Standing on the Shoulders of Giants!

• ARNOLD GESELL, M.D.
  • Vision is the key to a child’s whole development, therefore;
  • If vision is not working well, the child is not working well
• John W. Streff, O.D.
  • When vision is working well, it guides and leads.
  • When it is not, it interferes.
• Darrell Boyd Harmon, PhD
  • Movement is not just for moving—movement is for action! VISION is not for seeing. VISION is for discrimination, appraisal, decision and action in a lighted world.

Factors Impacting Development

• Prenatal
  • Disruption in development leads to difficulties
• Genetic vs. Environmental
  • Parental lifestyle
• Birth Process
  • APGAR score
• Birth Weight and Prematurity
  • Physical, emotional, cognitive and sensory development

Newborn

• Birth to Four Months
  • Primary focus is 8-10 inches
  • 20/200-20/400
  • Improving focusing ability
  • Improving eye control
  • Normal vs. abnormal
  • Eye-hand coordination is developing
  • Color vision
  • present but like tones are hard to distinguish
  • Black and white patterns
Newborn

- Five to eight months
  - Refinement in eye control
  - Development of stereopsis
  - Fine focusing
  - Movement of body coordinated with vision
  - Motor planning
- Nine to twelve months
  - Refinement of depth perception
  - Integration of fine motor coordination
  - Start of visual processing
  - Vision used to direct walking

Developmental Milestones

Just for fun!

- 10 Things Every Child In Memphis Should Experience Before Kindergarten
  - Visit the Children’s Museum
  - See Animals at the Zoo
  - Watch the Peabody ducks
  - Ride the Trolley
  - Visit your child’s elementary school

DEMANDS ON STUDENTS

There seem to be many more kids having difficulty today than ever before! Why??

- No kindergarten for kindergartners?
- Small number of kids in a class
- One computer for each student
- At least one computer in every classroom
- Computer classes for many children
- Summer reading programs
- Cutting of physical education
ADDITIONAL DEMANDS ON KIDS

- Kaiser Family Foundation
- Two-thirds of infants and toddlers watch a screen an average of 2 hours a day.
- Kids under age 6 watch an average of about 2 hours of screen media a day, primarily TV and videos or DVDs.
- Kids aged 4 to 8 year spend over 4 hours a day in front of a TV screen and almost 2 additional hours on the computer (outside of school).
- Hand-held computer games
- Surfing the net
- Texting
- TV shows
- The issue is not that kids use them, it is that they use/play them obsessively.

The Examination

- General observation
- Visual acuity
- Alignment
- Convergence
- Pupils
- Visual fields
- Intraocular pressure measurement
- Anterior & Posterior segment

Eye Movements

- Fixation
  - Make a red finger
  - Grab the toy
  - Silent targets
- Pursuits
  - Same strategy
- Saccades
  - Attractive targets with motion
  - Puppets dancing in turn
  - Parent holds head stable
EOM fields

• Move your face with the target while Mom holds head
• Move head watching you & target
• Surprise noise and target in each position of gaze
• Multi-modality targets best

Teller Card Norms (1986)

<table>
<thead>
<tr>
<th>Age</th>
<th>Visual Acuity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn</td>
<td>20/400 - 20/1200</td>
</tr>
<tr>
<td>One Month</td>
<td>20/300 - 20/1200</td>
</tr>
<tr>
<td>Two Months</td>
<td>20/150 - 20/600</td>
</tr>
<tr>
<td>Four Months</td>
<td>20/80 - 20/300</td>
</tr>
<tr>
<td>Six Months</td>
<td>20/50 - 20/200</td>
</tr>
<tr>
<td>One Year</td>
<td>20/50 - 20/200</td>
</tr>
<tr>
<td>Three Years</td>
<td>20/15 - 20/40</td>
</tr>
</tbody>
</table>

Lea Gratings
Lea Gratings

The Face Dot Test

The OKN Drum

Motor Fusion

R/O strabismus or pseudostrabismus

• Hirschberg
  • with penlight for gross assessment of binocularity
  • Nasal placement = exotropia
  • Temporal placement = esotropia

• Cover test
  • observation with occlusion
  • loose prism
  • prism bar
  • with dynamic targets
  • lighted targets best for observing alignment reflex
Motor Fusion

- Brückner Test
  - Strabismus, amblyopia, & anisometropia
  - 80-100 cm away from child
  - Ophthalmoscope light on both eyes simultaneously
  - Anisocoria: larger pupil is brighter
  - Anisometropia: higher refractive condition is brighter
  - Strabismus: non-fixating eye is brighter

Sensory Fusion

- Based upon stereo acuity development during the first 24 months
- A sensitive period for development of binocularity
- 10° BU prism test

Worth Four Dot
Sensory Fusion

- **Stereo tests**
  - Lang
    - no filter glasses required
    - change orientation of target to be sure response is valid
  - Stereo Fly and Butterfly
    - 18 - 20 months +
  - Frisby Stereo test
    - >2 + years of age
  - Random Dot E

The Keystone Basic Binocular Test (KBB)

Excellent for young children, patients with strabismus, amblyopia, and patients who suffer from head injury.

