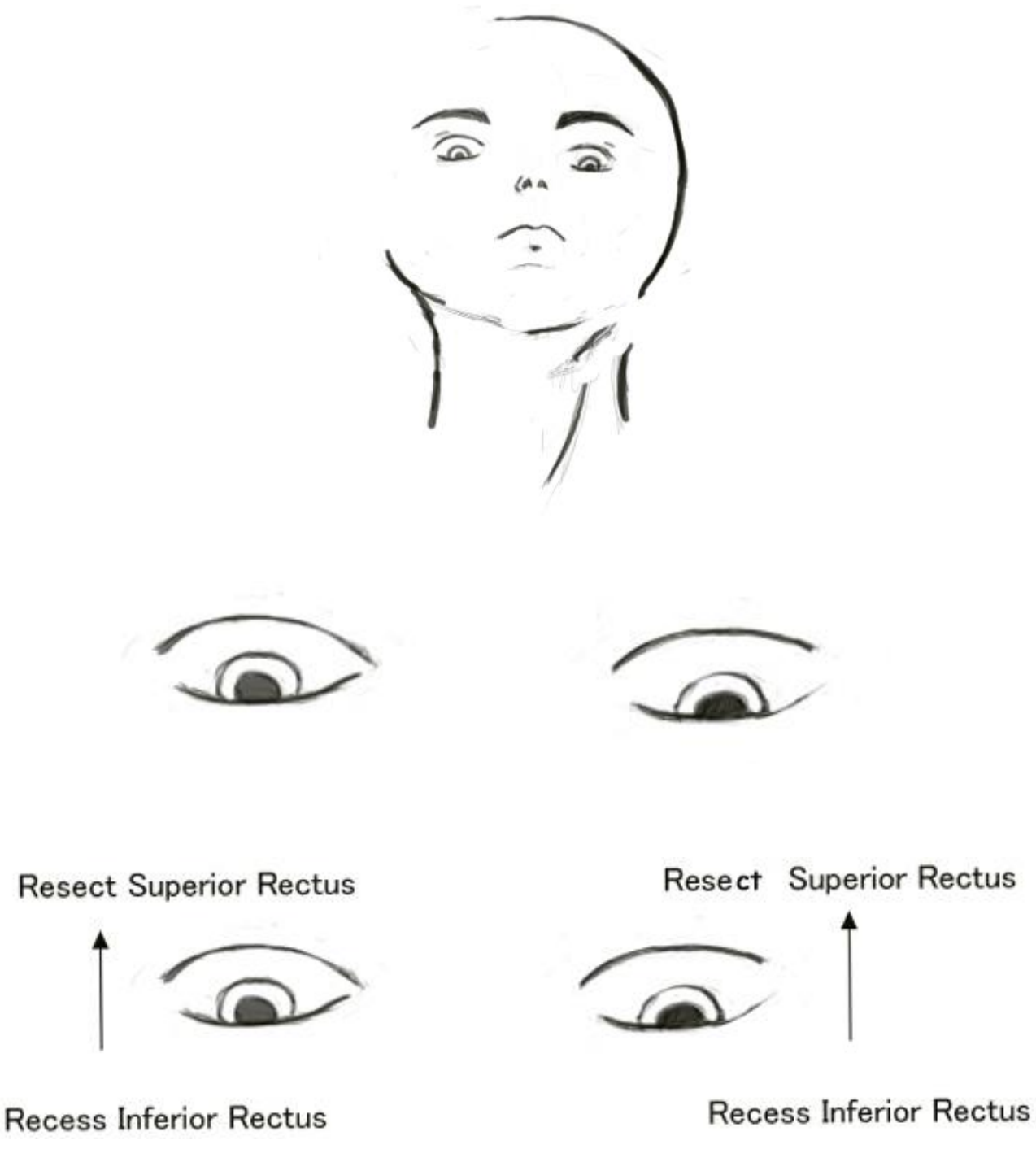
1. If Null position is not in primary gaze the patient will develop a head turn/gaze prefence
2. Strabismus surgery can correct a head turn by shifting the null position closer to primary position.
3. **Kestenbaum-Anderson Procedure** for Horizontal Head Turn
   Bilateral Recession-Resection
   Eyes rotated toward the head turn or away from the null position

