

CLINICAL IMPORTANCE OF CRANIAL NERVES

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ABSTRACT

There are 12 pairs of Cranial nerves in the body having major importance in clinical practice among these Nerves some are Sensory, Some are Motor and some are both. It most important and necessary in every Neurological patient to examine these affected or involved nerves to find out its lesion and this helps to diagnose and plan the treatment in various neurological disorders. In this present article the clinical importance of twelve pairs of cranial nerves, Location, Examination, Functions and Applied aspects of each Cranial nerve has been discussed.

Keywords: Cranial Nerves, Motor function, Sensory, Facial nerve, Motor and Sensory Pathway

INTRODUCTION

Cranial- of or relating to the cranium which encloses the brain; Nerves - Any bundle of nerve fibers running to various organs and tissues of the body. Cranial Nerves: Means any of the 12 paired nerves that originate in the Brain stem.⁽¹⁾

The systemic examination of Cranial nerve is an important part of the examination of every neurological patient. It may reveal a lesion of a Cranial nerve nucleus or its central connections, or it may show an interruption of the lower motor neurons.⁽²⁾

Cranial nerve like spinal nerve is a part of the peripheral nervous system. 12 pairs of Cranial nerve 10 originate from the brain stem but all passes through foramina of the skull.

Some Cranial nerve contain only sensory fibers and thus are called sensory and motor fibers and are referred to mixed nerves. The cell bodies of sensory neurons are found outside the brain, whereas the cell bodies of

motor neurons lie in nuclei within the brain.⁽³⁾

The 12 pairs of Cranial nerves supply muscles of Eyeball, Face, Palate, Pharynx, Larynx, Tongue and two large muscles of Neck. Besides these are afferent loop to special senses like Smell, Sight, Hearing, Taste and Touch.⁽⁴⁾

Cranial nerves are involved in head and neck function, and processes such as eating, speech and facial expression. These arise from the brain as twelve pairs. They pass through or into the cranial bones (thus cranial nerves) and are numbered I to XII roughly in order from top (rostral) to bottom (caudal). Their functions are those of the head, some are concerned with awareness of, and communication with, the environment; and some are concerned with sustenance, the gut tube and movements associated with it.⁽⁵⁾

Meaning of 12 cranial nerves: With Mnemonic means Of or relating to or involved the practice of aiding the memory.

Mnemonics- A method or system for improving the memory.⁽⁶⁾

Olfactory nerve (oh): Olfacere- to smell, this is Sensory.

Optic nerve (oh): Optikos- Vision, Eye or Optics this is Sensory.

Oculomotor nerve (oh): Oculus-eye, motor- mover, this both Motor and sensory.

Troclear nerve (try): Trokholear- pulley, this is both Motor and sensory. Primarily Motor.

Abducent nerve (again): Ab- away, duces- to lead both Motor and sensory. Primarily Motor.

Trigeminal nerve (try):: Tri-three, geminus-twin, trigeminus- three fold for its branches this is both Motor and Sensory.

Facial nerve (failure):: Facies- face this is both Motor and Sensory.

Vestibulocochlear nerve (victory): Vestibulum- vestibule, Kokhlos and snail Primirily Sensory.

Glossopharangeal (Give): Glossa- tongue, Pharynx-Throat this is both Motor and Sensory.

Vagus nerve (value): Vagus- Vagrant or wondering both Motor and Sensory.

Accessory nerve (and): Accessorius- assisting this is both Motor and sensory. Primarily Motor.

Hypoglossal nerve (Happiness): Hypo- below, glossa-tongue.⁽⁷⁾

Cranial Nerves: There are totally 12 pairs of cranial nerves explained in all modern texts.

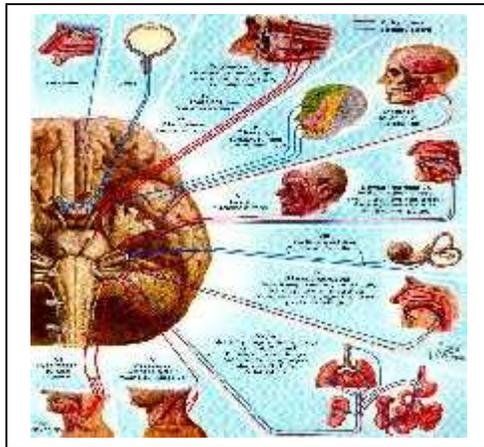
Table 1: showing cranial nerve location, examination, functions and applied aspects^{(8), (9), (10)}

