

BRAINSTEM ANATOMY, SURGICAL PROCEDURES AND CRANIAL NERVE MONITORING

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SECTIONS OF THE BRAINSTEM

- Thalamus
- Midbrain
- Pons
- Medulla Oblongata



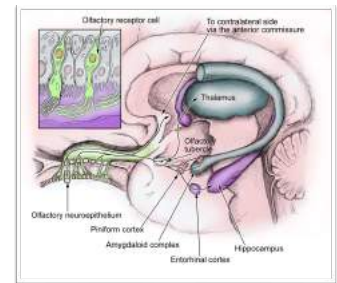
CRANIAL NERVES

- | | |
|---------------|----------------------|
| 1. Olfactory | 7. Facial |
| 2. Optic | 8. Vestibulocochlear |
| 3. Oculomotor | 9. Glossopharyngeal |
| 4. Trochlear | 10. Vagus |
| 5. Trigeminal | 11. Spinal Accessory |
| 6. Abducens | 12. Hypoglossal |

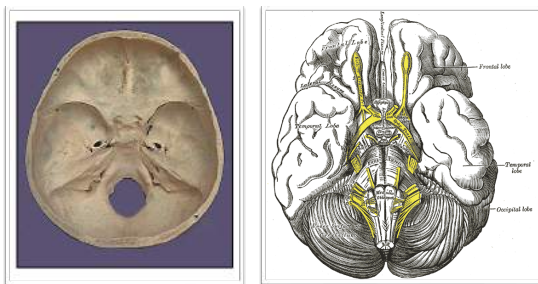


I. OLFACTORY NERVE

- Sensory
- Not monitored during surgery
- Origin - Telencephalon
- Nuclei - Anterior olfactory nucleus



THE BIG PICTURE



THE BIG PICTURE

- Optic Canal - II
- Superior Orbital Fissure - III, IV, VI and V(1)
- Foramen Rotundum - V(2)
- Foramen Ovale - V(3)
- Internal Acoustic Meatus - VII & VIII
- Jugular Foramen - IX, X, XI
- Hypoglossal Canal - X



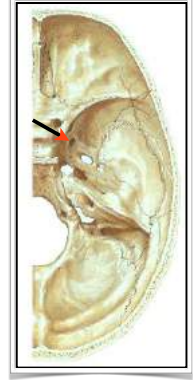
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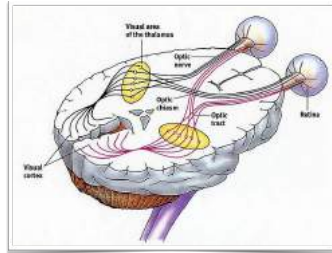
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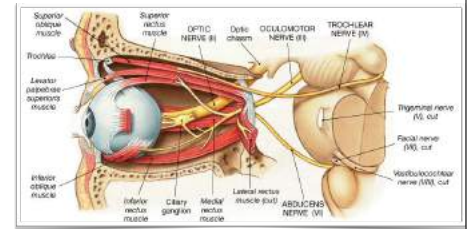
2. OPTIC NERVE

- Sensory
- Monitored using Flash Visual Evoked Potentials during surgery
- Origin - Retina
- Nucleus - Lateral geniculate nucleus



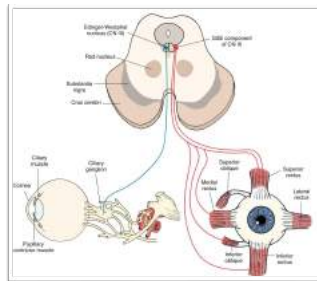
3. OCULOMOTOR

- Mainly motor
- Spontaneous and triggered EMG monitored during surgery
- Origin - Anterior aspect of Midbrain
- Nucleus - Oculomotor nucleus, Edinger-Westphal nucleus