Head turn right with Null Position in Gaze Left



4. **Vertical Kestenbaum-Anderson Procedure** for Head tilt Up or Down
   Bilateral Recession-Resection or Bilateral Recession of Yoke muscles
   Eyes rotated toward the head tilt or away from the null position

Chin up with null position in down gaze



Amblyopia

1. Decreased visual acuity with full refractive correction for which no organic pathology is evident
2. Generally accepted that amblyopia is present if best corrected vision in one eye is at least 2 lines worse in the Snellen chart than the other eye.
3. Most common cause of uniocular visual loss, occurs in 2-4% of population
4. Usually reversible in early stages
5. Develops prior to visual maturity

Characteristics of Amblyopia

1. Crowding Phenomenon - Amblyopic eyes have more difficulty recognizing letters when presented in a line than when isolated.
2. Grating Acuity is reduced considerably less than Snellen acuity
3. Less effected by lowering illumination
4. No Afferent Pupillary Defect
5. Poor Accommodation
6. Amblyopia is associated with decreased reading speed
   - Slower reading speed due to increased saccades
   - No effect on word accuracy or comprehension
   - No evidence this leads to diminished academic achievement

Kelly, Birch et al. J AAPOS. 2015 Dec; 19(6): 515–520.

Binocular reading speed	Amblyopes	150 WPM
	Controls	200 WPM

Amblyopia Causes

1. Anisometropia
   - $\geq$ 1.50 diopters
     - Hyperopic Anisometropia is more amblyogenic than myopic
     - Oblique astigmatism is more amblyogenic than astigmatism at 90 or 180 degrees
2. Strabismus
3. Media Opacity

Amblyopia Treatment - Historic

1. Treat underlying cause for amblyopia
   - Glasses for refractive error remove cataract, etc
   - Full hyperopia of symmetrically undercorrect up to 1.5 diopters
2. Occlusion
   a. One week per year of age
   b. Patch till Visual acuity becomes equal to that of the other eye or stops improving with 3 interval of patching.
3. Maintenance Patching

PEDIG Studies (Pediatric Eye Disease Investigative Group)

Atropine vs Patching for Treatment of Moderate Amblyopia in Children

Moderate Amblyopia (VA 20/40 – 20/100)
Daily Atropine 1% Vs Patching ≥ 6 hours
Similar visual outcome

Va improvement in log Mar lines

	6 months	2 years
Patching	3.2	3.7
Atropine	2.9	3.6

Mean Amblyopic Acuity 20/32

PEDIG. *Arch Ophthalmol* 2002; 120:268-278
PEDIG. *Arch Ophthalmol* 2005; 123:149-157

Atropine vs Patching for Treatment of Moderate Amblyopia: Follow-up at 15 years of age of a randomized clinical study.

PEDIG. JAMA Ophthalmol. 2014; 132(7):799-805

Outcome Similar with Atropine and Patching
Mild Residual Amblyopia is common
- Mean IOD (interocular acuity difference) is 2.1 lines
- Similar to 10 yr outcome
- Visual Outcome better in those who began treatment under 5 years old compared to those who began treatment at 5 to 6 years old

A Randomized Trial of Atropine regimens for Treatment of Moderate Amblyopia in Children PEDIG. Ophthalmology 2004;111:2076-2085.

