

WHAT TO DO WHEN THE EYES TURN: EVALUATION AND MANAGEMENT OF STRABISMUS

Marie I. Bodack, OD, FAAO, FCOVD, DiplBVPPO
Southern College of Optometry
mbodack@sco.edu


1

Goals

- Review commonly encountered forms of strabismus and primary care treatment options
- Discuss the work up of patients who present with an eye turn.
- To be aware of current treatment options for strabismus.
- Be able to initiate treatment of strabismus in a primary care office.
- Discuss when referrals are needed and to whom

2

Why is Strabismus Scary?



- Practitioners don't know what to look for
- Testing is thought to be too complicated
- Treatment is thought to be too difficult/time consuming
- Practitioners don't want to miss bigger pathology

3

Strabismus

- AOA Definition - "manifest deviation of the primary lines of sight of 1 prism diopter or more"
- 2-6% of the population
- Can result in
 - ▣ Amblyopia
 - ▣ Poor cosmesis
 - ▣ Poor or no stereopsis
 - ▣ Poor fine motor skills
 - ▣ Poor reading
 - Double vision, words move on the page, loss of place, headaches, avoidance

4

Strabismus Classification

Direction	Frequency
<ul style="list-style-type: none"> □ Horizontal <ul style="list-style-type: none"> ▣ In = Esotropia ▣ Out = Exotropia □ Vertical <ul style="list-style-type: none"> ▣ Up = hypertropia ▣ Down = hypotropia □ Torsional* <ul style="list-style-type: none"> ▣ Incyclotorsional ▣ Excyclotorsional 	<ul style="list-style-type: none"> □ Constant <ul style="list-style-type: none"> ▣ 100% of the time □ Intermittent <ul style="list-style-type: none"> ▣ 1-99% of the time

5

Strabismus Classification

Magnitude	Comitancy
<ul style="list-style-type: none"> □ Prism diopters Δ <ul style="list-style-type: none"> ▣ Prism bar & cover test ▣ Small $<10\Delta$ ▣ Medium 11-30Δ ▣ Large $> 30\Delta$ □ Degrees 	<ul style="list-style-type: none"> □ Comitant = Deviation is the same in all position of gaze □ Non-comitant = Greater than 5 prism diopter change <ul style="list-style-type: none"> ▣ Field of gaze ▣ Other eye fixating

6

Strabismus Classification

Laterality

- Right eye
- Left eye
- Alternating

Distance Near

7

Prevalence of Strabismus

- Neurologically normal 3.5%
- Prematurity – 18% From Harcourt B. Br J Ophthalmology 58:224;1974
- Cerebral Palsy – 44%
- Down Syndrome – 50%
- Myelomeningocele – 53%
- Hydrocephalus and myelomeningocele 74%
- Craniofacial dysgenesis – 90%

- Family history 23-70%

8

Stats on Strabismus

- 627 cases of strabismus in study < 19 years
 - ▣ 60% were esotropes
 - ▣ 33% were exotropes
 - ▣ 7 % were hypertropes
- Top types were
 - ▣ **Accommodative esotropia (28%)**
 - ▣ **Intermittent exotropia (17%)**
 - ▣ Acquired non accommodative esotropia (10%)
 - ▣ Esotropia secondary to CNS disorder (7%)
 - ▣ Convergence Insufficiency XT (6.4%)

Mahoney BG. Common forms of childhood strabismus in an incidence cohort. Am J Ophthalmol 2007

9

Causes of Acute Strabismus

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

10

STRABISMUS

- Symptoms
- Testing
- Results
- Action
 - ▣ Behavioral Interventions
 - ▣ Surgery
 - ▣ Monitor?
- Unusual forms*
- Success!

11

Symptoms

- None
- Someone notices eye/head turn
- Patient notices eye/head turn
- Patient complains if any
 - ▣ Blur
 - ▣ Double vision
 - ▣ Words move
 - ▣ Headaches
 - ▣ Nausea/Vomiting
 - ▣ Acute v. chronic



12


Testing

- Visual Acuity
- Cover Test
 - ▣ Hirschberg
 - ▣ Krimsky
- Motilities
- Retinoscopy
- Stereopsis/Fusion
- Fixation*
- Correspondence*
- HEALTH!

