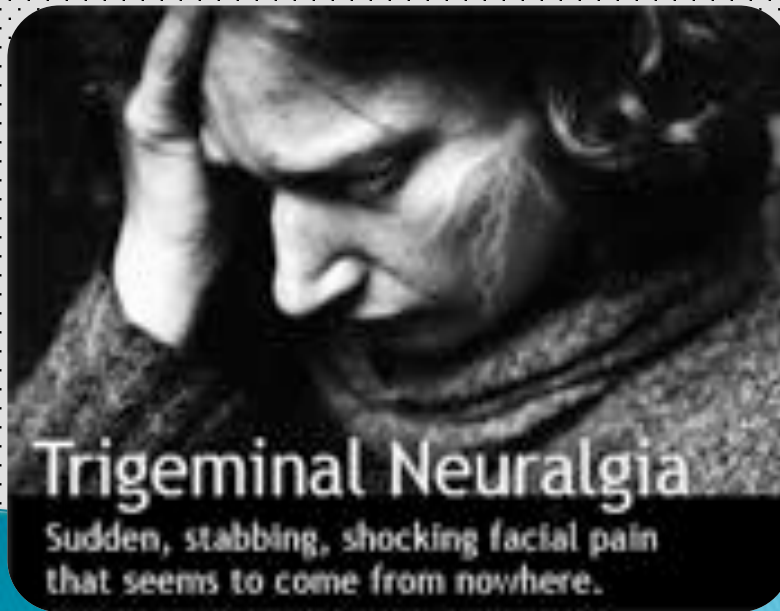
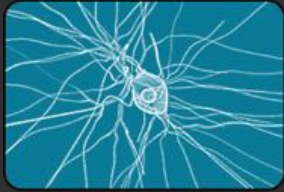


MVD for Trigeminal Neuralgia & IONM



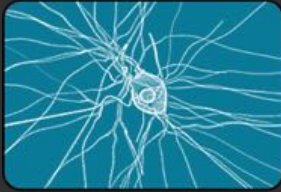
Presented by

Andrew Kopka B.S. CNIM R. EEG T



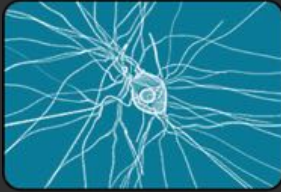
What is IONM?





What Types of Evoked Potentials & Recordings?

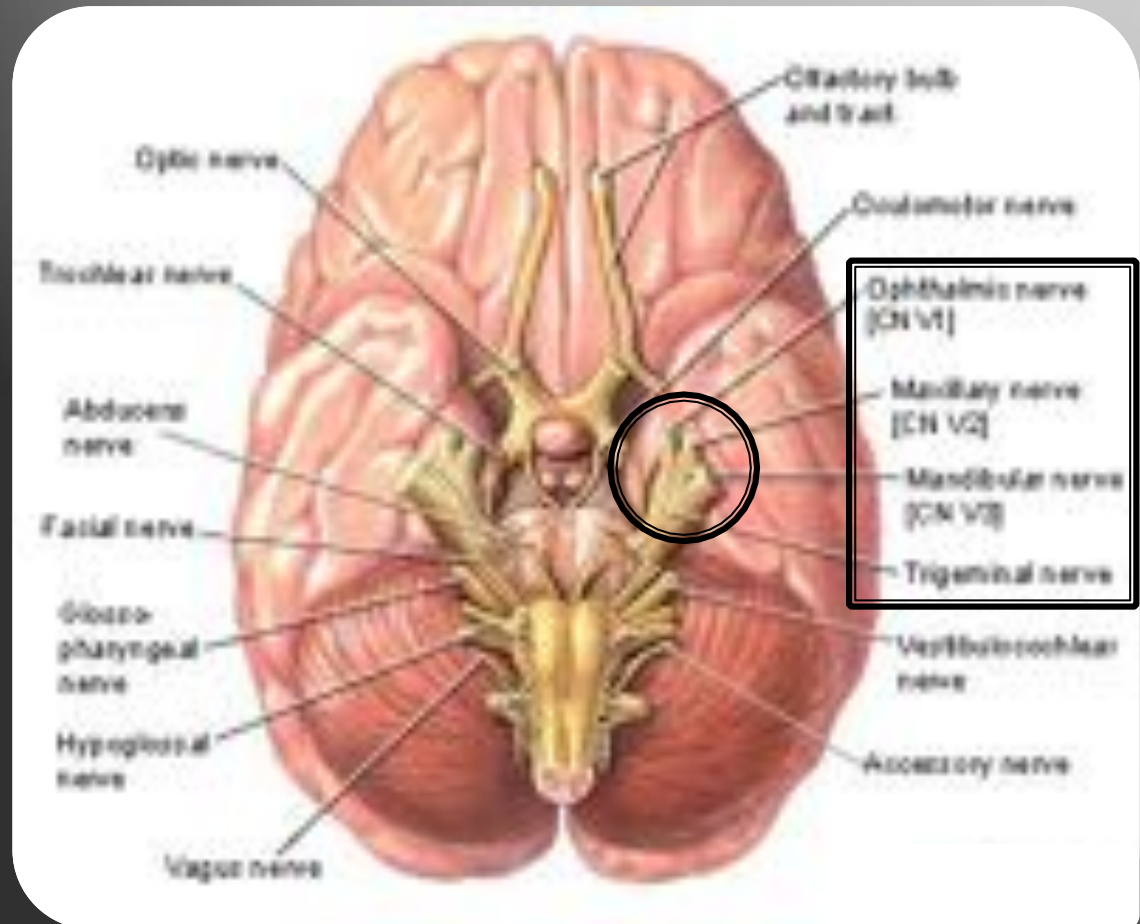
- ▶ Common EP's / recordings used in the O.R.
 - SSEP - Somatosensory evoked potentials
 - TcMEP - Transcranial motor evoked potentials
 - BAER - Brainstem auditory evoked responses
 - EMG - Free Run
 - EMG -Triggered
 - EEG - Electroencephalography

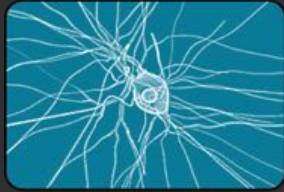


ANATOMY: Trigeminal Nerve

Cranial Nerve V:

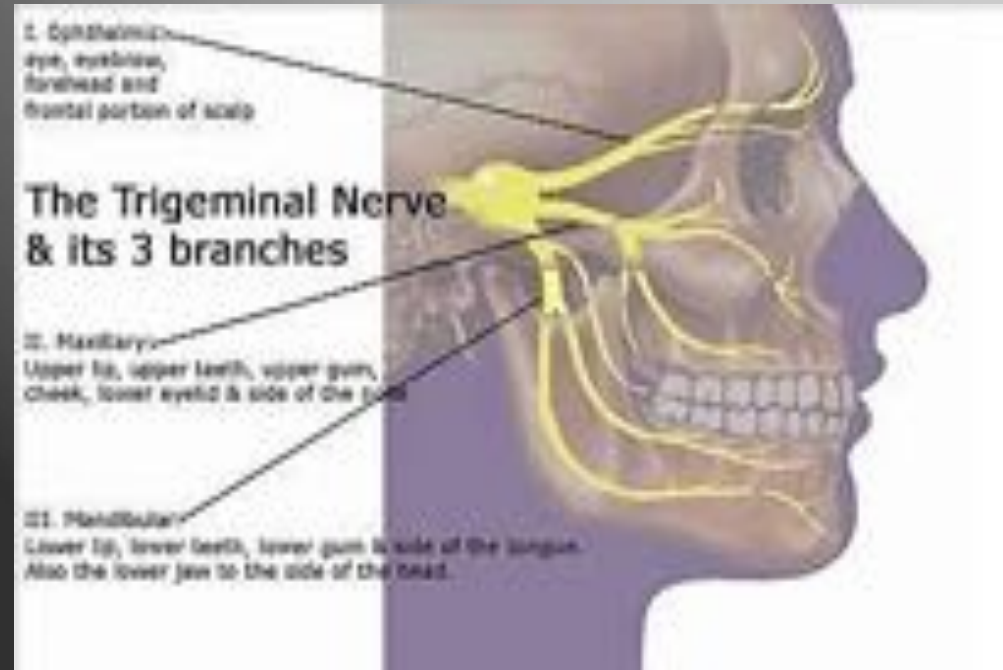
- Mixed nerve
- Largest cranial nerve
- 2 roots from venterolateral of the pons
- Large sensory root (Portio major) and small motor root (Portio minor)





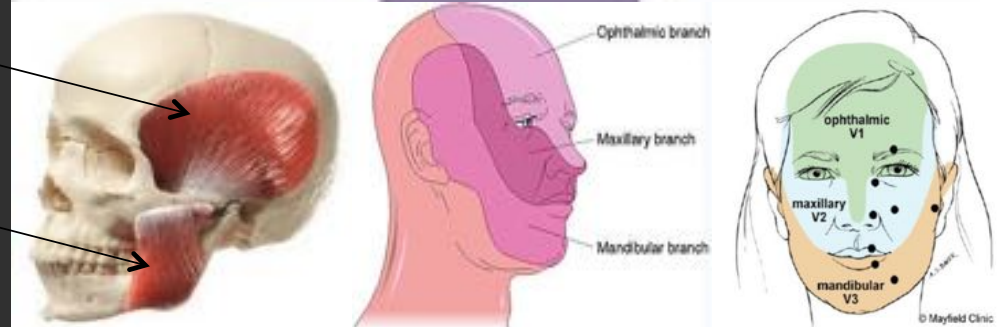
ANATOMY: Trigeminal Nerve

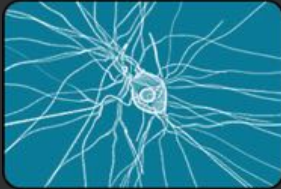
- Cranial Nerve V:
 - Major sensory face
 - Motor for mastication
- 3 divisions
 - Ophthalmic division V1
 - Maxillary division V2
 - Mandibular division V3