Randomized to Daily or Weekend Atropine
Va measured at 4 months
Improvement was 2.3 lines in both groups
Weekend group
- Compliance more difficult
- Reported light sensitivity more frequently

Moderate Amblyopia 2 vs 6 hrs Patching

PEDIG Arch Ophthalmol 2003 121:603-11

Outcome Reported Similar
6 hour group
- More achieved 20/25
- Achieved best Va sooner

Residual Amblyopia

Unimproved for 3 visits

Verify Compliance, repeat cyclo refraction, look for ocular pathology

If compliant may improve with intensifying treatment

Atropine Rescue

Some children who were patched may improve if switched to atropine

Some children who were treated with atropine may improve if the hyperopic lens in the glasses is removed from the atropinized eye

Increase patching from 2 hours per day to 6 hours per day

2 line improvement in 40% that increased patching vs 18% that stayed at 2 hours per day (PEDIG, Ophthalmology. 2013;120:2270S–2277S)

Combined Therapy

- Atropine & Patch
  - On Weekends Atropine 1% + patch on lens of glasses

A Randomized Trial of Treatment of Amblyopia in Children Aged 7 to 17 Years

PEDIG. . Arch Ophthalmol 2005; 123:437-447

Improvement with patching up till 12 years old

Effect of Age on Response to Amblyopia Treatment in Children

Arch Ophthalmol. 2011 Nov;129(11):1451-7

3 age groups 3 to < 5yo

5 to <7 yo,

Less responsive for severe amblyopia (20/125 or worse)

7 to <13 yo

Less responsive for severe (>20/125) and moderate (20/40 to 20/100) amblyopia

Treatment of Anisometropic Amblyopia in Children with Refractive Correction
PEDIG. Opthahalmology 2006; 113:895-903.

Optimal refractive Correction Provided

-Full cycloplegic refraction or symmetrically undercorrected up to 1.5 diopters

Measured at 5 week intervals till Va maximized

77% improved by $\geq$ 2 lines

27% amblyopia totally resolved

-Improvement took up to 30 weeks

Average improvement 3 lines

Age not a significant factor

Binocular iPad treatment for Amblyopia

Dichoptic images

J AAPOS 2015;19:401-405

Risk of Amblyopia Recurrence after Cessation of Treatment
PEDIG. J AAPOS 2004: 420-428.
If patching greater than 6 hours daily risk of recurrence is greater if not weaned to 2 hours daily

Recurence with patching

-2hrs daily non weaned 14%

-6-8 hrs daily weaned 14%

-6-8 hrs daily nonweaned 42%

How I Treat Anisometropic Amblyopia in 2021

1. Prescribe hyperopic correction, can reduce the sphere in both eyes symmetrically up to 1.50 diopters. Give full cylinder or myopic correction if present.
2. Continue with glasses till Va is maximized (stops improving)
3. If Va is not equal to fellow eye begin patching /atropine till Va is maximized (stops improving with 3 cycles)
4. Taper patching if patching is greater than 2 hours daily

Pediatric Ophthalmology Questions

1. 5 year-old child, failed school vision test

VA sc OD 20/200
OS 20/25
EX = EX' = 0
Cyclo ref. OD +3.00 +1.00 x 90
OS +1.00 +1.00 x 90

DX & RX?

2. 8 month old child, constant ET noticed at 5 months of age

VA OD GCM
OS GC not M
LET = LET' = 50 P.D.
Cyclo ref. +1.50 OU

DX&RX?

3. 3 year-old child, ET noted at 5 months of age
Recess MR OU 6mm, age 7 months
ET noted again at age 2.5 yrs,
VA GCM OU
ET = ET' = 25 P.D.
Cyclo ref. +2.25

DX & RX?

4. A 2.5 year-old child with intermittent ET noticed for 3 months.

VA 20/40 ET = 15 ET'=30
20/40

Cyclo Ref. = +2.25 OU

DX & RX?

5. 3 year-old child, ET noted 6 months ago.
Now wearing Cyclo Ref. = +2.25 OU
VA 20/30
20/30
ET cc = 6 ET' cc =30

DX & RX?

