

Esodeviations and Exodeviations

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Esotropia

Esotropia (ET)

- Congenital
 - Infantile ET
 - 6th Nerve Palsy
 - Duane Syndrome
- Acquired ET
 - Accommodative ET
 - Partially Accommodative ET
 - Non Accommodative ET
 - 6th Nerve Palsy
- Monofixation Syndrome

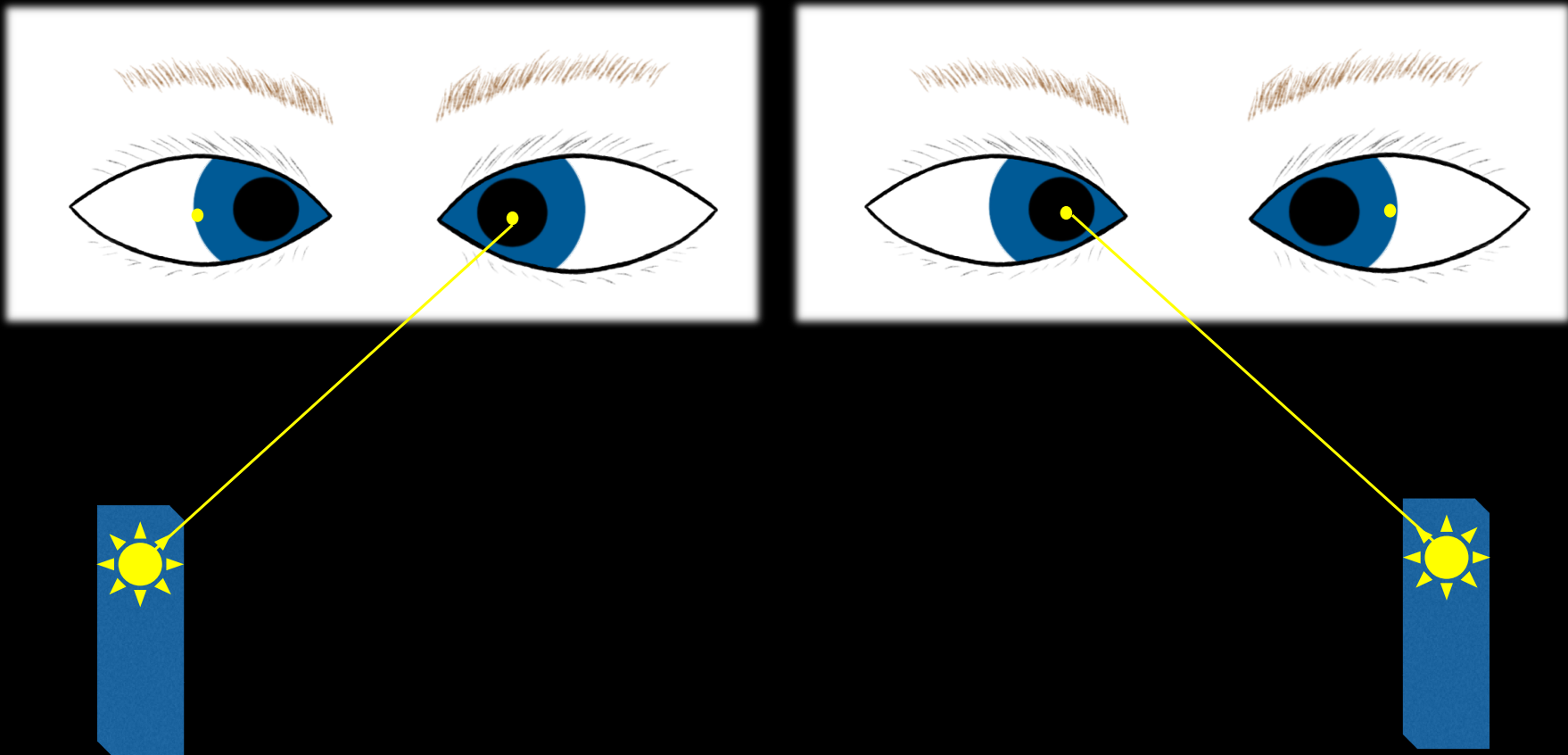


Infantile Esotropia

- Onset before six months of age - generally not present at birth.
- Large angle of deviation.
- Amblyopia 40%-50%
- Crossfixation
- Distance and near deviations are equal
- Low refractive errors



Crossfixation



Infantile Esotropia

- Latent nystagmus 50%
- Dissociated Vertical Deviation 60%
- Inferior oblique over-action common
 - V pattern
- Peripheral fusion at best - not bifoveal fusers.
- 40% will develop an accommodative component.
- Strong family history.

