The Tear Free Infant Examination

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Goals of the Infant Eye Examination

• Detect risk factors for:
  — Strabismus
  — Amblyopia

• Determine need for refractive error correction

• Detect pathology

• Get kids on the path to a lifetime of visual health
The Facts

- Vision disorders are the fourth most common disability in the United States and the most prevalent handicapping condition in children.

- Vision Problems exist in:
  - 10% of preschoolers
  - 25% of school age children
  - 60% of problem learners

- Early detection of child’s vision problem ↓ negative effect on child development
  - More responsive to treatment when diagnosed early

AOA Guidelines

1st exam at 6 months

Follow up at 3 years

Repeat before entering school (Kindergarten)

Infant/Preschool Exam Summary

Case History
Vision Assessment / Visual Acuity
Refraction
Alignment / Motility
Ocular Health
Parent Education

Infant Exam Summary

- Visual Acuity (Gross)
  - Fixate and Follow
  - Preferential Looking
- Motilities / Alignment
  - EOMs
  - NPC
  - Kappa / Hirschberg
  - Bruckner Test
- Pupils
- Refraction
  - Dry/Mohindra Retinoscopy
  - Cycloplegic Retinoscopy
- Anterior Segment Evaluation with 20 D
- Dilated Exam
  - Posterior Pole Evaluation with BIO

Infant Exam Cooperation Tips

- Schedule at time when child is alert and well rested
- Allow child to remain with parent
- Bottle / pacifier
- Toys / Age appropriate examination tools
Preschool Exam Summary

- Visual Acuity Symbols vs. Snellen (quantitative when possible)
- Motilities
- Cover Test (accommodative target)
- Vergence
  - NPC
  - Prism bar Vergences as needed
- Accommodative
  - Pull away amplitudes when needed
- Random Dot Stereopsis / Stereo Fly
- Color Vision Made Easy
- Dry / Mohindra Retinoscopy
- Pupils
- Anterior Segment Evaluation (20 D Lens / Head held slit lamp)
- Cycloplegic Retinoscopy
- Dilated Exam/ Posterior Segment Evaluation
  - Posterior Pole Evaluation with BIO

What equipment do you need?

Transilluminator
Age appropriate toys/targets
Direct Ophthalmoscope
Retinoscope
Trial lenses / Skiascopy Bars
Loose Prisms/Prism Bars
BIO
20 D lens
Suggested Additional Equipment

- Hand Held Keratometer
- Monocular Indirect Ophthalmoscope
- Hand held Slit Lamp
- Tonopen
- Infant Visual Acuity Tests
- Infant Stereo tests
- Color Vision Made Easy

Evaluation of the Infant/Toddler

Direct Observation
Evaluation of the Infant / Preschooler

Step I – Case History

Birth History: Is the child high risk?

- Prenatal History
  - Infections / Especially in first trimester
  - Fetal drug exposure

- Perinatal History
  - Fetal distress
    - Premature < 37 weeks
    - Oxygen exposure
  - Birth weight
    - 5 lb 8 oz = normal

- Complications during pregnancy / delivery?
  - Looking for any event causing CNS damage
    - Fetal distress
    - Seizures
    - Respiratory arrest
    - Low Apgar Score: Normal is > 7 after 3 minutes

APGAR Score

<table>
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<tr>
<th>FACTOR</th>
<th>0</th>
<th>1</th>
<th>2</th>
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<tbody>
<tr>
<td>Heart Rate</td>
<td>Absent</td>
<td>=100</td>
<td>&gt;100</td>
</tr>
<tr>
<td>Respiration Effort</td>
<td>Absent</td>
<td>irregular</td>
<td>Regular</td>
</tr>
<tr>
<td>Muscle Tone</td>
<td>No response</td>
<td>Some flexion of extremities</td>
<td>Well Flexed</td>
</tr>
<tr>
<td>Reflex Irritability</td>
<td>No response</td>
<td>Some motion</td>
<td>Cry, cough, sneeze</td>
</tr>
<tr>
<td>Circulation</td>
<td>Blue (or pale)</td>
<td>Body pink, extremities blue</td>
<td>Completely pink</td>
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Medical History

– Medications?
– Allergic to medications?
– Allergies?
– Review of Systems
– Has the child ever been hospitalized?