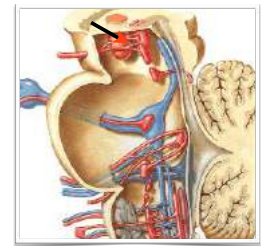
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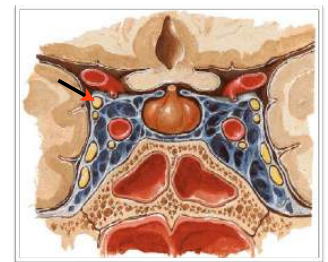
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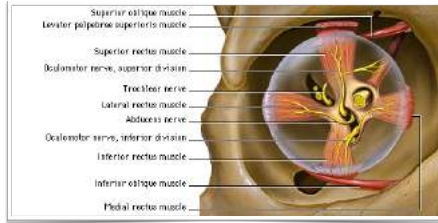
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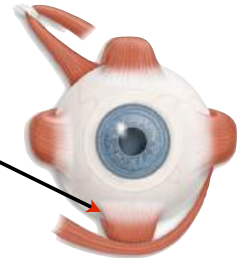
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3. OCULOMOTOR

- EMG monitored from
 - Inferior Rectus Muscle
- Nerve also innervates
 - Superior Rectus Muscle
 - Medial Rectus Muscle
 - Inferior Oblique Muscle



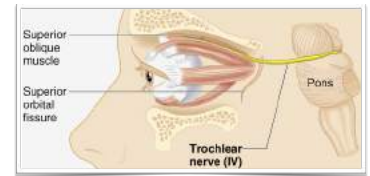
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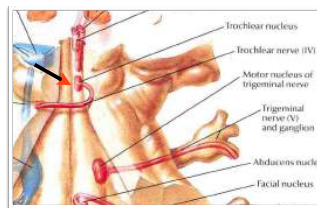
4. TROCHLEAR NERVE

- Motor
- Spontaneous and triggered EMG monitored during surgery
- Origin - Dorsal aspect of Midbrain
- Nucleus - Trochlear nucleus



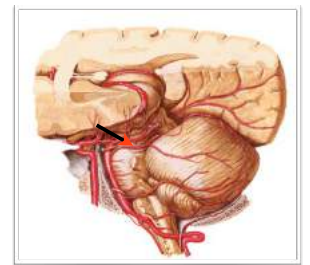
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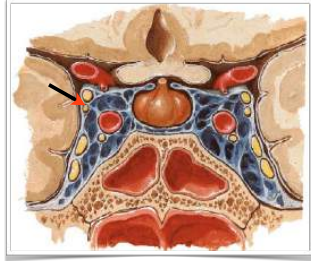
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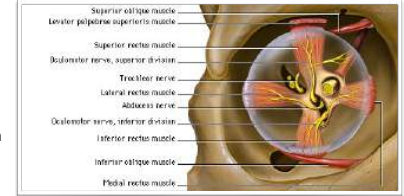
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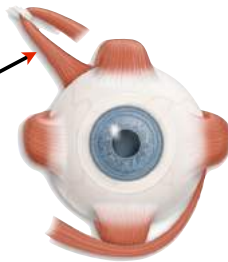
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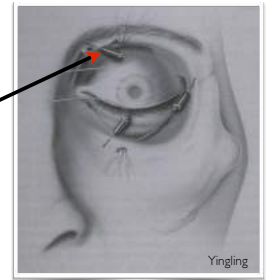
4. TROCHLEAR NERVE

- EMG monitored from
- Superior Oblique Muscle



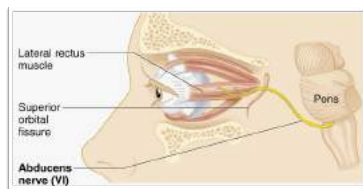
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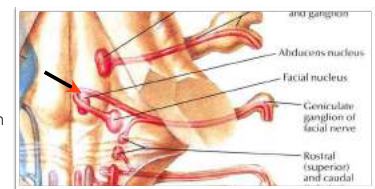
6. ABDUCENS NERVE

- Mainly Motor
- Spontaneous and triggered EMG monitored during surgery
- Origin - floor of the fourth ventricle in the Pons
- Nucleus - Abducens nucleus