The Keystone Basic Binocular Test (KBB)

- Myopia, hyperopia and astigmatism can vary measurably throughout the first year.
- Refraction may vary as much as 6.00 - 8.00 diopters.
  - This includes hyperopia, myopia astigmatism, and anisometropia
- Frequent re-assessment is necessary until it is determined that the refraction is stable over a three month period

The Keystone Basic Binocular Test (KBB)

- [Image]

The Keystone Basic Binocular Test (KBB)

- [Image]
Significant refractive conditions in children 12 months and older:
- > +3.00 D hyperopia in any meridian
- > -3.50 D myopia
- > 1.50 to 2.00D astigmatism
- > 1.00 D anisometropia
  (esp if higher ametropic eye is > +3.00D)

When strabismus is present, refractive compensation could be considered for:

<table>
<thead>
<tr>
<th>Isometropia</th>
<th>Anisometropia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myopia &gt;3.50 D</td>
<td>Myopia &gt;3.00 D</td>
</tr>
<tr>
<td>Hyperopia &gt;2.00 D</td>
<td>Hyperopia &gt;1.00 D</td>
</tr>
<tr>
<td>Astigmatism &gt;1.50 D</td>
<td>Astigmatism &gt;1.00 D</td>
</tr>
</tbody>
</table>

Prescribing lenses from the cycloplegic refraction during the first year may delay or offset the emmetropization process.

"Pushing plus" should be reserved for minimization of the angle for ET.

Cycloplegia

- Prescribing lenses from the cycloplegic refraction during the first year may delay or offset the emmetropization process.
- "Pushing plus" should be reserved for minimization of the angle for ET.
- Wet vs. Damp
- Optometry & Visual Performance Vol 1, Issue 1
  - Smith and Laudon Point/Counterpoint

Distance Retinoscopy

- Mohindra Retinoscopy
  - non cycloplegic
  - monocular technique
  - infant fixates a dimmed retinoscope light
  - 50 cm working distance
  - totally darkened room
  - Correction factor:
    - 0.75 D for infants
    - 1.25 D after age 2 yrs

Near Retinoscopy

- Have the baby look at a near target
- MAKE IT AN INTERESTING TARGET!
- Compare right and left eyes before trying to determine a refractive amount
- JUST LOOK-Glen Steele
Prescribing Pearls

- Allow emmetropization to take place
- Wait on Rx unless esotropia is present
- Wait on Rx if child was a preemie
- Prescribe lenses that positively affect the child's interaction with the environment.
- General guide: be conservative: 1/3rd of what you measure to begin with!

Anterior Segment

- Penlight and 20 D lens is your friend.

Posterior Segment

- However you can get it done!
- Wait for it!
  - Baby
    - In mother's arms
  - While feeding
  - While sleeping
  - Toddler
    - Standing on your head
    - Laying on the floor
    - Watch out for flying hands and kicking feet!

The Toddler/Young Child

- History
  - Preparation should ideally begin before the patient enters the practice.
  - Intake forms and questionnaires on the patient's medical and ocular history can be sent out beforehand.
  - This information will provide insight about the patient's needs and their level of functioning.

More History

- Discussion of any occupational and physical therapy services used can also provide background about the patient's developmental level.
- When assessing medical history, note any ocular or systemic medications and the length of time they were taken.
- Be familiar with commonly used medications and their side effects.
  - Academic
  - Social
  - Birth

Color Vision Testing

- Color Vision Testing Made Easy
  - For patients who do not know their numbers
  - If they cannot communicate verbally
  - Ask the patient to trace the shapes with a cotton-tipped applicator or a small paintbrush.
- Ishihara Plate Test
- Wool/Yarn Test
Visual Acuity Assessment

- **HOTV Test**
  - Developmental ages beginning at three or four years old.
  - Four letters (H, O, T and V) are used in the chart.
  - The test is performed at 10 feet
  - **Advantage**: No directional component, good for children with issues of letter reversals
  - **Disadvantage**: Unequal blur - possible for the patient to identify the letters correctly, when they are actually guessing.

- **Lea Symbols Test**
  - Developmental ages of two to five years old
  - Non-verbal patients.
  - The test is performed at 10 feet
  - Contains four symbols (circle, square, house and apple)
  - The child matches each symbol at distance to a companion card at near
  - **Advantage**: All the symbols blur out evenly to circles, reducing the likelihood of the patient guessing each symbol correctly.
  - Also available in a near visual acuity test.

- **Broken Wheel Test**
  - Developmental ages of three to six years
  - Landolt C symbol replaces the wheels of the car
  - Performed by placing two pictures side by side.
  - One picture has complete wheels while the other picture has sections missing
  - The child is asked to point to the car with the "broken wheel".
  - **Advantages**: Highly sensitive to detect subtle differences between the two eyes due to amblyopia or refractive error.