Infantile Esotropia- Treatment

- Complete Eye examination
 - Refractive Error correct $> +3.00$
 - Ensure no fundus abnormality
 - Rule out A or V pattern
 - Reliability of measurements
- Treat Amblyopia



Infantile Esotropia

- Differentiate from 6th nerve palsy
 - Floating saccades to midline
 - Vestibular ocular response abnormal
- Differentiate from Duane Syndrome
 - Smaller angle
 - Co-contraction



Congenital Esotropia Observation Study

- 2001- 137 PEDIG investigators
- 175 infants with Esotropia
 - 1st exam 4-19 weeks old
 - Intermediate exam 2-4 weeks after initial
 - Last exam 28-32 weeks old

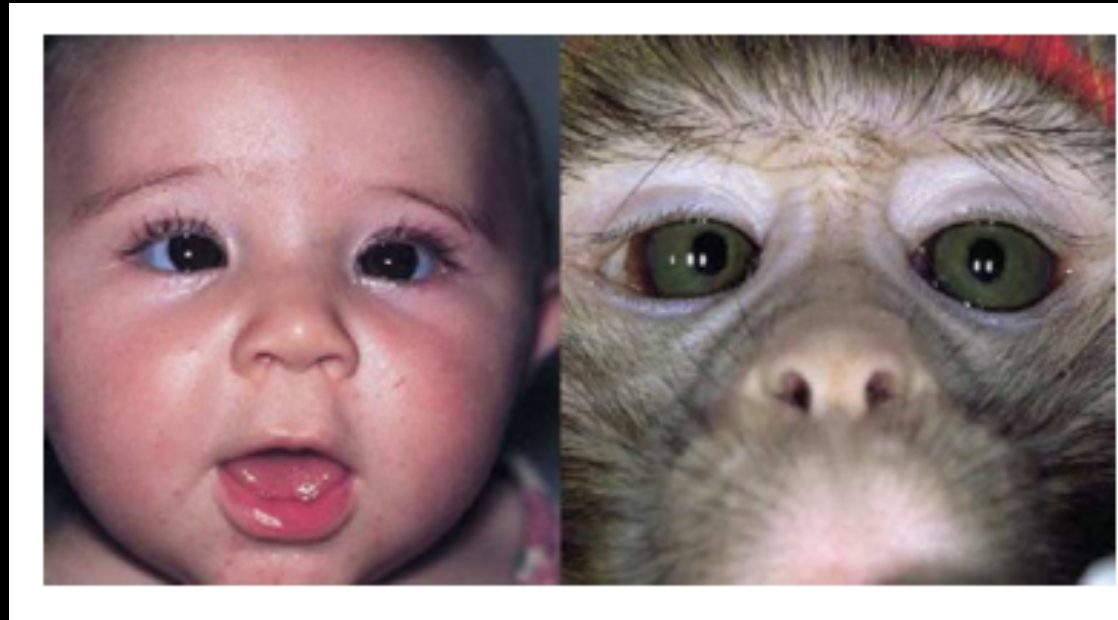
Congenital Esotropia Observation Study

- Esotropia Resolved in 27%
 - Esotropia $< 40 \Delta$
 - Intermittent
- Unresolved Esotropia
 - $> 40 \Delta$
 - Constant
- Level of hyperopia no correlation