13

Visual Acuity Concerns

- Differences in VA
 - ▣ Amblyopia - constant unilateral strabismus or asymmetric amblyogenic refractive error
 - ▣ Is child bored/tired?
- Does VA make sense?
- Testing
 - ▣ Infants
 - ▣ Toddlers
 - ▣ Preschooler
 - ▣ School-age
 - ▣ Resistance to occlusion!



This Photo by Unknown Author is licensed under CC BY-ND-4.0

14

Visual Acuity Case

- 4-year-old female amblyopia follow up
 - ▣ 30LET → 10LET with plus
 - ▣ VA 20/80 prior exam
 - ▣ Patching
 - ▣ Follow up 3 months
 - ▣ Intern says VA 20/25!!! Very happy ☺
 - ▣ What did I do?
 - ▣ What did child do?

15

Cover Test

- Cover Test
 - ▣ Equipment
 - ▣ Protocol
 - At Distance
 - At Near
 - Prism
 - ▣ Placement
 - ▣ Deviation too large for prism bar
 - Unilateral then Alternating then Unilateral
 - ▣ Constant
 - ▣ Intermittent
 - ▣ Fixation preference
 - ▣ Interesting target





16

Comitancy

- 9 positions of gaze
- Difference of 5Δ
- Special Forms in eso/exotropia:
 - "A" Pattern Strabismus
 - ▣ More Eso in upgaze relative to downgaze (10+)
 - "V" Pattern Strabismus
 - ▣ More Exo in upgaze relative to downgaze (15+)

17

Additional Evaluation for XT – Cover Test

- Exotropia Control Score
 - ▣ A better way than estimating "deviation is present x% of the time"
 - ▣ Done at distance and near
 - ▣ Can be done multiple times during exam
 - Initial
 - Middle
 - End

18

Control Score	Control Score Description
5	Constant exotropia during a 30-second observation period (before dissociation)
4	Exotropia >50% of the time during a 30-second observation period (before dissociation)
3	Exotropia <50% of the time during a 30-second observation period (before dissociation)
2	No exotropia unless dissociated (10 seconds); recovery in > 5 seconds
1	No exotropia unless dissociated (10 seconds); recovery in 1-5 seconds
0	Pure phoria: < 1 second recovery after 10-second dissociation

Mohney BG, Holmes JM. An office-based scale for assessing control in intermittent exotropia. *Strabismus* 2006;14:147-50.

19

Hirschberg

- Hirschberg
 - Distance
 - 1 mm displacement = 20-25 prism diopters
 - Nasal = eso
 - Temp = exo



20

Krimsky


- Essentially, Hirschberg with prism
- Fixating** v. *non-fixating* eye
 - Differences
 - Modified/Reverse Krimsky



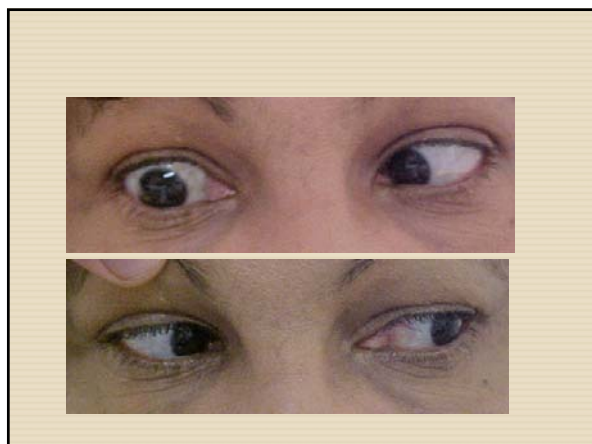
21

Ocular Motility Testing

- Ensure no restrictions of gaze which may be indicative of a cranial nerve palsy
 - Abduction**/Adduction Deficits
 - Versions & Ductions
 - Caution true abduction deficit v. difficulty = CNVI
- Over/underactions




22



23

Sensorimotor Fusion

- Randot Stereopsis
 - Global (bifoveal)/Local (monocular cues)
 - Polarized glasses
- Lang Stereotest
 - Global
 - No glasses
- Worth 4 Dot



