

Eye System

Visual Testing

- Used to assess CN II
- For a more complete vision test, far and near visual acuity testing should occur with each eye individually with *uncorrected* vision first (without contacts/glasses) and then with *corrected* vision. A quick screening exam could also occur only with *corrected* vision. For peripheral, central, and color vision testing each eye is individually test with *corrected* vision if these tests are required.
 - Far
 - Snellen chart is used (“Snellen smells and you want to keep it *far* away.”)
 - Tests for defects in far visual acuity and the smaller the fraction means the worse the vision
 - Instruct the patient to stand 20 feet away (or at what distance is listed on the Snellen chart that you are using). Ask the patient to cover one eye with their palm or with a card. Instruct the patient to read the smallest font that they can clearly read. Record the visual acuity as the designated number that the patient can correctly read the chart. Repeat for the other eye.
 - The bottom number is the distance that a person with **normal** vision can read the same line of the chart
 - Near
 - Rosenbaum chart/pocket visual acuity card (“Roses smell good, thus you want the Rosenbaum *near* you.”)
 - Tests for defects in near visual acuity and the smaller the fraction means the worse the vision
 - Hold the eye chart 14 inches away from the patient. Ask the patient to cover one eye with their palm or a card and read the smallest font that they can clearly read. Record visual acuity as the designated number that the patient can correctly read the chart. Repeat for the other eye.
 - The bottom number is the distance that a person with **normal** vision can read the same line of the chart
 - Video Link:
 - <https://www.youtube.com/watch?v=w1hWJAnaYc>
 - Peripheral (Confrontation Test)
 - Tests for loss of peripheral vision (could be a clue to underlying pathology such as glaucoma) and the patient cannot see your fingers when you first see them
 - Stand or sit 3 feet away from the patient. Instruct the patient to cover one eye with their palm or a card while you cover your opposite eye (the open eyes should be facing each other). Tell the patient to fixate on your nose (you should do the same by fixating on the patient’s nose). Ask the patient to tell you when they first see your fingers. This is done by extending your arm midway between you and the patient as you move your arm centrally while also wiggling your fingers. Compare the patient’s response to when you first see your fingers in your peripheral vision. Do this in all visual fields (i.e. nasal, temporal, superior, and inferior). Repeat this exam for the other eye.
 - You may also hold up fists and then show one or two fingers on each hand at the same time asking the patient how many fingers they see (another option is to hold up varying numbers of fingers and ask the patient to tell you the *total number* that you are holding up). This is conducted in the upper and lower quadrants simultaneously.
 - Video Link:
 - <https://www.youtube.com/watch?v=kqPVSsVN4b8>

- Central
 - Amsler grid is used to test for macular degeneration (another indication is when drusen bodies are noted to be increasing in number or color intensity upon fundoscopic exam of the eye) and an abnormal test is if the patient sees any distortion of the grid pattern.
 - Instruct the patient to look at the grid one eye at a time. Ask the patient if any movement or irregularity of the grid pattern occurs. The patient should see a symmetric grid pattern with no distortion. Repeat for the other eye.
- Color
 - Color plates are used and these assess the ability to differentiate primary colors and a deficit might indicate optic nerve disease. The test is abnormal if the patient is unable to see hidden images, usually numbers or letters.
 - Hand color plates to the patient. Have the patient cover one eye. Ask patient what number or letter they see. Record the patient observation and repeat for the other eye.

External Examination (*Inspection and Palpation*)

- Surrounding eye structures should be inspected
 - Eyebrows: hair texture, size, and extension/pattern
 - Orbital area: edema, erythema, lesions, and sagging tissues
- Eyelids
 - Inspect for the ability to open wide and close completely, inversion or eversion of eyelids, eyelash position, ptosis, tremors, flakiness, erythema, and edema
 - Common abnormalities of the eyelids include the following:
 - Ptosis – excessive coverage of the iris or pupil by the upper eyelid
 - Ectropion – eyelid everts
 - Entropion – eyelid inverts
 - Hordeolum – (also referred to as a sty) suppurative infection usually caused by *Staph* (this *hurts* when palpated)
 - Chalazion – non-suppurative, *non-painful* inflammation of the meibomian (tarsal) gland
 - Blepharitis – crusting of the eyelashes caused by a variety of things
 - Palpate for nodules, tenderness, and firmness of eye globes
 - Ask the patient to close eyes and palpate gently while noting any abnormalities
 - A very firm globe may indicate increased intraocular pressure in diseases such as glaucoma
- Lacrimal apparatuses
 - Includes the lacrimal gland and puncta
 - Inspect for enlargement of the lacrimal gland and puncta erythema
 - Palpate for fullness or enlargement of the lacrimal gland and puncta
 - Dacrocystitis – infection of the nasolacrimal sac caused by nasolacrimal duct obstruction or infection
- Conjunctiva
 - Includes bulbar and palpebral conjunctivae
 - Inspect for color, cobblestoning along palpebral conjunctiva, exudates, pterygium, and foreign bodies (if suspected, evert the upper eyelid over a cotton-tipped applicator)
 - Exudates indicate infection and pterygium is common in people exposed to excessive amounts of UV light (i.e. road workers)
- Sclerae
 - Inspect for color (normally white, but might be slightly muddy in dark skinned people)
 - Common abnormalities of the sclerae include the following:
 - Jaundice or icterus – yellow pigment, may signify liver disease

