Science Education Collection

Cranial Nerves Exam II (VII-XII)

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Overview

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The cranial nerve examination follows the mental status evaluation in a neurological exam. However, the examination begins with observations made upon greeting the patient. For example, weakness of the facial muscles (which are innervated by cranial nerve VII) can be readily apparent during the first encounter with the patient. Cranial nerve VII (the facial nerve) also has sensory branches, which innervate the taste buds on the anterior two-thirds of the tongue and the medial aspect of the external auditory canal. Therefore, finding ipsilateral taste dysfunction in a patient with facial weakness confirms the involvement of cranial nerve VII. In addition, knowledge of the neuroanatomy helps the clinician to localize the level of the lesion: unilateral weakness of the lower facial muscles suggests a supranuclear lesion on the opposite side, while lesions involving the nuclear or infranuclear portion of the facial nerve manifest with an ipsilateral paralysis of all the facial muscles on the involved side. Cranial nerve VIII (the acoustic nerve) has two divisions: the hearing (cochlear) division and the vestibular division, which innervates the semicircular canals and plays an important role in maintaining balance. During a routine neurological examination, special testing of the vestibular nerve is usually not performed.

Cranial nerve IX (the glossopharyngeal nerve) and cranial nerve X (thevagus nerve) arise from the medulla and have laryngeal and pharyngeal function; their function is tested by assessing speech and motility of the soft palate.Because cranial nerves IX and Xform the sensory and motor limbs of the gag reflex, eliciting for gag reflex can also test their function. Cranial nerve XI (the spinal accessory nerve) innervates the sternocleidomastoid muscle and the upper portion of the trapezius muscle. These muscles control side-to-side turning the head and shrugging of the shoulders. The cranial nerve exam concludes by testing cranial nerve XII (the hypoglossal nerve), which provides motor control of the muscles of the tongue.

During the neurological assessment, the clinician should always be trying to tie together the findings of the exam to get insight into the underlying disease. The important diagnostic clues might include signs of multiple cranial nerve involvement and unilateral vs. bilateral cranial nerve dysfunction. It will help the clinician formulate differential diagnoses to know whether the patient's symptoms occurred suddenly (as expected with a stroke), over about a day (as in Bell's palsy), or gradually over weeks to months (as with an expanding mass lesion).

Evaluation of cranial nerves I-VI is covered in another video of this collection. This video demonstrates the systematic examination of cranial nerves VII-XII (Table 1).

I	Olfactory	Smell
II	Optic	Visual acuity, afferent pupillary response
III	Oculomotor	Horizontal eye movements (adduction), efferent pupillary response
IV	Trochlear	Downward vertical eye movement, internal rotation of eye
V	Trigeminal	Facial sensation, jaw movement
VI	Abducens	Horizontal eye movement (abduction)
VII	Facial	Facial movement and strength, taste, dampening of loud sounds, sensation; anterior wall of external ear canal
VIII	Acoustic	Hearing, vestibular functioning
IX	Glossopharyngeal	Movement of pharynx, sensation of pharynx, posterior tongue (including taste of posterior tongue), and most of ear canal
X	Vagal	Movement and sensation of palate, pharynx, gag reflex, guttural sounds
XI	Spinal accessory	Strength of sternocleidomastoid and trapezius muscles
XII	Hypoglossal	Tongue protrusion and lateral movements

Table 1. The 12 cranial nerves and their basic functions

Procedure

1. Cranial Nerve VII: Facial

1. Begin by observing the patient. If there is facial asymmetry, determine which side is affected, which may not be immediately obvious. Remember that most people have a slight bony facial asymmetry. Smoothing of the nasolabial folds or widening of a palpebral fissure on one or both sides could be subtle signs of facial weakness.
2. The following maneuverstest the motor function of the facial nerve. Peripheral facial palsy (Bell's palsy) manifests with unilateral weakness of both the upper and lower facial muscles, unlike central facial palsy (such as seen in stroke) where the upper facial muscles are not affected by weakness because of the bilateral cortical innervation of the forehead.
    1. Ask the patient to raise the eyebrows. Look for an inability to wrinkle the forehead on the involved side.
    2. Tell the patient to smile or show teeth, which will accentuate the weakness on the involved side, as the patient may not be able to fully raise the ipsilateral upper lip, resulting in a crooked appearance.
    3. Ask the patient to close the eyes tightly against resistance applied by the examiner. You can also assess if the patient buries the eyelashes equally on both sides.
    4. Ask the patient to blow up the cheeks and try to push the air out against pursed lips.
3. Bell's palsy may result in an ipsilateral loss of taste on the anterior 2/3 of the tongue. Therefore, special testing of the taste sensation can be performed.
    1. Tell the patient to stick out the tongue.
    2. Hold the tip of the tongue with a gauze pad.
    3. Swab the side of the tongue with the solution of sugar water.
    4. Ask the patient to identify the taste.
    5. Ask the patient to rinse out the mouth with water, and repeat the testing on the other side. Ask the patient to compare the sense of taste on each side of the tongue.

