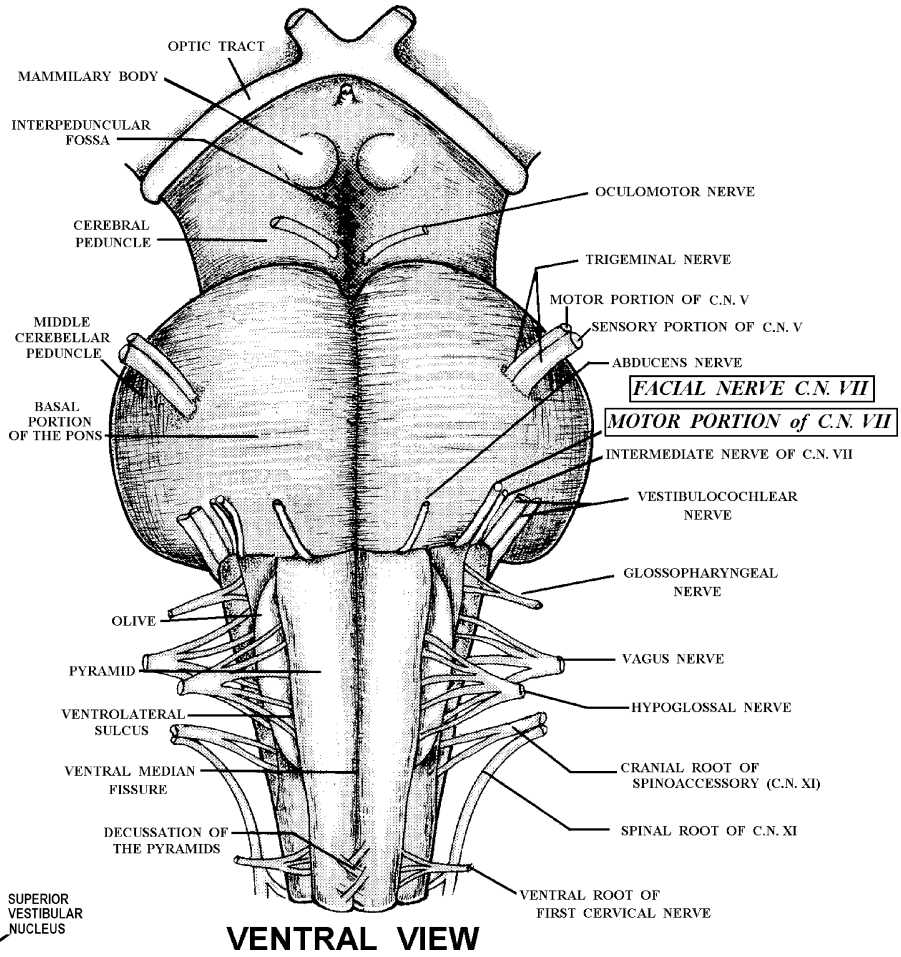
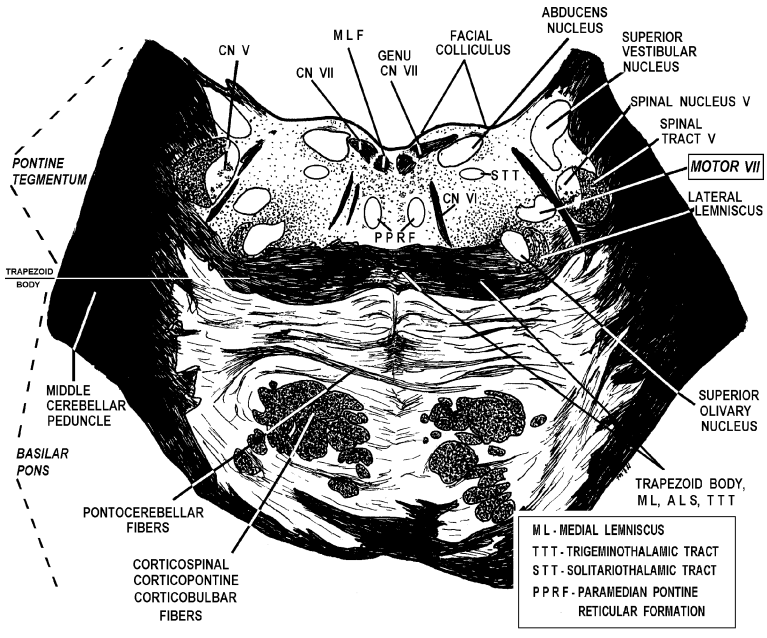
14 MOTOR NUCLEUS OF CRANIAL NERVE VII (MOTOR VII)

Before turning to the motor VII, you should note that the pons consists of two zones, a dorsal portion called the **tegmentum** of the pons and a ventral zone called the **basilar pons**. The tegmentum contains cranial nerve nuclei and ascending pathways such as the medial lemniscus, lateral lemniscus, ALS (spinothalamic tract), STT (solitariothalamic tract) and TTT (trigeminothalamic tract). The basilar region contains the pontine grey nuclei and massive groups of descending fibers, including the corticospinal, corticobulbar, and corticopontine tracts.

