Hearing & Vision Screening ©

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Rationale

• Early Identification

• Rule out hearing or vision loss prior to ERP testing

• Use average hearing threshold as a covariate if hearing is WNL
Statistics: Hearing

- Hearing loss affects 17/1000 in children under 18
- 2-3/1,000 children are born deaf or hard-of-hearing
  - 3-6% of these children have Usher syndrome
- 3/4 children experience ear infection (otitis media) by the time they are 3 years old
  - (NIDCD)
Types of Hearing Loss

- Sensory-Neural
- Conductive
- Mixed
Speech and Spoken Language Development

Birth to 3 months of age:
- Begins to localize or turn towards interesting sounds
- Appears to "listen" (makes eye contact during P⇔C)
- Awakens more easily to environmental sounds
- Crying, comfort, and vegetative sounds

3 - 6 months of age:
- Localizes sounds more accurately
- Starts to understand a few words such as “no”, “bye-bye”, or “so big”
- Starts to imitate some sounds
- Begins to babble (limited by size, shape of oral cavity and oral-motor control)
Speech and Spoken Language Development

6 to 12 months of age
- Reduplicated babbling and jargon; some protowords
- Understands many single words, especially if referent is present
- Communication signals are clearly intentional, aimed at achieving specific goals

12 months of age
- First meaningful words mixed with protowords
- Starts to understand numerous single word and some 2-word utterances, especially in familiar routines
- May start to use 2-word utterances
- Jargoning with conversational intonations may continue to 18 months
Speech and Spoken Language Development

- **12 -24 months**
  - p, b, m, w, h sounds and most vowels
  - One and 2-word utterances
    - Names of objects and people
    - Actions, a few state verbs
    - “more, again, no X”
    - “please, thank-you”
    - Some locations
  - Takes 1-2 turns in conversation

- **24-36 months**
  - 2-3 word utterances
  - Combines words previously used in 1-word utterances
  - Takes 2-3 turns in conversation; some primitive narratives
Risk Factors for Hearing Loss

- Family history of hereditary childhood sensorineural hearing loss.
- In-utero infection (e.g. cytomegalovirus, rubella, syphilis, herpes, or toxoplasmosis.)
- Craniofacial anomalies, (e.g. abnormalities of the pinna and ear canal.)
- Birth weight less than 1500 grams (3.3 lbs).
- Hyperbilirubinemia at a level requiring exchange transfusion.
- The use of ototoxic medications (e.g. aminoglycosides, and aminoglycosides with loop diuretics.)
- Bacterial meningitis
Risk Factors for Hearing Loss (cont.)

- Postnatal asphyxia
- Other diseases and syndromes associated with hearing loss (e.g. measles, Down syndrome)
- Mechanical ventilation lasting 5 days or longer.
- Parent or caregiver concern about hearing, speech, or language development or developmental delay.
- Head trauma associated with loss of consciousness or skull fracture.
- Recurrent of persistent otitis media with effusion for at least three months.
Pure Tone Screening

- Test frequencies: 500, 1000, 2000, & 4000 Hz
- Intensity Level: 20 dB (assuming a quiet room)
- Duration: 3 Seconds / frequency
- Response Method: Hand raise
- Who: Children 3 years old and up
- Refer Criteria: Failure to hear any one frequency in either ear.
Hearing Threshold Testing

- Test at 250, 500, 1000, 2000, 3000, 4000, 6000, and 8000 Hz
- Start at 1000 Hz; sweep up from 0 dB to when child hears it (raises hand).
- Use “down 10 dB, up 5 dB” to establish lowest level at which person hears tone 2/3 times.
- For other frequencies, start at 0 dB; increase in 10 dB increments until person responds; use “down 10, up 5 rule” to establish threshold
- What is “normal?”
Audiogram

The audiogram divided according to degree of hearing loss:

- **Normal**
- **Mild**
- **Moderate**
- **Severe**
- **Profound**

For normal speech at a sound pressure level (SPL) of 65 dB, 90% of speech sounds exceed the levels of curve A and 10% of speech sounds exceed the levels of curve B. Thus, 80% of normal speech falls between curves A and B.

“Speech banana”
SPL vs HL

- **SPL = Sound Pressure Level**
  - Measured according to ANSI standards

- **HL = Hearing Level**
  - In relation to the individual’s hearing threshold
  - If threshold at 1000 Hz is 20 dB and you introduce a sound at 75 dB SPL, it will be at 55 dB HL
  - Auditory stimuli needs to be comfortably well above the threshold (e.g. 75 dB SPL is normal conversational loudness, assuming normal threshold), but not uncomfortably loud (85 dB or >)
Hearing Loss

Mild hearing loss (26-45 dB)

- One-on-one conversation audible if speaker’s face can be seen or he/she is close
- Difficulty hearing & understanding soft or distant speech
- Difficulty understanding conversation in noisy backgrounds

*For young children who are learning speech and language, even a mild hearing loss can have serious effects on speech and language development.*

Moderate hearing loss (45-65 dB)

- Conversational levels of speech are difficult to hear and understand, even in quiet backgrounds.
- Extreme difficulty listening in noise
Hearing Loss

Severe hearing loss (66-85 dB)
- Difficulty hearing in all situations
- Speech may only be heard if a speaker is talking loudly or at close range

Profound hearing loss (>85 dB)
- Person may not hear even loud speech or environmental sounds
- May not use hearing as a primary method of communicating
Sound Level Meter

- Used to determine the SPL of the auditory output (through speaker) in the testing environment
- Place SLM where person’s vertex will be
  - Vertex vs. ear level placement
- Set meter
  - Instant vs. Max hold
  - Frequency weighting: A vs C
  - Time weighting: F vs S
A- vs. C-Weighting for Frequency

