Vision Acuity, Binocular Single Vision and Other Sensory Vision tests in Children

Vasiliki Follidi
Children's world
i. Vision Acuity
Definition

- **Ability** to resolve detail
- **Measurement of ability**: VA tests
- Smallest retinal image
- **Visual Angle**: angle subtended at the nodal point

<table>
<thead>
<tr>
<th>Visual Angle</th>
<th>VA</th>
<th>VA</th>
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</thead>
<tbody>
<tr>
<td>1'</td>
<td>6/6</td>
<td>10/10</td>
</tr>
<tr>
<td>2'</td>
<td>3/6</td>
<td>5/10</td>
</tr>
<tr>
<td>10'</td>
<td>0.6/6</td>
<td>1/10</td>
</tr>
<tr>
<td>20'</td>
<td>0.3/6</td>
<td>1/20</td>
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</table>
Prerequisites

- Anatomical changes (up to 2-3y)
- Neurological connections (visual pathway up to striate cortex)
- Functional changes (throughout life)

Nature maturation with growth
(Brown & Yamamoto, 1986) or Nurture environmental stimuli?
(Smith et al, 2007)
Why to assess?

- Early detection \( \Rightarrow \) VA = prevention & treatment “critical plastic period”
- Ocular disease
- Significant refractive error
- Amblyopia

Visual disorders:

Leading cause for childhood disabilities
Development

- Rapidly developing VA during 1 year up to adult level (~ 5-6 years).

Dramatic changes in eyeball size & orbital position.
Types

Weymouth classification:

- Minimum detectable (visible)
- Minimum separable (resolution)
- Minimum cognizable (recognition)
- Minimum discriminable (hyper acuity)
Factors affecting VA “score”

- Refractive status
- Ocular health
- Tests targets used (illumination, contrast etc)
- Test conditions
- Pupil size
- Cognitive ability
VA tests

- Indirect - Direct

ALL RIGHT, NOW COVER THE OTHER EYE, AND TELL ME WHICH WAY THIS "E" IS POINTING...THIS ONE?
- **Historical / observational**

- **Pupillary response**
  >29-31wGA

- **Popping eye**

- **Binocular fixation preference**

- Blink to bright light (30wGA)
- Blink to threatening gesture (5m GA)
• CSM method

★ C: corneal light reflex
★ S: steadiness of fixation
★ M: maintain alignment

- CSM 6/9 - 6/6
- CSNM 6/36 – 6/60
- Unsteady central fixation <6/60
- Fixation targets

- 10 Pd (base up or down) Fixation Preference test

fix & follow reflex by 6w
VA tests

- Indirect - Direct: ★ Detection
  ★ Resolution
  ★ Recognition
• Non & Pre – verbal
  🌟 Birth - 3y

• Verbal
  🌟 Preschoolers 3-5y
  🌟 School going
Detection acuity

- Dot VA test
  - Smallest identified (touched)

- Boek candy bead test
  - If picks up small sweet at 33cm
    VA at least 6/24

- Catford – drum test (OKN)
  - Smallest dot evoking PEM
Resolution acuity

- Optikokinetic nystagmus
  - 1st technological approach
  - Slow pursuit phase - fast saccade
Resolution acuity

- Forced choice preferential looking test
  - Infants tend to fix to a pattern:
    - Teller cards
    - Cardiff cards $>18\text{m}$
Resolution acuity

- Visual evoked potentials
  - Change of electrical occipital lobe responses
  - Only objective technique beyond retinal ganglion cells
  - Types:
    - Flash
    - Pattern reversal
  - 6/120 at 1st month, 6/6-6/12 at 6-12th m
🌟 Recognition acuity

- Marble game test
- Worth ivory ball test
- Coin test
- Miniature test
- Sheridan ball test
Recognition acuity (preschoolers)

- Flooks symbol test
- LEA symbols

Oliver Flooks 1964

Crowding & confusing
Recognition acuity (preschoolers)

- Kay pictures
- Allen test

★ Based on Snellen principle
★ From 6/60 to 6/6
Recognition acuity (preschoolers)

- Broken wheel test
  - Identify broken
  - 8 pair of cards 20/20-20/120

- Landolt 'C' chart
  - Broken circles
Recognition acuity (preschoolers)

- Sheridan letter test

- Distance: 6 & 3 meter
- HOTVX(Lippmans) / A&U
Recognition acuity (preschoolers)

- Illiterate E - cut out test
- Tumbling E

- Match a cut out E
- Siogren replaced E
Recognition acuity (school going)

- Tumbling E
- HOTV chart
- Snellen's chart
- Logmar chart
  - 1862 Snellen
  - Distant central VA

  - 1916 Bailey and Lovie
  - Logarithm of the minimum angle
  - Low vision- amblyopia
ii. Contrast Sensitivity

- Ability to see objects not outlined clearly or not stand out from their background.
CS Tests

- Infants, toddlers
  - Cardiff acuity cards
  - Lea symbol
  - Hiding Heidi
- Schoolgoing
iii. Color Perception

- Ability to **distinguish** objects based on the **wavelengths** (or frequencies)

- Trichromatic vision.
CP tests

- Ishihara color test (red - green)
  Hardy, Rand, Rittler test (blue - yellow)

- Preschoolers

- Schoolgoing

⭐ Nagel's anomaloscope  ⭐ Munsell Color Chart
iv. Peripheral Vision

- Visual fields
PV tests

- Confrontation test
  Count and a white ball

- Hemispheric perimetry

- Arc perimetry

- Goldman perimetry
v. Binocular Single Vision
Definition

- Separate & slight dissimilar as single image
- Hallmark of retinal correspondence
Why to assess?

- Abnormal BSV

🌟 Sensory adaptation

Confusion – diplopia

Suppression

Exendric fixation

Abnormal ARC

🌟 Motor adaptation

Head tilt

Chin up

Face turn
Prerequisites

- **Motor mechanisms:**
  - Direct visual axes
  - Overlap of visual fields

- **Sensory:**
  - Equal VA
  - NRC
  - Normal visual pathways

- **Mental process**
  - Visual cortex ability to promote BSV

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Cyclopean Eye
Development

- 1-3 months: superimpose images
- Begins at 3-4 months
- 3-6 months: stereopsis
- Peaks: 2 years
- Well developed: 4 years
Grades

Worth's classification:

☆ Simultaneous perception

☆ Fusion:
  a. sensory
  b. motor

☆ Stereopsis
BSV tests

- Before any test:
  - VA
  - Squint? Direction & size
Children < 5y

🌟 20 prism diopter test

<table>
<thead>
<tr>
<th>Age</th>
<th>Prism Diopter</th>
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<tbody>
<tr>
<td>6 months</td>
<td>10 Δ base out</td>
</tr>
<tr>
<td>18-12 months</td>
<td>15 Δ base out</td>
</tr>
<tr>
<td>&gt;18 months</td>
<td>20 Δ base out</td>
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</table>
- Preschoolers / Schoolgoing

- Synoptophore

- Simultaneous perception
- Fusion with some amplitude
- Stereopsis
Worth four – dot test

Bagolini striated glasses
Stereoscopic tests

a. Qualitative:
   - Lang's two pencil test
   - Synoptophore

b. Quantitative:
   - Titmus Fly test
   - TNO test
   - Frisby test
   - Lang's Stereo test
TAKE HOME MESSAGE

- Visual function: sensory, motor, perceptual

- Functional Vision Assessment
  
  ✨ VFA – K test: Visual concentration, VA, CS, CP, Visual field, Binocular cooperation, Perform saccades, Coordination eye-hand ...

- AOA Recommendations
Thank you