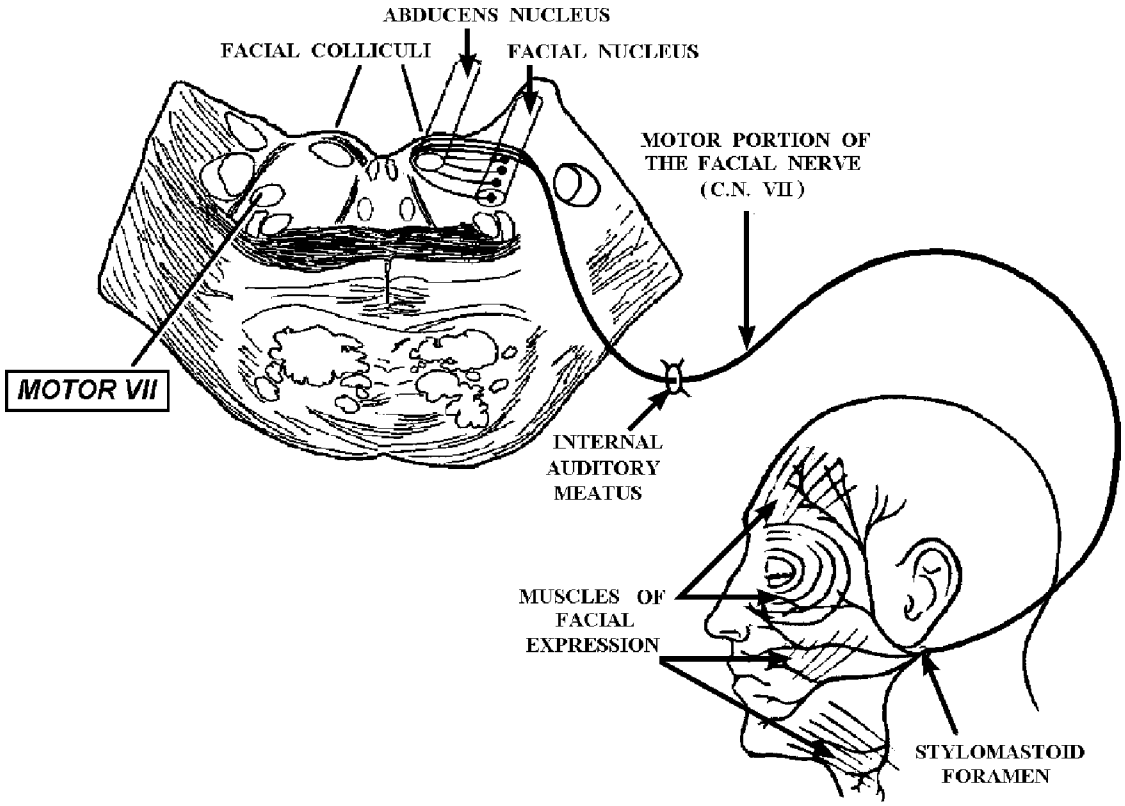


VENTRAL VIEW



LEVEL 5. MIDDLE PONS - FACIAL COLLICULUS

The motor nucleus VII contains motor neurons (branchiomotor) that innervate the muscles of facial expression including the orbicularis oculi (**CLOSES** eyelid), the stapedius, the stylohyoid and the posterior belly of the digastric. Neurons comprising motor VII possess axons that pursue a rather circuitous route in order to exit the brain stem. Initially they pass dorsally and medially to loop over the abducens nucleus. The fibers then course ventrally and laterally to exit the brain stem. The bump in the floor of the fourth ventricle caused by the motor fibers of C.N. VII looping over the abducens nucleus is called the **FACIAL COLLICULUS**.

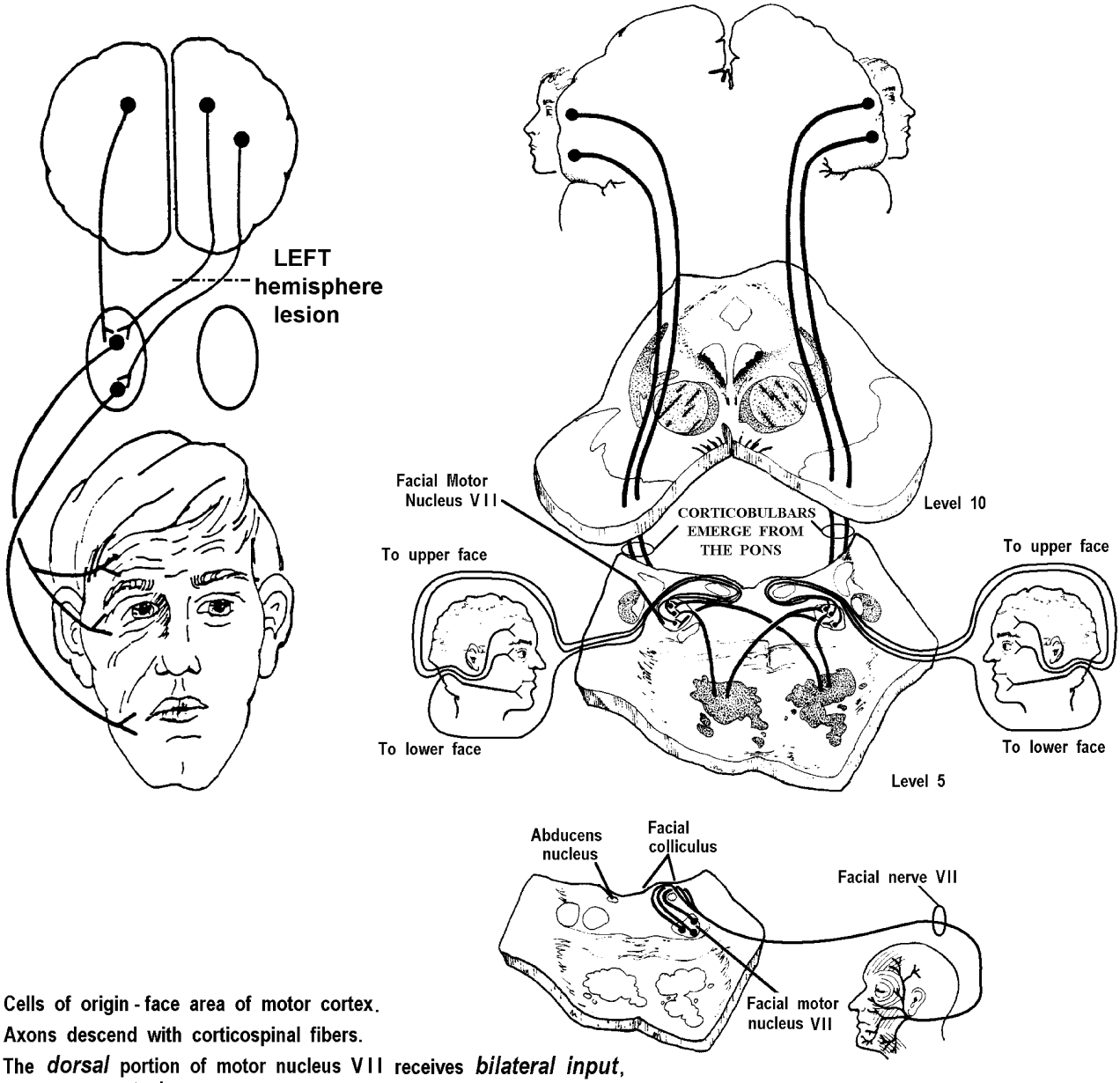


A unilateral lesion interrupting the axons of C.N. VII results in the following: On the ipsilateral side, the forehead is immobile, the corner of the mouth sags, the nasolabial folds of the face are flattened, facial lines are lost, and saliva may drip from the corner of the mouth. The patient is unable to whistle or puff the cheek because the buccinator muscle is paralyzed. When the patient is smiling, the normal muscles draw the contralateral corner of the mouth up while the paralyzed corner continues to sag. Corneal sensitivity remains (C.N. V), but the patient is unable to blink or close the eyelid (CN VII). To protect the cornea from drying, therapeutic closure of the eyelids or other measures are taken (patient wears an eye mask, or lids are closed with sutures). Because of the paralysis of the stapedius muscle, which normally dampens the amplitude of the vibrations of the ear ossicles, the patient will experience sounds as uncomfortably loud. **THIS IS CALLED HYPERACUSIS**. **REMEMBER, THERE <u>WILL</u> BE ATROPHY OF ALL OF THE ABOVE MUSCLES** (i.e. Lower Motor Neuron).