24

Sensorimotor Fusion

- Remember:
 - ▣ Patients with intermittent strabismus may have Randot stereopsis depending on alignment
 - ▣ Patients with constant strabismus do not have Randot stereopsis
- Variable results possible (PEDIG)
 - ▣ Time of day
 - ▣ Attention
 - ▣ Not necessarily related to magnitude

25

Sensorimotor Fusion – Worth 4 Dot

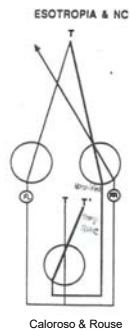
- Responses
 - Fusion (4)
 - ▣ Eyes straight
 - Suppression (2 or 3)
 - Diplopia (5)
 - Anomalous Correspondence (4)
 - ▣ Eyes turned



26

Adaptations to Strabismus - Correspondence

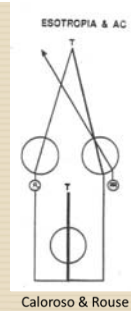
- Normal Correspondence
 - ▣ The fovea of each eye gives rise to the same visual direction
 - ▣ Corresponding retinal points
 - ▣ Object stimulates corresponding retinal points = seen as single
 - ▣ Non-corresponding points = double



27

Adaptations to Strabismus - Correspondence

- Anomalous Correspondence
 - ▣ Non corresponding retinal points
 - ▣ Fovea of the fixating eye and a NON-foveal point in the deviating eye
 - ▣ Target stimulates anomalous points and patient reports anomalous fusion
 - ▣ It allows for some level of binocularity
 - ▣ This is NOT ECCENTRIC FIXATION
 - ▣ Hand example



28

Retinoscopy

- Dry v. Cycloplegic?
 - ▣ Hyperopia
 - ▣ Esotropia
 - ▣ Variable reflex
 - ▣ 2nd opinion



29

Thorough Ocular Health

- Pupils
- Color vision
- Visual Field
- IOP
- Dilation
- Photos/Retinal Imaging
- Electrodiagnostic

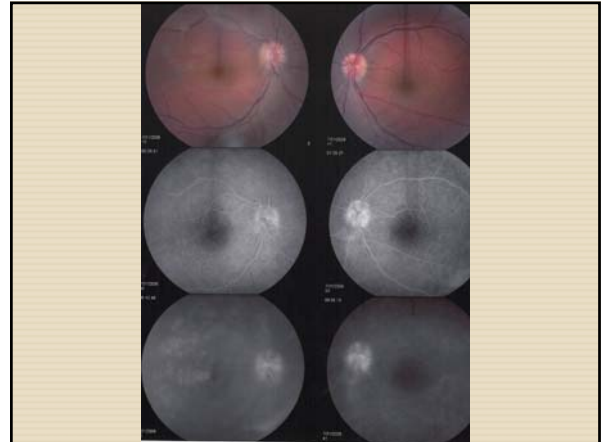


30

Strabismic Amblyope?

- 15-year-old F referred for amblyopia and strabismus treatment
 - ▣ OD turns out
- Ret
 - ▣ OD -1.25 20/30-
 - ▣ OS plano 20/20
- Cover Test
 - ▣ Distance 6XP
 - ▣ Near 8 RX(T)'
- Stereopsis
 - ▣ 1/6 Randot shapes

31



32

Strabismic Amblyope

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

33

Characteristics Of Exotropia

- Less common than ET**
 - ▣ Children ET 3-5x more common than XT
 - ▣ Adults - ET 2x more common than XT
- Onset
 - ▣ First 3 years of life (33-75%)
 - ▣ Adult - Decompensated
 - ▣ Consecutive
- 85% Intermittent, Alternating common
 - ▣ **Caution constant, unilateral XT in infant!**
- Common in children with documented neuro dx¹
 - ▣ CP, Developmental delay, Hydrocephalus
- Amblyopia?
- Rx

1. Mohney & Huffaker 2003

34

Esotropias Characteristics

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

35

Esotropias

- **Infantile Esotropia (Congenital Esotropia) (28-54%)**
 - ▣ Develops in first 6 months of life (3-4 months)
 - ▣ Magnitude 40-60Δ
 - ▣ Refraction
 - ▣ (+) Amblyopia
 - ▣ Sensory adaptations
- **Accommodative**
 - ▣ Refractive
 - ▣ Magnitude 11-45 (77%)
 - ▣ Refraction 2-6 (+4.00)
 - ▣ Partially Accommodative (33%)
 - ▣ Stability