| Name | Location | Examination | Functions | Applied |
|-----------------|---|---|---|---|
| Olfactory nerve | Arises in olfactory mucosa passes olfactory foramina in the cribriform plate of ethmoid bones and ends in olfactory bulb. | -determine the nasal passages are clear. -apply some easily recognizable aromatic substance. Ex: oil of peppermint, oil of cloves, -ask the patient to identify the smell. | For smell | -unilateral anosmia -bilateral anosmia -complete anosmia Allergic rhinitis cause temporary olfactory impairment |
| Optic nerve | Arises in the retina of eye passes through optic foramen from optic chiasma | -ask the patient whether any change in the eye sight. Visual acuity should be tested for near & distant vision by snell's type -visual fields should be tested by closing right eye by looking into the examiners right eye. -examination of fundi- by ophthalmoscope patient is asked to look distinct objects. - optic disc- creamy pink, retina-pinkish red, blood vessels - macula is examined by asking the patient look directly at the light of the ophthalmoscope | Vision | Fracture in the orbit, lesion of vision pathway Disease cns may results vision field loss of vision activity. Damage- blindness, optic neuritis |
| Oculomotor | Motor portion- originates in midbrain, passes through orbital fissure and distributed to levator palpebrae superioris of upper eyelid and extrinsic eyeball muscle superior inferior medial rectus and medial oblique. Sensory parts- consists of the fibers from proprioceptors in eyeball muscles passes through supernal orbital fissure and terminate in | - this supplies all the extra ocular muscles except superior oblique and lateral rectus. -in a complete lesion oculomotor nerve eye cannot be moved upward, downward or inward. | Mototrfunction- movements of eyelid and eyeball oculomotor of lense for near vision. Sensoryfunction – muscles strabismus patois pupil dilatation, diplopic. | The patient see double vision(diplopia) Ptosis, Lateral squint |

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| | midbrain. | | | |
| Trochlear | Motor portion- originate from midbrain passes through superior orbital fissure and distributed to superior oblique, muscle, an extinct eyeball muscle . Sensory portion- consists of fibers of proprioceptors in superior oblique muscle that parts through superior orbital in mide brain. Fissure and terminate in midbrain. | Supplies superior oblique muscle which rotates the eye downward and laterally. | Motor function- movements of eye ball. Sensory function- in truckler nerve paralysis diplopic and strabismus. | Double vision, cavernous sinus thrombosis, aneurysm of the internal carotid artery. |
| Trigeminal | This has both motor & sensory roots, passes through trigeminal ganglion and emerge the ophthalmic, maxillary and mandibular. The sensory function may be tested by using cotton, a pin over each area of the face. | Supplies the lateral rectus muscle which rotates the eye laterally in this lesion patient cannot turn the eye laterally. | Motor function-chewing Sensory function- Convey sensation of touch pain temperature. | Injury results paralysis of muscles of mastication and loss of sensation of touch. |
| Abducens | Motor portion- originate in pons passes through superior, orbital fissure, distributed to lateral rectus muscles Sensory portion- consists of fibers from proprioceptors in lateral rectus muscles pass through fissures, end in pons. | | Motor function- movements of eyeball Sensory function- muscle sense | With damage attached eyeball cannot move. |
| Auditory/ vestibulocochlear nerve | Cochlear branch- arise in spinal organ from spinal ganglion passes through the auditory meatus and ends in thalamus. Vestibular branches- arise in semicircular canals succulent utricle and forms end in pons and cerebellum. | This nerve innervates the utricle and saccule which are sensitive to static changes in equilibrium. | Cochlear branches convey impulses associated with hearing. Vestibular branches function – convey impulses associated with equilibrium. | Injury causes vertigo, ataxia, and nystagmus, Deafness, tinnitus |
| Glossopharyngeal | Motor portion- originated in medulla passes through jugular foramen and distributed to stylopharyngeus muscles Sensory portion- arises from taste buds on posterior 1/3 rd of tongue & from carotid sinus, passes through jugular foramen, ends in medulla. Contains fibers from somatic sensory receptors on posterior 1/3 rd of tongue and proprioceptors in swallowing muscles supplied by motor portion. | This supplies the stylopharyngeus muscle. Sensory fibres innervate the posterior 1/3 rd of the tongue for general sensation of taste. Isolated lesion of this nerve are rare and usually involve the vagus nerve. | Motor function Secretion of saliva Sensory function Taste, regulation of blood pressure and muscle. | Injury leads to difficulty in swallowing. Reduced secretion of saliva, loss of sensation in the throat and loss of taste. Glossopharyngeal neuralgia |
| Vagus | Motor portion- originated in medulla passes through jugular foramen and terminates in muscles airways, lungs esophagus, heart, stomach, small intestine and gall bladder, parasympathetic innervate involuntary muscle. Sensory portion- arises from essentially same structures supplied by motor fibers passes through jugular foramen and ends in medulla and pons. | -this innervates many important organs but examination depends upon testing the branches of function of pharynx, soft palate, and larynx. -the pharyngeal or gag reflex may be tested by touching the lateral wall of the pharynx with a spatula. -the movement of the vocal cord may be tested by means of laryngoscopic examination. | Motor function- Smooth muscles contraction & relaxation secretion of diagnosis fluids. Sensory function- sensation from visceral organs supplies, muscle, sense. | Severing of both nerve in the upper body interferes with swallowing paralyses, vocal cords and interrupts sensation from many organs. |
| Accessory | Motor portion – consists of cranial portion and spinal | This supplies the sternocleidomastoid and the trapezius muscle | Cranial portion mediates swallowing movements, | If nerve damaged The sternocleidomastoid |