You will recall that the cortex sends axons to cranial nerve motor nuclei. These are called **CORTICOBULBAR** fibers (remember those to the hypoglossal and nucleus ambiguus?). A unilateral lesion of the corticobulbar fibers to motor VII, for example in the motor cortex, results in weakness of the muscles of expression of the face **BELOW THE EYE ON THE SIDE CONTRALATERAL TO THE LESION**. The frontalis muscle (wrinkles forehead) and the orbicularis oculi muscle (closes eyelid) are unaffected. The accepted explanation states that **BILATERAL** (crossed and uncrossed) corticobulbar projections from the cerebral cortex influence the lower motor neurons (within Motor VII) innervating the frontalis muscle and orbicularis oculi, while only CROSSED corticobulbar projections influence the lower motor neurons innervating the muscles of the **LOWER** face. Think about it like this, the lower part of Motor VII is like the hypoglossal nucleus (crossed corticobulbars), while the upper part is like nucleus ambiguus (bilateral corticobulbars).

A lesion in the face representation of area 4 (motor cortex) will mean that those motor neurons in the contralateral region (ventral) of motor VII that innervate the lower facial muscles are completely deprived of cortical input. In contrast, the lower motor neurons in that part of motor VII that innervate the upper facial muscles still have cortical input from the ipsilateral motor cortex. Such muscles, therefore, contract when the patient wants to voluntarily contract them. **REMEMBER, THERE IS NO MUSCLE ATROPHY FOLLOWING A LESION OF THE CORTICOBULBAR FIBERS**.

You should now think about the resulting neurological deficits following a lesion of the **LEFT** motor cortex that interrupts all **CORTICOSPINAL** fibers and **CORTICOBULBAR** fibers to **motor VII, nucleus ambiguus and the hypoglossal nucleus**. There will be a **RIGHT** hemiplegia, the tongue will deviate to the **RIGHT** upon protrusion, and the lower facial muscles on the **RIGHT** will be weak. Any problems with swallowing? Will the uvula deviate when you say ahhh? **THINK! THIS IS VERY IMPORTANT.**



1. Cells of origin - face area of motor cortex.
2. Axons descend with corticospinal fibers.
3. The *dorsal* portion of motor nucleus VII receives *bilateral input*, while the *ventral* portion receives only *crossed input*. Thus, after a stroke involving these fibers, a patient can voluntarily wrinkle the forehead but muscles below the eyes on the contralateral side do not respond (all cortical input is interrupted). There is NO ATROPHY!

CORTICOBULBARS TO MOTOR VII

PROBLEM SOLVING MATCHING

Match the best choice in the right hand column with the pathway or cell group in the left hand column

____1. left rostral nucleus solitarius

____2. right abducens nerve

____3. right superior olivary nucleus

____4. left nucleus ambiguus

____5. right motor nucleus VII

A. lesion results in atrophy of the left medial rectus muscle

B. lesion results in tongue deviation to the left upon protrusion

C. cells project to the left stylopharyngeus muscle

D. lesion results in the inability to move the right eye past the midline to the right; double vision

E. receives input from the left inferior ganglion IX

F. lesion results in a loss of pain and temp from the left side of the pharynx

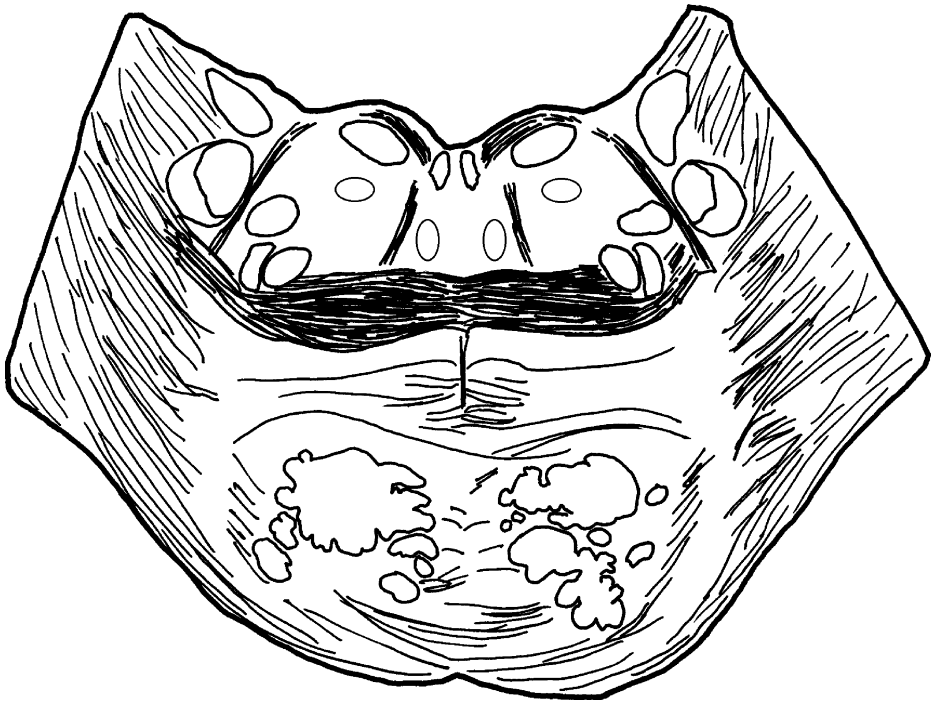
G. lesion results in atrophy of the left orbicularis oculi

H. lesion results in deafness in the right ear

I. lesion results in failure of corneal blink reflex in the right eye following stimulation of either cornea

J. lesion results in subtle auditory deficits

PROBLEM SOLVING

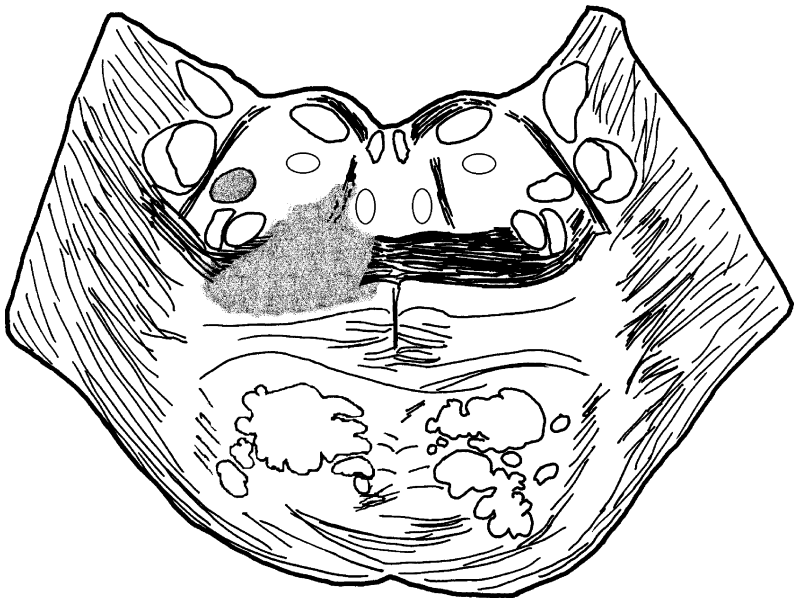


RIGHT LEFT

Shade in the location, of <u>unilateral</u> <u>lesions</u> in the above drawing that will account for the following neurological problems: (MAKE THE LESIONS AS SMALL AS POSSIBLE)

loss of pain and temperature from the <u>left</u> side of the body, double vision, especially when attempting to turn eyes to the <u>right</u>, hypersensitivity to sounds, drooling from the <u>right</u> side of the mouth, dry cornea on the <u>right</u>

PROBLEM SOLVING ANSWER



AN INTERESTING CLINICAL OBSERVATION

It is known that following a stroke muscles of facial expression of the lower face on the opposite side are weak and the patient cannot voluntarily move these muscles. However, reflex smiling (at a joke) did result in movement of these muscles. This suggests that there are different pathways involved in moving these muscles during voluntary and reflex movements.

