SESSION V

EYE EXAMINATIONS: NYSTAGMUS, CONVERGENCE, PUPIL SIZE AND REACTION TO LIGHT

<u>SESSION V</u> **EYE EXAMINATIONS: NYSTAGMUS, CONVERGENCE, PUPIL SIZE AND REACTION TO LIGHT**

Upon successfully completing this session the student will be able to:

- State the purposes of various eye examinations in the DEC drug influence evaluation procedure.
- Describe the administrative procedures for the eye examinations.
- Describe the clues of each eye examination.
- Conduct the eye examinations and note the clues observed.
- Prepare complete, clear and accurate records of the eye examinations.

In this session, you will have an opportunity to observe demonstrations of the various eye examinations of the drug influence evaluation process. You will also have opportunities to practice administering those examinations.

The eye examinations include:

- Horizontal Gaze Nystagmus
- Vertical Gaze Nystagmus
- Lack of Convergence
- Pupil Size Estimation
- Pupil Reaction to Light

Horizontal Gaze Nystagmus (HGN).

As a review, we already know that HGN is an excellent indicator of alcohol impairment and will also disclose impairment by any CNS Depressant other than alcohol, Dissociative Anesthetics, such as PCP and its analogs and by most Inhalants. These three categories of drugs usually will cause HGN.

We check for three clues of HGN in each eye:

✓ Check #1: Does the eye track smoothly?

As a reminder, we start with a stimulus (pencil, pen, penlight, etc.) held vertically in front of the subject's face, above eye level and about 12 to 15 inches away from the subject's nose. Tell the subject to keep his/her eyes focused on the stimulus, to hold his/her head steady, and to follow the movement of the stimulus with their eyes only.

Check the subject's left eye by moving the stimulus to your right. Move the stimulus smoothly, at a speed that requires approximately two seconds to bring the subject's eye as far to the side as it can go. While moving the stimulus look at the subject's eye and determine whether it is <u>able to pursue smoothly</u>. Then move the stimulus all the way to the left, back across subject's face checking if the right eye pursues smoothly. Movement of the stimulus should take approximately two seconds out and two seconds back for each eye. Make at least two complete passes in front of the eyes to check for this clue.

While the eye is moving you should examine it closely for signs of "a lack of smooth pursuit". If a person is not under the influence of a CNS Depressant, Inhalant or a Dissociative Anesthetic their eyes should glide smoothly in the sockets, in much the same way that windshield wipers slide smoothly across the windshield when it is raining steadily. But if the person is under the influence of a CNS Depressant, an Inhalant or a Dissociative Anesthetic their eyes will usually jerk noticeably as they move, similar to a windshield wiper dragging across a dry windshield.

✓ Check #2: Does the eye exhibit distinct and sustained nystagmus when it is held at maximum deviation for a minimum of four seconds?

After you have checked both eyes for lack of smooth pursuit, check the eyes for distinct and sustained nystagmus at maximum deviation beginning with the subject's left eye. This is done by moving the stimulus to the subject's left side until the eye has gone as far to the side as possible. Usually no white will be showing in the corner of the eye at maximum deviation. Hold the eye at that position for a minimum of four seconds and observe the eye for distinct and sustained nystagmus. Move the stimulus all the way across the subject's face to check the right eye holding that position for a minimum of four seconds. Repeat the procedure. Someone under the influence of Depressants, Inhalants or a Dissociative Anesthetic usually will exhibit distinct and sustained nystagmus at maximum deviation. A slight, barely visible tremor of the eye **does not** constitute "distinct jerking" for our purposes.

Check #3: What is the angle of onset of the nystagmus?

When using HGN as a Standardized Field Sobriety Test of alcohol impairment, you determine whether the jerking of the eye begins prior to 45-degrees. As a DRE, you are going to have to be more precise than that. Within certain limits, it is important for the DRE to estimate the actual angle at which the jerking first begins. We need to do this because it gives us a clue as to whether the subject is impaired by alcohol alone, or by some combination of alcohol with another Depressant, an Inhalant or a Dissociative Anesthetic.

