

Binocular Vision Made Easy: A Practical Approach to the Diagnosis and Management of Binocular Vision Disorders

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Why is it important to diagnose binocular vision problems?

- Prevalence
 - Much more common than ocular disease conditions in children
 - 8.5 times more common than ocular disease in patients ages 6-18

Schiffman et al. Journal of the AOA 1996, 67(1):193-202

Why is it important to diagnose binocular vision problems?

- Impact of binocular vision problems in children
- Impact of binocular vision problems in adolescents
- Impact of binocular vision problems in adults

Chief Complaint

- Often BV problems have non-specific complaints
 - Blur at near
 - Asthenopia with near work
 - Diplopia
 - Headache
 - Eye strain
 - Avoidance of near work

Chief Complaint

- Sometimes the chief complaint is more specific, and can often help you diagnose the condition....
 - Diplopia at near, with words "moving around on the page"
 - Blur at distance after reading/near work
 - Diplopia at distance

Chief Complaint

- Patient complaints
- Parent complaints

Get the Details!!!

- How long has it occurred for?
- When do they notice symptoms?
- How often?
- Does anything relieve symptoms?
- Occur on the weekend?
- Do the symptoms subside as soon as near work stops?

Patient/Parent Symptom Questionnaires

Caution!! Neurological Signs and Symptoms....

- Headache***
- Diplopia
- ONH edema
- Clumsiness, ataxia, gait imbalance
- Nystagmus
- Nausea or vomiting
- Personality or behavior change
- Lethargy

Diagnosis: History

- Ocular History
- Systemic History
 - Birth
 - Development
- Family History

Diagnosis: Academic History

- Subject specific performance in school
- Learning problems
 - Tutoring or remediation
 - Repeated a grade?
- Behavioral problems
 - ADHD

What tests do we use???

- Distance CT
- Near CT
- NPC
- NRA/PRA/BCC
- AA/MEM
- Vergence Ranges
 - Smooth
 - Step
- Facility
 - Accommodative (MAF/BAF)
 - Vergence

Diagnosis: Accommodative Testing

- Monocular versus Binocular Testing

Diagnosis: Accommodative Testing

- Accommodative Amplitude Testing
 - Push Up/Pull Away
 - Advantages
 - Disadvantages
 - Minus Lens to Blur
 - Advantages
 - Disadvantages

Diagnosis: Accommodative Testing

- Calculating normative values
 - Average
 - $18.5 - 1/3 \text{ age}$
 - Minimum
 - $15 - 1/4 \text{ age}$

Diagnosis: Accommodative Testing

- Case Example

Diagnosis: Accommodative Testing

- Binocular Crossed Cylinder/Fused Crossed Cylinder
 - Expected Value
 - $+0.50 (+/- 0.50)$
 - Disadvantages
 - Difficult on young patients

Diagnosis: Accommodative Testing

- Negative Relative Accommodation
 - Expected Value: $+2.00 (+/- 0.50)$
 - Test of relaxation of accommodation
 - Indirect test of positive fusional vergence

Diagnosis: Accommodative Testing

- Positive Relative Accommodation
 - Expected Values: -2.37 (+/-1.00)
 - Test of stimulation of accommodation
 - Indirect test of negative fusional vergence

Diagnosis: Accommodative Testing

- Monocular Estimation Method
 - Objective test
 - Accuracy of accommodation
 - Expected values: plano - +0.75

Diagnosis: Accommodative Testing

- Accommodative Facility Testing
 - Monocular
 - +/- 2.00 flippers
 - 8-12 years old - 7 cpm
 - Over 12 - 11 cpm
 - Binocular
 - +/- 2.00 flippers
 - Suppression check
 - 8-12 years old - 5cpm
 - Adults - 10cpm

Diagnosis: Vergence Testing

- Smooth Vergence Testing - Vergence Amplitude
 - Blur
 - Fusional Vergence without Accommodation
 - Break
 - Fusional and Accommodative Vergence
 - Recovery

Diagnosis: Vergence Testing

- Smooth Vergence Ranges
 - Negative Fusional Vergence (BI)
 - Norms
 - Distance - 5/7/4
 - Near - 13/21/13
 - Indirectly testing positive relative accommodation

Diagnosis: Vergence Testing

- Smooth Vergence Ranges
 - Positive Fusional Vergence (BO)
 - Norms
 - Distance - 9/19/10
 - Near - 17/21/11
 - Indirectly testing negative relative accommodation

Diagnosis: Vergence Testing

- Step Vergence Ranges
 - Advantages
 - Outside the phoropter
 - Objective test

Diagnosis: Vergence Testing

- Vergence Facility
 - Different from amplitude testing
 - 3 BI / 12 BO
 - Vertical row of letters
 - Norm
 - 15 cpm

Diagnosis: Vergence Testing

- Near Point of Convergence
 - Target Selection
 - Accommodative target
 - Penlight
 - Penlight with R/G glasses
 - Repetition of test

Diagnosis: Vergence Testing

- Near Point of Convergence
 - Expected Values
 - Accommodative Target
 - 5cm/7cm
 - Penlight and R/G glasses
 - 7cm/10cm

Scheiner et al. Optometry and Vision Science 2003 Mar;80(3):214-25

Treatment: Will Lenses Help?