"SPEED PLAY"

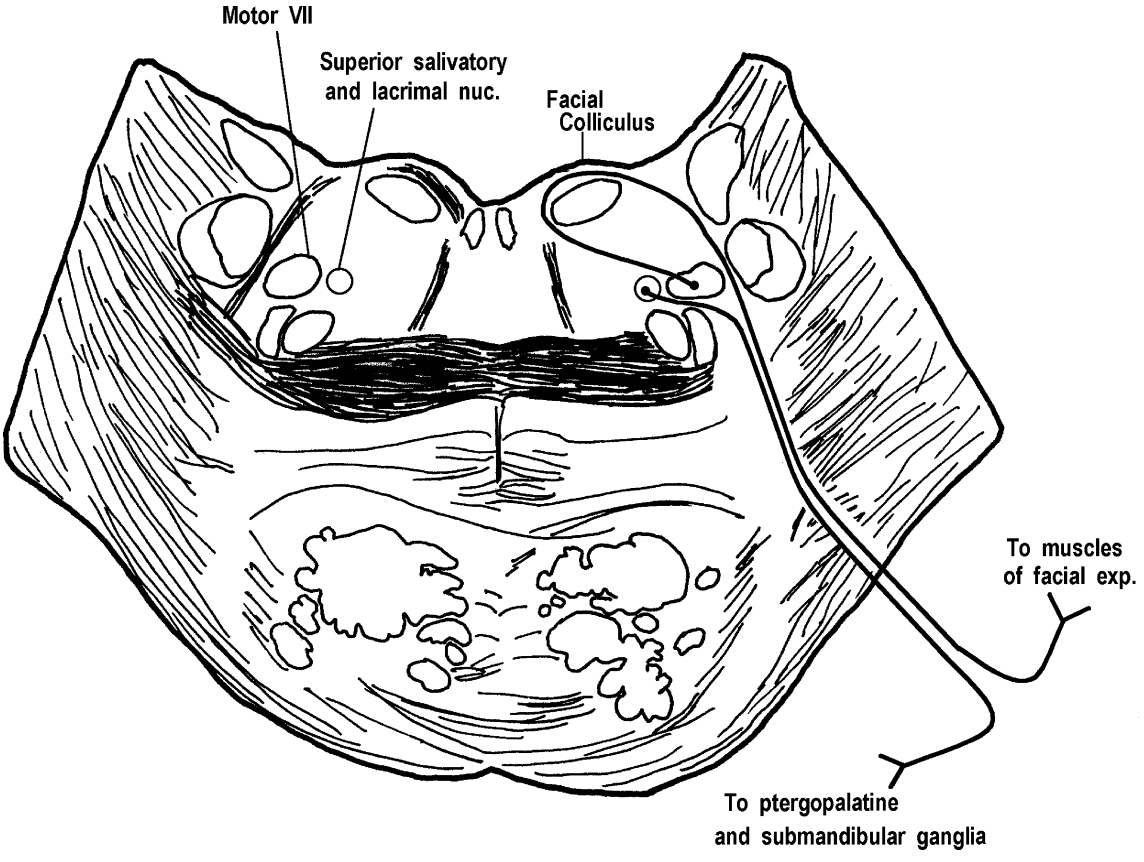
Facial weakness ipsilateral to body weakness implies a lesion in or above the rostral pons.

15 SUPERIOR SALIVATORY AND LACRIMAL NUCLEI

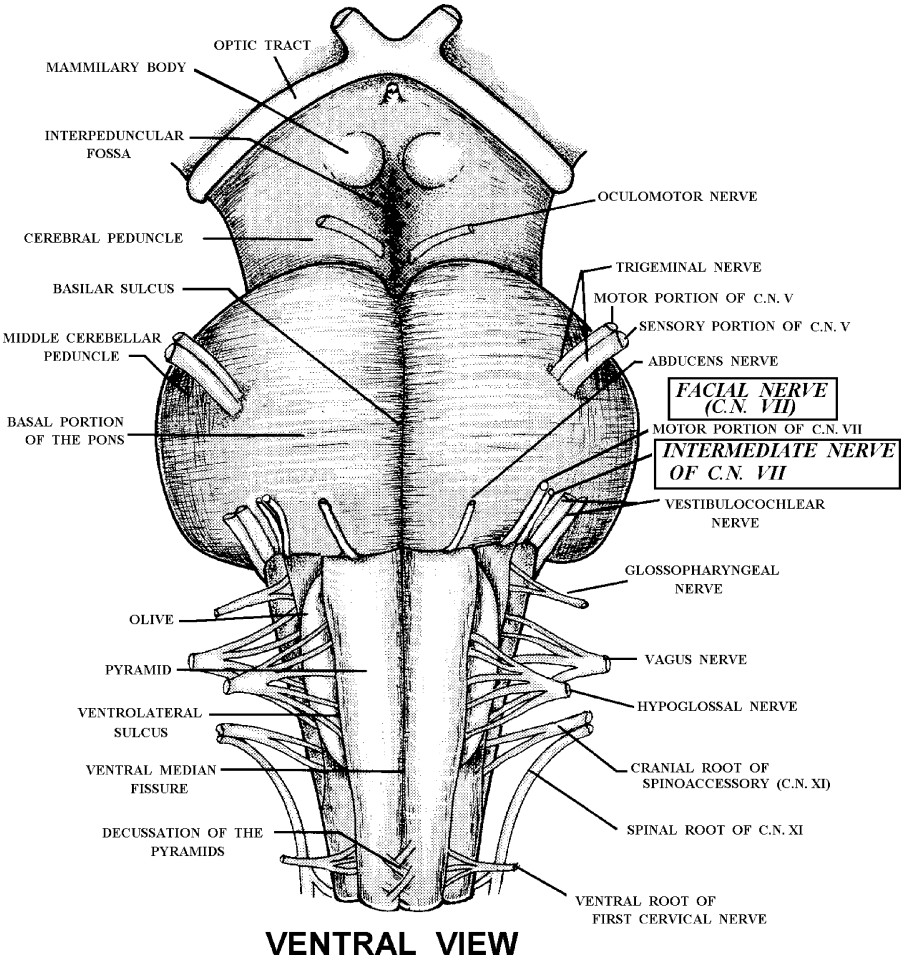
We have already discussed two **PREGANGLIONIC PARASYMPATHETIC** (visceromotor) nuclei, the dorsal motor nucleus X (C.N. X) and the inferior salivatory nucleus (C.N. IX). Another area in the brain stem that contains preganglionic parasympathetic cell bodies is the **SUPERIOR SALIVATORY-LACRIMAL** nucleus. These cells lie in the pons, just medial to the **MOTOR VII**. Like the inferior salivatory nucleus, we cannot identify the **superior salivatory** and **lacrimal nuclei**.