You should remember from your earlier training that some original research led to the development and validation of HGN as a Standardized Field Sobriety test for alcohol, and that we know that there is an approximate statistical relationship between blood alcohol concentration (BAC) and the angle of onset of nystagmus. The relationship is expressed by this formula:

BAC = 50 – Angle of Onset

According to the formula, if the angle of onset were 40 degrees, then the "BAC" would approximately equal 50 minus 40 or 10; that corresponds to a BAC of 0.10. If the onset angle were 35 degrees, the "BAC" would be approximately 15, for a BAC of 0.15.

It is important to always keep in mind that this formula expresses an average, approximate statistical relationship, **not a precise mathematical relationship**. Humans, and their eyes, do not all react to alcohol or other drugs in exactly the same way. The formula may be reasonably accurate for some people but much less accurate for others. The formula is **not** sufficiently accurate for us to use HGN to produce evidence of a specific BAC and courts routinely reject any attempt to do so. But the formula is of value to us as DREs because it can help us detect an evident gross disparity between the subject's BAC and the nystagmus observed.

For example, you are called in to evaluate a subject who has a BAC of 0.07. Based on that alone, you would expect to find the onset of HGN close to 40 to 45 degrees. But suppose you discover that the subject's HGN begins at about 30 degrees. That would be inconsistent with the BAC, and you would begin to think that this subject might also have taken some other Depressant, an Inhalant, or possibly a Dissociative Anesthetic.

Remember for DRE purposes, you will be expected to be able to estimate angle of onset to the nearest 5 degree increment, over the range from 30 degrees to 45 degrees. If the subject's eyes begin to jerk before they have moved to the 30 degree angle, you will not attempt to estimate the angle precisely and will record that the subject exhibits "immediate onset". But from 30 degrees on out, you will record a numeric estimate of onset, i.e. 30 degrees, 35 degrees, 40 degrees, or 45 degrees.

To determine the angle of onset, position the stimulus about 12-15 inches from the subject's nose and slowly move the stimulus toward your right. Watch the left eye closely for the first sign of jerking. When you think that you first see the eye jerk, stop moving the stimulus and hold it steady. Verify that the eye is jerking. If it is not, start moving it again to your right until you see the jerking begin. Once you find the point of onset of nystagmus estimate the angle to the nearest five (5) degrees. Repeat this procedure for the subject's right eye. One final point about the nystagmus onset angle, don't forget that there are many drugs that **do not cause HGN**.

Vertical Gaze Nystagmus (VGN)

From your earlier training you learned that Vertical Gaze Nystagmus, like HGN, is a jerking of the eyes. Vertical Gaze Nystagmus is an involuntary jerking of the eyes (up and down) which occurs as the eyes are held at maximum elevation.

Vertical Gaze Nystagmus is associated with the same drugs that cause Horizontal Gaze Nystagmus. High doses, for that individual, of Depressants, Inhalants or a Dissociative Anesthetic cause Vertical Gaze Nystagmus. Therefore, it is not uncommon to encounter subjects who exhibit HGN but do not exhibit Vertical Gaze Nystagmus.

To check for Vertical Gaze Nystagmus, hold a stimulus horizontally in front of the subject, about 12-15 inches in front of the subject's nose. Direct the subject to focus their eyes at a specific point on the stimulus. Instruct the subject to hold their head steady and to follow the stimulus with their eyes only. Elevate the stimulus until the eyes are raised as far as possible and hold them at that position for a minimum of four seconds. Observe the eyes closely to see whether any up and down jerking occurs. With Vertical Gaze Nystagmus, we do not attempt to identify an angle of onset: we simply record that Vertical Gaze Nystagmus is either "present" or "not present". There is no drug that will cause VGN that will not cause HGN.

Remember, the mere fact that Vertical Gaze Nystagmus is present does not guarantee that the subject is under the influence of some drug other than alcohol. Alcohol itself will cause Vertical Gaze Nystagmus, if the BAC is high for that individual. Also remember that there are many drugs that do not cause Vertical Gaze Nystagmus.