A-, B-, and C- Weighting Functions

Relative Response, dB

Frequency, Hz

A-Weighting
B-Weighting
C-Weighting
Other Types of Hearing Screening

- Screening Tympanometry
- Auditory Brainstem Response (ABR)
- Oto-Acoustic Emissions (OAE)
Vision Screening
Signs of Vision Loss

A child with vision loss might:

- close or cover one eye
- squint the eyes or frown
- complain that things are blurry or hard to see
- have trouble reading or doing other close-up work, or hold objects close to eyes in order to see
- blink more than usual or seem cranky when doing close-up work (such as looking at books)
- One eye of a child with vision loss could look out or cross. (CDC)
Development of Vision

- By 12 months
  - Looks at small objects
  - Recognizes familiar objects across the room
  - Looks at pictures in books
  - Follows rapidly moving object

- By 24 months
  - Fixates on small objects
  - Points to distant interesting objects
  - Recognizes fine detail in pictures
  - Exhibits well-established convergence

- By 36 months
  - Copies a circle
  - Makes smooth convergence with eyes
Prevalence of vision loss

- 7-8.2% of all children have a visual impairment (includes all refractive errors)
- 3-4% have visual impairment due to amblyopia

Causes of Visual Impairment

- Amblyopia
- Cataracts
- Cortical Visual Impairment
- Infantile Glaucoma
- Infections
- Malformations
- Ocular-muscle problems (e.g. *strabismus, nystagmus)
- Ocular trauma
- Optic nerve defects (e.g. Optic atrophy)
- *Refractive errors
- Retinoblastoma
- Retinopathy of Prematurity

*American Academy of Ophthalmology lists these as the top 3 concerns
# Eye Exam Guide

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Eye Examination Frequency</th>
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<tbody>
<tr>
<td><strong>Infants (birth to 24 months)</strong></td>
<td>By 6 months of age</td>
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<tr>
<td>§ By the age of 3 to 4 months an infant's eyes should focus on small objects</td>
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<tr>
<td>§ Infants eyes should appear straight or parallel.</td>
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<td>§ At six months, infants should be able to focus on both distant and near objects.</td>
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<tr>
<th>Pre-school Age (2-5 years)</th>
<th>At ages 3 and 5</th>
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<tr>
<td>Instead of a standard eye chart, the doctor uses pictures to measure visual acuity. To detect differences in focusing power, a child only needs to look briefly at an object. These, and other tests, require very little input from the child.</td>
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<th>School Age (6-19 years)</th>
<th>Annually</th>
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<td>By this age, the examination is very similar to that of an adult. If properly approached, children should respond to examination techniques with the same reliability as an adult.</td>
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Vision Screening: Familiar Objects

- Allen object recognition chart
- Child points to or states where objects are located while looking with one or both eyes.
Symbols Test

- Point to the first symbol in the line
- Move down until child hesitates or misidentifies a symbol
- Move back up one line and ask child to identify all symbols in one line of symbols
- If the child identifies all the symbols correctly and ask child to identify all symbols in one line (a child with an ambliopic eye may typically skip a symbol in the line)
- If the child skips a symbol, ask them to try again while briefly pointing to the symbol

Lea Chart (10 feet)

Pass: 10/20 or better without a 2-line difference (3-4 yrs); 10/15 (5 yrs)
Instructions for Symbol Test

- Visual acuity is recorded as the last line on which at least 3 of the 5 symbols are identified correctly.
- When tested at 3 meters (10 feet) the visual acuity value is found in the margin adjacent to that line.
- When testing monocularly, use the first symbol of each line or every second line for one eye and the last symbol of each line for the other eye to determine on which line to start testing.
Snellen Chart

- The chart is usually read while standing at a distance of 20 feet.

- Acuity is represented as a fraction.
  - Numerator = The distance at which you are standing
  - Denominator = The normal maximum legible viewing distance

- If, at 20 feet, you read the letters on the row marked "40", you have visual acuity of 20/40 or better.
Tumbling E Chart

Examiner says, “Please tell me or point in the direction the open part of the E is facing. Start on the top row and go from left from right.

Stop testing when child misses 2 or more numbers on a line, 2 lines in a row.

http://www.cdc.gov/nchs/data/nhanes/nhanes_03_04/VI.pdf
Eyelid and Orbit Examination

Examine eyelids and orbits for:

- Function (e.g. ability to open both eyes).
- Asymmetrical prominence of one eye compared with the other
- Masses such as hemangiomas
- Craniofacial abnormalities involving the orbital bones

*Neonates and young infants generally will open their eyes when held upright or leaned slightly forward.*
External Examination

- Use a penlight to examine: conjunctiva, sclera, cornea, and iris.

- A cloudy or asymmetrically enlarged cornea may be a sign of congenital glaucoma.

- The pupils should be equal, round, and reactive to light on both sides.
Ocular Motility, Muscle Balance & Visual Acuity

- Move an interesting toy up, down, and from side to side to determine whether the eyes see together.
  - Although young infants (<3 months) may not be able to do this, older infants should do so readily.

- **Unilateral Cover Test**
  - If the child will follow an object with one eye covered but protests when the examiner attempts to cover the other eye for the same purpose, poor visual acuity in the opposite eye may be suspected.
References

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  - [http://www.cdc.org](http://www.cdc.org)
  - [http://www.aaoo.org](http://www.aaoo.org)
  - [http://www.asha.org](http://www.asha.org)

- **Auditory System & Statistics**
  - [http://www.earaces.com/anatomy.htm](http://www.earaces.com/anatomy.htm)
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- **Speech and Language:**

- **Vision Tests:**
  - [www.mdsupport.org/snellen.html](http://www.mdsupport.org/snellen.html)

- **Acoustics**