Preganglionic parasympathetic axons arising from cells in the **superior salivatory** nucleus end within the **SUBMANDIBULAR GANGLION**. Short postganglionic fibers then pass to the **sublingual** and **submandibular** glands where they stimulate secretion. Preganglionic parasympathetic axons arising from cells in the **lacrimal nucleus** terminate in the **PTERYGOPALATINE** ganglion. Postganglionic axons then pass to the **lacrimal gland** to stimulate secretion.

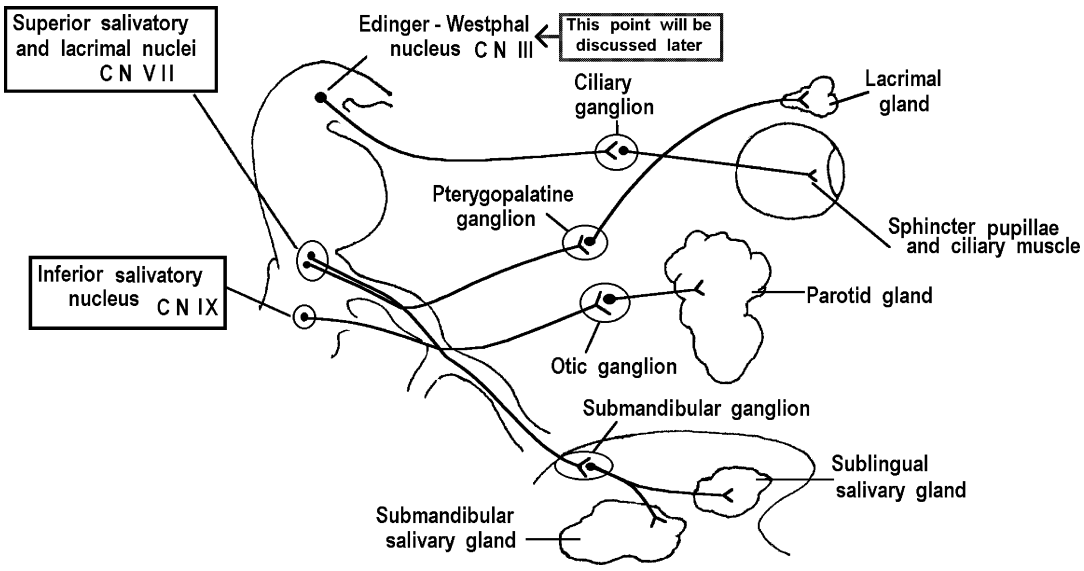
You should remember that the **inferior salivatory lies medial to NUCLEUS AMBIGUUS** in the medulla. A lesion involving this nucleus will result in the loss of salivation from the ipsilateral parotid gland. In contrast, the **superior salivatory and lacrimal nuclei lie medial to MOTOR VII**. For our PROBLEM SOLVING, any lesion that includes **motor VII, AND THE REGION IMMEDIATELY MEDIAL TO IT,** will result in motor VII problems **PLUS** a lack of saliva secretion from the ipsilateral submandibular and sublingual glands, and the loss of tearing from the ipsilateral lacrimal gland.



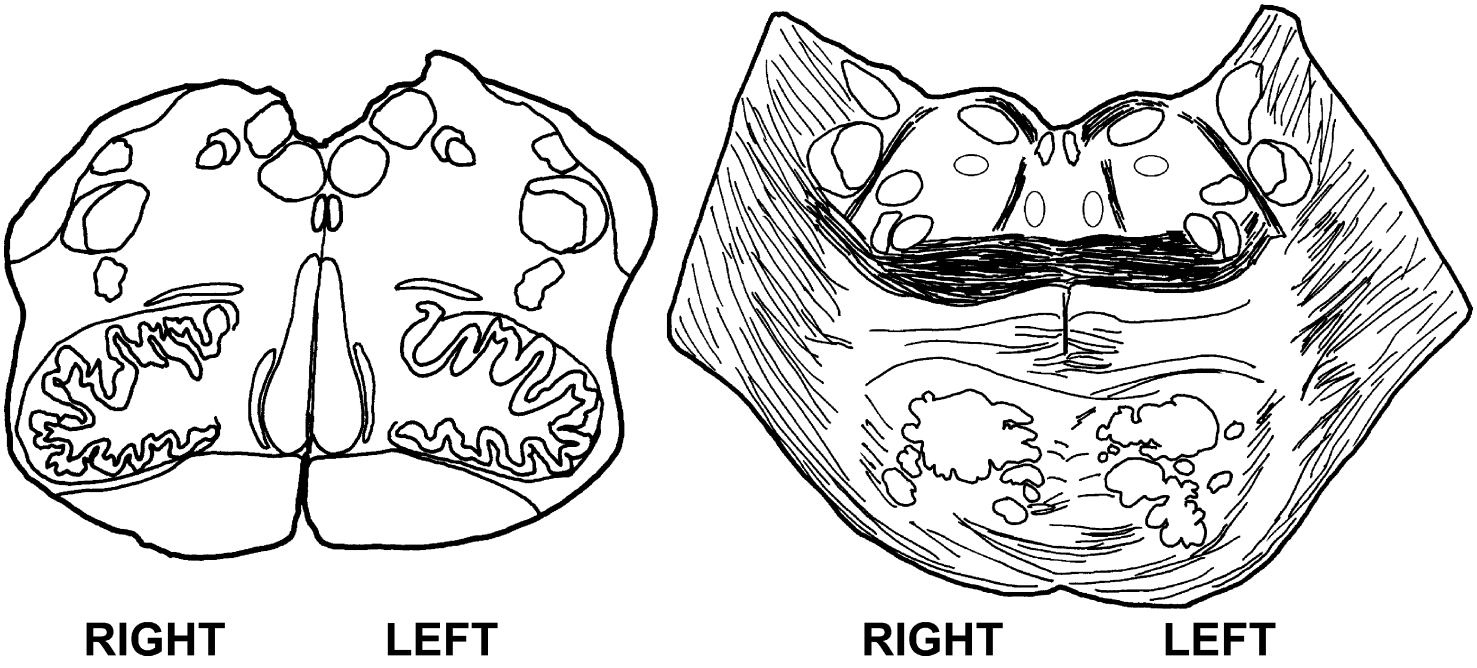
You should also be aware of what is called the **intermediate nerve** of cranial VII. This nerve contains all axons associated with this cranial nerve **EXCEPT** those arising from **MOTOR VII**. This leaves the (1) preganglionic parasympathetic fibers to the superior salivatory nucleus and the lacrimal nucleus; (2) fibers conveying taste whose cell bodies lie in the geniculate ganglion and (3) the somatic sensory fibers conveying information from the "EAR" (whose cell bodies also lie in the geniculate ganglion and whose central processes enter the spinal tract V).