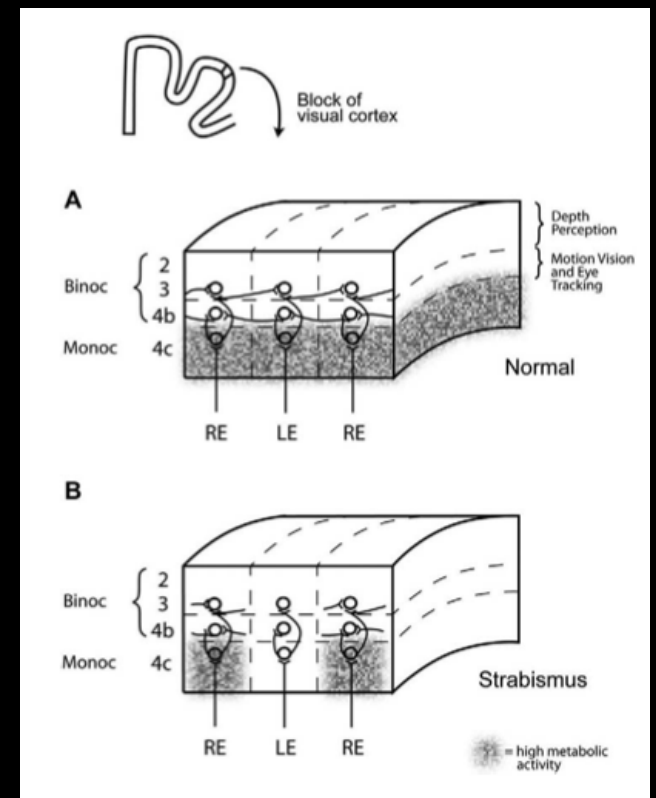
Animal model of Infantile Esotropia

- Primate Infants also have infantile ET
- Dr. Lawrence Tychen, MD
Washington University,
St. Louis

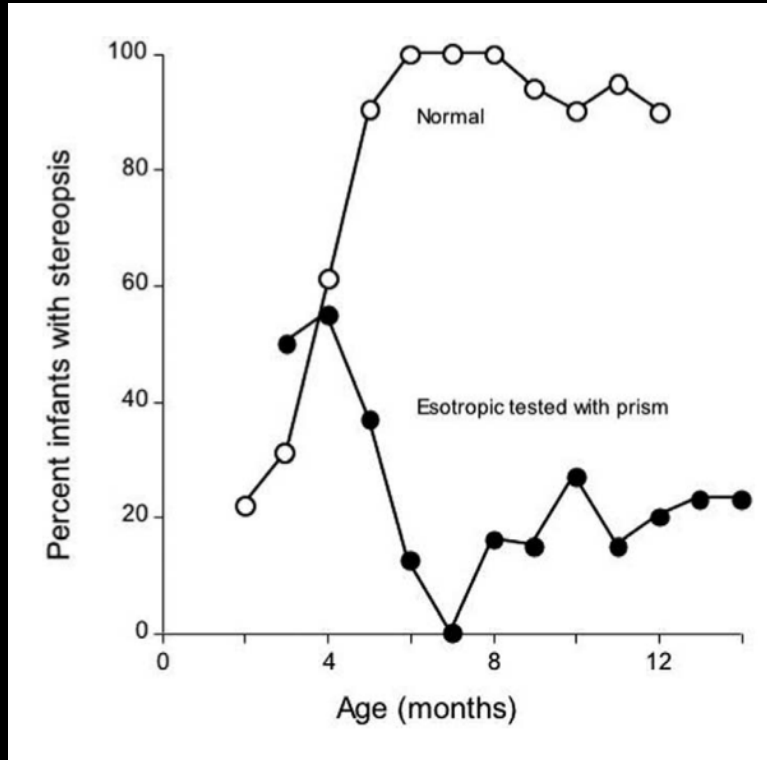


Neuroanatomic abnormalities

- Metabolic suppression of binocular stimulated cells
- Prolonged suppression leads to permanent changes in binocular cellular structure
- Restoring eye alignment by 3 weeks (equivalent of 3-4 months in humans) normal binocular structures returned