Case History

Common Chief Complaints

History of prematurity = ↑ risk
Delayed motor development
Frequently rubs eyes / Blinks excessively
Eye turn
Cannot maintain eye contact or fixation
Poor eye tracking skills
Failed pediatrician/preschool screening

Case History

Previous Ocular Diagnosis & Treatments

Occlusion
EOM surgery
Spectacle / CL Correction

Family History

High Refractive Error
Strabismus / Amblyopia
Ocular Pathology

FAMILY OCULAR HISTORY: Strabismus

• 2 or more family members with strabismus
  – ~ 50% Esotropia
  – ~ 40% Exotropia
• 70% = (+) FHx Strabismus
• 30-50% siblings of strabismic patients exhibit strabismus if 1 or both parents are affected
• 96.5% of siblings developed strabismus of same type as sibling / 51% at same age

Developmental Milestones

Gross/Fine Motor
Language Development
Developmental Skills

KNOW WHAT IS NORMAL!!!!

Integrity of the visual system is important to a child’s overall development
Developmental Milestones

Question to elicit history of developmental delay....

Is the patient undergoing any of the following therapies?

Physical
Occupational
Speech
Developmental

Motor Development

Sit-up
• Supported → 4-6 months
• Independent → 8-9 months

Crawl → 9-12 months

Walk → 12-14 months

Language Development

Single words → 9-12 months

3-5 word sentences → 2 years

Names Primary colors → 4 years

Evaluation of the Infant / Preschooler

Step II – Visual Acuity/Vision Assessment

KNOW WHAT IS NORMAL AND WHEN SYSTEM IS AT ADULT LIKE FUNCTION

Visual Acuity

Is acuity age appropriate & equal?

Interocular Acuity Difference – IAD

Best Infant Acuity Tests

High contrast optotypes
Forced choice or matching

Visual Acuity Development / Preferential Looking Method

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<th>Visual Acuity</th>
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<td>1 month</td>
<td>20/300 – 20/1200</td>
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<tr>
<td>2 months</td>
<td>20/150 – 20/600</td>
</tr>
<tr>
<td>6 months</td>
<td>20/50 – 20/200</td>
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<tr>
<td>18 months</td>
<td>20/40 – 20/100</td>
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<tr>
<td>24 months</td>
<td>20/30 – 20/80</td>
</tr>
<tr>
<td>3 years</td>
<td>20/20</td>
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At what age is 20/20 VA development demonstrated by VEP testing?

6 months
Visual Acuity Assessment: Infant

Fixate and Follow (F&F)
Optokinetic Drum
 Preferential Looking
 Non-qualitative Measures
 Candy Bead Test

Visual Acuity Assessment: Fixate and Follow

- **Target:** Transilluminator / Face / Toy
- **Evaluate:**
  - Response to light
  - Note: lid closure to bright light ≠ cortical function
  - Tracking ability
  - Comparison of ability of each eye
- **When delayed:**
  - Possible prematurity
  - Possible generalized motor delay
  - Possible Visual System Diagnosis

**Visual Acuity Assessment: Fixate and Follow**

- **Procedure**
  - Cover one eye
  - Examiner hand/thumb, Parent’s hand
  - Light directed at patient’s face
  - Obtain fixation with non-occluded eye
  - May tap/flash/move light

- **Recording:**
  - **F&F** = able to fixate and follow target
  - **CSM**
    - **Central** = light reflex = central
    - **Steady** = eye maintains alignment with stationary and moving object
    - **Maintenance** = under binocular conditions does previously fixating eye maintain fixation
Optokinetic Drum

- Working Distance = 5-10 cm
- (+) OKN Response
  - Reliability of visual resolution up to but not including the visual cortex
- To rule out Amblyopia:
  - Monocular OKN
    - Asymmetric in newborns
      - 0-4 months = brisk T→N, weak N→T
      - >4 months = asymmetrical
    - If asymmetric: = amblyopia/abnormal binocular development (secondary to midbrain deficiencies in binocular integration)

Optokinetic Drum

Preferential Looking

- Infant/child presented with a series of grating stripes with progressively smaller stripe widths
- Gratings appear to L or R of midline and examiner observes which side the infant prefers to look
- Optimum response
  - 3-12 months
  - >9 months — may not sustain interest in target
Preferential Looking

Candy Bead Test
Candy Bead Test

Candy Bead Test (cooperative 16 month old)

Candy Bead Test (1 y.o., Not as cooperative!)