- First step: good manifest prescription
 - Dry retinoscopy
 - Cycloplegic retinoscopy

How do I know if plus will help???

- Is your patient a plus acceptor??
 - Lag on MEM/BCC
 - High NRA, Low PRA
 - Fails (-) on MAF/BAF
 - Eso at near
 - Low AA

How to Determine Near Plus Rx?

- For Convergence Excess
 - Lenses that provide desired alignment (eso reduced or eliminated at near)
- For AI or Pseudo CI
 - Lenses that produce normal lag on MEM
 - Normal lag on MEM: +0.25 to +0.75D
- Balance NRA/PRA??

Treatment: Will Plus Lenses Help?

- Prescribing plus for near
 - Taking myopic glasses off for near work
 - NVOs
 - Bifocals
 - PALs

Treatment: Will Minus Lenses Help?

- When to consider added minus lenses for your patient
 - Exophoria/Exotropia
 - Divergence Excess
 - High CA/C ratio
 - Young patients

Treatment: Will Minus Lenses Help?

- Prescribing overminus lenses
 - Methods of prescribing
 - Add at near?

Treatment: Will Minus Lenses Help?

- Case example

Treatment: Will Prism Help?

- Indications for prism
 - Vertical deviation
 - Intermittent strabismus
 - Large heterophoria

Treatment: Will Prism Help?

- Prescribing Prism
 - Dissociated Prism Criteria
 - Associated Prism Criteria

Treatment: Will Prism Help?

- Dissociated Prism Criteria
 - Percentage Criteria
 - Percentage of the total dissociated deviation given
 - May be 1/3 to as high as 2/3

Treatment: Will Prism Help?

- Dissociated Prism Criteria
 - Residual Vergence Demand

Type of Deviation	Size of Deviation	Residual Vergence Demand
Esodeviation	6 – 20 prism diopters	4-6 prism diopters
Exodeviation	20-30 prism diopters	10-15 prism diopters
Hyperdeviation	3-10 prism diopters	2-4 prism diopters

Caloroso and Rouse, *Clinical Management of Strabismus*, 1993

Treatment: Will Prism Help?

- Associated Prism Criteria
 - Fusion prism
 - Sheard's Criteria
 - Amount of prism = 2/3 phoria – 1/3 compensating fusional vergence
 - Percival's Criteria
 - Amount of prism = 1/3 Greater lateral limit – 2/3 Lesser lateral limit
 - Fixation Disparity

Accommodative Conditions

- Accommodative Insufficiency
 - Common symptoms: Near blur/asthenopia
 - Clinical signs
 - Low PRA
 - Large lag of accommodation
 - Low NFV
 - Difficulty with (-) on MAF/BAF
 - Low amplitude of accommodation

Accommodative Conditions

- Accommodative Insufficiency
 - Management
 - Lenses
 - Vision Therapy

Accommodative Conditions

- Accommodative Excess
 - Symptoms: Asthenopia/Blur at near
 - Signs:
 - Lead on MEM/BCC
 - Low NRA
 - Difficulty with plus on MAF/BAF
 - Low PFV

Accommodative Conditions

- Accommodative Excess
 - Treatment
 - Vision therapy

Accommodative Conditions

- Accommodative Infacility
 - Symptoms: Blurred vision when looking from distance to near and near to distance, near asthenopia
 - Clinical signs:
 - Low NRA/PRA
 - Low MAF/BAF
 - May have low NFV/PFV

Accommodative Conditions

- Accommodative Infacility
 - Management
 - Vision therapy
 - Near lenses???

Vergence Conditions

- Convergence Insufficiency
 - Symptoms: Near asthenopia, diplopia, words moving on the page, poor attention or concentration
 - Clinical Signs:
 - Exo > near than distance
 - Receded NPC break
 - Inadequate PFV ranges at near
 - Lead on MEM/BCC
 - Low NRA ranges
 - Fails (+) on BAF

Vergence Conditions

- Convergence Insufficiency Symptom Survey

Vergence Conditions

- Convergence Insufficiency
 - Management
 - Office based vision therapy

Vergence Conditions

- Pseudo Convergence Insufficiency
 - Truly an AI
 - (+) Acceptor
 - AI with a near XP
 - Lag on MEM/BCC
 - Low AA
 - (+) for near will improve NPC

Vergence Conditions

- Convergence Excess
 - Symptoms: Blurry vision, diplopia, asthenopia at near
 - Clinical Findings
 - Eso at near > Eso at distance
 - Low NFV at near
 - Low PRA
 - Fail BAF with (-)
 - High lag on MEM or BCC

Vergence Conditions

- Convergence Excess
 - Management
 - Plus at near
 - VT

Vergence Conditions

- Divergence Insufficiency
 - Symptoms: Diplopia at distance
 - Clinical Signs:
 - Eso D > N
 - Decreased NFV at distance