Stereopsis in Esotropic infants by age



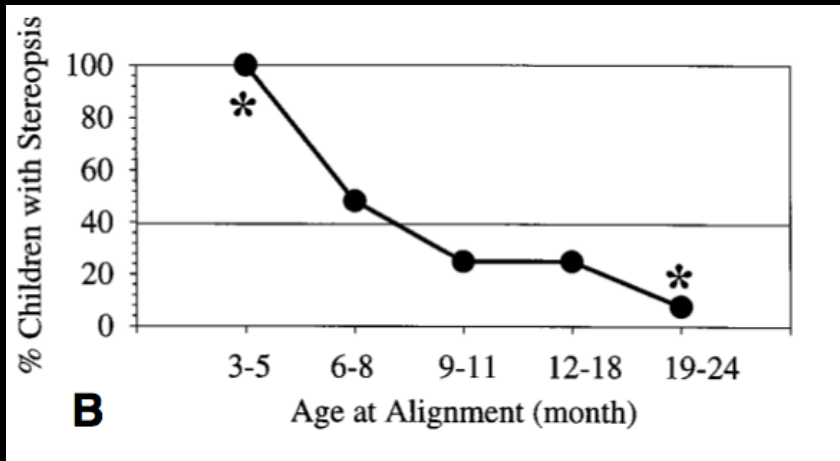
J AAPOS 2005;9:510-521

Stereopsis recovery in treated Infantile Esotropia

Alignment age	Prevalence*	Investigator(s)
> 24 mo	0%	Taylor ¹¹ von Noorden, 1988 ¹⁶
7–24 mo	27–67%	Hiles et al ¹² Ing ^{13, 14} Zak and Morin ¹⁵ von Noorden ¹⁶ Birch and Stager ⁶ Birch et al, 1990 ^{17, 19} Kushner and Fisher ²¹ Parks ²²
≤ 6 mo	40–86%	Ing ^{13, 14, 20} Wright et al ¹⁸ Birch et al ^{23, 25} Helveston ²⁴ Ing and Okino ²⁶

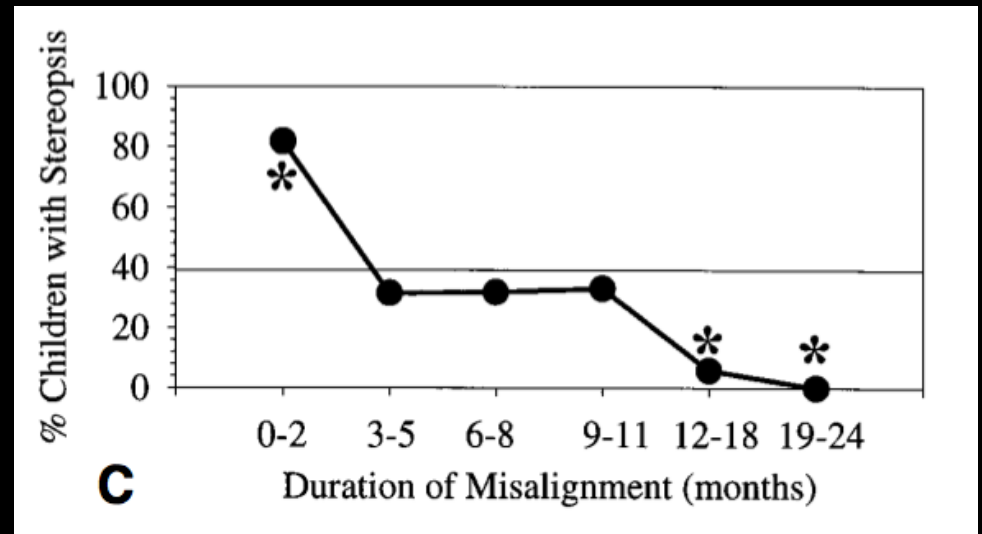
*Averages from pooling of cited studies.