Rutstein JAOA 2008

36

Esotropias

- **Accommodative**
 - Non-refractive/Convergence excess esotropia (5%)
 - Magnitude D/N
 - Refractive error
 - Mixed
 - Magnitude D/N
 - Refractive error
- **Acquired Non-accommodative**
 - Early Onset
 - Acute Acquired/Late Onset
 - Binocularity?
 - Subtypes
 - **Caution about acute acquired – distance > near, non comitant**
 - "Rare"

37

Case 3y4m

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

38

6 week f/u

- Rx worn FT X 3 wks; patient likes glasses; no eye turn cc
- DVA cc
 - OD 20/60-2
 - OS 20/30-2
- Stereo ? Resp
- DCT ortho
- NCT flick esophoria



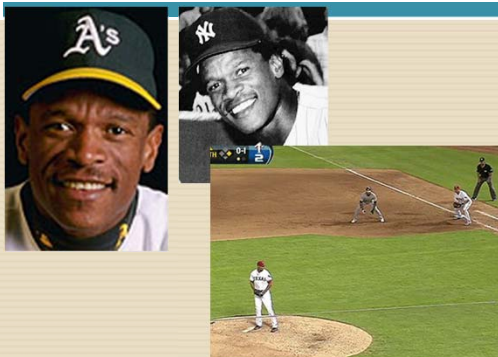
39

Desired Results/Goals

- **Cosmetic Cure**
 - Deviation <10Δ
- **Functional Cure**
 - Looks at alignment and binocular vision
 - Flom
 - Clear, comfortable, single binocular vision at all distances
 - Stereopsis and normal ranges of motor fusion
 - Deviation may be present up to 1% of the time*
 - Prism up to 5 prism diopters can be worn

40

Exotropia – Panoramic Viewing



41

Strabismus Treatment – Potential Urgencies

- Constant unilateral XT in infant/toddler without pathology
- Sudden onset ET in older child/adult
 - Distance > Near
- Non-comitant strabismus
- Strabismus associated with neurological symptoms
- Motility restriction
- Optic nerve edema/palor

42

Strabismus Treatment – Step 1

- Spectacle Rx = clear retinal image
 - ▣ 6-8 weeks
 - ▣ Esotropia*
 - Maximum plus
 - ▣ Exotropia
 - Myopia
 - Astigmatism
 - Hyperopia?
- Amblyopia Treatment

43

Accommodative Esotropia Spectacles

- Magnitude of plus?
 - ▣ Dry v. cyclo
 - Push plus OU (BB)
 - ▣ Accommodation?
 - MEM
 - ▣ By age/prior Rx:
 - Cut 0.50 to 1.00 diopter for toddler/preschoolers
 - May cut 1.00 to 1.50 for school aged
 - Monitor for blur
 - ▣ Check alignment with dry
 - ▣ Cut over time?
 - As kids get older they become more myopic/less hyperopic

44

Strabismus Treatment – Step 2

- Additional lens power to help with alignment
- For esotropia
 - ▣ Bifocal at near
- For exotropia
 - ▣ Overminus

45

Non-Refractive/Partially Refractive Accommodative Esotropia Treatment

- Use of bifocal is controversial
- If Rx bifocal
 - ▣ Magnitude?
 - ▣ Wean out of bifocal/Add = goal single vision
 - Tween/teen years
 - ▣ Goal: have the patient in single vision

46

Exotropia - Overminus

- Basis: stimulate accommodative convergence to decrease the magnitude of the deviation & make motor fusion easier
- Magnitude
- Who benefits?
 - ▣ Anyone but primarily younger children
 - ▣ Hold off on surgery
 - ▣ Smaller angles
- PEDIG (2020)
 - ▣ Ages
 - ▣ Magnitude

47

Exotropia - Overminus Lenses

Group	12 months	18 months	Eyes Hurt
Overminus	1.8	2.4	38%
Non overminus	2.8	2.7	22%

- "Beneficial effect of overminus was not maintained"