VENTRAL VIEW



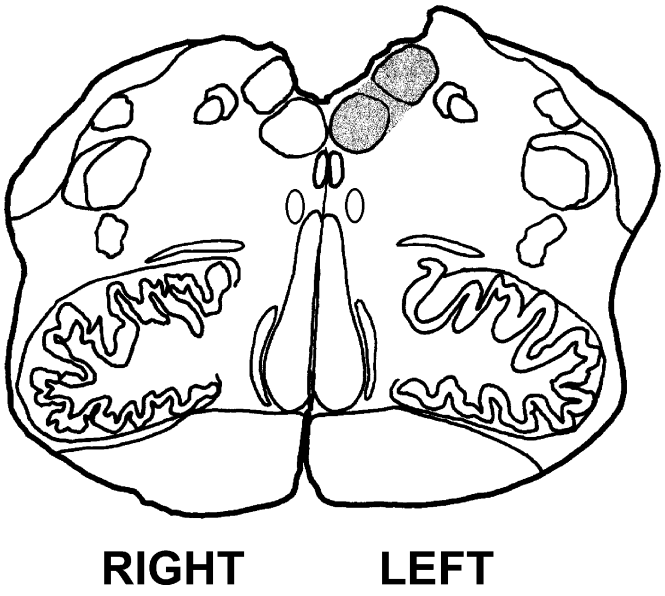
PROBLEM SOLVING

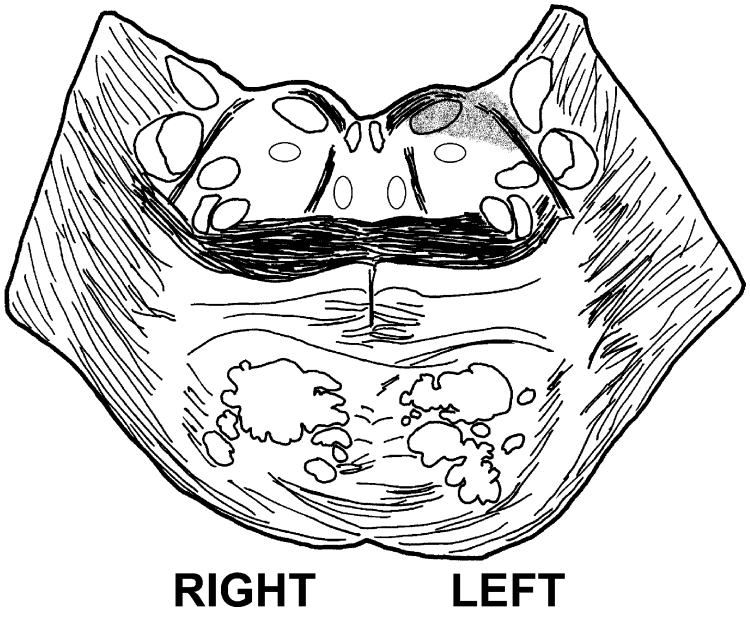


Shade in the locations of two relatively small lesions, one in each level, that will account for the following neurological problems: (MAKE THE LESIONS AS SMALL AS POSSIBLE)

deviation of the tongue to the left upon protrusion, increase in heart rate, fasciculations of the muscles on the left side of the tongue, inability to turn both eyes past the midline of the orbits upon attempted horizontal gaze to the left, hypersensitivity to sounds, drooling from the left side of the mouth, inability to close the left eyelid

PROBLEM SOLVING ANSWERS





PROBLEM SOLVINGMATCHING

Match the best choice in the right hand column with the pathway or cell group in the left hand column

____1. left trigeminothalamic tract (TTT)
____2. right inferior salivatory nucleus
____3. left dorsal motor X
____4. left motor nucleus VII
____5. right superior salivatory nucleus

A. lesion results in a loss of pain and temp from the left side of the face
B. lesion results in a constricted pupil in the left eye and ptosis of the left eye lid
C. lesion results in drooling from the left side of the mouth
D. lesion results in a loss of pain and temp from the right "EAR"
E. lesion results in a lack of secretion from the right sublingual gland
F. lesion results in atrophy of the left pharyngeal constrictors
G. lesion results in a loss of secretion from the right parotid gland
H. lesion results in tachycardia
I. cells project to the right stapedius muscle
J. lesion results in tinnitus (ringing) in the left ear