Stereopsis recovery

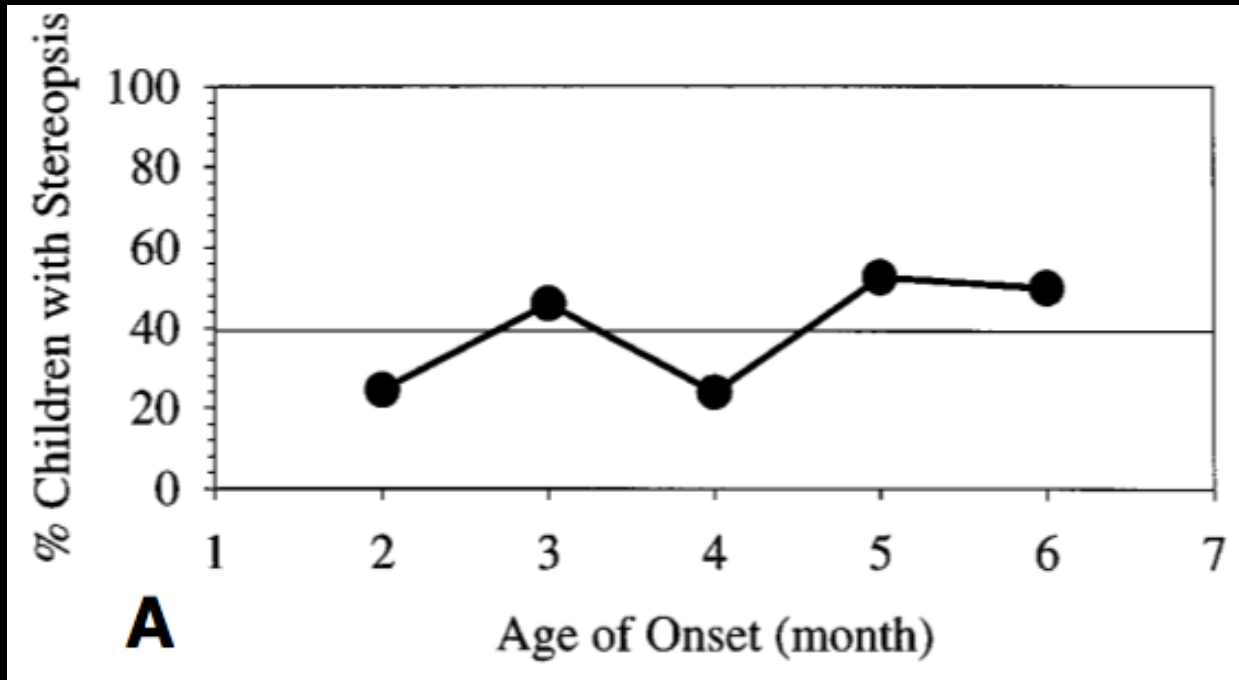


*Statistically significant difference

J AAPOS 2000;4:10-4



Stereopsis recovery



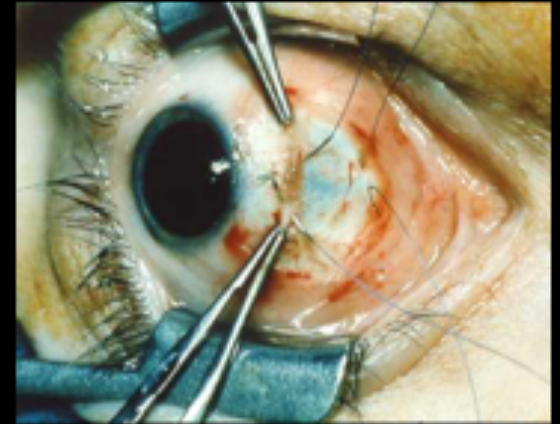
J AAPOS 2000;4:10-4

Infantile Esotropia: Summary

- Duration of misalignment and age of realignment are important factors in restoring stereo acuity
- Early realignment more likely restores binocularity/stereopsis
- Constant misalignment $>40 \Delta$ less likely to resolve
- May be best candidates for early surgery

Infantile Esotropia- Surgery

- Bilateral Medial Rectus Recessions
- Large angles >60 PD might need Lateral rectus resection(s)
- Measure insertion of muscle before disinsertion
- Measure placement of muscle from limbus



Congenital 6th Nerve Palsy

- May have large angle esotropia in primary
- Poor or absent abduction
- Clinically normal adduction
- Absent firing or reduced firing of lateral rectus with EMG
- Normal adduction with saccades

Congenital 6th Nerve Palsy

- Birth trauma
- Hypoplasia of VIth nerve
- Rule out CNS abnormality

Acquired Esotropia

Accommodative Esotropia

- Average age of onset: 3.5 years
- Average refractive error: +4.75 D
- Incidence of amblyopia: 15%
- Deterioration rate of: 15%

Accommodative Esotropia Treatment

- Give cycloplegic refraction
- May need more than one refraction
- Watch for deterioration



Accommodative Esotropia with high AC/A Ratio

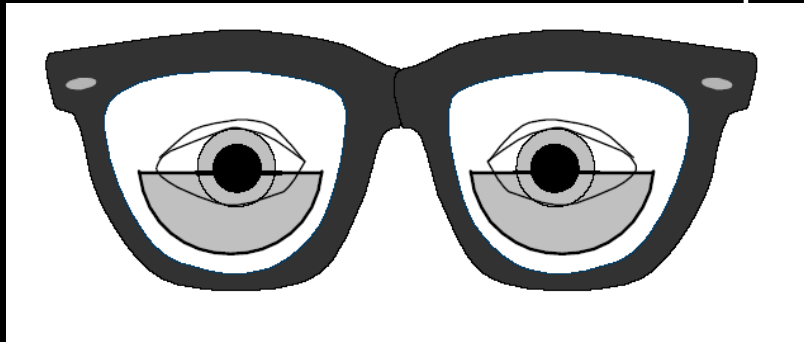
- Accommodative convergence/ Accommodation ratio
- Near deviation exceeds distance by 10 D
- Difference can be 30 D or more
- Measure with +3.00 at near
relaxing accommodative convergence

