Evaluation of Eye Movements
Vision Science III
Spring 2007

Reading: Chapters 8 and 9 Eye Movement Basics for the Clinician

In Clinical Setting;

Evaluation of Fixation Movements:

Gross observation: essentially just descriptive, very hard to quantify.

- Fixation should be tested at distance and near. (Remember how convergence helps nystagmus).
- Target should hold accommodation level, a muscle light or a Snellen letter slightly above acuity level. At near a Snellen letter is held at midline at 40cm and in children closer for their shorter working distance.
- Testing should be done both monocular and binocularly. Use complete occlusion to reveal maximum of fixation disorder.
- Check fixation in the cardinal fields of gaze. Look for over action or under action revealing muscle disorders.. Remember other fixation tests that have a subjective component on the patient's part, red lens, Maddox rod test. These are difficult to use on some children.
- Watch for null points in nystagmus.

External Photography: New digital cameras allow for video and still photos of eyes. These can be used to education patient and family on disorders.

Slit Lamp Observation or Video recording:

- Illumination and Magnification can be controlled
- .
- Use fixation light to control gaze
- Torsional movement can be observed using a physical landmark such as vessel or freckle
- Can observe fixation abnormality and see if nystagmus or saccadic intrusions

Direct Ophthalmoscopy (visuoscopy) and fundus photography :

- Should be done monocularly, occlude non fixating eye.
- View the grid to note fixation
- Do not dazzle macula and create abnormal fixation, keep illumination low
- Try to do nondilated or with Neosynephrine to avoid changes in nystagmus level
- The foveal reflex will shift in the opposite direction to the eye movement
- To calculate your expected acuity with this:

  MAR (minimum angle of resolution)= EF(PD) +1
  1/MAR = VA snellen
  VA= 1/MAR
  20/X= 1/ EF +1 so if the
  EF is 2PD, the VA is 20/60

Expect the acuity loss to equal near to this calculated value, if not pathology could be present..

Keratometetry:

- Observe the mires, remembering that the movement is opposite of what is seen.

Clinical Evaluation of Saccades:

Very difficult to do by simple observation. Remember developmental ability of patient when evaluating results.

Gross Observation:

Two fixation targets are used equidistant from the patient's midline at 40cm. If desired move the targets closer to look at smaller saccades. Vary the timing of the saccadic response to prevent prediction unless wanting to show this in Parkinson's. Do horizontal, vertical, oblique, both monocular and binocular. May be assessed with clear Plexiglas with numbers or letters.

Look for errors in dysmetria, latency and velocity.

If no neurological cause is noted, Use the NSUCO Oculomotor test to evaluate the pursuits and saccades.

Box 9-2,9-3,9-4 and video

Auxiliary Tests:

King-Devick and Pierce Test: Patient names sequence of digits arranged in various degrees of complexity.
Fig 9-5
Patient reads numbers aloud from left to right and line to line. Results are scored with respect to total test time and error. King-Devick has more comparative data and more range in difficulty. If the patient has trouble in naming numbers, this can affect the results.

The Developmental Eye Movement Test…(DEM) First tests the patients ability to read numbers aloud. Then assesses the saccade.

These tests do not assess the eye movement components such as latency, accuracy and dysmetria but assesses the saccadic tracking performance in complex tracking. Task with identification involved….is this more like reading?

Pursuit Testing:

Gross observation:

Remember that saccades take on over when the pursuits are faulty.

Select target velocity and movement.

Begin at 40 cm with target at midline, alternate cycles in each meridian. Moving about 2 1/2 inches each way at a speed of about 2 seconds a cycle.

Test 3 to 5 cycle s in each meridian.

Test slowly, going too fast will kick into saccades.

Watch for smoothness.
Note scoring test from SCCO
Can use the NSUCO test

Table 9.2

VOR/OKR System

Gaze stability during fixation:

- Vestibular nystagmus increase in the absence of a fixation target.
- Note nystagmus with fixation, have patient close eyes and see cycle through the lids. Increase in nystagmus indicates a vestibular problem.
- With a pair of high magnifying lenses blurred vision should increase the nystagmus. Magnification with these lenses helps the clinician view the motion.

Head rotation during fixation:

- Patient fixates binocularly on a visual acuity chart, the head is rotated horizontally and vertically. Note the ability to hold fixation as head is rotated.

- This can also be monitored by using the direct ophthalmoscope to observe the optic nerve as the head is rotated.

Optokinetic Drum or tape:

- Patient views the repetitively moving target at a moderate speed.
- Allow 30 seconds for response to build
- The OKN response will be present in hysterical blindness but absent in blindness
- It indicates with use of the Drum approximately 20/200 vision.
- Tests the OKN and pursuit systems in young and non verbal patients
- May invert a congenital nystagmus

Clinical Research Environment

Electrooculography: EOG

DC Electrooculography uses the electronic difference between the cornea and the retina to measure movement by measuring change in the electric field potential. Electrodes are attached at the horizontal temporal region and with a common nasal electrode attached above the nose. A ground is placed above the earlobe. If the movement is not conjugate, electrodes would be placed nasally and temporally for each eye.

The Good:

- It can measure up to +/-70 degrees of movement. This is of benefit when muscles need to go to their limits to maximize the defects shown by paresis.
- Easy to sets up
- Can assess both horizontal and vertical eye movements
- Does not require bulky instrumentation attached to the head or blocking the eyes
- Spectacles can be worn if needed

The Bad:

- Other electrical signals from blinking, facial muscles may interfere
- System resolution is no better than 1 degree, so some jerk nystagmus and saccadic intrusions may not be seen.
- Signal is influenced by changes in light adaptation that might occur during either step changes in overall ambient room or test field illumination or by occluding an eye.

So have clean skin, all illumination in field and test should be constant for 10 minutes to stabilize the retinal activity. Patient needs to be comfortable to prevent unwanted signals from head and neck muscles.

Infrared Limbal Reflection:

- Other names for this technique include photocell, photodiode, photoelectric, scleral reflection, and limbal tracking system
- Low wattage infrared source illuminates the exposed surface of the eye. Sensors aimed at these areas pick up differences in reflected light, which creates a signal.
- Resolution is 0.25 degrees
- Can be use to +- 20 degrees of gaze
- Eye lid interference may interfere with vertical movement recordings
- M any models are available such as the Eye Trac and The Visagraph

Electromagnetic Search Coil

- Fine wire Coils are embedded in a soft annular contact lens worn by the patient. The patient is surrounded by large electromagnetic coils and voltage changes related to the horizontal, vertical and cyclorotary eye positions.

Low noise, high resolution but poor comfort.