Appendix A

A Summary Scheme for the Bedside Ocular Motor Examination with Video Examples of Abnormal Responses

Although the order and specific details of testing may be modified according to the nature of the clinical problem, systematic examination of each ocular motor subsystem is worthwhile, particularly in evaluating signs such as nystagmus. Here we outline a scheme for examining eye movements, providing video examples of abnormal findings for certain tests. The technical details of each step in the ocular motor examination are described in the respective chapters. The reader should note that ocular motor signs are rarely diagnostic touchstones; they require interpretation in the context of the history and full examination.

1. General Features
   a. Look for abnormal head postures, such as turns or tilts (see Video Display: Disorders of the Vestibular System), abnormal patterns of eye-head coordination—such as the head thrusts of ocular motor apraxia (see Video Display: Acquired Ocular Motor Apraxia), and head tremors (see Video Display: Congenital Forms of Nystagmus).
   b. Look for abnormalities of the lids including ptosis, retraction, lid nystagmus, lid-opening apraxia after forceful closure (see Video Display: Parkinsonian Disorders), and synkinesis (e.g., due to aberrant regeneration, such as Marcus Gunn phenomenon).
2. Examination of Vision
   a. Measure corrected visual acuity and check confrontation visual fields with each eye viewing.
   b. Check color vision (Hardy-Rand-Rittler or Ishihara plates), to screen for optic neuropathy (e.g., in patients with monocular pendular nystagmus or retinal abnormalities).
   c. Test stereopsis (e.g., Titmus Optical or Randot stimuli), especially when ocular misalignment is thought to be of early onset.
   d. Test pupillary reflexes to light and with convergence.
3. Range of Movement and Alignment of the Visual Axes
   a. Establish range of motion with ductions (one eye viewing) and versions (both eyes viewing) (see Video Display: Diplopia and Strabismus).
   b. Test ocular misalignment (in patients with diplopia or strabismus)
   - Confirm that diplopia is only present during binocular viewing
   - Subjective tests, such as the red glass, and Maddox rod (Fig. 9–11)
   - The cover test (Fig. 9–12) (see Video Display: Diplopia and Strabismus) for tropias
   - The alternate cover test (Fig. 9–13) (see Video Display: Diplopia and

Strabismus) for phorias. Measure deviation at both near and far, and in the nine cardinal positions of gaze.
- Quantify with prisms by nullifying the deviation as measured with alternate cover test (Fig. 9–13) or Maddox rod (Fig. 9–11).
- For vertical deviations, use the Bielschowsky head-tilt test (Fig. 9–14) (see Video Display: Diplopia and Strabismus), to diagnose superior oblique muscle paresis.

4. Fixation (using simple visual inspection, the ophthalmoscope, and Frenzel goggles)
   a. In primary position: Look for extraneous saccades (see Video Display: Saccadic Oscillations and Intrusions) and nystagmus.
   b. In eccentric gaze: Look for gaze-evoked and then rebound nystagmus (see Video Display: Disorders of Gaze Holding).
   c. Determine the position of the eyes under closed lids by noting corrective movements when the patients open their eyes (e.g., steady-state deviation of the eyes toward the side of the lesion in Wallenberg's syndrome) (see Video Display: Medullary Syndromes).
   d. In patients with nystagmus, the time in the cycle when the image of the target is brought to the fovea can be determined during ophthalmoscopy by having the patient fix upon the center of the ophthalmoscope cross hairs,
5. Vestibular
   a. Measure visual acuity (Snellen chart) before and during head shaking (horizontal and vertical) at a frequency of greater than 1 cycle/second.
   b. Look for corrective saccades during sinusoidal head oscillations at about 1 Hz and following brief but high acceleration head impulses, while the patient is required to fix upon a target straight ahead (see Video Display: Disorders of the Vestibular System).
   c. Using Frenzel goggles*, look for nystagmus after 10 to 15 seconds of brisk horizontal head shaking, then after vertical head shaking, (see Video Display: Disorders of the Vestibular System). In cases of suspected bilateral vestibular loss, look for nystagmus following circular head-shaking, in which case it should be absent.
   d. Using the ophthalmoscope, watch for abnormal movement of the retinal vessels or optic nerve head with the head still. Recall that the direction of horizontal or vertical motion of the retina is opposite to that of the front of the eye. For torsional nystagmus, the direction of the movement of the retinal vessels will change with looking to the right or left (it will be vertical) and with looking up or down (it will be horizontal). Alternately cover and uncover the other eye, to see if any drift of the retina is brought out or exacerbated by the removal of fixation. Watch for oscillation of the optic disc during small-amplitude head shaking (horizontal and vertical) at a frequency of greater than 1 cycle/second, to see if the gain of the VOR is correct. If the gain is too high, the disc appears to move with the head, if too low, opposite the head.
   e. Use positional maneuvers to elicit nystagmus. First use the Dix-Hallpike maneuver: the head is turned 45 degrees to the right or left, then the patient is brought to a supine position with the head just below the horizontal (Fig. 11–4); observe any nystagmus, preferably behind Frenzel goggles (see Video Display: Disorders of the Vestibular System). The patient is then brought back to the upright position; look again for nystagmus. The same maneuver is then repeated with the head turned 45 degrees in the opposite direction. Second, put the patient supine, look for nystagmus and then rotate the head to the right ear down, then straight back, then left ear