- **Tumbling E Test**
  - Developmental age beginning at four to five years.
  - Performed at 20 feet
  - The child must tell the orientation of the legs of the letter "E" (up, down, left, right)
  - **Advantage**: Helpful for non-verbal children
  - **Disadvantage**: May pose a problem to children who have issues with laterality and directionality.

- **Cardiff Cards**
  - Vanishing optotypes.
  - The targets disappear at the patient's resolution limit.
  - The cards contain pictures of a house, car, fish, train, dog and duck.
  - They are seen in an up down rather than a right left separations.
  - Easier to distinguish in cases of congenital nystagmus.
  - Does not use a peephole as in Teller acuity.

- **Optokinetic Nystagmus (OKN)**
  - Used to verify if the patient possesses a cortical visual response.
  - Developmental ages between 18 months and seven years
  - Requires little to no effort by the patient.

- **Visual Evoked Response/Potential**
  - Electrodiagnostic testing is very precise way to quantify the patient's visual acuity.
  - With Visual Evoked Response (VER), a scalp electrode is used to record electrical signals from the visual cortex while the patient views a grating or checkerdboard stimulus.
Stereo Testing

- Evaluate the degree and presence of stereopsis
- Suppression check (R-L)
- Local/Contour Stereopsis
  - Wirt circles, Titmus stereofly and animals
  - Differentiate similar targets that are laterally displaced
  - Contour-monocular cues
  - Helps differentiate if peripheral stereopsis is true stereopsis
  - What should we shoot for?
- Global Stereopsis
  - Random dot stereopsis
  - Helps to determine if peripheral stereopsis is present
- What should we shoot for?

Stereo Vision

- Lang Stereo Test
  - FOE frequency is disparity, ranging from 600 to 200 arc seconds
  - Patients must be able to perceive, or discern, the location of the objects
- Random Dot E Test
  - Measures global stereopsis
  - Different distances to examine different disparities
  - Useful for nonverbal patients or those with expressive aphasia

Visual field testing

- To uncover gross peripheral defects, and areas of constriction or neglect
  - The practitioner should be in front of the child observing their visual response and holding a target approximately 60 cm away
  - The practitioner will need another assistant to stand behind the child and present another toy (hand puppet) at a set distance
  - This toy and the assistant must not make any noise
  - The practitioner observes the patient and detects the stimulus should be noted

Refractive Error Assessment

- General Hints
  - Objective measurements
  - Static retinoscopy
  - Performed out of the phoropter
  - Using lens racks and plus spectacles (+1.50D to +2.00D) to fog the patient
  - Better idea of the patient's fixation and a better chance of holding their attention
  - Getting the patient to fixate in the distance may be a difficult task. The use of musical toys, bubbles and video players with cartoons may alleviate this problem
  - Near retinoscopy
  - The patient to focus on the retinoscope light monocularly at 50 cm
  - The test is performed in complete darkness
  - The child may be occluded by a patch or the parent's hand
  - Add -1.25D to the gross sphere power obtained if child is 18 months or older
  - Add -0.75D to the gross sphere power obtained if child is 18 months or younger

- Autorefraction
  - Should not be used as gospel
  - Used to confirm the results from retinoscopy
  - Proper fixation in order to gather measurements
- Keratometry
  - Used to confirm the amount and axis of the corneal astigmatism
  - Integrity of the cornea appearance of the mires

- Cycloplegic retinoscopy
  - Useful in patients with fluctuations in their accommodative system
  - Cyclopentolate-cycloplegic refraction
  - Tropicamide-wet refraction
  - Two drops of cyclopentolate (0.5% for infants and 1% for older children), five minutes apart
  - Refraction should be performed 30 minutes after installation of the last drop
  - Avoid over dosage in children with Down's syndrome, cerebral palsy and other central nervous system disorders
Measuring intraocular pressure

• **TonoPen**
  - Small, handheld
  - Multiple, quick measurements of IOP
  - Useful for patients in wheelchairs.
  - Disadvantages
    - Anaesthetic is required

• **Non-contact tonometry (NCT)**
  - Useful for patients who are uncomfortable with drop installation and having their eyes touched.
  - Stationary or portable
  - Prior to taking a reading, demonstration of the puff of air on the patient’s hand should be done.
  - Patient anxiety can be reduced by saying phrases such as “It’s going to give you a kiss.”

• **Goldmann applanation tonometry (GAT)**
  - Gold standard
  - Disadvantages
    - Anaesthetic prior to use
    - Patient must hold and steady their head
    - Need to get very close and touch the patient's eye
  - Digital tension estimation
    - When all else fails!
    - Reliable means of obtaining IOP. Ficara et al.
    - Pressure should be recorded as “soft to touch,” “medium to touch,” or “hard to touch.”

A good introduction!

Thank You

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