Vergence Conditions

- Divergence Insufficiency
 - Management
 - Prism
 - Vision Therapy

Vergence Conditions

- **Divergence Excess**
 - Symptoms:
 - May have diplopia at distance
 - Closes one eye in bright light
 - Clinical Signs:
 - Exo D > N
 - May have normal PFV ranges
 - Normal NPC

Vergence Conditions

- **Real versus Simulated DE**
 - Occlusion test
 - +3.00 test

Vergence Conditions

- **Divergence Excess**
- **Management**
 - Vision therapy
 - Added minus lenses

Vergence Conditions

- **Basic Esophoria**
 - Symptoms
 - May present at both distance and near
 - Clinical Signs
 - Esophoria D = N
 - Low NFV D & N
 - Low PRA
 - High lag on MEM
 - Difficulty with (-) lenses on BAF

Vergence Conditions

- **Basic Esophoria**
 - Treatment
 - Correct any hyperopia
 - Near addition lenses if indicated
 - Prism
 - Vision Therapy

Vergence Conditions

- **Basic Exophoria**
 - Symptoms
 - May occur at distance and near
 - Clinical Signs
 - Exophoria D = N
 - Low PFV
 - Low NRA
 - Receded NPC
 - MEM – lower lag or lead

Vergence Conditions

- Fusional Vergence Dysfunction
 - Symptoms
 - Near asthenopia, eye strain, headache, blurry vision
 - Clinical findings
 - D and N phoria normal
 - Low NRA/PRA
 - Low PFV/NFV
 - Fails BAF
 - Low vergence facility (BI and BO)

Vergence Conditions

- Fusional Vergence Dysfunction
 - Management
 - Vision Therapy
 - Vergence amplitudes
 - Vergence facility

Amblyopia

Unilateral or bilateral condition

-BCVA is poorer than 20/20

-No structural or pathologic anomalies

-One or more of the following conditions occurring before 6-8 years of age:

- **Significant refractive error**
- **Constant, unilateral strabismus**
- **Form vision deprivation**

What is **Significant** Refractive Error?

	Isoametropic	Anisometropic
Astigmatism	≥2.50D	≥1.50D
Myopia	≥6.0D	≥3.0D
Hyperopia	≥4.0D	≥1.0D

**Tarczy-Hornoch et al. (2013) *Ophthalmology*. 120:1220-1226.

Strabismus

- Early onset
- Constant
- Unilateral
- More commonly ET

Form Deprivation

- 0.1% of the general population*
- Severe amblyopia
- Obstruction of the line of sight
 - Prolonged blepharospasm/ptosis
 - Corneal opacity
 - Hyphema
 - Cataract
 - Vitreous opacity

*Friedman, D.S., et al. (2009). *Ophthalmology*. 66 (11) 2128-2134

Is It Really Amblyopia???

- Amblyogenic factor must be present
- **Must rule-out any underlying ocular or neurological pathology that may explain a decrease in VA**
- Ocular pathology may co-exist with amblyopia

Normal Findings in Patients with Amblyopia

- Pupils
- Amsler Grid
- Visual Field
- Color Vision

★if any of these are abnormal, carefully consider your diagnosis!!!! ★

Amblyopia

- Management
 - Spectacle Correction
 - Important first line of treatment for amblyopia
 - Cycloplegic retinoscopy/refraction
 - Should I cut the Rx?

Amblyopia

- Spectacle Correction
 - Resolves strabismic and strabismic/aniso amblyopia in 25% of children 3 - <7*
 - Most bilateral amblyopia resolves within 1 year of correction**
 - Resolves aniso amblyopia in 1/3 of children 3 - <7****
 - In older children (7-17 yrs) amblyopia improves in 25% of patients with correction alone*****

*Cotter, S. et al. Ophthalmology 2012 Jan;119(1):150-8
 **Wallace, D. et al. Ann J Ophthalmol 2007 Oct;144(10):1487-95
 ***Cotter, S. et al. Ophthalmology 2006 Jun;113(6):895-903
 ****Scheiman, et al. Arch Ophthalmology 2005 Apr; 123(4): 437-47

Amblyopia

- Management
 - Patching regimens

Vision Therapy Basics

- Improve accommodative amplitude and stimulation of accommodation
 - Lens sorting
 - Near/Far Hart Chart
 - Monocular Loose Lens Accommodative Rock
- Improve Smooth Positive and Negative Fusional Vergence Amplitudes
 - Vectograms
 - Brock String
 - Tranaglyphs
 - Computer RDS therapy

Vision Therapy Basics

- Improve Ability to Stimulate and Relax Accommodation Efficiently
 - Monocular Accommodative Rock
 - Red Red Rock
 - Binocular Accommodative Rock
- Improve Positive and Negative Fusional Vergence Facility
 - Aperture Rule
 - Vectograms
 - Tranaglyphs

Vision Therapy Basics

- Integrate accommodative changes in vergence therapy
 - Lenses to change accommodative demand with vergence therapy
- Improve Vergence facility (Change from convergence to divergence)
 - Aperture Rule(s)
 - BI/BO Vectograms
 - Eccentric circles
- Vergence integrated with versions and saccades
 - Eccentric circles
 - Brock string
 - Lifesaver Cards