2. Cranial Nerve VIII: Acoustic

1. Make sure the room is quiet before starting the test.
2. Hearing assessment:
    1. Begin by observing whether or not the patient can hear you during the interview. Note whether the patient is wearing hearing aids.
    2. A quick hearing assessment can be done by holding your fingers a few inches away from the patient's ear and rubbing them together softly.
    3. Ask the patient if the finger rub is audible. Repeat on the other side, and assess if hearing is the same on both sides.
3. The tuning fork tests (the Weber and Rinne tests) are performed if hearing loss is found, as these tests can help to distinguish between conductive hearing loss (such as from otitis media or perforation of the eardrum) and sensorineural hearing loss (as can occur with aging, acoustic neuroma, or from exposure to loud noises).
    1. The Weber test is performed to assess for lateralization.
        1. Hit the tuning fork's tines with the heel of your hand, and place the stem of the fork at the vertex of the patient's head. Be careful not to interrupt the vibration in the tines. The sound produced by a tuning fork is conducted through both the air and vibration of the bones. It is normally heard equally on both sides.
        2. Ask the patient where the sound is heard. Patients with normal hearing will hear the sound in the center of the head or equally in both ears.
        3. Sensorineural hearing loss should be suspected if the sound lateralizes (is louder on) to the "good" side; conductive hearing loss should be suspected if the sound lateralizes to the "bad" side.
    2. The Rinne test complements the Weber test in further differentiating between a conductive hearing loss and a sensorineural hearing loss
        1. Hit tuning fork tines with heel of hand, and place stem of the fork on the mastoid bone.
        2. Ask the patient to say "now" when the tone is no longer heard.
        3. Quickly move the tines adjacent to the outer ear canal, and ask the patient if the sound still can be heard. In the case of conductive hearing loss, the patient will hear the sound louder when the tuning fork is on bone compared to when it is in the air.

3. Cranial Nerves IX and X: Glossopharyngeal and Vagus

1. Listen to the patient's voice and determine if nasal quality of speech, which is characteristic to palatal weakness, is present.
2. Have the patient say "AAH" and look for elevation of the soft palate. Check for symmetry of the two sides and deviation of the uvula.
3. On a routine neurologic exam, it is generally not necessary to test the gag reflex. However, gag reflex should be elicited if there is concern for palatal weakness or reduced palatal sensation.
    1. Have the patient open the mouth wide. Then touch the patient's posterior pharynx with a cotton swab.

2. Observe for the elevation of the soft palate, and note if any asymmetry is present. Note that about 20% of normal individuals do not have a gag reflex, and many older patients have diminished or absent gag reflexes. The most important thing to assess for is presence of any asymmetry.

4. Cranial Nerve XI: Spinal Accessory

1. Observe trapezius muscle from behind the patient for signs of atrophy or fasciculations (twitching). Ask the patient to shrug their shoulders upward and then repeat the movement as the examiner provides resistance by pushing the patient's shoulders down. Look for weakness or asymmetry.
2. To test the strength of the sternocleidomastoids muscle, instruct the patient to turn the head to the left as you try to resist the movement by pushing the patient's chin in the opposite direction with the palm of your hand. Repeat with the patient turning head to the right.

5. Cranial Nerve XII: Hypoglossal

1. Inspect the tongue inside the mouth;look for fasciculations, which may be seen with amyotrophic lateral sclerosis and other motor neuron diseases.
2. Ask the patient to stick the tongue out straight, andlook for possible deviation to one side. If any weakness is present, then the patient's tongue would deviate to the side of the weakness.
3. Place your hand against the patient's cheek, and tell the patient to push the tongue against their same cheek. Repeat on the other side, each time looking for weakness or asymmetry.

Summary

An examiner should develop an orderly approach to going through each nerve in numerical order, and document what test is performed and any findings. Abnormalities found in the cranial nerve exam may impact the remainder of the examination, requiring the examiner to look for other signs of diseases, such as multiple sclerosis (MS), myasthenia gravis, or amyotrophic lateral sclerosis (ALS) on the motor examination. For example, motor dysfunction of the lower cranial nerves, often called bulbar weakness, can be an early sign of muscle weakness, as seen in diseases such as ALS or myasthenia gravis. These findings on the cranial nerve examination will help the clinician focus the rest of the neurologic exam to help reach a possible diagnosis. Knowledge of the anatomy of the cranial nerves, head, and neck is important in both localization and diagnosis.