ANSWERS TO PROBLEM SOLVING QUESTIONS-POINTS 11-15

Point # 11 Nucleus and Tractus Solitarius
Matching F,J,I,G,C

Point # 12 Cochlear Nuclei
Matching E,G,D,A,H

Point # 13 Vestibular -Abducens
Matching 1 I,D,G,F,B
Matching 2 F,J,E,I,H

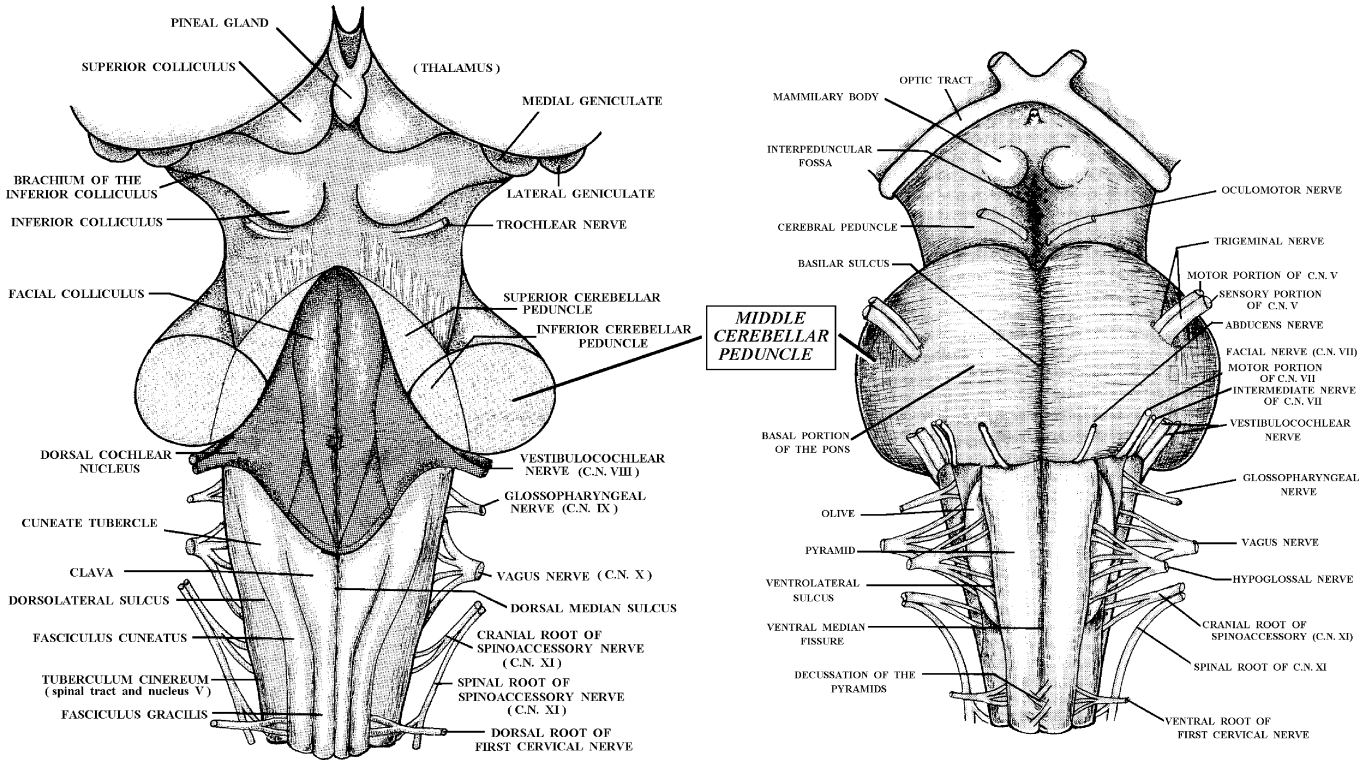
Point # 14 Motor VII
Matching E,D,J,C,I

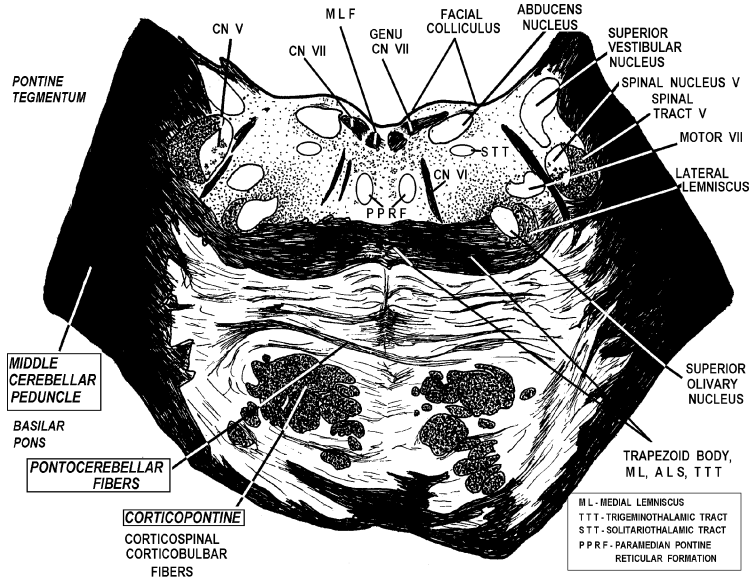
Point # 15 Superior Salivatory and Lacrimal
Matching D,G,H,C,E

16 PONTINE NUCLEI AND MIDDLE CEREBELLAR PEDUNCLE

As presented earlier, the pons is divided into two portions: the dorsal portion called the pontine **tegmentum**, and a ventral part referred to as the **basilar pons**.

The ventral portion of the pons is a massive structure that consists of orderly arranged transverse and longitudinal fiber bundles between which are large collections of pontine neurons called the **PONTINE GREY** (or GRAY). The longitudinal bundles are (1) corticobulbar, (2) corticospinal and, most important for this point, (3) **CORTICOPONTINE FIBERS**.





LEVEL 5. MIDDLE PONS - FACIAL COLLICULUS

I touched on some of the connections and functions of the cerebellum when discussing the accessory cuneate nucleus (POINT #5) and the inferior olivary complex (POINT # 6). There will also be several lectures on the cerebellum. Right now, you need to know that **CORTICOPONTINE** fibers convey information from motor related areas of cortex (i.e., the cells of origin) to neurons in the **IPSILATERAL** pontine grey (pontine grey neurons). More specifically, corticopontine axons convey to the pontine grey neurons information that is used in the **planning** and **initiation** of movements. These planning and initiation data are then sent to the **CONTRALATERAL** cerebellum by another projection called the **pontocerebellar tract**.

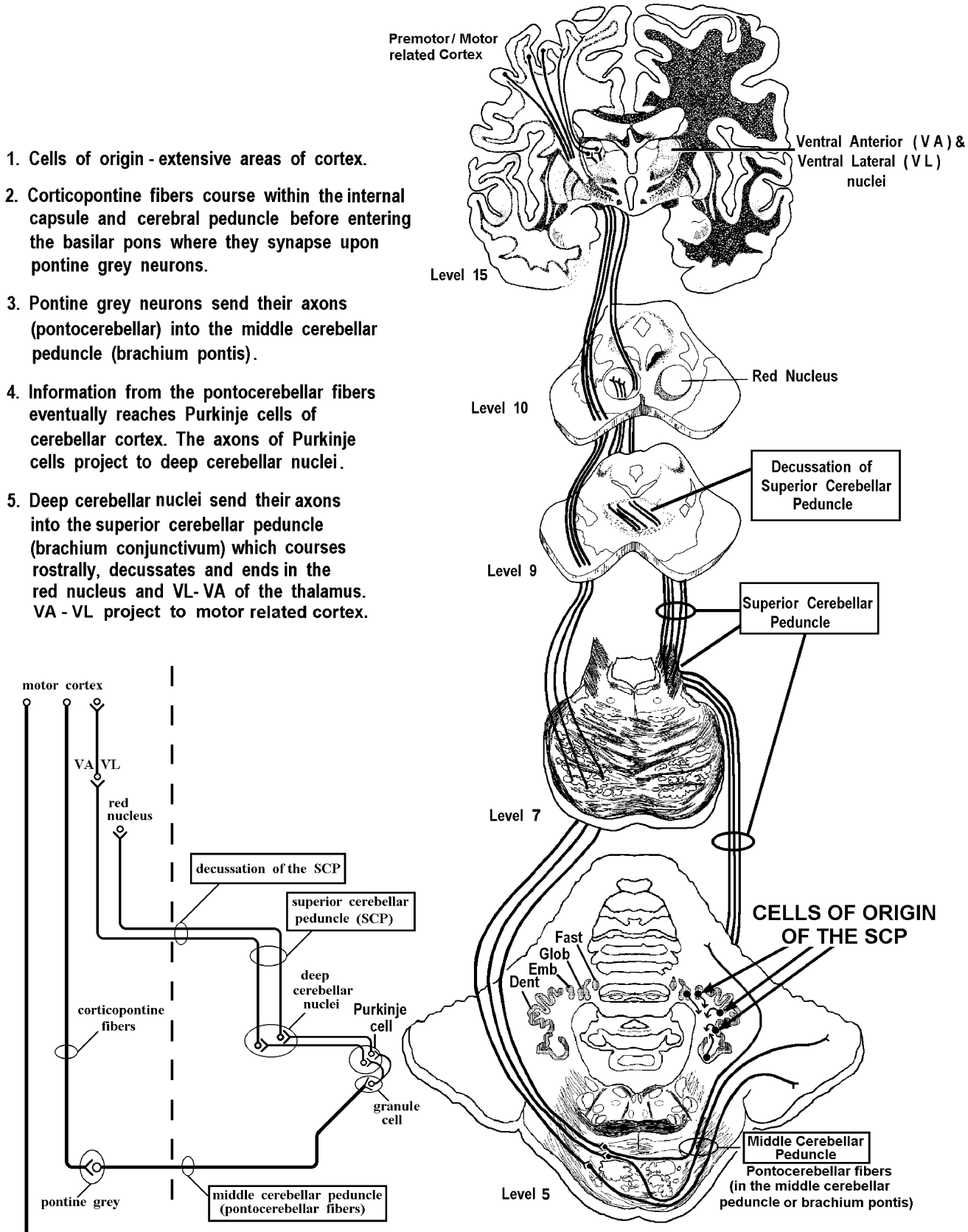
The corticopontine fibers descend from cerebral cortex **uncrossed** to end upon the pontine grey nuclei. Cells within the pontine grey then project via the **MIDDLE CEREBELLAR PEDUNCLE** (or brachium pontis) to the **CONTRALATERAL** cerebellum via pontocerebellar fibers. This cortico-ponto-cerebellar pathway is quantitatively the most important route by which the cerebral cortex can influence the cerebellar cortex. The corticopontine projection carries information that the contralateral cerebellum (via a synapse in the pontine grey) uses to participate in the preparation to move and in the initiation and execution of movements. Much more later!