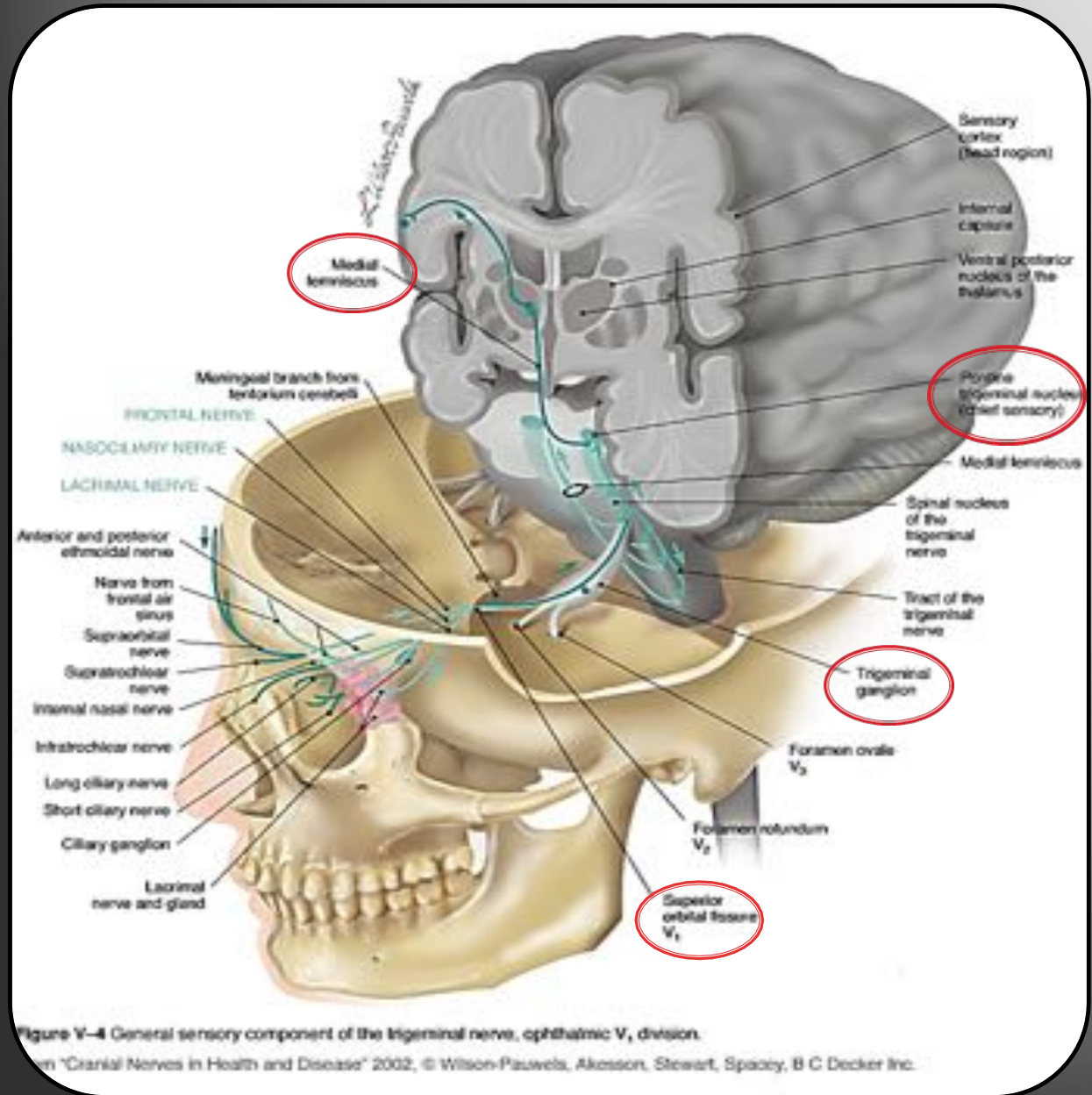
Temporalis

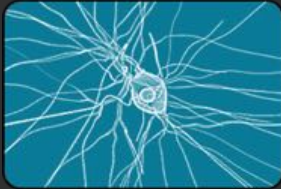
Masseter



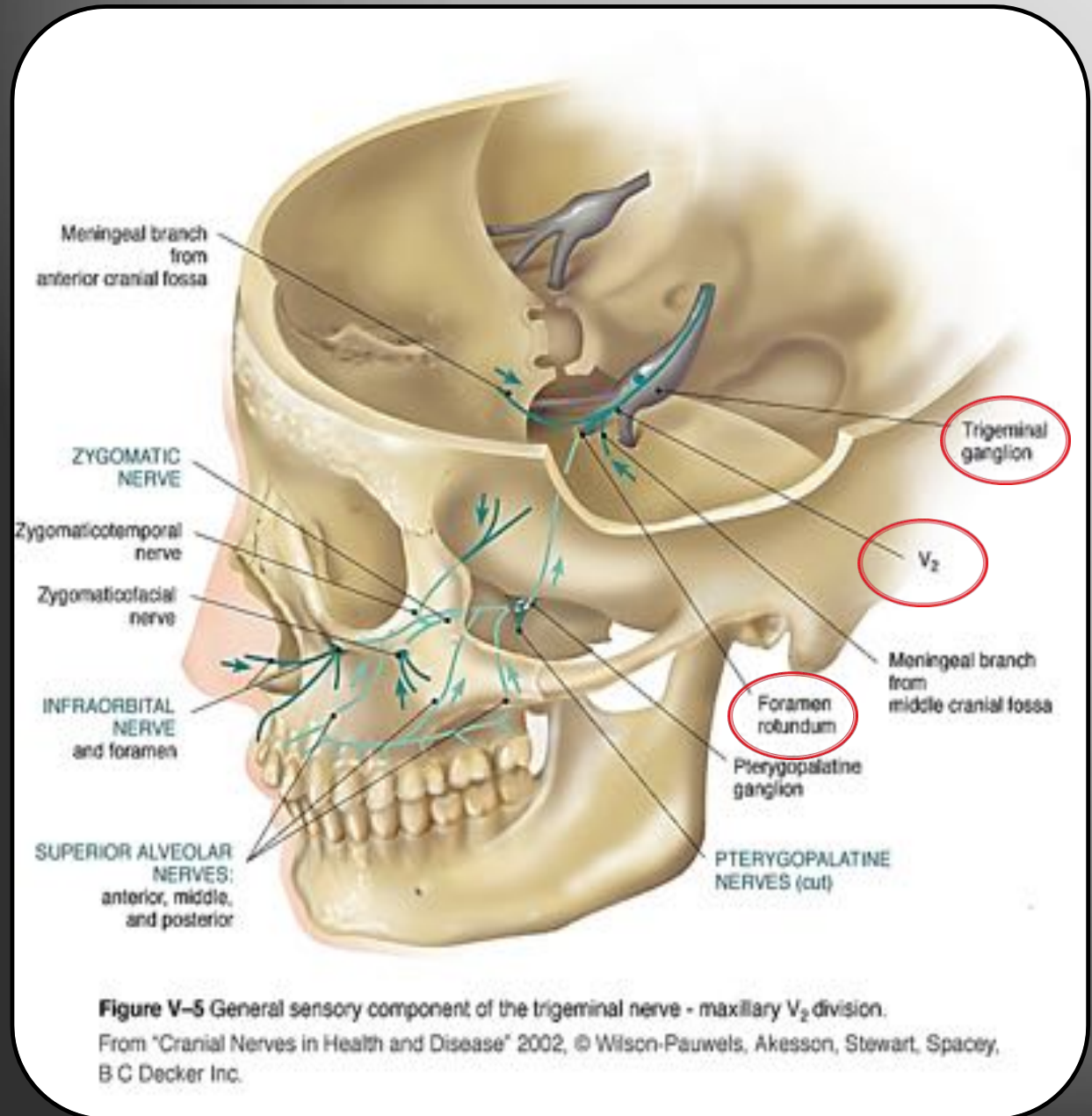


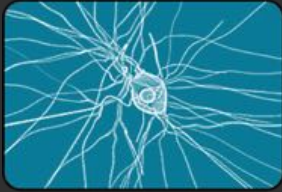
V1 - Ophthalmic Division





V2 - Maxillary Division





V3 - Mandibular Division

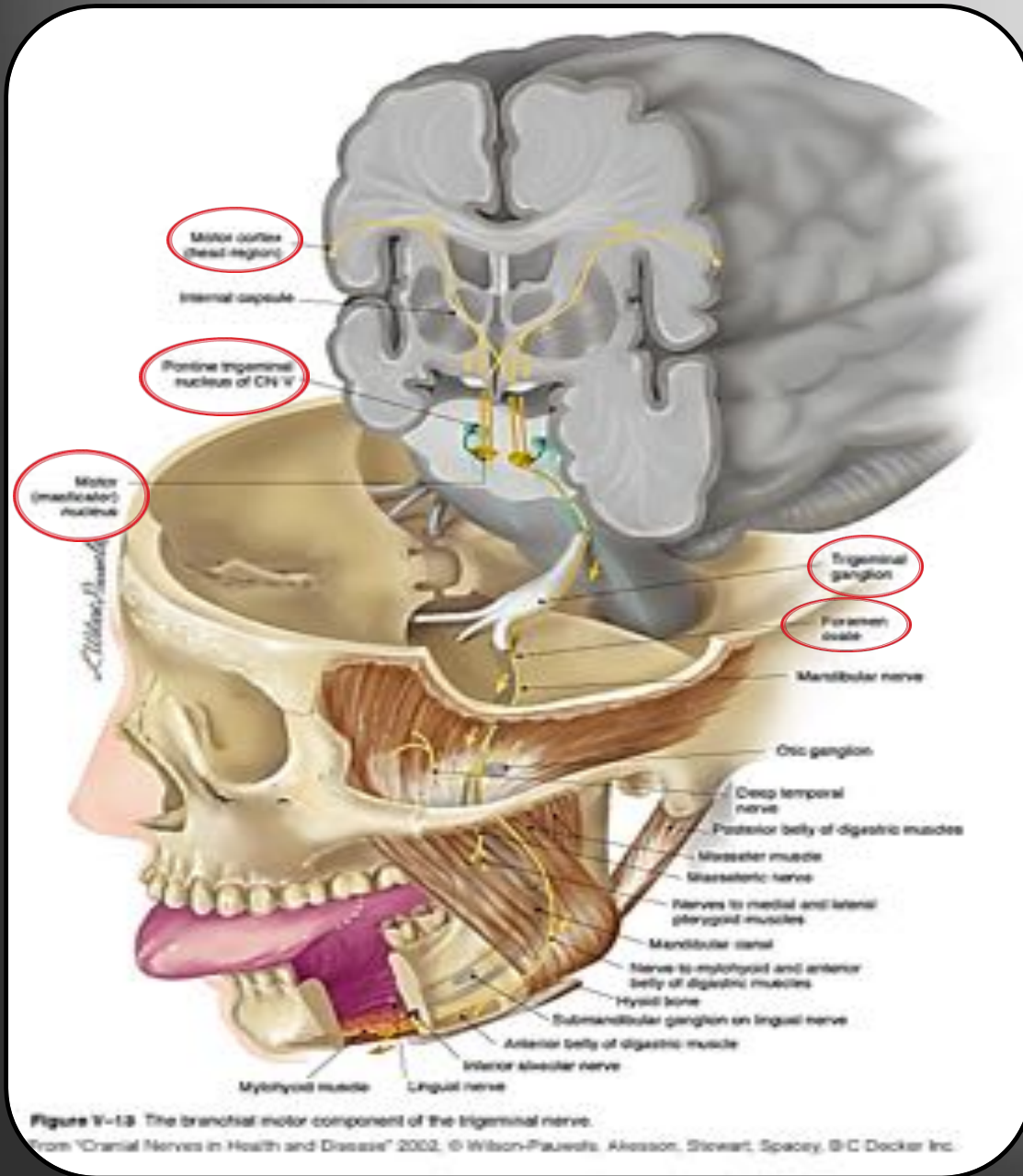
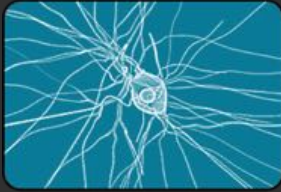


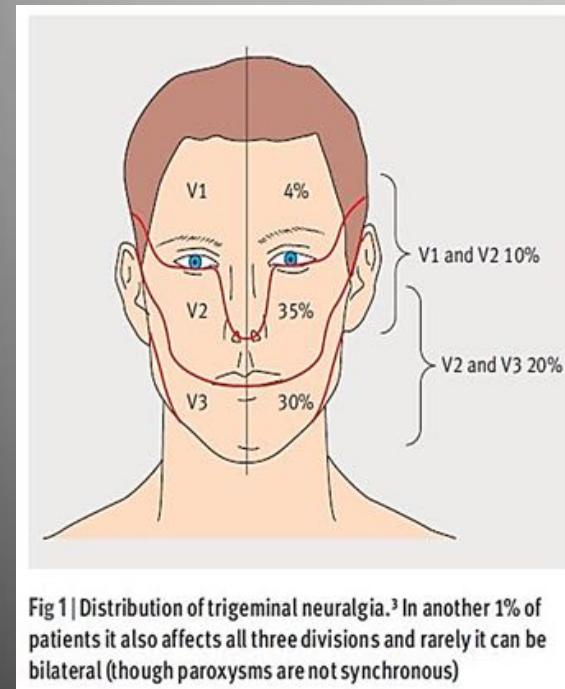
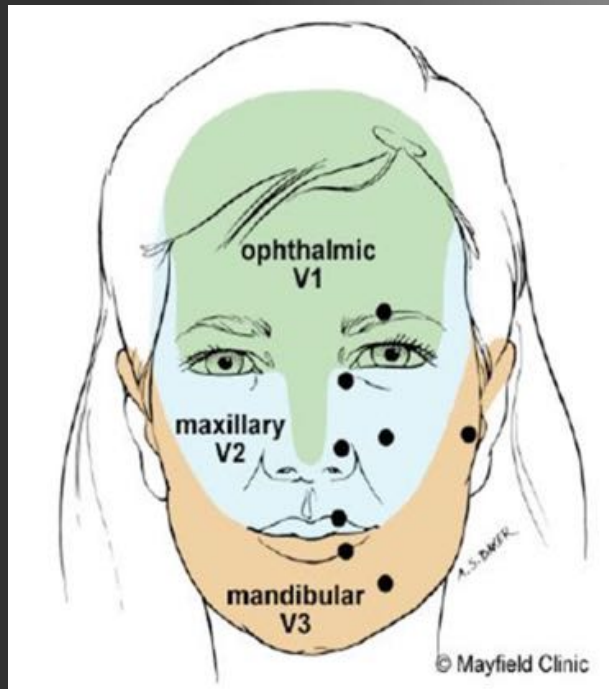
Figure V-13 The branchial motor component of the trigeminal nerve.
 From "Cranial Nerves in Health and Disease" 2002. © Wilson-Pauwels, Akesson, Stewart, Spacey, © C. Dockert Inc.



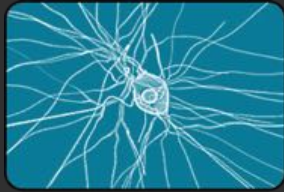