AC/A Ratio

- Gradient Method - average is 3.7:1, range is 0.9 - 9.8
 - Low - 0-2.0
 - Normal - 2.5 - 5.0
 - High - >5.0
- Measurement
 - $AC/A = \text{change in deviation} / \text{change in accommodation}$
 - Stimulate accommodation
 - Measure ocular misalignment while fixating at 6 meters, then remeasure with a -1.00 D lenses in front of both eyes
 - The difference between the two measurement is the AC/A ratio
 - Relax accommodation
 - Measure misalignment with target at 0.33 meters, then remeasure with +3.00 D lenses over both eyes
 - The difference, divided by 3 = AC/A ratio

Accommodative ET with High AC/A

- Treat Hyperopia
- Give bifocals if response to +3.00
 - Executive or flat top (power higher up)
 - Place bifocal line to split pupil



How to Reduce AC/A ?

- Bifocals
- Surgery
- Anticholinesterases (Phospholine Iodide)
- Parasympathomimetics (Pilocarpine)
- Time

Partially Accommodative Esotropia

- Angle of ET reduces but is not eliminated by hyperopic correction
- Repeat cycloplegic refraction
- May have High AC/A ratio



Partially Accommodative Esotropia- Treatment

- Surgery for amount of crossing not controlled with glasses
- Prism Adaptation
 - Pre-operative test to determine angle of deviation for surgery
 - Use fresnel prism for a week
 - Look for motor and sensory responses



Non-Accommodative Acquired Esotropia

- Moderate angle of deviation
- Equal vision
- Little or no hyperopia
- Normal AC/A Ratio
- May show suppression or Anomalous Retinal Correspondence



Non-Accommodative Acquired Esotropia

- Not Associated with CNS disease (99%)
 - Family history
 - Vision Loss
 - Myopia
 - Breakdown of very small angle strabismus (monofixation)
- Associated with CNS disease (1%)
 - Chiari I malformation
 - Hydrocephalus
 - Brain Tumor

Non-Accommodative Esotropia Treatment

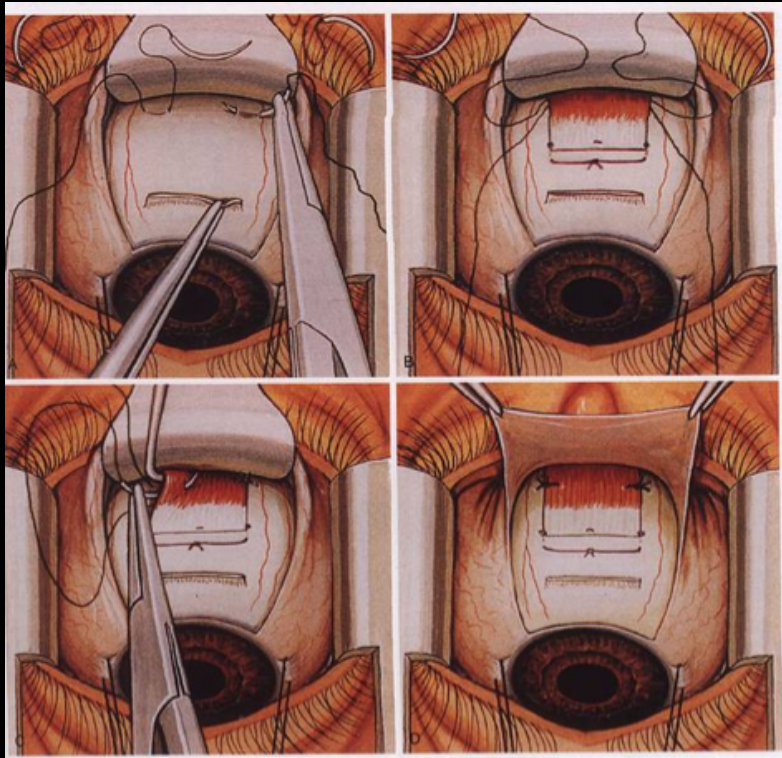
- Prism Adaptation...
- Surgery
 - Bilateral MR recessions
 - Recess/resect
 - Infraplace or Supraplace for A or V pattern
 - Weaken Obliques if overacting

Non Accommodative Esotropia $N > D$

- No response to bifocals
- Prism Adaptation for near angle
- Surgery for the near angle
- Posterior Fixation sutures