6. Same history as #5, but measurements were:

ET cc = 15 **ET' cc = 35**

DX & RX?

7. 3 year-old child, OD turns out when fatigued, 4 months now
VA sc 20/30 OU pictures
X(T') - 25
EX' = 0

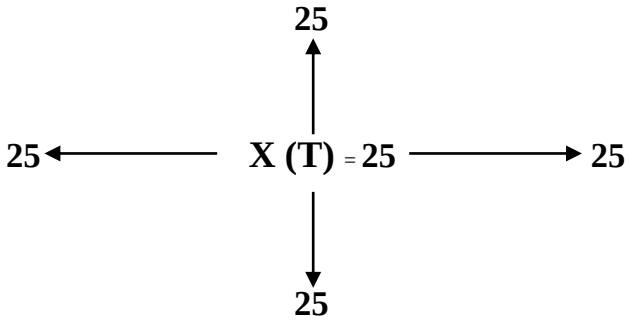
DX & RX?

8. 7 year-old child, OS turns out several times a day
VA OD 20/50
OS 20/50
X(T) = 20
X' =6
Cyclo ref. -1.50 OU

DX & RX?

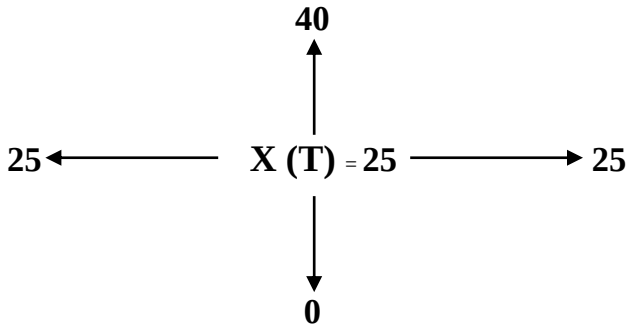
9. 5 year-old child, OS turns out one half of the time, OD closes in sunlight

VA SC 20/25 OU
X (T) = 25
X' = 8



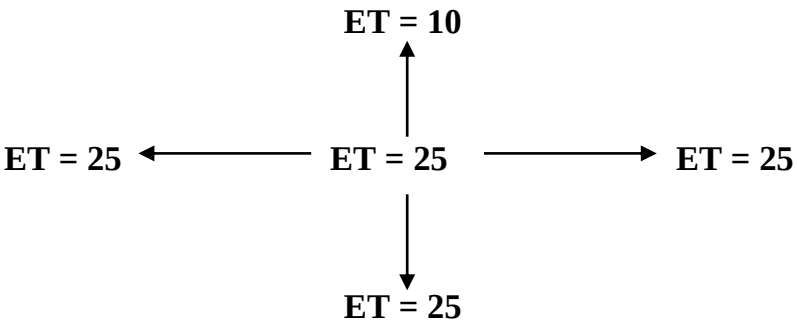
DX & RX?

10. Same history as #9 with chin-up posture



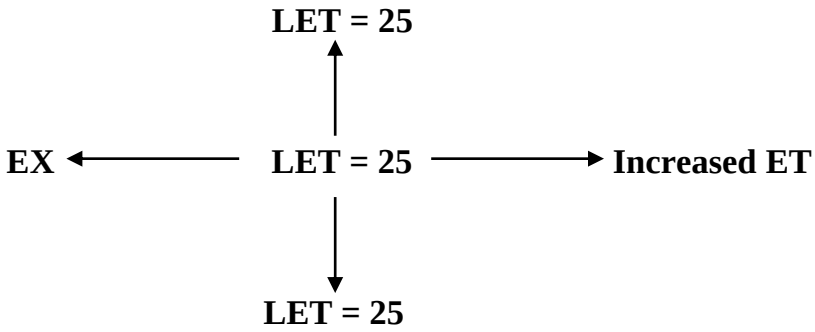
DX & RX?