- Episcleritis – purplish elevation of the bulbar conjunctiva anterior to the insertion of the rectus muscles
 - Senile hyaline plaque – sclera becomes translucent and allows dark color of choroid to shine through above the insertion of the medial rectus muscle (**no complications**)
- Corneas
 - Inspect for corneal arcus, sensitivity, and clarity
 - Clarity
 - While using a pen light, shine it tangentially on the cornea. Observe for clarity and any opacities.
 - Opacities can include band keratopathy and corneal ulcer
 - Sensitivity (Corneal Reflex)
 - While using a cotton wisp, touch the cornea with it (CN V₁) and a blink is the expected response (CN VII).
 - This reflex does not occur if the patient is wearing contacts, because the cotton does not touch the eye itself and decreased sensation is often associated with herpes simplex infection
- Lenses
 - Inspect for transparency or clarity (might appear gray or yellow when using a penlight)
 - Further inspection occurs during the ophthalmoscopic exam
 - If patient with cataracts has had surgery, they may have lens scarring that makes it difficult to perform an ophthalmoscopic exam
- Irides
 - Inspect for color and symmetry
- Pupil
 - Inspect for shape, size, symmetry, direct and consensual light response, afferent pupillary defect, and accommodation
 - Miosis is pupillary constriction of < 2 mm with dim lighting, mydriasis is pupillary dilation of > 6 mm with light, and unequal pupils are called anisocoria
 - Direct and Consensual Light Response (Pupillary Light Reflex)
 - Sensory and motor assessment of eye and abnormal result is pupil not constricting directly and/or consensually
 - Dim lights, so that pupils dilate (if possible). Shine pen light directly into one eye and note whether that pupil constricts (direct response). Shine pen light directly into one eye and note whether the opposite pupil constricts (consensual). Repeat tests on the opposite eye. Pupils should constrict *symmetrically* for both direct and consensual light responses.
 - Video Link:
 - <https://www.youtube.com/watch?v=E0BAqYKiYlw>
 - Accommodation (Near Reflex)
 - Abnormal result is when pupils do not constrict bilaterally
 - Hold object or place finger 12 inches from the patient's face at nose height. Slowly move your finger closer to the patient's nose. Note whether pupils constrict bilaterally. Pupils should **constrict and converge symmetrically** when the eyes focus on a near object.
 - When pupillary light response is abnormal, but constriction is retained during accommodation this can sometimes be seen in patients with *diabetes* or *syphilis*
 - Video Link:
 - <https://www.youtube.com/watch?v=cV8ZDaRi3VA>