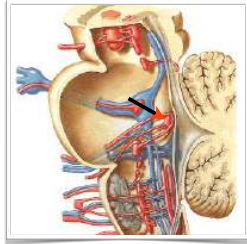
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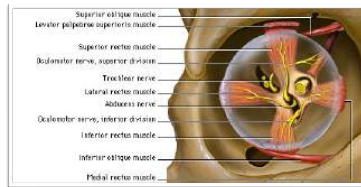
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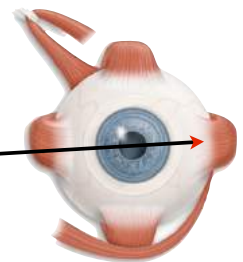
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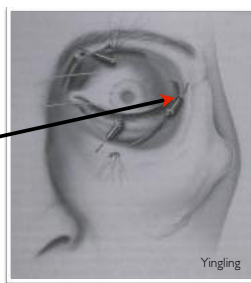
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- EMG monitored from
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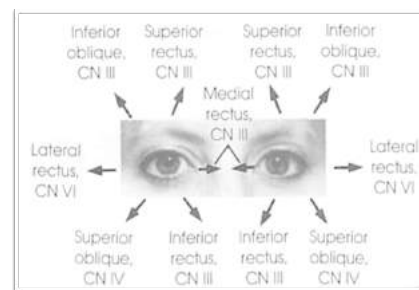


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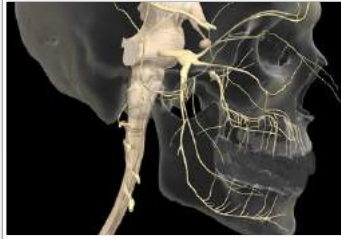


EYE MOVEMENTS



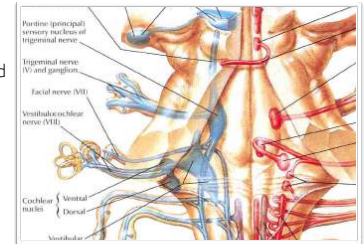
5. TRIGEMINAL NERVE

- Mixed Sensory and Motor
- Motor component monitored during surgery using spontaneous and triggered EMG
- Sensory component monitored using trigeminal SEPs and blink reflex
- Origin - Pons
- Nucleus - Trigeminal nucleus



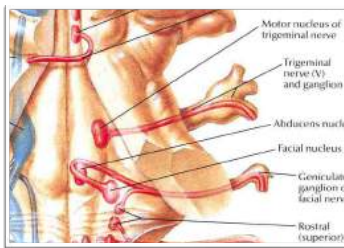
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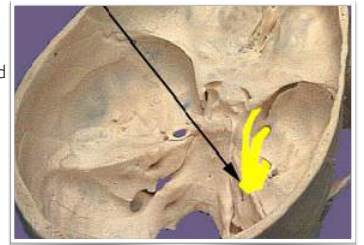
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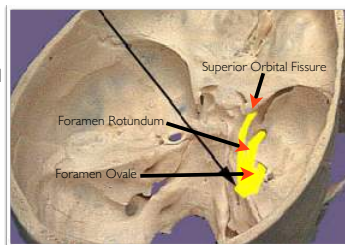
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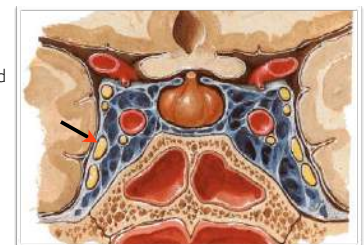
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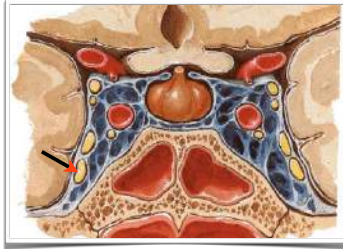
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5. TRIGEMINAL NERVE



V1 - Ophthalmic



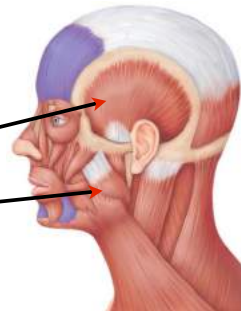
V2 - Maxillary



V3 - Mandibular

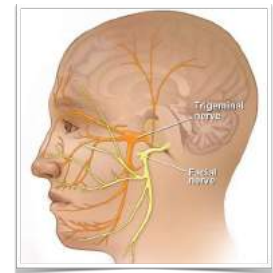
5. TRIGEMINAL NERVE

- EMG monitored from muscles of mastication
- Temporalis
- Masseter



7. FACIAL NERVE

- Mixed sensory and motor
- Motor component monitored using spontaneous and triggered EMG monitored during surgery
- Origin - Cerebellopontine angle
- Nucleus - Facial nucleus, solitary nucleus, superior salivary nucleus