Quantitative Visual Acuity Assessment
Toddlers/Preschoolers

Lea Symbols***
Broken Wheel
HOTV
Lighthouse Symbols

LEA SYMBOLS
BROKEN WHEEL

HOTV

Lighthouse Cards
Evaluation of the Infant/Toddler

Step III- Ocular Motility Assessment

KNOW WHAT IS NORMAL AND WHEN SYSTEM IS AT ADULT LIKE FUNCTION

Ocular Motility Examination

- **Position Maintenance** - Birth
  - dependent on interest of target
  - Present at birth
  - fully developed at 3 months

- **Smooth Pursuit** - 3 months
  - at birth - involuntary
  - at 3 months - voluntary

- **Saccades** - Birth
  - functional at birth
  - differ from adults in latency and hypometricity

Ocular Motility Evaluation

Ocular Alignment
9 month old HF

- FT birth / (+) developmental delay / (+) Goldenhar’s syndrome
- c/o eyeturn in as per Mom / seen daily / since about 3 months of age
- VA : F&S OD, OS
- NCT : ortho (primary gaze)
- EOM : - 4 abduction deficit OS
  - 30 △ ET in L gaze
  - Mild head turn to (L)

9 month old HF

- Anterior Segment Evaluation
  - Antimongolioid slant of palpebral fissure
  - (L) eye deeper inset/smaller appearance
    - VFW
    - OD 10.5-11.0 mm
    - OS 9 mm
    - Ptosis like appearance
  - CHD
    - OD/OS 10.5 mm
- (-) iris coloboma
- (-) limbal dermoid
- (+) preauricular dermoid

9 month old HF

- Assessment
  - Esotropia Left gaze
    - LR palsy 2° Goldenhar’s syndrome
    - Ptosis 2° Left sided Facial Nerve paresis
    - Developmental Delay
- Plan
  - RTC 3 months
  - Letter to OT regarding L gaze issues

Evaluation of the Infant/Toddler

Step IV – Refractive Error Assessment

KNOW WHAT IS NORMAL AND WHEN SYSTEM IS AT ADULT LIKE FUNCTION
Refractive Error Assessment

- Retinoscopy
  - Out of Phoropter
  - Cycloplegic
  - Mohindra Retinoscopy
  - Auto Refractor

- Keratometry (hand held)
- Auto Refractor

Refractive Error Assessment: Retinoscopy

Must control: Fixation & Accommodation

Mohindra Retinoscopy Technique

- Equipment needed:
  - Retinoscope
  - Graded lens bars or trial lenses
- Dark room
- Occlude other eye
- 50 cm working distance
- Patient looks at retinoscope light
- Neutralize primary meridians
- Transpose to sphero-cylindrical form
- Subtract 1.25 from sphere power
What is Mohindra Retinoscopy?

- **Goal**: control accommodation during retinoscopy
- **Pediatric ONLY** retinoscopy technique
- Recommend for infants
- Monocular / Occlusion
- Patient fixates retinoscopy light

**REASONS FOR DEVELOPMENT OF MOHINDRA’S NEAR RETINOSCOPY**

- Concerned with cycloplegic side effects
- Apprehension of parents
- Irritability of patients post-installation
- Increase pupil size => increases spherical aberration
- “Cut factor” used to determine final Rx

**Mohindra Technique**

+4.00

**Mohindra Technique**

+4.00

+2.00
Mohindra Technique

+4.00

+2.00

+4.00 – 2.00 x 180

Mohindra Technique

+4.00 – 2.00 x 180

-1.25

+2.75 – 2.00 x 180

Cycloplegic Refraction

Administration of Cycloplegic Agent

- Cycloplegic Spray
  - 0.5% Tropicamide
  - 0.5% Cyclogel
  - 2.5% Phenylephrine

- O’BRIEN Pharmacy
  - 800-627-4360

Cycloplegic Spray

- Shelf life – approved for 120 days (stability and potency)
  - Stable past that
  - FDA typically approves no more than 30 days

- Can vary percentages based on needs of practice
Cycloplegic Spray Administration / 6 mo.