Posterior fixation sutures

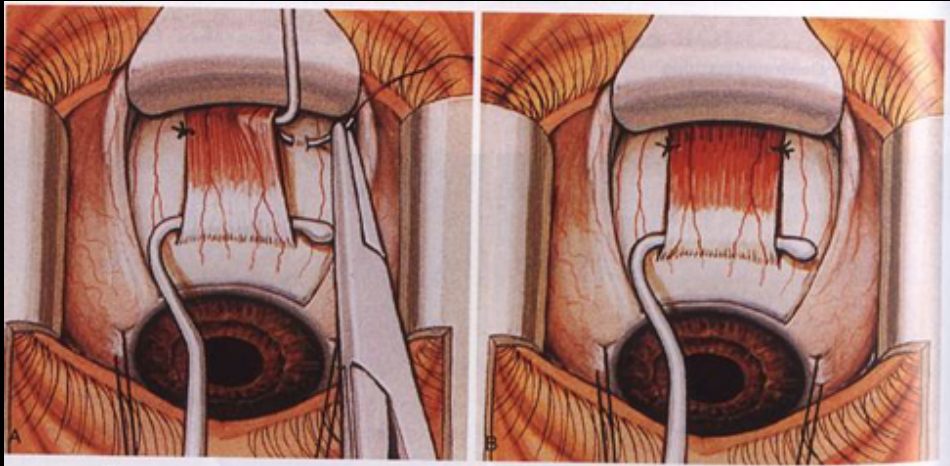
- When recessing muscle



Buckley EG, Freedman S, Shields MB: Strabismus and Glaucoma. In Atlas of Ophthalmic Surgery, vol III. St Louis, Mosby-Year book 1995

Posterior Fixation Sutures

- When not recessing muscle



Buckley EG, Freedman S, Shields MB: Strabismus and Glaucoma. In Atlas of Ophthalmic Surgery, vol III. St Louis, Mosby-Year book 1995



Esotropia and High Myopia

- aka “Strabismus Fixus”, “Heavy Eye Syndrome”, “Queen Mary syndrome”
- High axial myopia may lead to a large eye prolapsing out between the superior and lateral rectus
- Large ET, restriction to abduction and hypotropia possible



Esotropia and High Myopia

- Imaging evidence
- May also occur with age and atrophy of connective tissue
- Re-aligning SR and LR restores alignment and motility
- Often tight MR



Wong et al. J AAPOS 2005;9:589-591



AEL 33.5 OD, 33.3 OS



s/p Union of RSR and RLR with RMRc 6



+3.00 OU



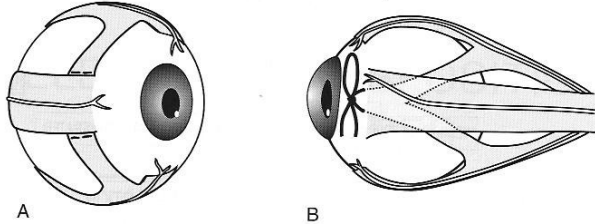
Acquired 6th Nerve Palsy

- Trauma to cranial floor.
- Increased intracranial pressure.
- Meningeal edema.
- Inflammation in base of skull.
- Displacement of brain stem.
- Sensitivity to toxic substances.
- Demyelinating disease.
- Viral illness.
- Vasculitis

6th Nerve Palsy

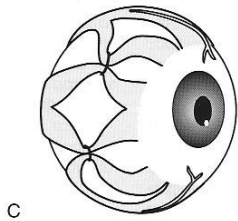
- Treatment
 - Amblyopia treatment
 - Wait for improvement or resolution
 - If due to trauma- wait 6 months
 - Improvement can occur first 12 months
 - Botox to medial rectus may prevent contractures while waiting for improvement
- Surgical Treatment
 - If some lateral rectus function: Resect/Recess
 - If no lateral rectus function: SR and IR transposition, +/- Botox or recess MR