INTRO: Trigeminal Neuralgia

- Trigeminal Neuralgia (TN) is neuropathic facial pain arising from the trigeminal nerve.
- The pain is intense, sharp, electric shock-like pain in the face, lasting periods seconds, minutes, hours.
- Incidence 4-5 cases : 100.000
- TN or Tic Douloureux occur patients > 45 years.
- Male : Female ratio 1 : 1.5
- Unilateral (97%). Most affected V2 and V3.

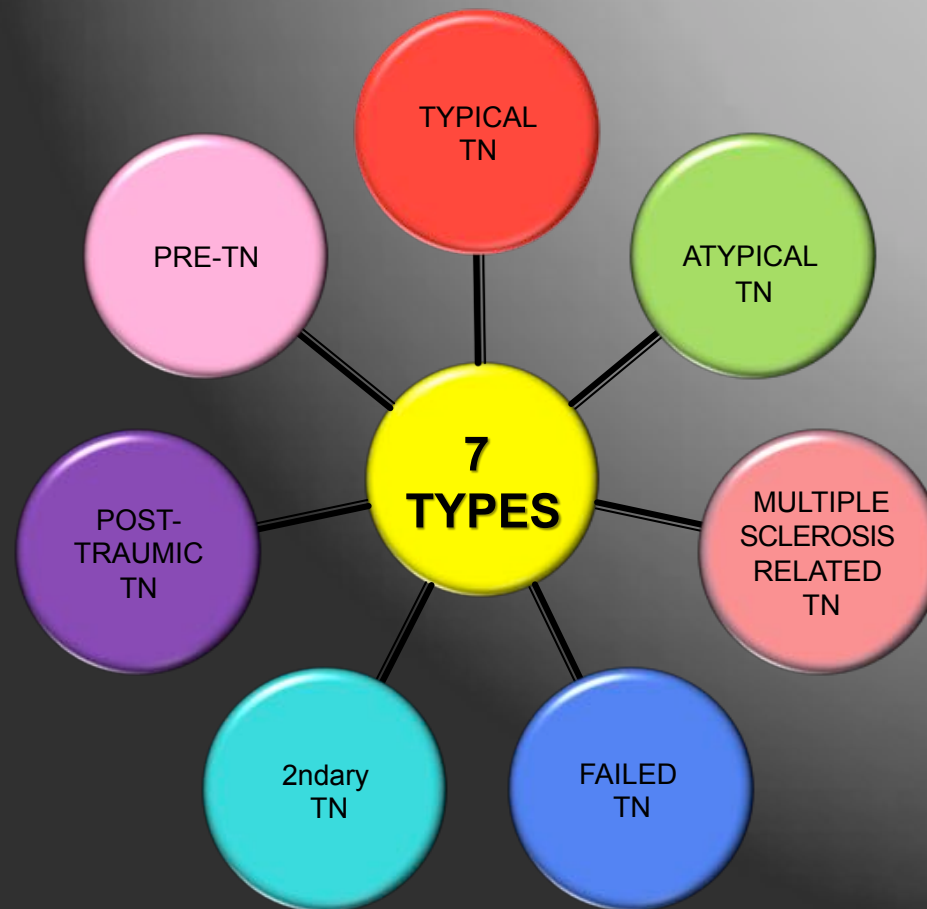
- Light pressure at “trigger points” can trigger attacks.

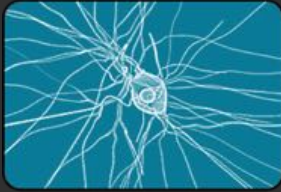


- Unpredictable symptom free intervals.
- Patient biggest ambitions
 - Eating, shaving, applying makeup.....