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| | <p>portion. Cranial portion originated from medulla, passes through jugular foramen and supplies voluntary muscles of pharynx and soft palate. Spinal portion_ originates from interior gray horn of 1st five cranial segments of spinal cord passes through jugular foramen & supplies sternocleidomastoid And trapezius muscles. Sensory portion – consists of fibers from proprioceptors in muscles supplied by motor portion and passes through jugular foramen.</p> | <p>by means of spinal root</p> | <p>spinal portion; spinal portion mediates movements of head. Sensoryfunction – Muscle sense</p> | <p>trapezius muscles become paralyzed resulting inability to raise the shoulders and difficulty in turning the head.</p> |
| Hypoglossal | <p>Motor portion – originates in medulla passes through hypoglossal canal and supplies muscles of tongue. Sensory portion – consists of fibers from proprioceptors in tongue muscle that passes through hypoglossal canal and end in medulla.</p> | <p>This supplies the intrinsic muscles of the tongue and the styloglossus, hyoglossus and genioglossus muscles.</p> | <p>Motor function- Sensory function Muscles sense movements of tongue during speech and swallowing.</p> | <p>Vascular accident's injury of the nerve in the neck may also follow stab and gun shot wounds. Paralysis of tongue</p> |

FIG 1: SHOWING CRANIAL NERVES DISTRIBUTION⁽¹¹⁾



FACIAL NERVE:

The facial nerve has two roots.

1. The larger contains the motor nerve fibers which supply the ipsilateral facial muscles.
2. The smaller root the intermediate nerve contains fibers covering taste sensation from the anterior two thirds of the tongue cutaneous sensory fibers from the posterior part of the ear and preganglionic parasympathetic fibers that innervate the lacrimal and submandibular and sublingual salivary glands.

MOTOR PATHAWAY:

The facial nerve motor nucleus lies in the ventrolateral tegmentum of the Pons. The efferent's fibers arising from the nucleus sweep dorsomedially to the floor of fourth ventricle loop sharply around the sixth nerve nucleus and then pass ventrolaterally to emerge from the lateral border of the candle Pons at the cerebellopontine angle.

After exiting from the Pons the facial nerve is medial to the 8th nerve and between the two lies the intermediate nerve. These 3 nerve passes through the internal auditory, meatus and than the facial nerve and

intermediate nerve enter the facial canal. In the facial canal on the middle site of the middle ear the facial nerve turns sharply as the genu of the facial nerve moving posteriorly and inferiorly gives off a branch to the stapedius muscles and exits from the skull through the stylomastoid foramen.

CARTIO BULBAR PATHWAY:

The facial nucleus is composed of a number of distinct cell groups, each innervating specific facial muscles. Those supplying the upper facial muscles receives bilateral supranuclear innervations, whereas those supplying the lower facial muscles receives mainly crossed fibers from the contralateral hemisphere.

SENSORY PATHWAY:

In the facial canal there is an expansion of the facial nerve as it makes its sharp backwards turn at the genu. The expansion is the geniculate ganglion and is formed by the cell bodies of the nerve that gives rise to two sensory components of facial nerve.