11. 7 year-old girl with +4 IO OU



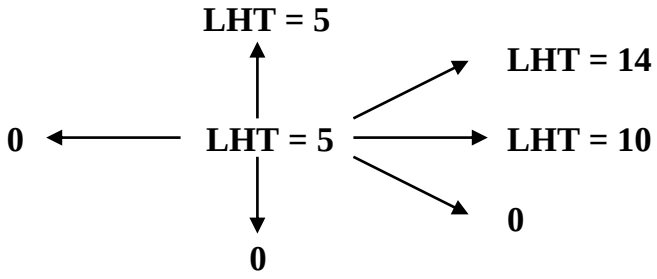
DX&RX?

12. 9 year-old female with head turn to left. Limitation OS abduction and retraction OS on attempted adduction

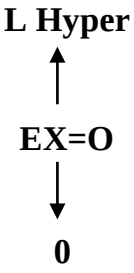


DX & RX?

13. 8 year-old female with head turn to left. Limitation of elevation in adduction OD

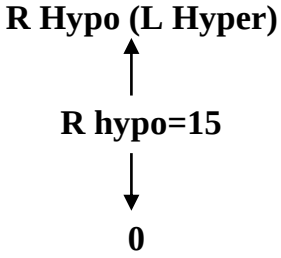


14. Limitation of elevation OD Since birth
No Head tilt or chin up position



RX& DX?

15. Same history as #16, except with chin-up head posture



RX& DX?

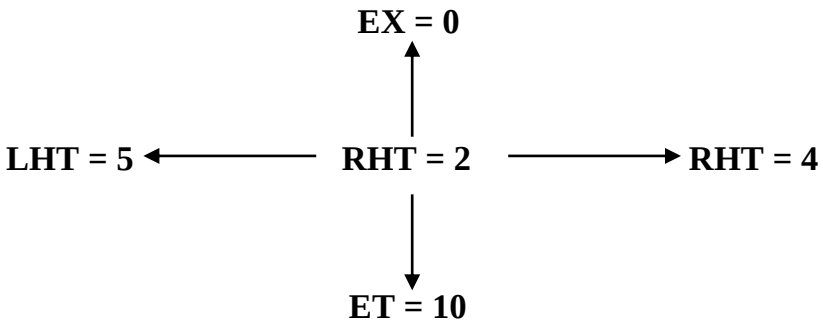
16. A 5 year-old child, ET noticed at 5 months of age.

Recess MR OU 7mm Age 7 months
Parents note OD drifting up when tired or daydreaming.

VA 20/25
20/25
ET = ET' = 6
Updrifting OD = 10 P.D. only under cover (latent)
No hypotropia OS when OD fixing

DX & RX?

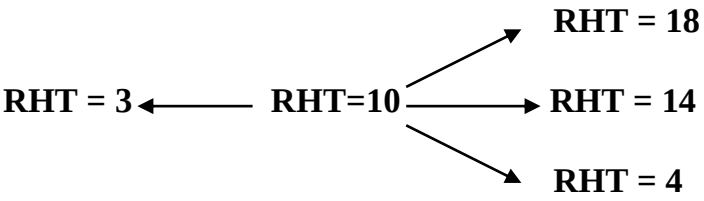
17. 25 year-old male sustained close head trauma 8 months ago. He is complaining of objects being tilted



Head Tilt

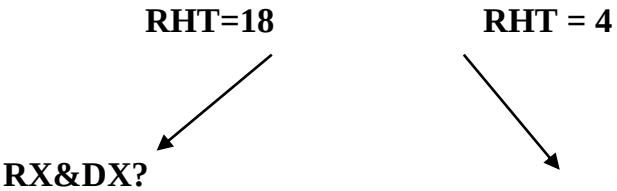
Double Maddox Rod
Excyclotropla 14 degrees

18. 5 year-old with head tilt to left shoulder since at least 10 months of age



Versions +4 OA RIO
+1-2 UA RSO

Head Tilt



RX&DX?