- Afferent (Sensory) Pupillary Defect (Swinging Flashlight Test)
 - Assess the optic nerve and an abnormal result is when one or both pupils dilate (Marcus Gunn Pupil occurs)
 - Dim lights, so that pupils dilate (if possible). Note size of the patient's pupils when in dim light (again, if possible). Ask patient to look at a distant object. Shine pen light in one eye and rapidly swing pen light from eye to eye. Note whether the pupil you are shining the light into and the opposite pupil constrict symmetrically. Pupils should constrict *symmetrically*.
 - The most common cause of Marcus Gunn pupil is a lesion on the optic nerve (before the optic chiasm) or severe retinal disease is another cause
 - Video Link:
 - <https://www.youtube.com/watch?v=tkzXpmZityU>
- Extraocular muscles
 - Inspect for extraocular muscle balance and movements (this includes assessing for nystagmus and strabismus)
 - Six Cardinal Fields of Gaze
 - Assesses integrity of muscles strength and cranial nerves (CN III, IV, and VI) and used to detect sustained nystagmus
 - Abnormal results include lid lag, sustained involuntary rhythmic movements of the eyes, and inability to look in a certain direction
 - Instruct the patient to hold their head still while following your finger with only their eyes. Move your finger through the six cardinal fields of gaze by making a H pattern with your finger. Note fluidity of movements and *sustained nystagmus* if present. Patient should be able to accomplish full movement of the eyes smoothly and without full exposure of the sclera.
 - Lid lag is exposure of the sclera above the iris when you direct the eye in a smooth movement from the ceiling (top of H) to the floor (bottom of H) and this may indicate thyroid eye disease
 - Video Link:
 - <https://www.youtube.com/watch?v=WWiq0j8oNFY>
 - Nystagmus is checked for while performing the six cardinal fields of gaze. Ask the patient to look quickly to the extreme lateral positions (ends in the parallel line in H). Observe if there are a few horizontal rhythmic movements or if there is sustained involuntary rhythmic movements in a horizontal, vertical, rotary, or mixed pattern. Nystagmic beats can be expected, but sustained nystagmus should not occur.
 - Optokinetic nystagmus is alternating movements of the eyes when they try to focus on a moving target and it is an involuntary response
 - Cranial Nerves of the Eye:
 - Can be remembered by the “chemical formula” of **LR₆SO₄AO₃**
 - Lateral rectus is innervated by CN VI (*Abducens Nerve*)
 - Superior oblique is innervated by CN IV (*Trochlear Nerve*)
 - All others (i.e. medial rectus, inferior oblique, superior rectus, and inferior rectus) are innervated by CN III (*Oculomotor Nerve*)
 - Strabismus
 - Deviation inward (esotropia), outward (exotropia), upward (hypertropia), or both eyes (alternating tropia)
 - Corneal Light Reflex
 - Used to assess for strabismus and an abnormal result is light shining on the eyes in an asymmetrical fashion

- Shine a light about 30 cm away from the patient at the bridge of their nose. Ask a patient to look at a nearby object, but not at the light source. Inspect the light reflex in the cornea for symmetry. The light should shine symmetrically in both eyes.
 - Video Link:
 - <https://www.youtube.com/watch?v=pBJcvahjn1E>
- Cover-Uncover Test
 - Performed when the corneal light reflex is **abnormal** and the strabismic eye will fixate on an object after the unaffected (straight) eye is covered
 - Have patient focus straight ahead at a near fixed point (i.e. your nose). Cover one of the patient's eyes. Look for movement of the other eye as it focuses on the point. Remove the cover and watch again for any movement of the eye as it focuses. Repeat for the opposite side. Eyes should **not** deviate/move or become cross eyed, because they are already fixated on an object.
 - Video Link:
 - https://www.youtube.com/watch?v=BAAnPhkd_E2Y
 - Movement may indicate esotropia or exotropia. Strabismus → diplopia → suppression → amblyopia. Amblyopia is the *loss of visual acuity secondary to suppression of the visual signal from one eye* (reversible until approximately age 7). If strabismus develops in an adult, they will have diplopia, but will **not** develop amblyopia, because they cannot suppress the deviated eye's image.

Internal Eye Exam

- Mydriatic eye drops may be used to dilate the pupils and allow for a better exam, but before applying the dilating drops, the following test **must** be performed:
 - Test for Applying Mydriatics
 - Used to evaluate the depth of the anterior chambers to determine whether usage of mydriatic drops is appropriate or not
 - Shine a focused light tangentially at the limbus (the union of the conjunctiva and sclera). Note the illumination of the iris nasally. This portion of the iris is not illuminated if the patient has a shallow chamber, indicating a risk for acute glaucoma. Mydriatics should be **avoided** in patients with **shallow anterior chambers** and in **pregnant** patients.
 - A shallow anterior chamber indicates a risk of *acute-angle glaucoma*
- Ophthalmoscopic (Fundoscopic) Exam
 - Inspect for the red reflex, lens clarity, retinal color and lesions, blood vessels (ratio, margins, and location), optic disc and cup (size, pulsations, margins, and color), macula lutea (color, margins, and avascularity), and fovea centralis (color and margins)
 - Optic disc and cup are located on the nasal side and the macula lutea and fovea centralis are located on the temporal side
 - Common abnormalities of the internal eye include:
 - Papilledema – ill-defined margins and central vessels over optic discs are pushed out (increased intracranial pressure)
 - Cupping – white compared to optic disc background (like a “donut” in which the cup is the hole and the disc is the surrounding “donut”) [in glaucoma the optic cup size increases]
 - Myelinated retinal nerve fibers – white areas and soft, ill-defined margins that appears continuous with the optic disc (benign condition)
 - Copper wiring – opacity of arteriolar walls (hypertensive retinopathy)