Classification Trigemina I Neuralgia





Clinical Features: Typical TN

1. Most common form. Severe sudden excruciating unilateral pain face.
2. Intense, stabbing, electrical shock-like pain.
3. Blood vessels compressing the trigeminal nerve root at the REZ - trigeminal nerve enters brain stem
 - Superior cerebellar artery (SCA)
 - Anterior inferior cerebellar artery (AICA)
4. Repeated vascular pulsations causes demyelination & injury to the trigeminal nerve - hyperactivity trigeminal nucleus - in TN pain
5. Frequently pain free between attacks.
6. Lasting only seconds - minutes - hours.
7. Each attack spontaneous or be triggered by specific stimulation.
8. Common triggers include touch, talking, eating, drinking, chewing, tooth brushing, hair combing

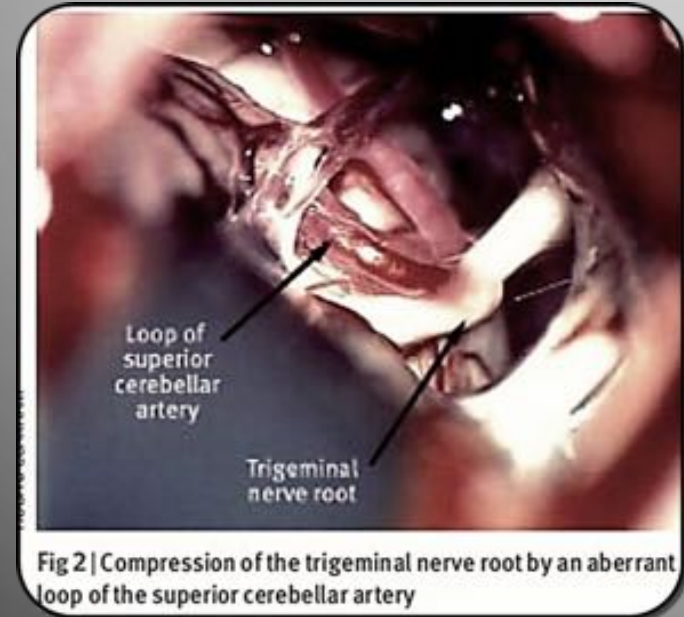
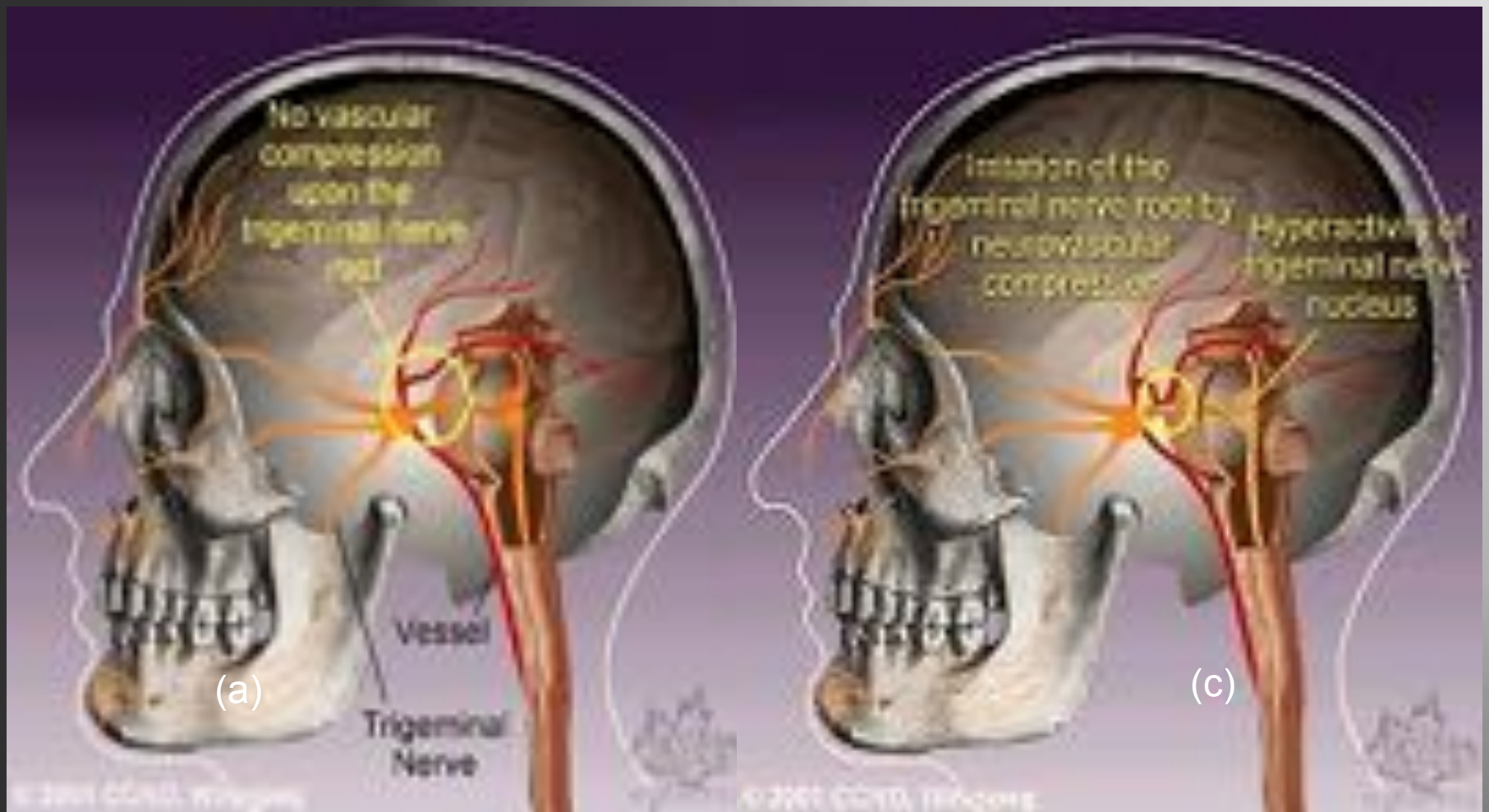
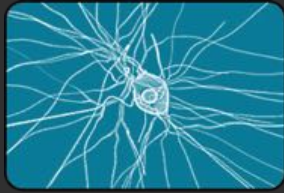


Fig 2 | Compression of the trigeminal nerve root by an aberrant loop of the superior cerebellar artery



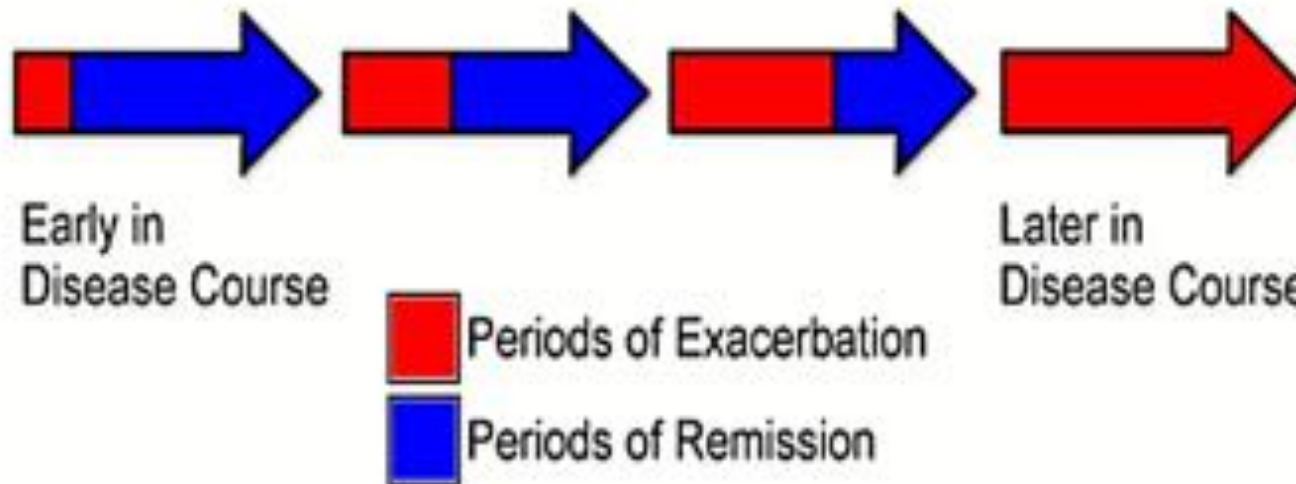
No compression CN V

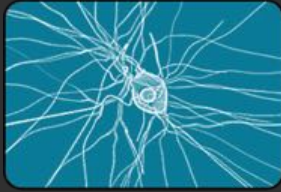
Vascular compression present



Typical TN Progression

Progression of Trigeminal Neuralgia Over Time

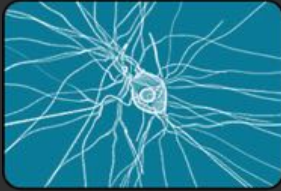




Diagnosis

- Clinical history
- Clinical examination
- CT scan and MRI
- MRA

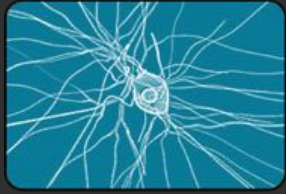




Treatments

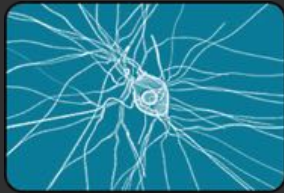
Medication: Anticonvulsants

- **Carbamazepine (Tegretol)**
 - Drug of choice for TN, effective dose 600 -1200 mg/ day for 3-4 x/ day
 - Side effect: drowsiness, mental confusion, dizziness, ataxia
- **Oxycarbazepine (Trileptal)**
 - Side effect: nausea, fatigue, tremor, anemia.....
 - Dose : 2 x 300mg, maximum dose : 2400-3000 mg/day
- **Phenytoin (Dilantin)**
 - Dose: 300-500mg/day for 3x day
 - Side effects: Nystagmus, dysarthria, gingival hyperplasia, hypertrichosis, allergic skin rash
- **Gabapentin (Neurontin)**
 - Dose: 300-1200mg/day
 - Side effects: drowsiness, ataxia, fatigue