Lack of Convergence

You should recall from your earlier training that **Lack of Convergence** means an inability to cross the eyes. To check for Lack of Convergence, we first determine if the subject routinely wears eyeglasses during reading and near visual tasks. If so, ensure that the eyeglasses are worn by the subject for the check for Lack of Convergence, if they are

available. The role of clear vision and focusing can have a significant effect on the convergence of the eyes. In the clinical setting, the Lack of Convergence check is routinely conducted with the eyeglasses on if normally worn by the subject. To conduct the Lack of Convergence check, we position the stimulus approximately 12 to 15 inches in front of the subject's face in the same position we use for the HGN test. Inform the subject that you are going to move the stimulus around in a circle, then you are going to move it toward their face and that you will bring it in close to the nose. You will not touch the subject's nose with the stimulus. Make sure that the subject knows this in advance so that he/she does not become frightened during the test and jerk their head away. Instruct the subject to keep their head steady, and to follow the movement of the stimulus with the eyes only.

Start moving the stimulus in a circle in front of the subject's face either clockwise or counterclockwise, and observe their eyes to verify that the subject is tracking the stimulus. Then, slowly move the stimulus in toward the bridge of the nose.

The eyes should come together and cross (converge) as they track and stay aligned on the stimulus. Continue moving the stimulus and have the subject's eyes converge toward the bridge of the nose. If the subject cannot converge towards the bridge of the nose, (the minimum distance for a normal convergence response is approximately two inches (2") from the bridge of the nose) hold the stimulus at the convergence point for approximately one (1) second then remove the stimulus while observing the eyes.

Remember that you should not actually touch the subject's nose and should not come in any closer than approximately two (2) inches from the bridge of the nose. Also, you should keep the stimulus high enough so that you can observe the eye movements, making sure the subject does not close the eyes to a point where you cannot observe them.

Lack of Convergence usually occurs with people who are under the influence of any drug that causes HGN. Thus, Depressants, Inhalants, and Dissociative Anesthetics usually will cause Lack of Convergence. Cannabis also will usually cause Lack of Convergence, even though it doesn't cause HGN. Other kinds of drugs, i.e. CNS Stimulants, Hallucinogens and Narcotic Analgesics usually do not prevent the eyes from converging. But you should be aware that many people have difficulty crossing their eyes even when they are totally drug free. So it is not uncommon to find unimpaired individuals who exhibit Lack of Convergence.

Estimating Pupil Size

The pupils of our eyes continually adjust in size to accommodate different lighting conditions. When we are in a darkened environment, the pupils expand, or "dilate", to allow the eyes to capture as much light as possible. When the lighting conditions are very bright, the pupils shrink, or "constrict", to keep the eyes from being overloaded. This process of constriction and dilation normally occurs within limits.

We use a device called a **pupillometer** to estimate the size of the subject's pupils. The DRE pupillometer has a series of circles or semi-circles, with diameters in half-millimeter increments. The pupillometer is held alongside the subject's eye and moved up or down until the circle or semi-circle closest in size to the pupil is located.

We record the pupil size estimations that corresponds to the diameter of the circle/semi-circle closest in size to the subject's pupil in each lighting condition.

The three pupil size estimations conducted by the DRE are:

1. Estimation of Pupil Size Under Room Light

Here the pupils are examined in room light prior to darkening the room. Since room lighting conditions can vary considerably and often cannot be controlled, the range of pupil sizes may also vary.

The final two pupil size estimations are made with the use of a penlight in a near totally darkened room. After darkening the room, we wait 90 seconds to allow the subject's eyes and our own eyes to adapt to the dark. Once we have done that, we proceed with the estimations.

2. Estimation of Pupil Size Under Near Total Darkness

For this examination, we completely cover the tip of the penlight with our finger or thumb, so that only a reddish glow and no white light emerges. Bring the glowing red tip up toward the subject's left eye until you can distinguish the pupil from the colored portion of the eye (Iris). Continue to hold the glowing red tip in that position and bring the pupillometer up alongside the subject's left eye and locate the circle/semi-circle that is closest in size to the pupil. This is then repeated for the subject's right eye.

3. Estimation of Pupil Size Under Direct Light

During this examination we bring the penlight from the side of the subject's face and shine the beam directly into their left eye. Position the penlight so that it illuminates and approximately fills the subject's eye socket. Hold the penlight in that position for 15 seconds with the pupillometer up alongside the left eye, and find the circle/semi-circle that is closest in size to the pupil. Then repeat this procedure for the subject's right eye. While observing the eye for the 15 seconds with the pupillometer in position, you should also check for rebound dilation. Rebound dilation has been reported with persons under the influence of cannabis, CNS Stimulants, and/or hallucinogens. If rebound dilation is observed, it should be recorded by indicating the smallest or constricted size and the largest or dilated size,
e.g. 3.0 – 4.5mm.

