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
  - Explore the Botanic Gardens
  - Enjoy Shelby Farms Park
  - Tour Memphis Museums
  - Walk the Mississippi River
  - Get a library card
  - Visit your child’s elementary school

DEMANDS ON STUDENTS

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

- 1950
  - No kindergarten
  - No computer
  - Small number of kids in a class
- 1985
  - Kindergarten
  - One computer for each room
  - 30 kids in a portable classroom
- 2003
  - At least one computer in every classroom
  - Computer lab
  - For many children: Summer reading program
  - Career in 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 5 watch an average of about 3 hours of screen media a day, primarily TV and videos or DVDs
- Kids aged 5 to 8 years spend more than 4 hours a day in front of a TV screen and almost 2 additional hours on the computer (outside of schoolwork) playing video games
- 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

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**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>

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**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

Motor Fusion

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

Motor Fusion
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

Motor Fusion

Worth Four Dot
- Stereo tests
  - Lang
    - No filter glasses required
    - Change orientation of target to be sure response is valid
    - Test for disparities of 350”, 400”, and 450” with car, star, and cat.
    - Page 2 has images of 200”, 250”, and 300”. Star is never necessarily observed.
    - Stereo Fly and
      - Three plates - 6mm, 3mm, and 1.5mm.
      - Different distances to further vary the disparity cues.
      - Stereo acuity measurement in the range 600-20
  - Frisby Stero Test
    - 2-4 years of age
    - Three plates - 5mm and 1.5mm.
    - Slight distance to further vary the disparity cues.
    - Stereo acuity measurement in the range 600-20
  - Random Dot E
    - Tests for 500-52 seconds of arc by variations in the testing distance.
    - Standard scale (20/20 minimum)
    - New Low Vision Random Dot E version permits resolution to 20/200 acuity.

Sensory Fusion
- Stereo tests
  - Stereo Smile
    - Forced choice test
      - Page 1: 720 minutes of arc cards
      - Page 2: 2, 480 and 240 minutes of arc cards
      - Page 3: 480, 240, 120 and 60 minutes of arc cards
  - Randot Preschool Stereo
    - Three pages in one booklet:
      - Page #1: 200 and 100 seconds of arc
      - Page #2: 60 and 40 seconds of arc
      - Page #3: 800 and 400 seconds of arc

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

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)

Refraction

- 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

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>

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 Laubin-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 paint brush.
• 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
  • Near card for matching
  • 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.
    • Reduces 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
    • High sensitivity
    • Detects differences between the two eyes due to amblyopia or refractive error.
Visual Acuity Assessment

• **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.
  - The targets are in an up/down rather than a right/left separation.
  - Useful for children with congenital nystagmus.
  - Does not use a peephole as in Teller acuity.
  - The practitioner does not know the position of the target.
  - Credit for a particular acuity level.

• **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.
  - The drum is spun slowly and the examiner observes the patient's eye movements as they follow the rotating dots.
  - The patient should exhibit a nystagmus movement.

• **Visual Evoked Response/Potential**
  - Electrodiagnostic testing is a 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 checkerboard stimulus.

Stereo Vision

• **Lang Stereo Test**
  - Measured in arc seconds, ranging from 60 to 200 arc seconds.
  - Polarized spectacles are not needed.
  - Patient must be able to point to or describe the location of the objects.

• **Random Dot E Test**
  - Measures global stereopsis.
  - Different patterns on each eye eliminate 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 stands to the front of the child observing the visual response and holding a target (puppet or another moving toy).
  - The practitioner may stand further to close behind the child and observe whether toy (food) pops up in area of interest.
  - Observe, and the patient must nourish any areas.
  - The position where the patient first detects the stimulus should be noted.
Refractive Error Assessment

- **General Hints**
  - Objective measurements

- **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

- **Mohindra near retinoscopy**
  - The patient fixes on the retinoscope light monocularly at 50cm
  - 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 is required 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
- Retinoscopy should be performed 30 minutes after installation of the last drop
- Avoid over dosage of 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
    - Must hold proper fixation and posture
    - Patient may be too young or disabled to reach the patient’s eye

- **iCare Tonometer**
  - Eliminates the need for drops
  - A very light probe is used to make momentary contact with the cornea

- **Digital tension estimation**
  - When all else fails
  - Reliable means of obtaining IOP
  - Pressures should be recorded as “soft to touch,” “medium to touch,” or “hard to touch.”
A good introduction!

Thank You

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