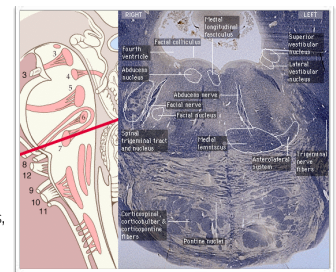
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- Nucleus - Facial nucleus, solitary nucleus, superior salivary nucleus

Branchial motor (special visceral efferent)	Supplies the muscles of facial expression; posterior belly of digastric muscle, stylohyoid, and stapedius.
Visceral motor (general visceral efferent)	Parasympathetic innervation of the lacrimal, submandibular, and sublingual glands, as well as mucous membranes of nasopharynx, hard and soft palate.
Special sensory (special afferent)	Taste sensation from the anterior 2/3 of tongue, hard and soft palate.
General sensory (general somatic afferent)	General sensation from the skin of the sonche of the auricle and from a small area behind the ear.

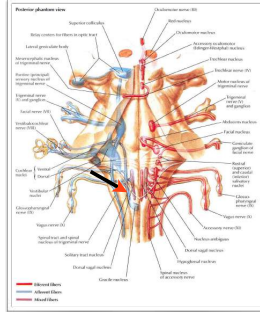
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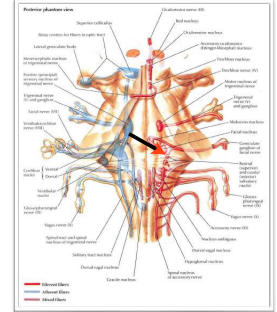
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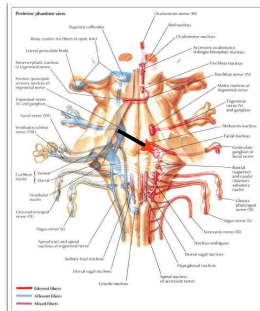
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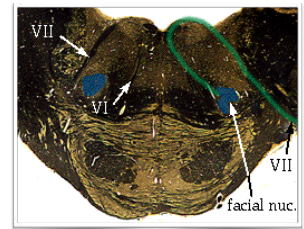
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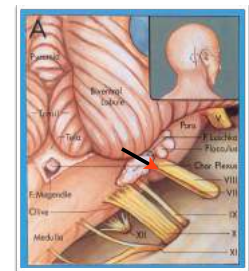
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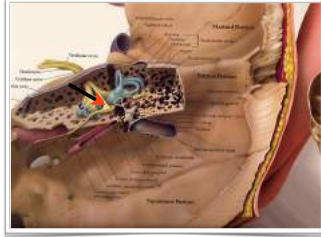
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- Origin - Cerebellopontine angle
- Nucleus - Facial nucleus, solitary nucleus, superior salivary nucleus



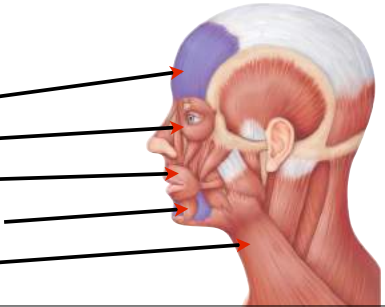
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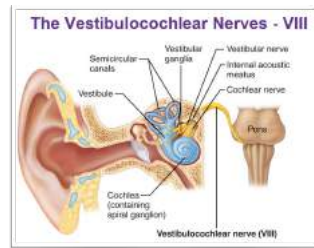
7. FACIAL NERVE

- EMG monitored from
 - Temporal branch - Frontalis
 - Zygomatic branch - O.Oculi
 - Buccal branch - O.Oris
 - Mandibular Branch - Mentalis
 - Cervical Branch - Platysma



8. VESTIBULOCOCHLEAR NERVE

- Sensory
- Monitored during surgery using brainstem auditory evoked potentials
- Origin - Cerebellopontine angle
- Nucleus - Vestibular nucleus, cochlear nucleus