48

Exotropia - Overminus Lenses

- **New Concern**
 - Risk for >1D myopia progression in myopic patients

Refractive Error	Overminus (N=189)	Non-overminus (N=169)
> -1.00 increase	33 (17%)	2 (1%)
Within 1D	155 (82%)	166 (98%)

Presented at AAOptomety Meeting October 2020

49

Strabismus Treatment – Step 3

- Prism Lenses
- Basis – help with fusion
- Deviation < 20Δ
- Magnitude in distance Rx: variable
 - Minimum amount to achieve fusion
 - Relieving prism
 - Correcting prism
- Schedule: full time
 - Some taper strength over time
- Who benefits?
 - Exotropia: Basic Exo, CI Types
 - Esotropia: Acquired forms, Partially accommodative

50

Relieving Prism

- Compensate for some of the magnitude of the deviation
- Goal: decrease the demand on fusional vergence and allow for greater fusional stability
 - Moves image closer to the fovea
 - Patient still has to converge
- Magnitude
 - Less than the angle of deviation
 - Can decrease magnitude as stabilize
- Indications
 - Intermittent strabismus
 - Phorias
- PEDIG for IXT (2020)
 - 40% magnitude

51

Correcting/Neutralizing Prism

- Optically neutralize the entire deviation to allow for sensory fusion while the visual axes remain deviated
- Goal: to stabilize normal **sensory fusion**
- Magnitude: equal to magnitude of the deviation
 - Separate distance and near
 - Residual vergence demand = 0
- Studies:
 - Patients wear glasses 3 months – 15 years
 - Goal is no strabismus, fusion, positive and negative fusional vergence ranges

52

Strabismus Treatment – Step 3

- Ground in Prism
 - Permanently placed in lenses
 - By Decentration
 - By Mounting
- Fresnel Prism
 - Thin wafer
 - Adhesive to glasses
 - Not permanent
 - Lines visible
 - Can blur >12Δ



<https://www.bfwh.nhs.uk>

53

Strabismus Treatment – Step 3

- Prior to incorporating into an Rx **trial** prism in office
 - Symptoms
 - Comfort
 - Magnitude of deviation
 - Other variables
 - Fusion
- Trial frame kit
- Fresnel trial



54

Prism Adaptation

- Definition
- Reportedly rare in exotropia
- Trial BO prism slightly higher than the deviation
- Patient wears for up to 1 hour
- Remeasure alignment
- If ortho, small exo = GOOD; If residual eso = BAD
- May be more common in first 3 months of treatment

55

Strabismus Treatment – Step 4

- Occlusion
 - For exos
 - Basis: Passive anti-suppression
 - ↓Decrease suppression ↑sensory fusion & control
 - Schedule
 - What eye?
 - PEDIG (2 RCTs)
 - Ages
 - 3-10 year
 - 1-<3 years

56

Strabismus Treatment – Step 4

- Occlusion
- PEDIG ages 1-<3



Group	Deterioration >10Δ or Parent Concern	Motor Deterioration Only
Obs	4.6%	2.3%
Patch	2.2%	2.2%

- Conclusion
 - Deterioration uncommon in either group
 - Insufficient evidence to recommend PTP for treatment in this age group

57

Strabismus Treatment – Step 4

- Occlusion
- PEDIG ages 3-10

Group	Deterioration >10Δ	Stereo Deterioration	Stereo	Control D/N
Obs	6.1%	2.6%	1.84 arc sec	2.3/1.2
Patch	0.6%	0.6%	1.84 arc sec	2.0/0.9

- Conclusion
 - Deterioration uncommon
 - Slightly lower with patch
 - Both treatments acceptable



58

Strabismus Treatment – Step 4

- Occlusion
 - For esos
 - Binasal occlusion
 - Goal: stimulate alternation of the eyes to inhibit sensory adaptations (AC) and encourage divergence
 - Recommended for non alternating fixation, residual amblyopia
 - Magnitude of strip: variable
 - Bisect pupil
 - Temp edge of pupil
 - Tilt 10deg



Review of optometry

59

Strabismus Treatment – Step 5

- Additional Treatments
 - Vision Therapy
 - Surgery
- Considerations
 - Magnitude
 - Direction
 - Goals
 - Patient
 - Parent



60

Thank You

61