IONM during MVD for TN

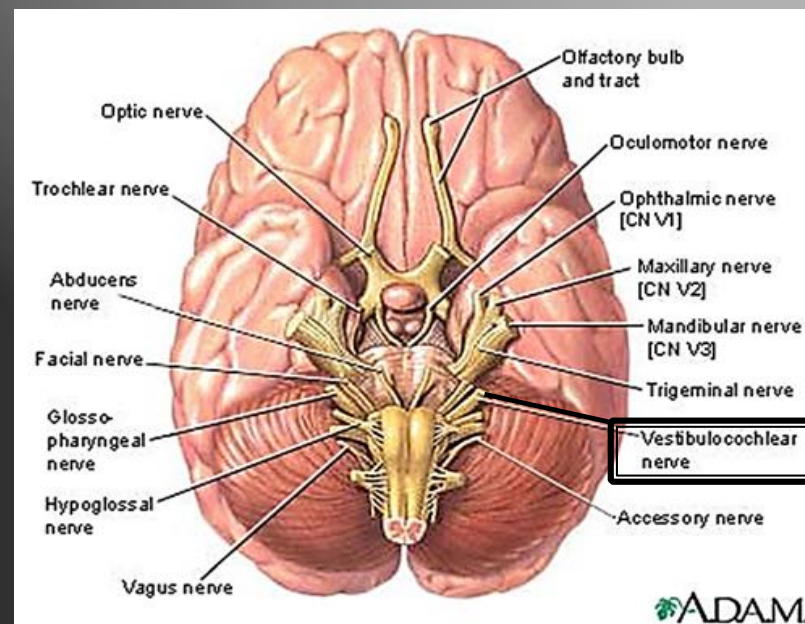
- “It’s the surgeons decision”
- General use EP’s and recordings for MVD’s:
 - *BAER’s
 - SSEP’s
 - *Triggered and Free run EMG



BAER's

- BAER's reflect the neurological responses of the 8th cranial nerve (vestibulocochlear nerve), following activation at the cochlea via a click stimulus, to various generator sites along the 8th cranial nerve and the brainstem. The first five waves are resistant to anesthesia and therefore are well suited to IONM. The multiple generator sites allow relative localization of insults during surgeries involving the brainstem and the 8th cranial nerve pathways.

Goal! - early warning impending neurological hearing deficits!

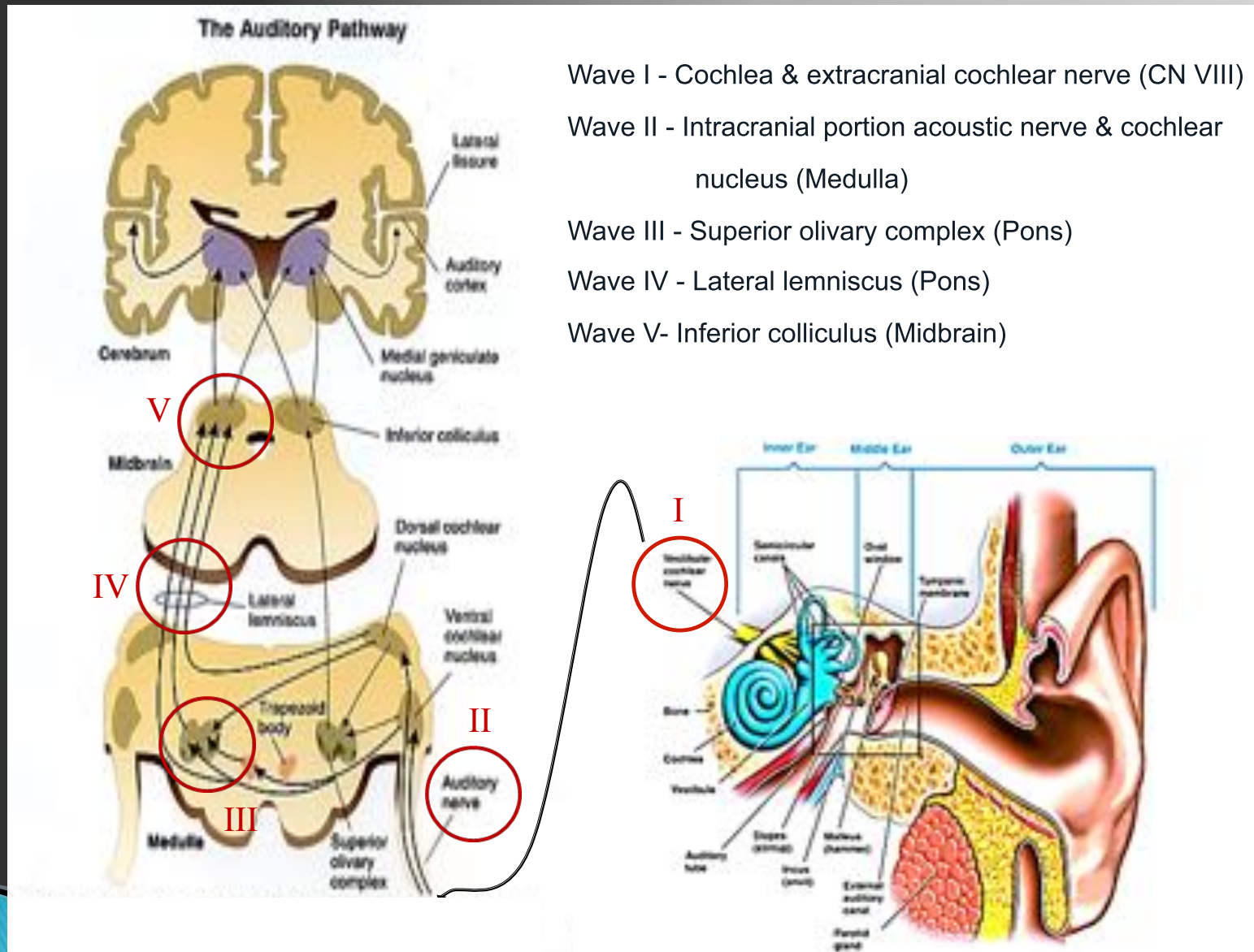


- **BAER Stimulus:**

- BAER's are elicited by delivering a click stimulus to the ear. To avoid contributions from the contralateral ear, masking white noise is delivered to the contralateral ear at approx. 40dB nHL.
- Many averaged trials are required to record reliable responses. Recommended stimulation rates are between 5-15 Hz (that's 5-15 stimuli/sec) with 11 Hz being a reasonable balance. Recommended stimulation and recording parameters are as follows:

	Low Freq Filter (Hz)	High Freq Filter (Hz)	Am p (μ V)	Typical latencies (ms)	Stim. Intensity (dB)	Stim Duration (ms)	Stim. Rate (Hz)
BAER	30-100	1500-3000	0.3-3	1.5-10	75-110 dB	0.1	5-15

- BAER pathways:



Wave I - Cochlea & extracranial cochlear nerve (CN VIII)

Wave II - Intracranial portion acoustic nerve & cochlear nucleus (Medulla)

Wave III - Superior olivary complex (Pons)

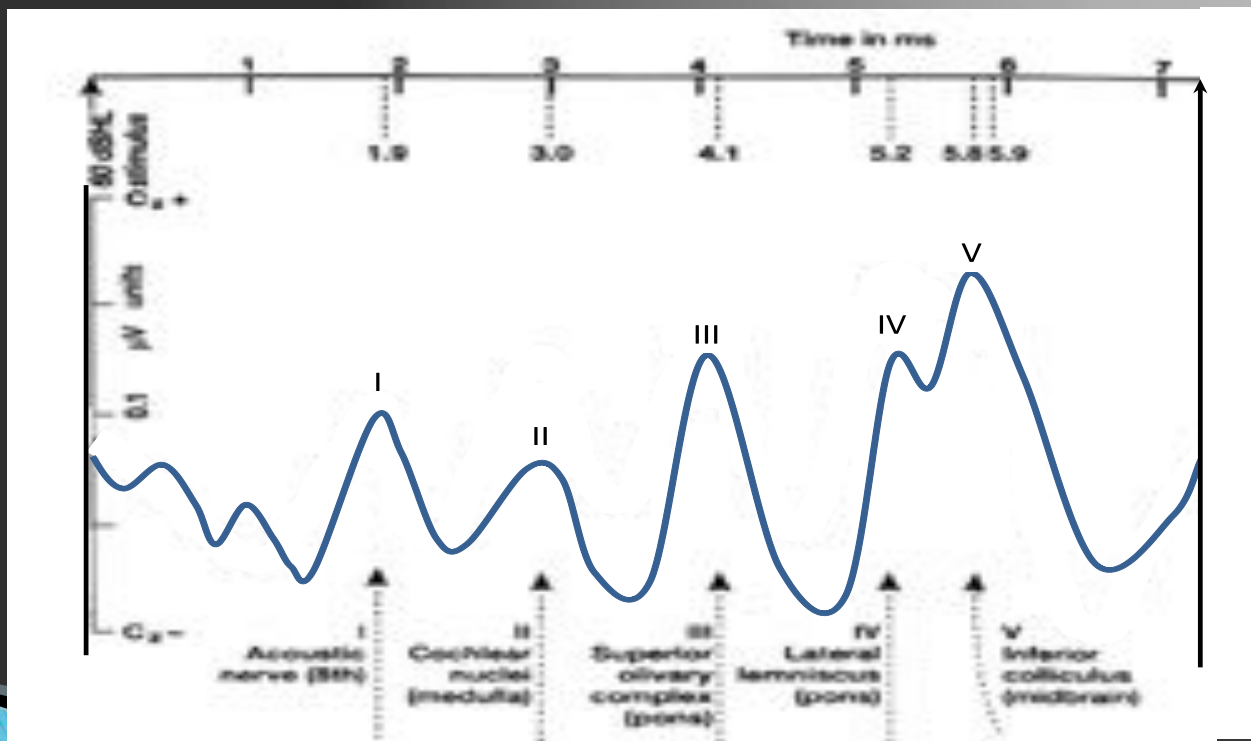
Wave IV - Lateral lemniscus (Pons)