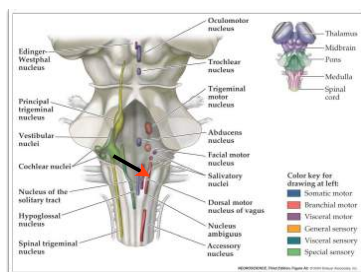
9. GLOSSOPHARYNGEAL NERVE

- Mixed sensory and motor
- Motor component monitored using spontaneous and triggered EMG during surgery
- Origin - Medulla
- Nucleus - Nucleus ambiguus, inferior salivary nucleus, solitary nucleus

Branchial motor (special visceral efferent)	Supplies the stylohyoid muscle.
Visceral motor (general visceral efferent)	Parasympathetic innervation of the smooth muscle and glands of the pharynx, larynx, and viscera of the thorax and abdomen.
Visceral sensory (general visceral afferent)	Carries visceral sensory information from the carotid sinus and body.
General sensory (general somatic afferent)	Provides general sensory information from the skin of the external ear, internal surface of the tympanic membrane, upper pharynx, and the posterior one-third of the tongue.
Special sensory (special afferent)	Provides taste sensation from the posterior one-third of the tongue.

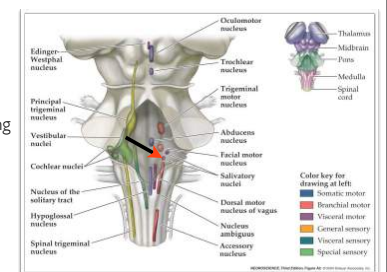
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- Mixed sensory and motor
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- Origin - Medulla
- Nucleus - Nucleus ambiguus, inferior salivary nucleus, solitary nucleus



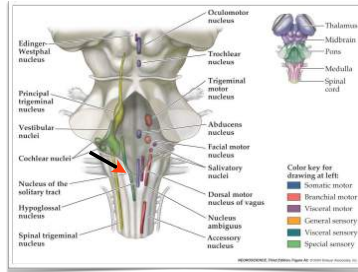
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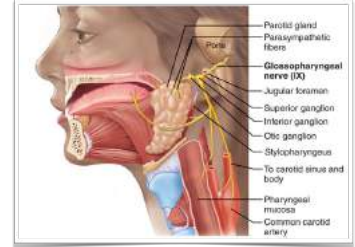
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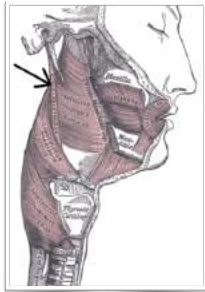
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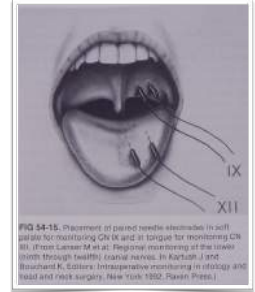
9. GLOSSOPHARYNGEAL NERVE

- EMG monitored from
- Stylopharyngeus muscle of the soft palate



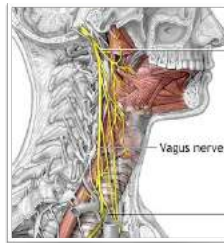
9. GLOSSOPHARYNGEAL NERVE

- EMG monitored from
- Stylopharyngeus muscle of the soft palate



10. VAGUS NERVE

- Mixed sensory and motor
- Motor component monitored using spontaneous and triggered EMG during surgery
- Origin - Medulla
- Nucleus - Nucleus ambiguus, dorsal motor vagal nucleus, solitary nucleus



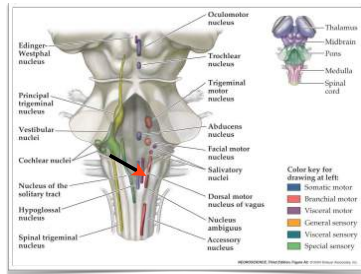
10. VAGUS NERVE

- Mixed sensory and motor
- Motor component monitored using spontaneous and triggered EMG during surgery
- Origin - Medulla
- Nucleus - Nucleus ambiguus, dorsal motor vagal nucleus, solitary nucleus

Branchial motor (special visceral efferent)	Supplies the voluntary muscles of the pharynx and most of the larynx, as well as one extrinsic muscle of the tongue.
Visceral motor (general visceral efferent)	Parasympathetic innervation of the smooth muscle and glands of the pharynx, larynx, and viscera of the thorax and abdomen.
Visceral sensory (general visceral afferent)	Provides visceral sensory information from the larynx, esophagus, trachea, and abdominal and thoracic viscera, as well as the stretch receptors of the aortic arch and chemoreceptors of the aortic bodies.
General sensory (general somatic afferent)	Provides general sensory information from the skin of the back of the ear and external auditory meatus, parts of the external surface of the tympanic membrane, and the pharynx.
Special sensory (special afferent)	A very minor component of CN X. Provides taste sensation from the epiglottic region.