19. 21 year status post surgery for esotropia. What is the best test to determine if the patient now has fusion?

1. Maddox Rod
2. Bagolini lenses
3. Worth 4 light
4. Measure Stereo acuity

20. 55 year-old hypertensive male had a 5mm resection of the left lateral rectus and 5mm recession of the left medial rectus 8 months ago. He now undergoes a 5mm recession of the left inferior rectus. On the first postoperative day, he complained of blurry vision. On SLE corneal edema with folds in Descemet's and low IOP.

DX&RX?

21. Nystagmus with head turn right. To correct the head turn which muscles should be recessed and which muscles should be resected?

22. Which has the highest incidence of Amblyopia ?

1. Intermittent exotropia
2. Congenital Esotropia
3. Accomodative Esotropia
4. Duanes Syndrome with compensatory head position
5. All with similar incidence of Amblyopia

23. A 9 month old girl with a left esotropia of 50 prism diopters is patched full time. When should the child return for follow-up?

1. 2weeks
2. 1 month
3. 1 week
4. 3 weeks
5. 6 weeks

24. All of the following can be seen with monofixation syndrome EXCEPT:

1. Amblyopia may be present
2. Stereo-acuity of 200 seconds
3. Esotropia of 7 prism diopters
4. Sees 4 lights (worth 4-dot) at 12 feet
5. Latent deviation

25. A 5 year old has 3 mm of ptosis and amblyopia. The most likely cause of the amblyopia is:

1. Occlusion (Deprivational) Amblyopia
2. Anisometropic Amblyopia
3. Meridional Amblyopia
4. Strabismic Amblyopia

Answers to Questions

1) **DX -** Anisometropia amblyopia
RX - Give glasses initially
Re-evaluate every 6-8 weeks till visual acuity is maximized.
If Va remains less that of fellow eye, patch/atropine till Va equals fellow eye

2) **DX-** Congenital esotropia and amblyopia OS
RX - Patch till VA is equal, then strabismus surgery

3) **DX -** Congenital esotropia initially, recurrent ET
RX - Give glasses (+2.25) reevaluate one month

4) **DX** Accommodative ET
RX Gibv Give glasses (+2.25)

5) **DX-** High AC/A ratio ET
RX – Give full cycloplegic refractin with +2.50 bifocal add

6) **DX-** Decompensated ET
RX - Surgery for ET'=35 Because ETcc=15 which is >10 P.D. therefore cannot give bifocals

7) **DX-** X(T)
RX – Observe,

8) **DX-** X(T)
RX -- Give -1.50 OU return one month

9) **DX-** X(T)
RX -Strabismus surgery for XT = 25

10) **DX-** V pattern X(T)
RX – Lateral rectus recession with supraplacement

11**)** **DX**- VET
RX - Recess MR OU and weaken IO OU

12) **DX-** Duane's Syndrome
RX – Recess LMR

13) **DX-** Brown's syndrome
RX – Strabismus surgery , SO tenotomy or SO lengthening

14) **DX-** Monocular elevation Deficency **(**Double elevator palsy)
RX – Observe because no deviation in primary position

15) **DX-** Monocular elevation Deficency **(**Double elevator palsy)
RX - Forced duction test
positive do RIR recession
negative do Knapp procedure

16) **DX** -Congenital esotropia initially
Now small ET, latent DVD latent
RX- Observe

17) **DX -** Bilateral SO Palsy
RX –Harada-Ito procedure or bilateral tuck

18) **DX-** RSO Palsy
RX- Recess RIO

19) (2)

20) **DX** - Anterior segment ischemia
RX - Steroids topically, observe

21) Recess right medial rectus and left lateral rectus
Resect right lateral rectus and left medial rectus

22) (3)

23) (3)

24) (4)

25) (2)