Cycloplegic Retinoscopy / 6 mo. old

Cycloplegic Spray Administration/16 months

Cycloplegic Retinoscopy / 16 mo. old

“Refraction”
Pediatric Trial Frame Use
Prescribing for Infants and Preschoolers

Issues to consider:
- Age
- Visual Function
- Refractive Error Norms
- Amblyogenic Factors
- Birth History
- Family History
- Developmental History

Refractive Error Norms

- **Hyperopia**
  - Highest rate of emmetropization – 1st 12-17 months
  - Average refractive error in infants = +2 D
  - > 1.50 diopters hyperopia at 5 years old – often remain hyperopic

- **Myopia**
  - 25% of infants are myopic
    - Myopic Newborns (Scharf)
    - @ 7 years 54% still myopic
    - @ 7 years 46% emmetropic
    - @ 7 years no hyperopia
Refractive Error Norms

**Astigmatism**

- Against the rule astigmatism more prevalent switches to with-the-rule with development
- At 3 1/2 years old astigmatism is at adult levels

**POTENTIALLY AMBLYOGENIC REFRACTIVE ERRORS**

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**Evaluation of the Infant/Toddler**

**Step V – Posture Assessment**

*Know what is normal and when system is at adult like function*

**Detection of Strabismus in the Infant/Preschooler**

- Bruckner Evaluation
- Kappa / Hirschberg
  - *Infants/toddlers/deep amblyopes*
  - Cover Test
    - *Preschool age*

**Bruckner Test**

**Procedure**

- Use direct ophthalmoscope @ 1M from pt (scope set @ plano)
- Room is dark / Pt looks at light
- Look through the scope as you shine the light at the bridge of the pts nose
- With the pt optically corrected look at the orange - red retinal reflexes
- Compare the color and brightness btw the 2 eyes

**Whiter & Brighter Reflex : Strabismic Eye**
Hirschberg / Kappa Test

Procedure

- **Hirschberg**
  - *Patient is binocular*
  - Shine light at bridge of nose, pt fixates penlight
  - Evaluate placement of the corneal reflexes in relation to the center of the pupil (OD, OS)

- Follow with *Kappa*
  - *Patient monocular*
  - Evaluate placement of the corneal reflexes in relation to the center of the pupil (OD, OS)
Information gathered

direction of strabismus = *exotropia*
Laterality = *alternating*
estimation of magnitude ~ 25 Δ
estimation of frequency = *intermittent*
Hirshberg / Kappa Tests

Information gathered

- Direction of strabismus = esotropia
- Laterality = alternating
- Estimation of magnitude ≈ 40 Δ (variable)
- Estimation of frequency = constant
HIRSBERG / KAPPA TESTS

Information gathered

direction of strabismus = exotropia
Laterality = right eye
estimation of magnitude ~ 20-40 ∆ (variable)
estimation of frequency = constant

Krimsky Test (quantifies Hirschberg)

Procedure
• Perform Hirshberg
• Place neutralizing prism in front of fixating eye
• Add prism until the corneal reflex in the deviating eye looks symmetrical with that of the fixating eye
• The amount of prism necessary to achieve this
  = the Magnitude of the Deviation
Evaluation of the Infant/Toddler

Step VI – Assessment of “others”

KNOW WHAT IS NORMAL AND WHEN SYSTEM IS AT ADULT LIKE FUNCTION

Cover Test

Visual Development Norms

- Convergence
  - Accurate at 3 months

- Accommodation
  - Adult like at 3-4 months

- Random Dot Stereopsis
  - Developed at 3-4 months

- Color Vision
  - Developed at 3-4 months

How do we measure/observe each?
Vergence

Near Point of Convergence (NPC)

Stereopsis

Prism Bar Vergences
Color Vision

Color Vision Made Easy

Evaluation of the Infant/Toddler

Step VII – Eye Health Assessment

KNOW WHAT IS NORMAL AND WHEN SYSTEM IS AT ADULT LIKE FUNCTION
Examination Techniques for Infants: Anterior / Posterior Segment

- Hand Held Slit Lamp
- 20D Lens
- Burton Lamp
- Tonopen
- Monocular Indirect Ophthalmoscope
- BIO