SPECIAL VISCERAL:

Special visceral afferent fibers convey taste sensation for the anterior two-thirds of the tongue. From the tongue these fibers travel first from the lingual nerve then the chord tympani which enters the skull crosses the tympanic cavity and joins the facial nerve in the facial canal.

SOMATIC AFFERENT NERVE:

Somatic afferent nerve fibers arise from a small area of skin which includes the posterior part of the external auditory meatus and the skin behind the ear and in front of the mastoid. They enter the facial canal just proximal to the stylomastoid foramen from the cell bodies in the geniculate ganglion. The fibers pass centrally in the intermediate nerve and terminate in the spinal trigeminal tract.

AUTONOMIC PATHWAY: Autonomic pathway of the facial nerve divides into two groups.

1. One group passes with the greater superficial petrosal nerve to the pterygopalatine ganglion. Postganglionic fibers innervate the lacrimal glands and mucous membrane of the nose and mouth.

2. The other group of fibers travel in the chord tympani and terminate in the submandibular ganglion. Postganglionic fibers innervate the submandibular and sublingual salivary glands.

EXAMINATION POINTS

It supplies the muscles of the facial expression, supplies the anterior two-thirds of the tongue.

To test facial nerve - patient is asked to show teeth by separating the lips with teeth clenched.

If lesions of facial nerve are present on one side, the mouth is distorted.

Another test usually will be to ask the patient to close eyes firmly.

On the side of the lesion, the orbicularis oculi is paralyzed so that the eye lid on that side is easily raised by the raising of the patient's upper lid by the physician.

FACIAL NERVE REFLEXES:

- In clinical practice the corneal reflexes and to a lesser extent the glabellar tap reflexes are of value. The glabellar tap reflex is polysynaptic and elicited by tapping the forehead over the bridge of the nose and observing contraction of orbicularis oculi as blinking bilaterally. After several taps there is habituation and blinking stops.

- Other reflexes include

- the naso-lacrimal reflex of tearing in response to stimulation of the nasal mucosa,

- the naso mental reflex which on the tapping the side of the nose, causes elevation of the upper lip and
- the stapedius reflex in which stapedius contracts in response to loud noise.

LESION OF THE FACIAL NERVE:

Lesion of the facial nerve, its nucleus or supranuclear pathways may produce

- Facial muscles weakness, only peripheral lesion affecting facial nerve itself affecting taste sensation and autonomic function.
- Numbness is not an expected finding in facial nerve lesion although symptomatic complaints of sensory disturbance are common in Bell's palsy.

SUPRANUCLEAR LESIONS:

- The upper facial muscle have almost equal bilateral cortical representation whereas
- The lower facial muscles receive mainly crossed fibers from the contralesional hemisphere thus a unilateral upper motor neuron lesion causes contralesional facial weakness with the lower part of the face more affected than upper .
- Depending upon the site of the lesion spontaneous emotional movements may be more affected than voluntary movements and vice versa.

SUPRANUCLEAR AND PERIPHERAL LESION:

A lesion of the nucleus or facial nerve generally causes equal weakness of all ipsilateral facial muscles and the clinical feature are exemplified by Bell's palsy.

Considering the origins and site of union with facial nerve of the greater superficial petrosal nerve, the nerve of stapedius and chorda tympani, the presence of impaired lacrimation hyperacusis or an impaired

stapedes reflex, altered taste sensation a facial nerve lesion.

The facial nucleus may be affected by pontine lesion and the nerve by the lesions in the cerebella pontine angle, within the petrous temporal bone and outside the skull.

PONTINE LESIONS:

These rarely affect the facial nucleus or nerve fibers in isolation and associated features include ipsilateral rector and conjugate gaze palsy trigeminal hemiparesis and hemisensory loss. Common pathology include Vascular lesion, Multiple sclerosis and Tumors and less common disorder being brainstem Encephalitis, Syringobulbia and Poliomyelitis.

INFECTION INVOLVING THE FACIAL NERVE: Ramsay hunt syndrome, Lyme disease and Bilateral facial nerve-Guillain-Barre Syndrome.⁽¹¹⁾

CONCLUSION

Now a days majority of the diseases belongs to Central Nervous System like Stroke, Facial palsy in which we find the involvement of Cranial nerves. Cranial nerves better understood in terms of Upper motor neuron and Lower motor neuron. Involvement of Different Cranial nerves impact on different sense organs of the body like Tongue (Loss of taste), Eye (Unable to close), Nose (Loss of Smell) etc. It is better to plan treatment based on the cause not based on symptoms.

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