- AV nicking – crossing of arterioles and venules (hypertensive retinopathy)
 - Drusen bodies – small and yellow discrete spots (aging and macular degeneration result in an increased number)
 - Neovascularization – increased blood vessel number (proliferative diabetic retinopathy)
 - Hemorrhages:
 - Flame hemorrhages – bright red fan shaped (diabetic and hypertensive retinopathies)
 - Round hemorrhages – dark red and circular (hypertensive retinopathy)
 - Dot hemorrhages or microaneurysms – small dot-like hemorrhage or ballooning out of vessels (diabetic and hypertensive retinopathies)
 - Roth spots – pale-centered surrounded by hemorrhage (bacterial endocarditis)
 - Cotton wool spots (soft exudates) – gray infarcted tissue (diabetic and hypertensive retinopathies)
 - Hard exudates – bright yellow lipid depositions (hypertensive retinopathy)
 - Cherry-red spot – bright red spot (fovea) surrounded by white (rest of retina) [central retinal artery occlusion and lysosomal storage diseases]
 - Leukocoria – white reflex (retinoblastoma)
- Coaxial Examination
 - Coaxial ophthalmoscope is used and remember to give the patient breaks as needed
 - Dim the room lights to help pupils dilate (if possible). Remove your glasses and ask the patient to remove theirs (contacts are fine). Turn on the ophthalmoscope (not necessary to use the brightest light). Set lens diopter to “0” if you have “perfect” vision. Use red numbers if you (or your patient) are near-sighted and green numbers (or black depending on scope brand) if you (or your patient) are far-sighted. Focus on your fingerprint using the diopter wheel. Have the patient pick an object and focus on it throughout the examination (forward and slightly upward is preferred). Use the clear small or large aperture (use large aperture if eyes are dilated). Cross hatched is used for measuring and describing size and location of lesions and blue is used as a black light for visualizing corneal abrasion or foreign body with eye staining. Place your hand on the patient’s shoulder or forehead to stabilize yourself and the patient. **Examine the patient’s right eye with your right eye and vice-versa. Find red reflex about 12 inches away from the patient.** Approach the eye at a 15-20 degree angle temporally. Keep red reflex in view as you gradually move closer to the patient (about 1-2 inches away) adjusting the diopter when needed to visualize internal eye structures. **Remember to always keep your finger on the diopter wheel.**
 - Items to note upon examination include the following:
 - Lens for opacities (stand out as black densities)
 - Retina for red reflex, retinal color (no discrete areas of lighter or darker pigmentation are expected, except at disc margin), and retinal lesions
 - Blood vessels should be observed in all 4 quadrants (superior and inferior nasal, superior and inferior temporal), arterioles (smaller and brighter than venules), arteriole to venule (A:V) ratio should be **3:5 – 2:3**, venous pulsations on the disc (expected), and AV nicking
 - Optic disc and cup should have vessels traced toward the disc or out from the disc, disc margins should be sharp and well defined, yellow-creamy pink (color varies with race), disc is 1.5 mm in diameter (used as a unit of measurement when describing lesion size and location and termed disc diameter [DD]), and cup has a central depression
 - Macula lutea and fovea centralis is observed by having the patient look directly into the light for a few seconds (this might be uncomfortable and hard to see unless the pupils are dilated), located 2 DDs temporal to the optic disc, macula

lutea is an avascular area, and the fovea appears as a lighter dot within the macula lutea

- Repeat this exam for the other eye making sure that you examine the patient's **left eye with your left eye or vice-versa**

- Video Link:

- <https://www.youtube.com/watch?v=95kz2PbF6zE>

- Pan-Optic Examination

- Pan-optic ophthalmoscope is used
 - Dim the lights in the exam room (if possible). Remove your glasses and use your dominant eye. Turn the scope on and turn the light intensity to its maximum position. Set the aperture dial to the green line. Focus on an object about 10-15 feet away and turn the dynamic focusing wheel with your thumb until the object is **clear**. Let the patient know that the **eyecup will touch their brow**. Ask them not to move and to focus ahead. **From about 6 inches away**, at a 15-20 degree angle from the temple of the patient, **shine the light in the patient's eye and look for the red reflex**. Follow the red reflex to the patient's pupil. Compress the eyecup to about half its length. A wide window of the retina should be visible. Inspect the internal eye structures (see aforementioned list for details). Repeat this exam for the opposite eye (you do not need to switch your eyes).

- Video Link:

- <https://www.youtube.com/watch?v=oiDjVaamIF0>