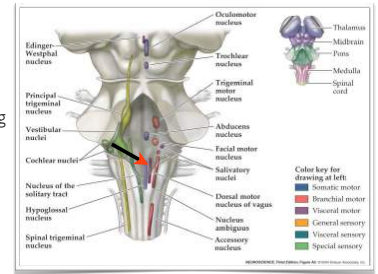
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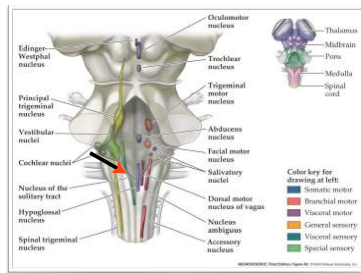
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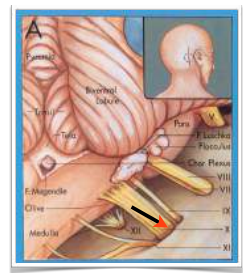
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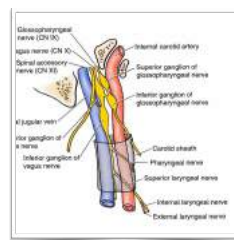
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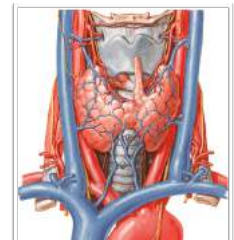
10. VAGUS NERVE

- Branchial motor fibers separate into three major branches
- Pharyngeal - innervates all muscles of pharynx and soft palate except stylopharyngeus and tensor veli palatini
- Superior laryngeal - innervates cricothyroid muscle
- Recurrent laryngeal - innervates intrinsic muscles of larynx



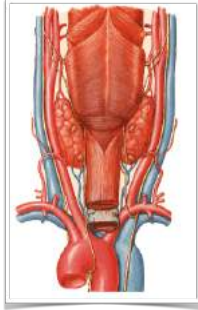
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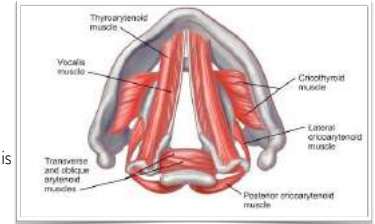
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10. VAGUS NERVE

- EMG monitored from
 - Vocalis Muscle
- Monitored using endotracheal tube electrode or hookwires placed in vocalis muscle

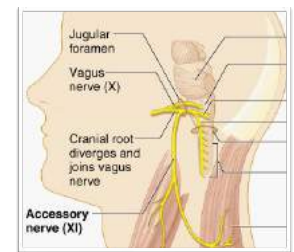


10. VAGUS NERVE



11. SPINAL ACCESSORY NERVE

- Mainly motor
- Spontaneous and triggered EMG monitored during surgery
- Origin - Cranial and cervical spinal roots
- Nucleus - Nucleus ambiguus, spinal accessory nucleus



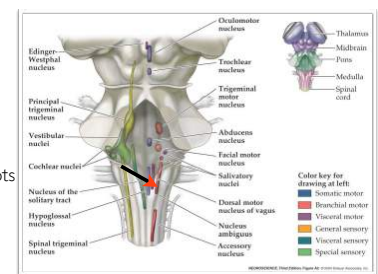
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- Spontaneous and triggered EMG monitored during surgery
- Origin - Cranial and cervical spinal roots
- Nucleus - Nucleus ambiguus, spinal accessory nucleus

Branchial motor - cranial root (special visceral efferent)	Innervates muscles of larynx and pharynx.
Branchial motor - spinal root (special visceral efferent)	Innervates the trapezius and sternocleidomastoid muscles.

