EVALUATING THE CRANIAL NERVES:

CRANIAL NERVE V

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INTRODUCTION

This article will present an overview of Cranial Nerve V, which innervates the greater portion of the head. Some cranial nerves contain only sensory fibers; those that contain both sensory and motor fibers are called mixed nerves.

CRANIAL NERVE V

Trigeminal Nerve (Mixed)

The Trigeminal Nerve (Cranial Nerve V) is the largest of the 12 cranial nerves.

The motor portion originates in the pons and terminates in the muscles of mastication (masseter, temporal, and internal and external pterygoids), the tensor tympani (which tenses the tympanic membrane), the tensor veli palatini (which tenses the soft palate and opens the tympanic tube), and the mylohyoid and digastric muscles (accessory muscles sometimes used in mastication).

The sensory portion divides into three main branches (hence the name, Trigeminal): the Ophthalmic Nerve (V^1), Maxillary Nerve (V^2), and the Mandibular Nerve (V^3).

Action of the Motor Portion

The chief action of the motor portion of the Trigeminal Nerve is to control those muscles that move the lower jaw for mastication.

The act of chewing is far more than a simple hinge opening and closing. The Mandibular Nerve (V^3) controls the muscles acting on the temporomandibular joint (TMJ) to effect cooperative bilateral or unilateral movements of rotation, depression, elevation, protrusion, and retraction of the jaw.

These complex movements mainly result from the actions of the temporalis, masseter, and medial pterygoids to produce a biting movement by raising the mandible to close the mouth. The lateral pterygoids protract the mandible (with assistance from the medial pterygoids), while the posterior fibers of the temporalis perform most of the retraction of the mandible (Figure 1).

The mylohyoid and anterior digastric muscles are used only if there is resistance to opening the mouth, such as wearing a chin strap or eating while hanging upside down (Table 1).

Sensory Portion of Cranial Nerve V

The Ophthalmic Nerve (V^1) contains sensory fibers from skin over the upper eyelid, cornea, lacrimal glands, nasal cavity, nose, forehead, and anterior half of the scalp. The Maxillary Nerve (V^2) contains sensory fibers from the nasal mucosa, palate, parts of the pharynx, upper teeth and lips, cheek, and lower eyelid. The Mandibular Nerve (V^3) contains sensory fibers from the anterior two-thirds of the tongue, lower teeth, skin over mandible, and side of face anterior to the ear (Figure 2).

Select Disorders of Cranial Nerve V

The trigeminal nerve may be affected by a number of disorders, including, but not limited to, neuralgia and neuritis, syphilis, tuberculosis, brain tumors, skull fractures, aneurysm of the circle of Willis or the carotid artery, or even psychoneuroses.

One syndrome of interest that involves the trigeminal nerve is *tic douloureux*, a condition that is characterized by paroxysms of excruciating electric-like pain that shoot down one or more branches of the trigeminal nerve. The pains last from a fraction of a second to several seconds in duration and can be so severe that suicide is contemplated.

With this condition, a trigger point on the face, lip, gum, or tongue that is irritated by cold, pressure, or even a

Figure 1: Major muscles of mastication. T = Temporalis, M = Masseter, LP = Lateral Pterygoid, MP = Medial Pterygoid. The temporalis closes and retracts jaw; the masseter closes and protracts jaw; the lateral pterygoid protracts jaw; and the medial pterygoid closes the jaw.

puff of air can set off an flash of pain down one or more branches of the trigeminal nerve.

Tic douloureux occurs in adults over 40 years of age and is usually confined unilaterally to one branch of the Trigeminal Nerve. The etiology is unknown, but may be associated with dental or sinus problems.

TABLE 1
MUSCLES INVOLVED IN CHEWING

OPEN MOUTH	CLOSE MOUTH	PROTRUDE CHIN	GRINDING, CHEWING
DIGASTRIC	TEMPORALIS	MASSETER	IPSILATERAL
MYLOHYOID	MASSETER	LATERAL	TEMPORALIS
GENIOHYOID	MEDIAL	PTERYGOID	CONTRALATERAL
INFRAHYOID	PTERYGOID		PTERYGOIDS
[GRAVITY]			MASSETER

Figure 2: Simplified distribution schematic of the three major divisions of trigeminal nerve distribution (Ophthalmic, V¹; Maxillary, V²; and Mandibular, V³) and the lingual branch (L).

