Don’t turn away from eye turns:  
How to approach strabismus with confidence

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Course Description:  
This course gives a general guideline for referring a patient for a strabismus surgery or for a vision therapy examination. Various types of strabismus will be presented and discussed.

Course Learning Objectives:  
• To present the pertinent tests to perform when diagnosing a strabismus patient.  
• To review the different types of strabismus.  
• To present appropriate management options for each patient including the referral for surgery and vision therapy.  
• To review the expected outcomes and possible complications from strabismus surgery.  
• To recognize who may benefit from strabismus surgery or vision therapy.

1. Epidemiology of strabismus  
a. The incidence of strabismus in children is 3 ~ 4%  
b. The collaborative perinatal project (1959) studied over risk factors for esotropia and exotropia in a cohort of over 39,000 children, followed from gestation to age 7 yrs  
c. Esotropia developed in 3.0%, and exotropia in 1.2%

2. Evaluation: Important clinical considerations  
a. Case history  
i. Age of onset  
1. Infantile Esotropia (0-6months old)  
2. Infantile Exotropia (before 1YO)
a. 150-300x less common than infantile ET

3. Accommodative Esotropia (onset around 2-3 YO)

4. Exotropia

5. Note
   a. In the first months of life, normal infants may demonstrate variable degrees of esotropia and/or exotropia
   b. Up to 25% of the unspecified <30 ET appearing between 3 and 6 months of age will resolve over time

ii. Important Follow-Up Questions
   1. Which eye has a turn?
   2. Turn in or out?
   3. Does it alternate?
   4. How often do you see it?
   5. Stable or getting worse?

iii. Birth history
   1. Born prematurely
   2. Low birth weight (<1500g or 3.3lb)
   3. Low Apgar scores (>= 7 is normal)
   4. Skin color, Pulse rate, Reflex irritability, Muscle tone, & Breathing
   5. Prenatal morbidity
   6. Substance abuse and smoking
   7. Maternal age (>30 yr)

iv. Developmental Hx
   1. Craniofacial anomalies
   2. Neuro-developmental impairment
   3. Down’s syndrome (38% develop strabismus)
   4. Retinopathy of Prematurity (18% develop strabismus)

v. Family ocular history
   1. Family history of strabismus
   2. Genetic disorders
   3. High hyperopia

b. Visual Acuity
   i. Amblyopia develops in 30–50% of those affected
   ii. Constant is worse than intermittent
   iii. Monocular is worse than alternating

c. Ocular Alignment
   i. Cover test at distance and near
   ii. Hirschberg (1mm=22PD)
   iii. Krimsky
   iv. Bruckner

d. Characteristics of the strabismus
   i. Esotropia vs Exotropia
   ii. Constant vs Intermittent
   iii. Monocular vs Alternating
   iv. Congenital vs Acquired
   v. Comitant vs Incomitant
   vi. Distance vs Near
e. Comitancy
   i. Incomitance
      1. All strabismus patients demonstrates some degree
      2. True incomitant has greater degree
      3. Also true incomitant follows predictable patterns representative of the etiology
   ii. Comitant horizontal deviations are usually NOT associated with underlying serious CNS or orbital pathology
      1. No neuro-imaging or serological workup indicated
f. Motility
   i. Forced duction may be useful if there is incominance or other evidence of EOM restrictions
g. Refraction
   i. 1/3 of children with Esotropia is Accommodative in nature
      1. Look for Hyperopia to rule out accommodative ET
   ii. Cycloplegic refraction depends on age group
h. Fixation
   i. Tests
      1. Visuoscopy
      2. Heidinger Brush
      3. Image transfer
   ii. Expected EF VA = 20/20(1+PD)
i. Correspondence
   i. Normal Correspondence
      1. Normal subjective visual sensation with or without the presence of strabismus
   ii. Anomalous Correspondence
      1. Sensory defense mechanism against diplopia that preserves binocular vision in response to a strabismus
   iii. Tests
      1. Bagolini lens
      2. Amblyoscope
      3. MIT and image transfer
j. Fusion status
   i. Stereo acuity
      1. Onset: 4-6 months of age
      2. Adult level (<60sec): Before 6-7 months of age
      3. Stereo in nonstrab: moderate stereo acuity seen even ina presence of mild amblyopia (20/40 or less)
   ii. Flat fusion/suppression
      1. Worth 4 dot
      2. Red lens
   iii. Motor fusion
      1. BO/BI Ranges
      2. Vectogram
k. Funduscopy
l. General Indications for surgery
   i. Ideal
1. Infantile strabismus
2. Hyper/hypotropia
3. Adult onset strabismus