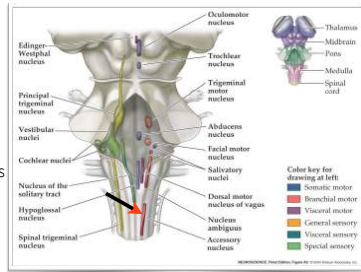
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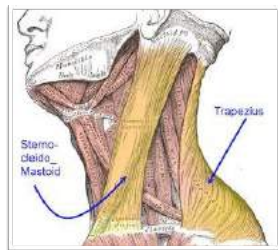
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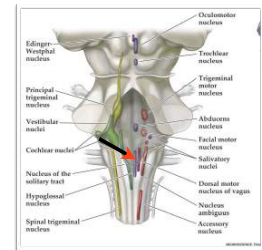
11. SPINAL ACCESSORY NERVE

- EMG monitored from
- Trapezius muscle
- Sternocleidomastoid muscle



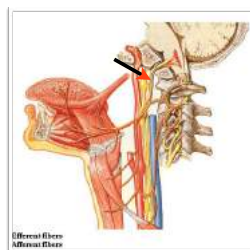
12. HYPOGLOSSAL NERVE

- Mainly motor
- Spontaneous and triggered EMG monitored during surgery
- Origin - Medulla
- Nucleus - Hypoglossal nucleus



12. HYPOGLOSSAL NERVE

- Mainly motor
- Spontaneous and triggered EMG monitored during surgery
- Origin - Medulla
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- Mainly motor
- Spontaneous and triggered EMG monitored during surgery
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- Nucleus - Hypoglossal nucleus



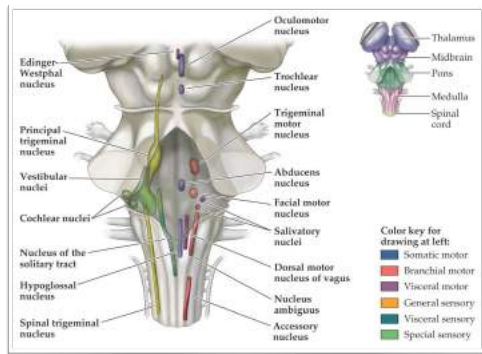
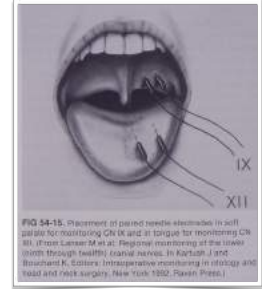
12. HYPOGLOSSAL NERVE

- EMG monitored from
- Anterior 2/3 of tongue
- Innervates all muscles of tongue except palatoglossus muscle



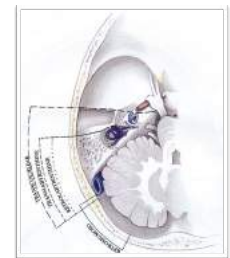
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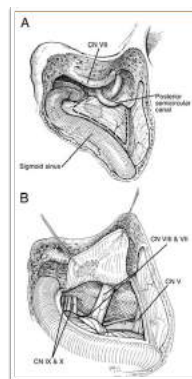
POSTERIOR FOSSA SURGICAL APPROACHES

- Transpetrosal Approach
- Retrolabyrinthine
- Translabyrinthine
- Transcochlear



RETROLABYRINTHINE APPROACH

- Indication - Small lesions of the anterior brainstem
- Cranial nerves 7 & 8 are at risk for injury, possibly lower cranial nerves for larger lesions



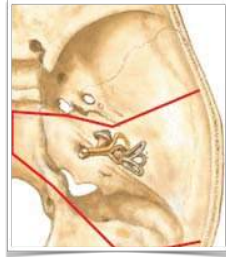
TRANSLABYRINTHINE APPROACH

- Indication - Vestibular Schwannoma
- Cranial 7 at risk, hearing sacrificed, possibly lower cranial nerves for larger tumors



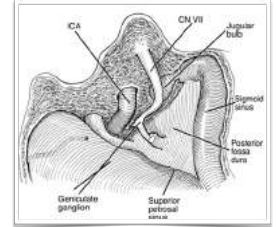
TRANSCOCHLEAR APPROACH

- Increases surgical exposure for complex lesions
- Hearing sacrificed, cranial nerve 7 likely to sustain injury during procedure