Normal Sizes for the Pupil

We estimate pupil size under three different lighting conditions; Room Light, Near Total Darkness and Direct Light, and remember that the range of pupil sizes will vary. For most non-impaired people, even under very bright light the pupils won't constrict much below a diameter of 2.0 millimeters (mm); and even under near total dark conditions, the pupils usually will only dilate to a diameter of not more than 8.5 mm. For a normal non-impaired person, the average pupil size and range for:

- **Room Light** is approximately **4.0 mm** with an average range of normal pupil sizes ranging from **2.5 to 5.0 mm.**

- **Near Total Darkness** is approximately **6.5 mm** with an average range of normal pupil sizes ranging from **5.0 to 8.5 mm.**

- **Direct Light** is approximately **3.0 mm** with an average range of normal pupil sizes ranging from **2.0 to 4.5 mm.**

Reaction of the Pupils to Light

During the direct light estimation of the pupil size, we also look for another clue of possible drug influence; reaction of the pupils to light. With a non-impaired person, the pupils will constrict within one second after the penlight is shined directly into the eye. Some drugs however, may affect the pupil's reaction to light. No category of drugs will speed up the reaction of the pupils, but some will slow it down. CNS Depressants and CNS Stimulants for example, will both slow the pupil's reaction. It may seem strange that CNS Stimulants will do this, since we think of those type of drugs as "speeding things up", nevertheless they do slow the reaction. With someone under the influence of Narcotic Analgesics, you may observe little or no visible reaction of the pupils to direct light. This may be due to the fact that the drug constricts the pupils to the point where any further constriction isn't noticeable to your naked eye. Hallucinogens, Dissociative Anesthetics, and Cannabis usually don't affect the reaction of the pupils. Inhalants will slow pupillary reaction.

Expected Results

The following summarizes the results that generally can be expected when these eye examinations are administered to persons under the influence of the various categories of drugs.

	CNS Depressants	CNS Stimulants	Hallucino gens	Dissoc. Anesthetics	Narcotic Analgesics	Inhalants	Cannabis
Horizontal Gaze Nystagmus	Present	None	None	Present	None	Present	None
Vertical Gaze Nystagmus	Present (High Dose)*	None	None	Present	None	Present (High Dose)*	None
Lack of Convergence	Present	None	None	Present	None	Present	Present
Pupil Size	Normal (**)	Dilated	Dilated	Normal	Constricte d	Normal (****)	Dilated (*****)
Reaction to Light	Slow	Slow	Normal (***)	Normal	Little or none visible	Slow	Normal

* High dose for that particular individual.
** Soma, Quaaludes and some anti-depressants usually dilate pupils.
*** Certain psychedelic amphetamines may cause slowing.
**** Normal, but may be dilated.
***** Pupil size possibly normal.

BEAR IN MIND that there is a great deal of difference among humans and their individual reactions to drugs. The chart lists what we can generally expect to find when we examine subjects, but no one can guarantee that we will always find precisely these responses.

SOME KEY TECHNICAL TERMS
REGARDING THE EYES

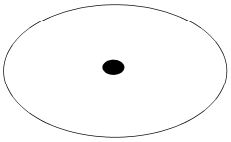
Rebound Dilation is defined as a period of pupillary constriction followed by a period of pupillary dilation where the pupil steadily increases in size and does not return to its original constricted size. Rebound dilation is observed only with the estimation of pupil size under the Direct Light procedure.

Pupillary Unrest is defined as the continuous, irregular change in the size of the pupils that may be observed under room or steady light conditions.

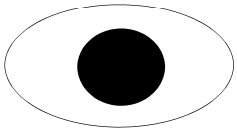
Accommodation Reflex is an adjustment of the eyes for viewing objects at various distances. Meaning the pupils will automatically constrict as objects move closer and dilate as objects move further away.

Pupillary Light Reflex means the pupils of the eyes will constrict and dilate depending on changes in lighting.

Miosis means an abnormally small pupil, i.e. constricted.



Mydriasis means an abnormally large pupil, i.e. dilated.



Ptosis is the technical term for "droopy eyelids".