Partial Tendon Transposition



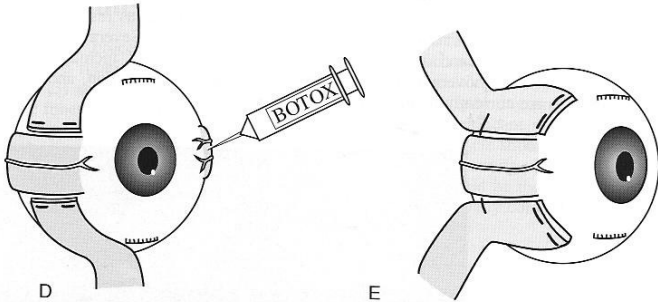
A. Hummelsheim Procedure

Rectus Muscle Union



C Jensen Procedure

Full Tendon Transposition



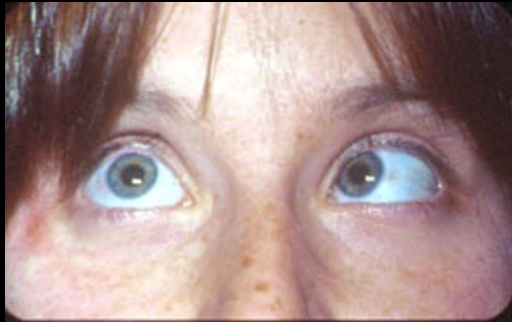
D. Schillinger Procedure

E: Foster Modification

from Clinical Strabismus Management.
Rosenbaum and Santio Eds. W.B. Saunders Co 199 p. 478







Monofixation Syndrome

- Tropia 8 prism diopters or less
- Phoria bigger
- Central suppression of deviated eye
- Peripheral fusion
 - Fusion of Worth 4-Dot lights at near.
 - 3000 to 60 seconds of stereo-acuity

Monofixation Syndrome

- Strabismus history
- Anisometropia
- Unilateral macular lesion
- Amblyopia
- Eccentric fixation
- Small tropia with larger phoria
 - Alternate cover exceeds cover-uncover

Monofixation Treatment

- Treat Amblyopia
- Surgery rarely indicated
- A stable post-op alignment for congenital ET

Exotropia

Exotropia

- Convergence Insufficiency
- Congenital Exotropia
- Intermittent Exotropia
- Sensory Exotropia



Convergence Insufficiency

- Symptoms: asthenopia with reading
- Signs:
 - Usually no tropia at distance
 - Exophoria or exotropia at near
 - Poor convergence amplitudes
 - Normal amplitudes:
near = 30D - 40D ; distance = 20D - 30D
 - Reduced near point of convergence
 - Normal range 4cm - 10cm.
 - Normal near point of accommodation (Prince Rule)
- Treatment
 - Orthoptic exercises: Pencil pushups, prisms, computer based

Congenital Exotropia

- Rare
- Often Associated with abnormal CNS function or optic nerve malformation
- Consider Neurology consultation and neuroimaging
- Usually large deviation
- Requires large amounts of surgery for alignment
- Poor fusional potential



Intermittent Exotropia

- Very common- 40% of all strabismus
- Frequently one eye closes in bright sunlight
- Worse with fatigue or illness
- Diplopia not present because suppression present- that's the problem!
- Family history often present



Intermittent Exotropia

- Onset usually between 0-10 years
- Peak incidence: newborn and 5.5 years
- 20% progress to constant deviations.
- A patterns tend to progress.
- V patterns tend to be stable.
- Amblyopia uncommon and if present mild ($\geq 20/40$)

Duane's classification of exotropia

- **Basic** - $D = N$
- **Divergence excess** - $D > N$
- **Convergence insufficiency** - $N > D$
- **Pseudodivergence excess**
 - apparent divergence excess
 - but near deviation equals distance when
 - fusional convergence eliminated (45 minute occlusion)
 - and/or accommodative convergence eliminated (+3.00 lenses)

Intermittent Exotropia Treatment

- Dominant eye or alternating patching
 - 2-4 hours a day
 - Improvement may be better in amblyopia
 - 6% better in latest PEDIG study
- Minus Lens therapy
 - Over minus by at least -3.00
 - Slow weaning over years
 - Best for High AC/A
- Muscle Surgery
 - Variable success rates: 50-75% for one surgery
 - Want small amount of ET for first week 0-15 ET

Exotropia Surgery based on Duane's Classification

- Divergence Excess
 - Bilateral LR recessions
- Convergence Insufficiency
 - Bilateral MR Resections or Monocular Recess/Resect
- Basic Exotropia
 - Monocular Recess/Resect
- Pseudo-divergence Excess
 - Bilateral LR recessions or Monocular Recess/Resect
 - Possible post-op Accommodative ET needing bifocals

Exotropia after Esotropia Treatment

- Secondary Exotropia= Surgery for Esotropia leads to Exotropia
 - Usually needs more surgery
- Consecutive Exotropia= Previously fully corrected Accommodative Esotrope now is exotropic in full plus.
 - Can try to cut plus
 - May need strabismus surgery

Sensory Exotropia

- Poor vision in one eye
 - Amblyopia, trauma, macular lesion
- Slowly progressive Exotropia
- Diplopia present even with very poor vision
- Treatment often requires large recess/resect on affected eye.