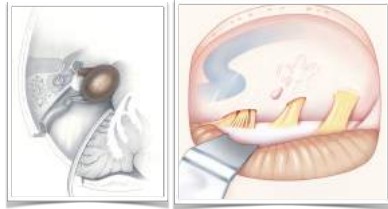
TRANSCOCHLEAR APPROACH

- Increases surgical exposure for complex lesions
- Hearing sacrificed, cranial nerve 7 likely to sustain injury during procedure



RETROSIGMOID APPROACH

- Cranial nerves 7 & 8 at risk, lower cranial nerves for larger tumors



TRANSPETROSAL APPROACHES

Surgical Approach	Post-op Hearing Function	Post-op Facial Function
Retrolabyrinthine	Preserved	Preserved
Translabyrinthine	Sacrificed	Preserved
Transcochlear	Sacrificed	Transient or permanent paralysis

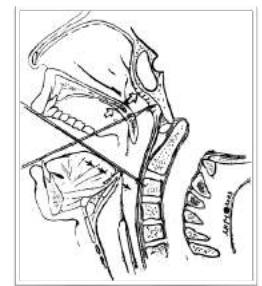
FAR-LATERAL APPROACH

- Provides access to basilar and vertebral arteries
- Provides access to lateral and anterior brainstem
- Decreases need for cerebellar retraction
- Lower cranial nerves at risk for injury



TRANSORAL APPROACH

- Provides access to anterior extradural lesions
- Upper cranial nerves at risk for injury



ANESTHETIC REQUIREMENTS

Motor Cranial Nerve EMG Monitoring

- No muscle relaxants
- No local anesthetics

Auditory Brainstem Response Monitoring

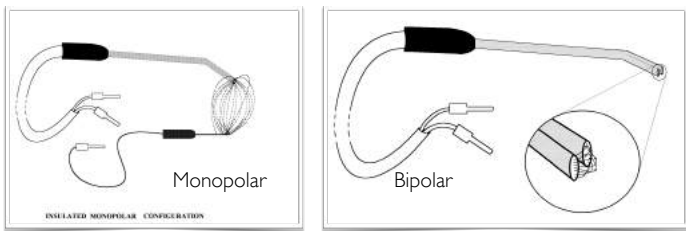
- Minimally effected by Propofol and inhalation agents
- Initial latency shift with induction
- Avoid Nitrous Oxide

MONITORING TECHNIQUE

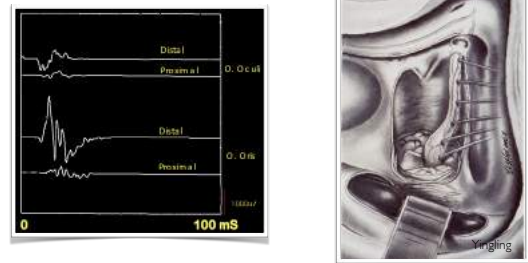
- Auditory Brainstem Evoked Response monitoring for brainstem and cochlear nerve function
- Monitor spontaneous EMG from motor cranial nerves to detect nerve irritation
- Monitor triggered EMG from motor cranial nerves to test nerve function and to detect neural ischemia

- Two triggered EMG techniques
 - Monopolar stimulation - sensitive, used as searching to locate cranial nerves that may not be visible because of tumor
 - Bipolar stimulation - specific, used to test motor cranial nerve function during resection and to demonstrate that nerve is intact at completion of resection

STIMULATOR TYPES

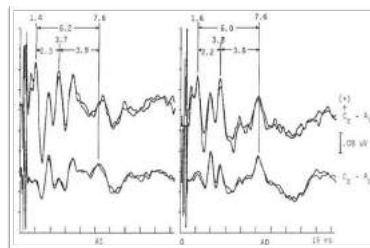


STIMULATOR TYPES



BRAINSTEM AUDITORY EVOKED RESPONSE

- Brainstem retraction and cranial nerve manipulation can cause BAER to change
- Wave V amplitude and interpeak latencies most important indicator of change



SPONTANEOUS AND TRIGGERED EMG MONITORING CAN INDICATE IMPENDING INJURY