ii. Not ideal
1. <10PD turn
2. ET especially CI type

m. General Indication for VT
i. Ideal
1. Small turn
2. XT

ii. Not ideal
1. Large turn (>30PD)

n. General Prognosis

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<th>Fair</th>
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3. Management considerations
a. Correct significant refractive errors
b. Treat any amblyopia
   i. Surgical treatment of ET in the presence of moderate to severe amblyopia has a lower success rate than in the presence of mild or no amblyopia
c. Prism
   i. Optical method to reduce or eliminate strabismus angle
   ii. Non-invasive
   iii. Easy and quick fix
   iv. Can be used with small deviations
   v. Prism >10 PD needs to consider the following effect
      1. Reflections/Distortions
      2. Angular Magnification
      3. Chromatic aberration
      4. Weight and cosmesis
d. Vision therapy
   i. Non-invasive
   ii. Highly effective as a part of amblyopia treatment
   iii. It change the neurophysiological vergence-control mechanism through specific visual stimulation
      1. Increase fusion ranges
      2. Improve oculomotor skills
      3. Anti-suppression therapy
e. Surgery
   i. The primary purpose is to improve the alignment of the visual axes of the eyes.
   ii. <12PD at distance or near are not usually considered for surgery
   iii. Except for acquired symptomatic deviation in older children or adults
   iv. Typical definition of success
       1. Within ~ 10-12 PD of deviation
       2. In Infantile ET it is favorable to have a small consecutive exotropia post-surgery
       3. To reduce a risk of developing a central scotoma and/or amblyopia
   v. Infants
       1. Depends on who you ask
       2. It can vary from 20% to 90%
       3. Success rate depends on
          a. Definition of success
          b. Length of follow-up
   vi. Adults
       1. 68% to 85%
   vii. Reoperation Rate
       1. Comitant strabismus
          a. Up to 21% (post-op 6 wks ~ >10 yrs)
   viii. Complex cases (Incomitant Strabismus & thyroid ophthalmopathy)
        a. Up to 50%
   ix. Frequency of operation
       1. 1-4 surgeries
          a. Usually it is only once or twice
          b. 4 surgeries are extremely rare
       2. On average 1.26 operations in case of Infantile ET (1-5 yr follow-up)
   x. Surgical Complications
       1. Infants
          a. Generalized muscle spasm after administration of Trapenal
          b. Venous hemorrhages during surgery
          c. Postoperative ocular infection
          d. A suture reaction
          e. A chest infection postoperatively
          f. Difficulty opening the eyes after surgery
       2. Adults
          a. 13-30% risk of intraoperative oculocardiac reflex
          b. 21-30% of postoperative nausea or vomiting
          c. 0.8-1.8% Inadvertent scleral perforation with intraocular injury
          d. 0.8% Endophthalmitis
          e. 1%-14% Post-operative diplopia

4. Case 1: Infantile Esotropia
   a. Characteristics
      i. ET greater than 35-40 PD and concomitant that appears during the first 6 months of life
ii. Amblyopia develops in 30-50% of those affected.
iii. Typical refractive error between +1.50 and +3.00
iv. Infantile ET rarely resolves spontaneously within the first year of life

b. Associated findings
   i. Dissociated vertical deviation (50-75%)
   ii. Inferior oblique overaction (70-75%)
   iii. Associated with V pattern and fundus extorsion
   iv. Asymmetrical monocular pursuit by OKN
   v. Amblyopia
   vi. Latent horizontal (50%) and manifest rotatory nystagmus
      1. Be aware during occlusion
         a. Monocular VA
         b. Patching

c. Differential diagnoses
   i. Early onset Accommodative ET
   ii. Duane’s syndrome Type 1 or 3
   iii. Nystagmus blockage syndrome
   iv. Mobius syndrome
   v. Cyclic esotropia
   vi. Acquired
      1. Visual loss in one eye
      2. Increased intracranial pressure
      3. Neurologic impairment
      4. CN 6 palsy

d. Common treatment options
   i. Strabismus surgery
      1. Stimulate the development of binocular fusion
      2. Good ocular alignment (ortho to small XT)
   ii. When is surgery indicated?
      1. Timing of surgery depends on a surgeon
         a. Earliest by 4 months
         b. Latest by 24 months
      2. The benefit of early surgery for gross binocular vision is balanced by a higher reoperation rate