**Frenzel goggles* consist of 10- to 20-diopter spherical convex lenses that defocus the patient's vision (so preventing fixation of objects) and also provide the examiner with a magnified, illuminated view of the patient's eyes. An alternative is +20 diopter lenses mounted in a spectacle frame and fitted with side-blinkers. The room lights should be turned off and either the lights of the goggles or a pen light used to illuminate the eyes.

down positions. Each time wait for 10 to 15 seconds to look for nystagmus.

f. With Frenzel goggles or using the ophthalmoscope to observe for nystagmus, irrigate with small amounts of ice-water (less than 1 ml), always being careful not to allow the catheter to go too far in the external ear canal.

g. Rotate the patient in a swivel chair to elicit per-rotational nystagmus; when the chair stops, look for post-rotational nystagmus. Test responses in each plane of head rotation: horizontal (head upright), vertical (head tilted over 90 degrees, ear-to-shoulder), or torsional (head looking to the ceiling).

h. With Frenzel goggles, use the Valsalva maneuver (first against a closed glottis and then against pinched nostrils), tragal compression, and mastoid vibration to elicit nystagmus (see Video Display: Disorders of the Vestibular System).

i. With Frenzel goggles, look for nystagmus after hyperventilating for 30 seconds (see Video Display: Disorders of the Vestibular System).

6. Saccades
   a. Observe spontaneous saccades, saccades to visual or auditory targets, and saccades to command and rapid self-paced saccades. Note latency, velocity, trajectory, accuracy, and conjugacy (see Video Displays: Disorders of Saccades and Parkinsonian Syndromes).
   b. Assess quick phases induced by vestibular rotation or caloric stimuli, and a hand-held optokinetic drum or tape. During vertical stimulation, with stripes moving down, check for retraction nystagmus (see Video Display: Disorders of Vergence).
7. Smooth Pursuit
   a. Instruct the patient to track a small moving target smoothly, horizontally and vertically. Look for corrective saccades that indicate an inappropriate smooth pursuit gain. If the gain is low, saccades will be catch-up, if the gain is too high, saccades will be back-up (see Video Display: Disorders of Smooth Pursuit).
   b. Use a small optokinetic drum, tape, or mirror to bring out pursuit asymmetries, or "inverted" optokinetic nystagmus, as occurs with congenital nystagmus.
8. Eye-Head Coordination
   a. Assess head and eye movements (latency, accuracy, velocity) during combined, eye-head rapid (saccadic) refixations (see Video Display: Acquired Ocular Motor Apraxia).
   b. Test cancellation of the vestibulo-ocular reflex by asking the patient to fixate a target moving with the head. Look for corrective saccades (see Video Display: Disorders of Smooth Pursuit).
9. Vergence
   a. Test vergence to disparity stimuli (place a prism in front of one eye)
   b. Test vergence to accommodative stimuli: With one eye covered with a semi-opaque Spielmann occluder, the other eye alternately fixes upon the near and distant targets (Fig. 8–1 and Video Display: Disorders of Vergence).
   c. Test vergence to combined disparity and accommodative stimuli by asking the patient to fixate a target brought in along the mid-sagittal plane toward the nose (Video Display: Disorders of Vergence).
   d. Note pupillary changes during vergence movements.