SYMPTOMS

The motor portion of the trigeminal nerve involves chewing; the sensory portion transmits sensations for touch, pain, temperature, and proprioception. Injury results in paralysis of the muscles of mastication and a loss of touch and temperature sensation over the area of distribution. Symptoms include:

1. Pain.
2. Loss of sensation over sensory distribution.
3. Dissociate anesthesia—a loss of pain, but not touch.
4. Paresthesia.
5. Paralysis of masticatory muscles, with deviation of jaw to affected side.
6. Loss of reflexes, involving jaw jerk, sneeze, and lid, conjunctival, and corneal reflexes.

7. Hearing loss from tensor tympani paralysis.
8. Lockjaw (trismus) from masticatory muscle spasm in rabies, tetany, tetanus, epilepsy, and hysteria.
9. Trophic and secretory disturbances, including herpes simplex, neurokeratitis, nasal dryness, facial ulcerations, and tooth loss.

CLINICAL TESTS

Motor Examination

1. Check for atrophy of the temporal muscle by inspecting the area of the temples. The temple is sunken if the muscle is atrophic from a LMN lesion.
2. Test the masseter muscle by palpating the region of the muscle about 2 cm above and anterior of the angle of the mandible while asking the patient to bite hard.
3. Test jaw closure strength by placing the heel of one hand on the patient's forehead and the other on the tip of the mandible. Press hard, trying to open the mouth, while the patient resists.
4. Test the lateral pterygoids by having the patient open and close his or her mouth while noting how the tip of the mandible aligns with the center of the upper front teeth.

The patient is then asked to move the jaw from side to side. Finally, the patient forcefully holds his or her jaw to one side. Try to push the jaw back, while pressing against the opposite cheekbone for support.

Clinical Example

A patient suffers from difficulty in chewing. The right temporal and masseter muscles appear to be completely paralyzed and atrophic. The jaw deviates to the right upon opening. No other motor deficits are found.

Because only the muscles supplied from Cranial Nerve V are atrophic and completely paralyzed, a lower motor neuron (LMN) lesion is indicated. The jaw opening test always points to the side affected. Therefore, the lesion involves the left Trigeminal Nerve (CN V).

Sensory Examination

Proprioception of the masticator muscles is not clinically testable, but sensation is easily tested. Figure 3 shows the areas of the head innervated by the trigeminal nerve. To thoroughly test the nerve, stimuli should be applied in each zone. The labels, V^1 – V^3 , are suggested spots for testing.

Figure 3: The area of the head innervated by the three divisions of the trigeminal nerve, known as the “mask of Trigeminus.”

1. Touch is tested by a mere wisp of cotton twisted into a point. More rigid objects would also test the sense of pressure. The patient's eyes are closed. The cotton is lightly touched at random on either side of the face in the area of each of the three divisions of the trigeminal nerve. The patient responds upon feeling the touch. To test patient reliability, occasionally withhold the stimulus and ask the patient if anything is felt. Inability to feel the cotton denotes anesthesia to light touch.
2. Test pain by using a straight pin or a safety pin. Alternating the sharp and blunt ends of the pin, test the trigeminal divisions as with the cotton wisp, but ask the patient whether a “sharp” or “dull” sensation is felt while the eyes are closed. Relieve any apprehension by first demonstrating the test on the patient's arm with their eyes open.
3. Test temperature sensation by using two test tubes, one filled with warm water and one with cool water. Demonstrate the tubes by placing them on the patient's arm and having the patient respond “hot” or “cold.” Then touch the tubes to each of the trigeminal divisions with the patient's eyes closed and ask what sensation is felt.
4. The corneal reflex is the reflexive closure of the eyelid when the cornea is touched. The afferent arc of the reflex is Cranial Nerve V^1 (Ophthalmic Nerve); the efferent arc is Cranial Nerve VII (Facial Nerve), which innervates the eyelid muscle. As a result, the corneal reflex really tests two cranial nerves.

Twist the cotton into a fine wisp. Ask the patient to look up and away from you. Bring the cotton directly in from the adducted side, out of the patient's field of vision, and lightly touch the cornea, not the conjunctiva (Figure 4). The normal response is blinking of the eyes.

A Clinical Comment

Herpes zoster (shingles), a painful viral infection characterized by vesicular formation, usually involves the trunk. But occasionally it affects the trigeminal ganglion, which may produce herpetic eruptions in one or more of the three divisions of the Trigeminal Nerve.

Figure 4: Testing the corneal reflex with a wisp of cotton. The eye is adducted, the cotton approaches from the side out of the line of vision, and touches the cornea in the area marked by an "X."

Herpes zoster of the face usually involves the Ophthalmic Nerve (herpes zoster ophthalmicus). The cornea, which is supplied by the Ophthalmic Nerve, is often affected. The infection sometimes causes paresis of the ocular muscles supplied by Cranial Nerves III, IV, and VI.

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