Wave V- Inferior colliculus (Midbrain)

- BAER Assessment / waveform:

There are 5 principle features used to assess routine BAER's

1. I-V interpeak interval
2. I-III interpeak interval
3. III-V interval
5. Presence of wave I-V



4. V/I amplitude ratio

- Interpretation changes:

- **Point change significant?.....institutional**

- baseline responses
 - a latency increase wave V of more than 1.0ms from baseline
 - a amplitude reduction of 50% from baseline

- **Changes I-III interpeak latency (IPL):**

- Suggests disturbance along the eighth nerve close to the cochlea and the lower pons/cochlear nucleus. Often due to stretching/manipulation 8th nerve

- **Changes III-V IPL:**

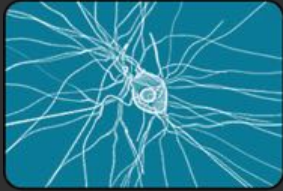
- Suggest disturbance between the lower pons/superior olivary complex and the midbrain/inferior colliculus. Often due to cerebellar compression due to retractor placement, or hypotension

- **Changes wave V latency:**

- Gradual latency/amp changes can begin w/ CPA exposure. Due to variety factors: stretch 8th CN, retractor placement, or cold irrigation.

- **Abrupt loss wave I:**

- Loss of wave 1, w / wo loss waves II - V due to compression/stretching auditory artery (labyrinthine artery) results – ischemia cochlea. Rapid: persists 15min = perm hearing loss

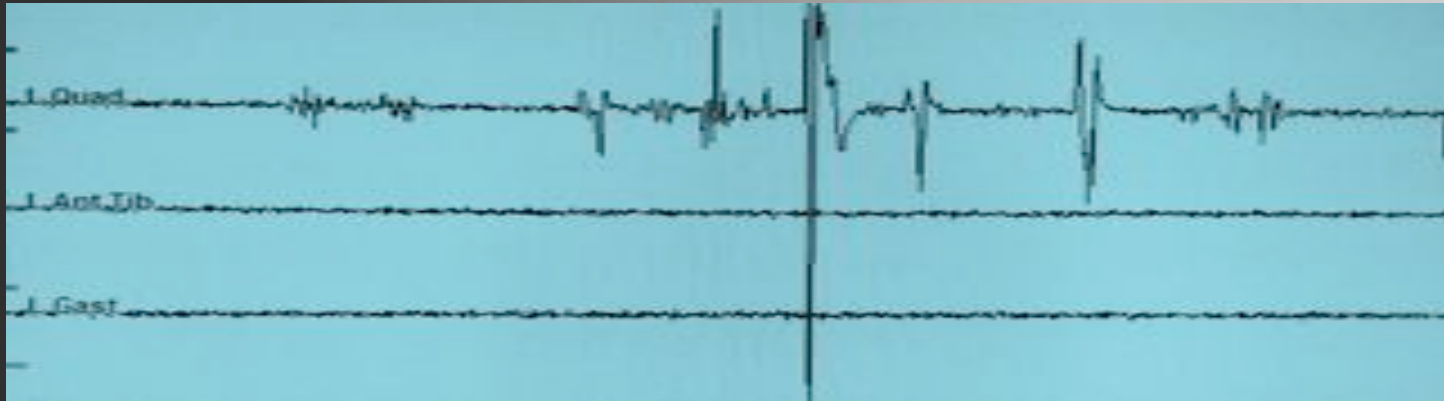


Free run & triggered EMG

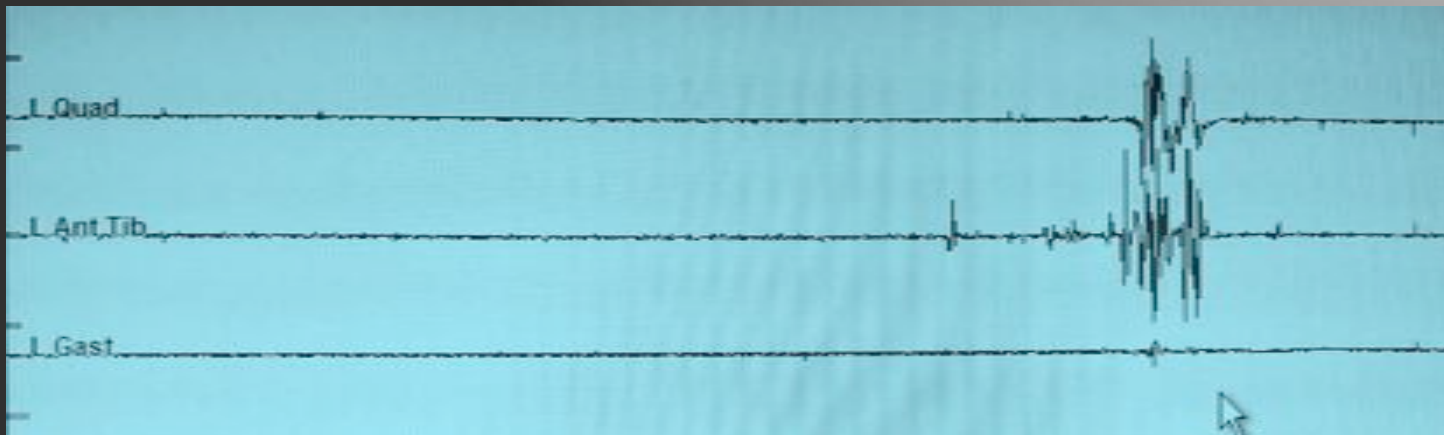
Free run EMG:

- Free run electromyography (EMG) records the patterns electrical activity assoc. w/ skeletal muscles: continuous, live real-time.
- Recorded subdermal electrodes: corresponding muscles assoc. neuro structures monitored.
- Resting muscle/assoc. nerve are electrically silent. No response at rest.

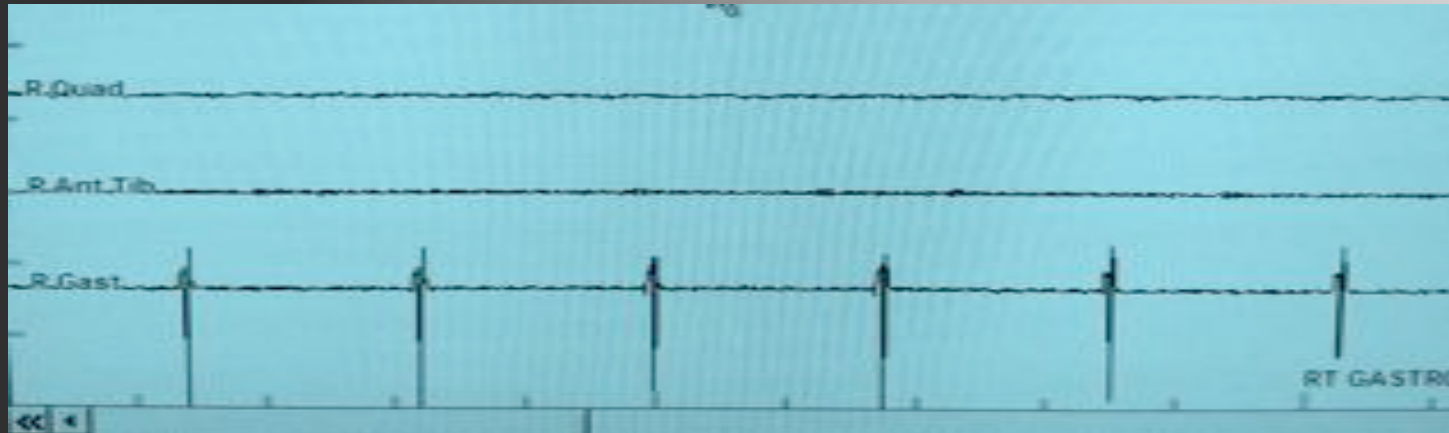
- ▶ spikes (individual discharges)



- ▶ bursts (brief flurries of discharges)



- ▶ train activity (more persistent regularly repeating discharge patterns)