Anterior Segment Examination Guidelines

- **Lids / Lid Margins**
  - Observe for:
    - Shape irregularity
    - Discharge on lashes/lid margin
  - Evert Lower lids to expose:
    - Bulbar / Palpebral conj, observe for:
      - Follicles
      - Papillae
      - Discharge
      - Edema

- **Cornea / Iris / Lens**
  - Observe clarity / opacities/ irregularity

- *Is there a difference between the two eyes????*

Anterior Segment Norms

- **Corneal Horizontal Diameter in Neonate**
  - 9-10 mm
- **Corneal Horizontal Diameter in a 1 year old**
  - 11 mm
- **Corneal Horizontal Diameter in Adult**
  - 11.5-12.0 mm
    - Reached by 3-4 years

Hand Held Slit Lamp

- **Pupils**
  - Size
    - Constricted - 1.2-2 mm
    - Fully dilated - 7.5-8 mm
    - Resting - 2.5-4 mm
  - In infancy pupillary ref to light less than in childhood
    - Often absent in very premature infants
    - 1st response at 28-32 wks

- **IOP**
  - 8-15 mmHg
  - Increases by 1 mmHg/yr from birth to age 5
Tonopen

Anterior Segment Anomalies

NLDO Patient
Congenital Cataracts

Posterior Segment Examination

Posterior Pole Development Norms

- Retinal vasculature begins at 16 weeks gestation

- Complete Vascularization of Infant Retina
  - Nasal Retina → 32 weeks gestation
  - Temporal Retina → 40-42 weeks gestation

- Macula
  - fully developed at 42 weeks

Posterior Pole Evaluation

- Optic Nerve Head
  - Color
  - Size
  - Symmetry
    - Is there a difference between the two eyes????

- Macula
  - Integrity / reflex

- Vessels
  - Tortuosity / attenuation

- Minimal peripheral views
  - Is there a difference between the two eyes????
BIO Technique

Examination Step by Step

I - Case History
II - Vision / Visual Acuity Assessment
III - Ocular Mobility Assessment
IV - Refractive Error Assessment
V - Posture / Strabismus Evaluation
VI - Vergence / Accommodative / Stereopsis / Color Vision
VII - Ocular Health Evaluation
VIII - Rule out Amblyogenic Risk Factors
Evaluation of the Infant/Toddler

Step VII – Rule out Amblyopia

KNOW WHAT IS NORMAL AND WHEN SYSTEM IS AT ADULT LIKE FUNCTION

Tools for Amblyopia Detection

• Visual Acuity Assessment
• Refractive Error Assessment
• Posture Evaluation
• Stereopsis / Fusion
• Eye Health Evaluation

Strabismic Amblyopia

CONSTANT / UNILATERAL
Strabismus
Refractive Amblyopia
Anisometropic Amblyopia

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Image Degradation Amblyopia
Summary

• Goals
  – To detect and properly treat:
    • Uncorrected refractive error
    • Strabismus
    • Amblyopia
    • Pathology
      – Get child on the path of a lifetime of proper visual health and development

Examination Step by Step

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Preschool Exam Summary

• Visual Acuity Symbols vs. Snellen (quantitative when possible)
• Motilities
• Cover Test (accommodative target)
• Vergence
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  – Prism Bar Vergences as needed
• Accommodative
  – Pull away amplitudes when needed
• Random Dot Stereopsis / Stereas Fly
• Color Vision Made Easy
• Dry / Mohindra Retinoscopy
• Pupils
• Anterior Segment Evaluation (20 D Lens / Head held slit lamp)
• Cycloplegic Retinoscopy
• Dilated Exam / Posterior Segment Evaluation
  – Posterior Pole Evaluation with BIO
**Review of Norms**

- VA = 20/20 @ 6 months
  - Repeatable at ~3 years

- Motility at ~3-4 months

- Vergence / Accommodation / Stereopsis / CV
  - ~3-4 months

**Review of Norms**

- Anterior Segment
  - Cornea almost adult size @ 12 months

- Posterior Segment
  - Retinal vasculature fully developed at 42 weeks

- Of all human organs the eye is the most fully developed at birth
  - Closer to adult size than any other organ

**QUESTIONS?**

*Contact:*

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