e. Outcomes
   i. Often the large ET is converted to a small esotropia (<8ET) with the development of
      1. Peripheral fusion
      2. Central suppression scotoma
      3. Amblyopia
   ii. (+) Stereo fly in 13.5%-30% of patients who had surgery before age of 24 months
   iii. Regardless of surgical realignment in Infantile ET, an affected children can still manifest
      1. Latent nystagmus
      2. Dissociated vertical deviation
      3. Inferior oblique muscle overaction
   iv. The presence of amblyopia or nystagmus increases the chance of reoperation
   v. Timing of surgery and outcomes for otherwise healthy infants with Infantile XT is thought to be similar to Infantile ET
5. Case 2: Accommodative Esotropia
   a. Characteristics
      i. High hyperopia (average +4.50D)
      ii. Large eso tendency at near
      iii. Anisometropia ≥1D, especially in patients who have lower overall hyperopia (<+3.00D)
      iv. Studies suggest that hyperopia ≥2.50 D can produce a significant accommodative component in ET
      v. Onset
         1. Typically around 2-3 yrs, at a time when toddlers are learning to explore the “near world”
   b. Common treatment options
      i. Single vision lens
      ii. Bifocal
      iii. Contact lens
   c. Outcomes
      i. Refractive correction alone is successful in most cases
      ii. Surgical Intervention needed in:
         1. 18%: onset before 1 year of age
         2. 4%: onset after 2 years of age
      iii. Later the onset, better the outcomes.

6. Case 3: Exotropia
   a. Characteristic
      i. Exophoria decompensates to an intermittent exotropia and finally to a constant exotropia
         1. Von Noorden: 75% progressed, 9% did not, and 16% improved with time.
      ii. Onset
         1. Infantile: before 1 yr of age
         2. Non-Infantile: 1.5-4 yrs
      iii. Exotropia seen in 1% of population (1/4 of ET)
         1. More prevalent in Middle east, Asia and Africa
         2. Infantile XT is extremely rare (0.3-0.7% of Infantile ET)
      iv. Types
         1. Divergence Excess Type
            a. Distance deviation > Near deviation
         2. Basic Type
            a. Distance deviation = Near deviation
         3. Convergence Insufficiency Type
            a. Distance deviation < Near deviation
   b. Associated findings
      i. History of squinting one eye in bright sunlight
      ii. Inferior oblique overaction or superior oblique overaction
      iii. V or A pattern
   c. Differential diagnosis
i. Pseudoexotropia from large positive angle kappa
ii. Third nerve palsy with medial rectus weakness
iii. Duane’s syndrome type 2
iv. Infantile exotropia
v. Consecutive exotropia
d. Common treatment options
i. Surgery
   1. Surgery is appropriate only after nonsurgical approaches have been attempted
   2. Convergence insufficiency type exotropia is a difficult form of exotropia to treat surgically
   3. In this group, orthoptic exercises may be beneficial
   4. Outcomes
      a. Cosmetic success: ET or XT of <15PD
         i. 70-95% success
      b. Functional success: Constant Tropia <10PD with peripheral fusion or small residual IXT
         i. 60-90% success
      c. While 80% are well aligned 6 months postoperatively, long term results are less favorable and recurrence is common over time
      d. Post operative esotropia is associated with amblyopia and may precipitate loss of stereoacuity
ii. Vision therapy
   1. 59-92% Success Rate using the following criteria
      a. Phoria at distance and near
      b. Criteria often include normal fusional ranges, stereo, and without suppression.
   2. Long term follow-up
      a. 63%-86% retained phoria after up to 2.5-3.0 yr follow-up
iii. Surgery and vision therapy
   1. Surgery with Orthoptics had the most success compare to surgery alone or orthoptics alone
e. Challenge with surgical only approach
   i. Expectation with surgical approach:
      1. Good alignment will disappear sensory anomalies and normal sensory processing will arise spontaneously and passively
      2. However, surgery rarely results in exact ocular alignment
   ii. Any residual strabismus is a significant obstacle to the development of normal sensory fusion
   iii. Sensory fusion provides the “glue” that prevents postsurgical drift

7. Take Home Message
   a. Treat your patient
      i. Be overjoyed when you see an eye turn
      ii. Optometrists can manage majority of them
b. Patient Education
   i. Provide all the current available options to patients and educate them so that they can make the best decision for themselves or for their child

c. Know your referral sources
   i. Know your local physicians
      1. Pediatric ophthalmologist
      2. American Association for Pediatric Ophthalmology and Strabismus
   ii. Optometrists who practice vision therapy
      1. College of Optometrist in Vision Development

d. When you make a referral
   i. Include the following
      1. Characteristic of strabismus
      2. Refraction
      3. Visual Acuity
      4. Stereoacuity
      5. Ocular Health

8. Reference
12. Garzia RP. Efficacy of vision therapy in amblyopia: a literature review. 1987;64:393-404