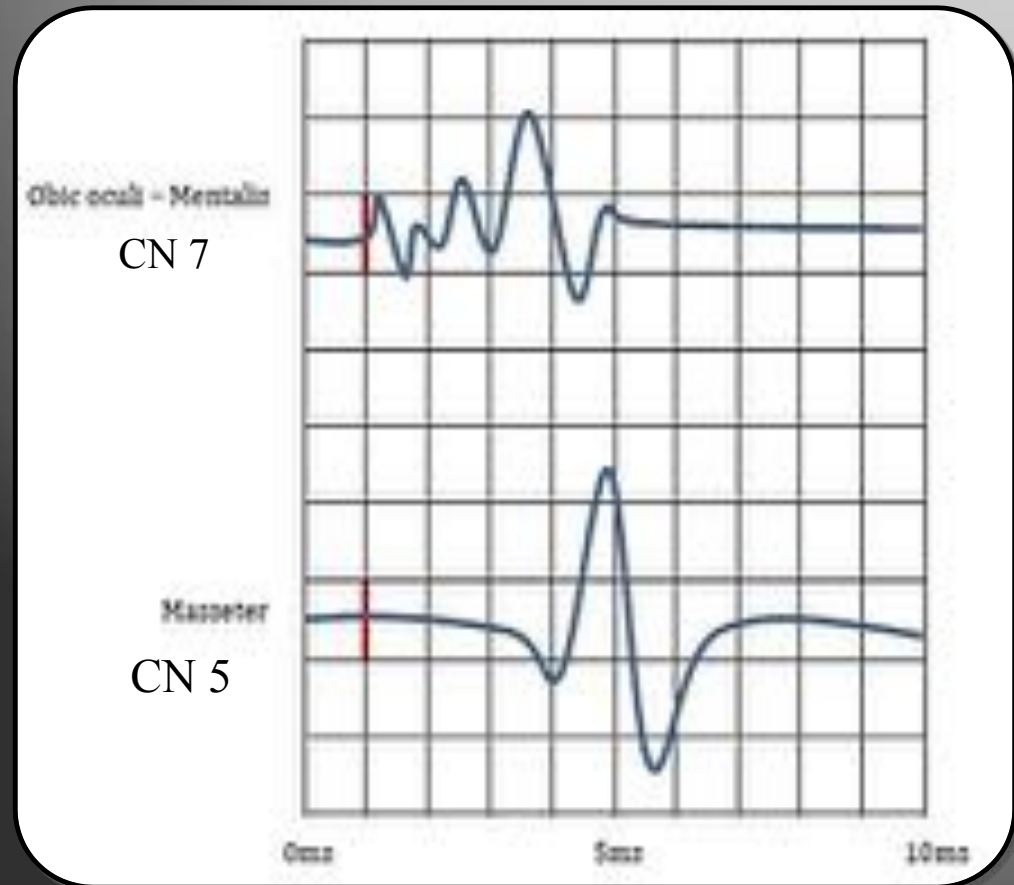


- ▶ neurotonic discharges (persistent prolonged bursting)



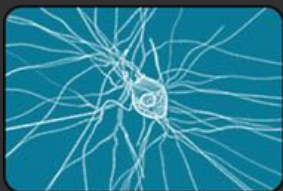
Triggered EMG:

- Neuro. structure/nerve stimulated and a CMAP is recorded in corresponding muscles innervated by the neurological structure.
- Used to:
 - ID nervous tissue
 - ID neurological structures (cranial nerve, nerve root)
 - Integrity nerve (damage)



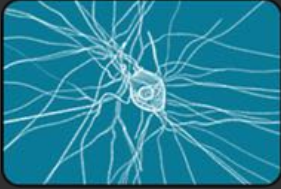
- Evaluate the health/state of muscles and motor neurons controlling muscles
- Recording parameters EMG:

	Low Freq Filter (Hz)	High Freq Filter (Hz)	Gain/ sensitivity (μV)	Typical latencies (ms)	Stim. Intensity (mA)	Stim Duration (ms)	Stim. Rate (Hz)	Time Base (ms)
Free EMG	30-100	1500-3000	20-50/div	n/a	n/a	n/a	n/a	100/div
Trig EMG	30-100	1500-3000	20-50/div	10-25	10-25	0.2	1-4	1-10/div



Anesthetic Concerns

- BAERS responses are subcortical!
 - Common anesthetic gases have little effect
- EMG responses require the patient not be paralyzed using common paralytic drugs.
 - Use paralytics at beginning vs critical monitoring portions of the surgery.



Case Progression for IONM

- How does this type of case typically progress for IONM?
 - Before the surgery
 - Case prep and communication: Patient, Anesthesiologist, Neurosurgeon, OR room staff.
 - Positioning patient, induction and intubation by anesthesiologist.
 - IONM tech places electrodes and stimulators then plugs in all leads. Where?
 - BAER's

- **BAER Montage:**

- 2 -3 channels used to record BAER's following the International 10-20 System:

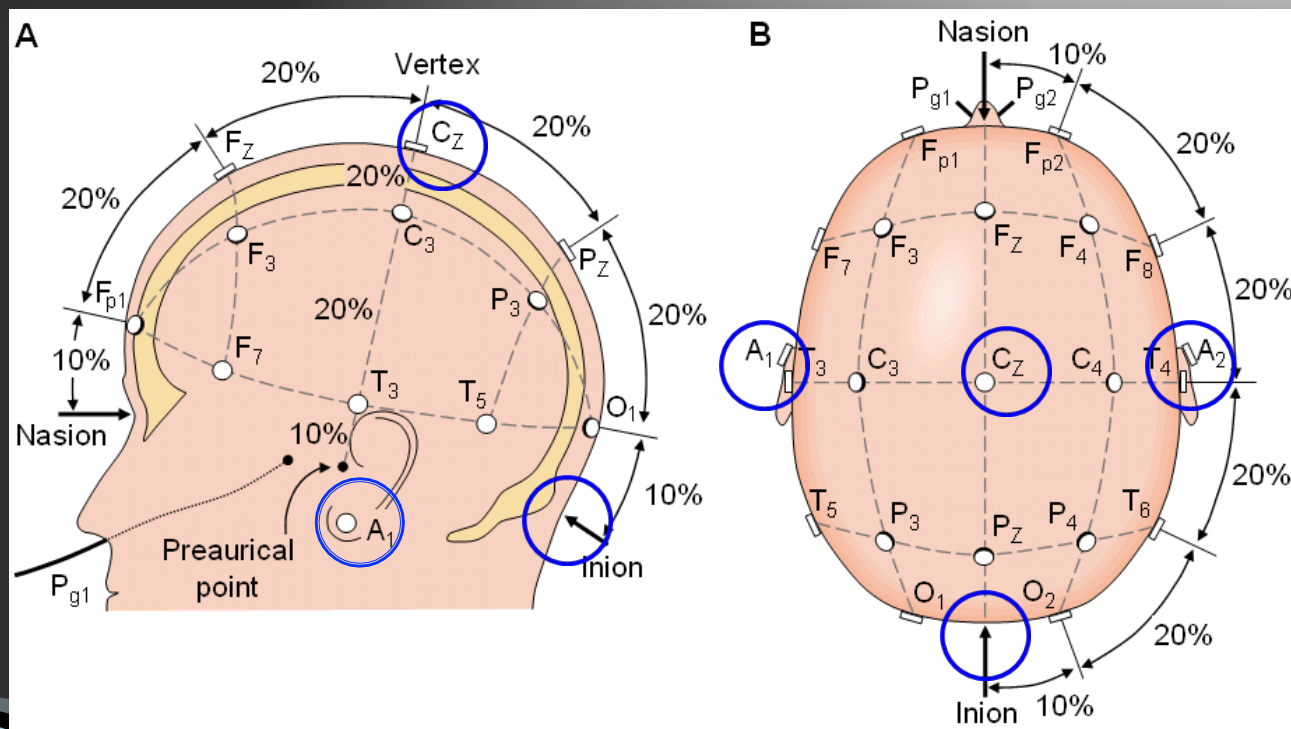
- **Channel 1:** A1 - Cz

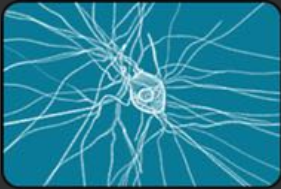
- **Channel 2:** A2 - Cz

- **Channel 3:** Cv2 (inion) - Cz

- **Important*** Cv2 - Cz generally have poorly defined Waves I-IV, but have a well defined Wave V.

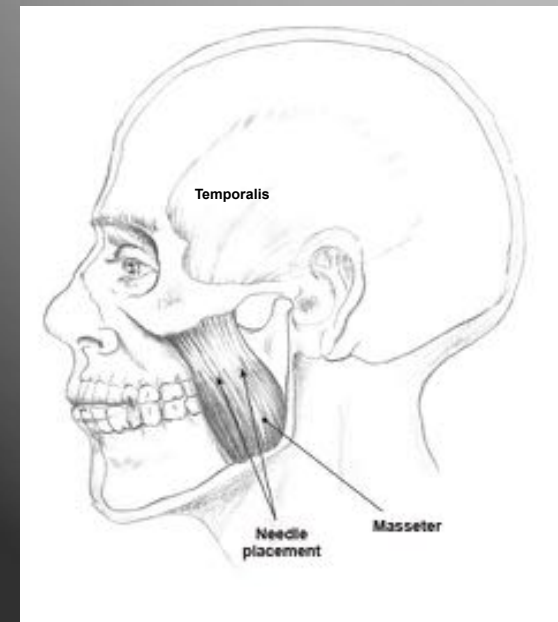
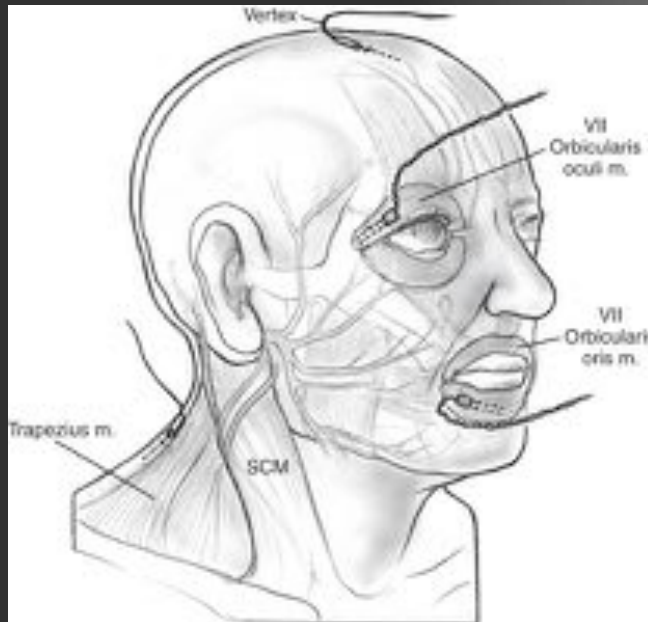
- **Note*** Mastoid substitute: A1 and A2





Case Progression for IONM

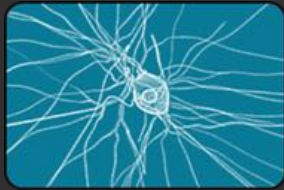
- Needle electrode placement. Where?
 - MVD: Needle electrode placement
 - Masseter and Temporalis (CN V)
 - Obic. oculi and Obic. Oris (CN VII).....reasons?
 - Trapezius (CN XI) - control



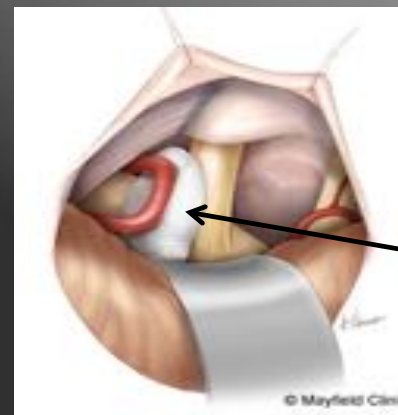
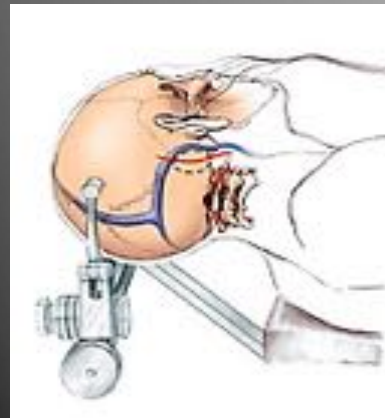
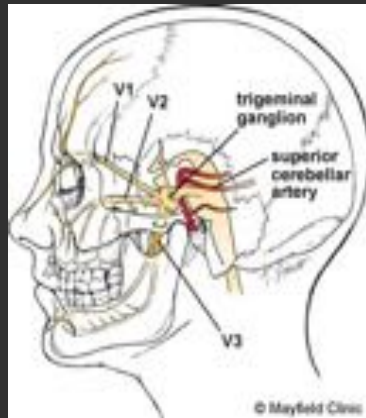


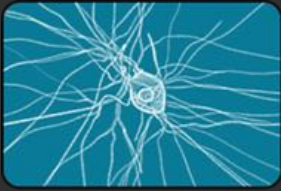
Case Progression for IONM

- How does this type of case typically progress for IONM?
 - Before the surgery
 - Impedance check and baselines acquired.
 - Communicate any problems, or response baseline abnormalities with the surgeon.
 - Skin incision: exposure/procedure begins.



Surgical Procedure: Microvascular decompression (MVD)

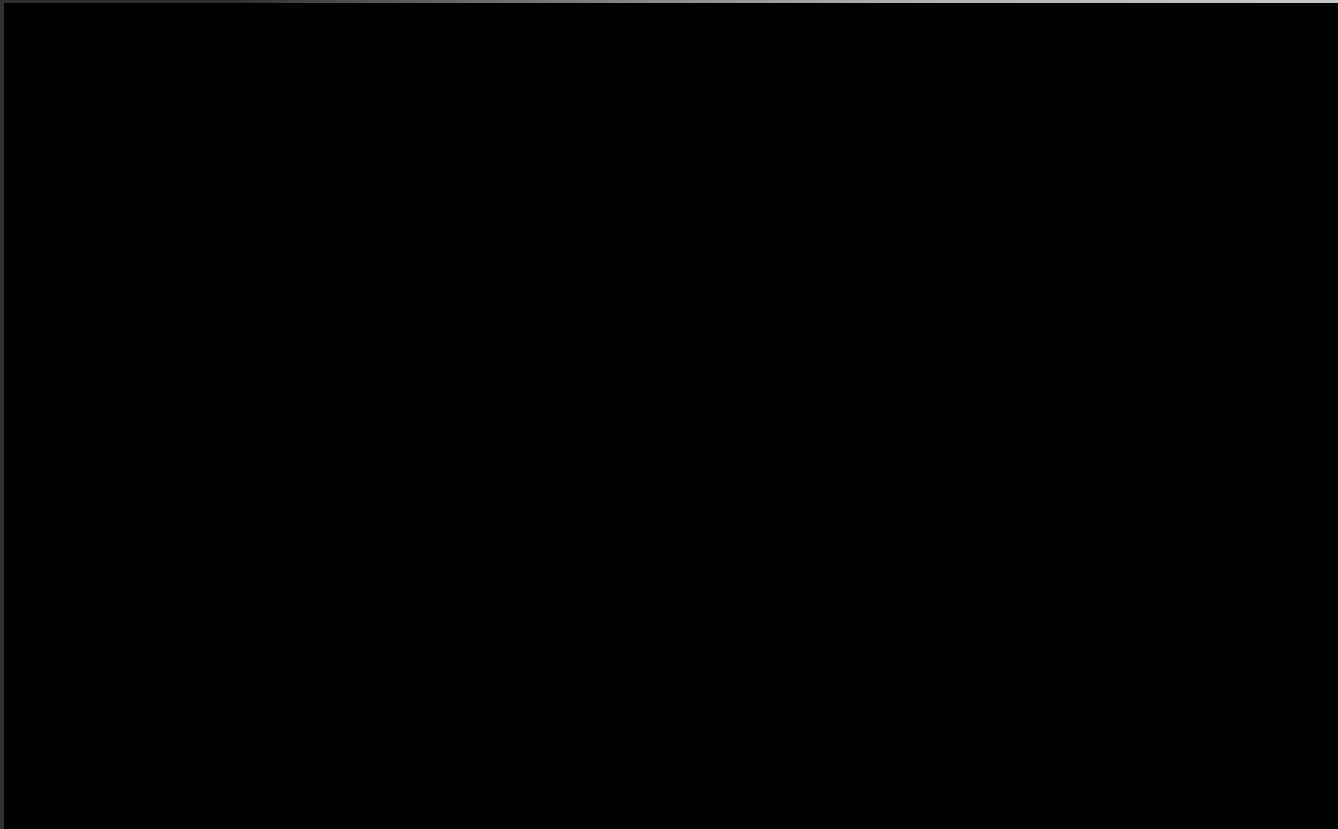




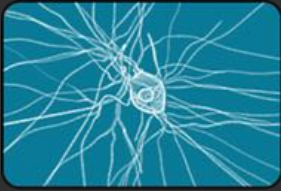
Critical Points in the Surgery

- Critical points?
- Lets I.D these points
 - Critical points:
 - i. Open dura.
 - ii. Place retractors (retract cerebellum).
 - iii. Arterial/Venous manipulation (AICA, SCA, Labyrinthine, Petrosal vein).
 - iv. Place Teflon pad.
- Surgical procedure
 - Video

Surgical procedure - MVD Video:



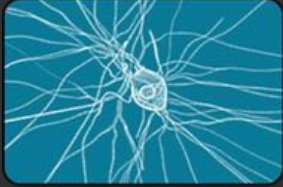
<https://www.youtube.com/watch?v=d8zWlhxzg4>



Complications and Results

2016 University of Pittsburgh Medical Center study: 6yrs

- 421 people with trigeminal neuralgia.
 - Complete relief in 82%
 - Partial relief in 16%
- One year after surgery
 - 75% continue complete relief
 - 8% partial relief
- Major complications- fewer than 5 percent of cases
 - Perm mild hearing loss 2.6%.
 - Using IONM loss 0.8%
 - Complete hearing loss 1.4%.
 - Using IONM loss 0.4%
 - Facial nerve palsy 0.6%



CONCLUSION

- Trigeminal nerve (CN V) separate into ophthalmic (V1), maxillary (V2), and mandibular (V3) branches provided major sensory feedback for the face and motor innervation masseter and temporalis muscles.
- Trigeminal Neuralgia (TN) is shock-like neuropathic facial pain arising from compression trigeminal nerve via SCA (AICA).
- Treatment for typical TN..... Medication: if pharmacologic treatment fails..... surgical procedure.
- MVD: craniotomy decompresses CN V by placing Teflon pads b/w SCA (or AICA) and CN V.
- BAER's and Trig / Free run EMG provide intraoperative feedback as to the state of CN V, CN VII, and CN VIII helping to protect these neuro structures during surgical procedure and preserve hearing, sensation to the face, and motor control of the facial muscles.

Thank you

1. Aatif M. Husain MD: A Practical Approach to Neurophysiologic Intraoperative Monitoring, Demos, 2008.
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3. www.eneuro.med.pro/images
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5. www.brain-surgery.com/microsurgical-decompression-of-trigeminal-neuralgia
6. www.cduma.com/trigeminal-neuralgia
7. www.umanitoba.ca/cranial_nerves/trigeminal_neural
8. <http://www.youtube.com/watch?v=FDQa95DqHes&feature=share&list=PL064AEF4C9053A3F3>
9. www.bmc.med.utoronto.ca/cranialnerves/index.php?option=com_content&view=article&id=48&Itemid=57
10. Cranial Nerves in Health and Disease, 2002 Sian D. Spacey, Patricia A. Stewart, Eliza