You know that each **CEREBELLAR HEMISPHERE** influences the **SAME SIDE** of the body. Lesions of the corticopontine projection and the basilar pontine grey result in **CONTRALATERAL** deficits in muscle coordination. This incoordination/ataxia involves both the arm and the leg. In contrast, a lesion of the middle cerebellar **PEDUNCLE** results in **IPSILATERAL** deficits in motor coordination of the arm and leg. Why??

What about a Romberg sign following a lesion of the middle cerebellar peduncle? Well, since the cerebellum is not receiving its normal input from the pons, you can't stand with your heels together to begin with, so you could not have a Romberg sign. Same for inferior cerebellar peduncle?

You will hear more about this pathway in the lectures on the cerebellum. Right now, remember, for the cerebral cortex to inform the cerebellum about a movement, two neurons are needed. The first lies in the cortex; its axon (corticopontine) enters the internal capsule (along with corticospinal and corticobulbar axons), passes into the cerebral peduncle at midbrain levels, and enters the basilar pons where it terminates upon pontine grey nuclei. Pontine grey neurons possess axons (pontocerebellar) that cross in the basilar pons and project to the contralateral cerebellar cortex via the middle cerebellar peduncle. The pontocerebellar projection is the primary constituent of the middle cerebellar peduncle, which is also called the brachium pontis. Oh, by the way, do pontocerebellars end as mossy or climbing fibers? (remember there is <u>one</u> source of climbing fibers).

1. Cells of origin - extensive areas of cortex.
2. Corticopontine fibers course within the internal capsule and cerebral peduncle before entering the basilar pons where they synapse upon pontine grey neurons.
3. Pontine grey neurons send their axons (pontocerebellar) into the middle cerebellar peduncle (brachium pontis).
4. Information from the pontocerebellar fibers eventually reaches Purkinje cells of cerebellar cortex. The axons of Purkinje cells project to deep cerebellar nuclei.
5. Deep cerebellar nuclei send their axons into the superior cerebellar peduncle (brachium conjunctivum) which courses rostrally, decussates and ends in the red nucleus and VL- VA of the thalamus. VA - VL project to motor related cortex.



Cortico - Ponto - Cerebello - Thalamo - Cortical Pathway

PROBLEM SOLVING MATCHING

Match the best choice in the right hand column with the pathway or cell group in the left hand column

____1. right frontal eye field

____2. right caudal nucleus solitarius

____3. right nucleus ambiguus

____4. right lacrimal nucleus

____5. left basilar pontine grey

A. lesion results in incoordination of the left side of the body

B. lesion results in a loss of tearing in the right eye

C. axons terminate in the right PPRF

D. lesion results in a loss of taste from right side of tongue

E. cells of origin lie in right primary motor cortex (Area 4)

F. lesion results in deviation of the uvula to the left

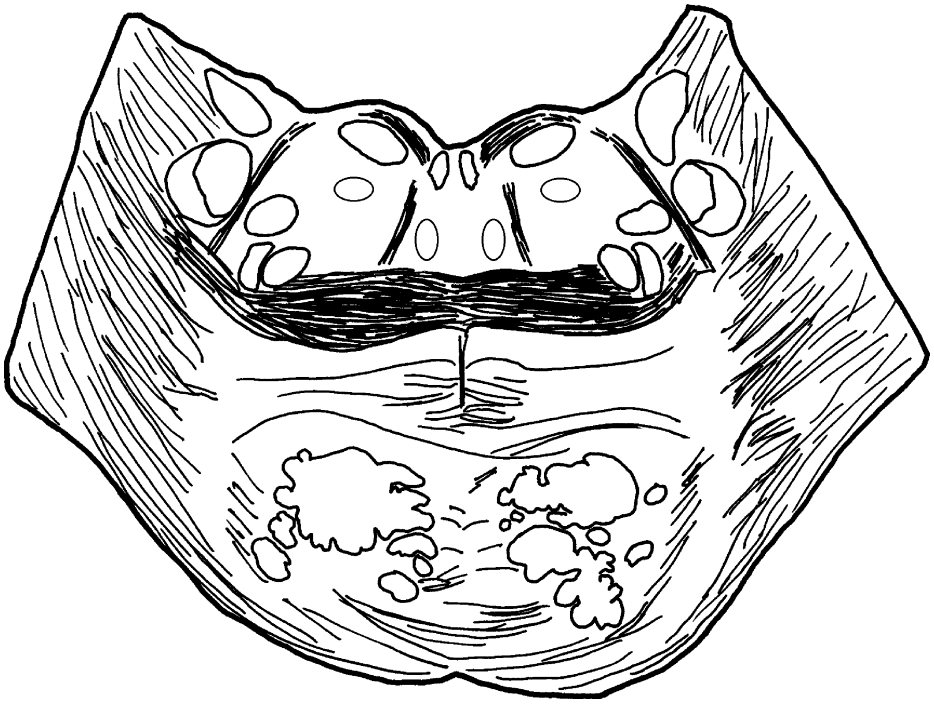
G. lesion results in incoordination of the right side of body

H. lesion results in the inability to initiate a voluntary horizontal saccade to the left

I. axons terminate in the right submandibular ganglion

J. excitatory projections to dorsal motor X slow the heart rate

PROBLEM SOLVING

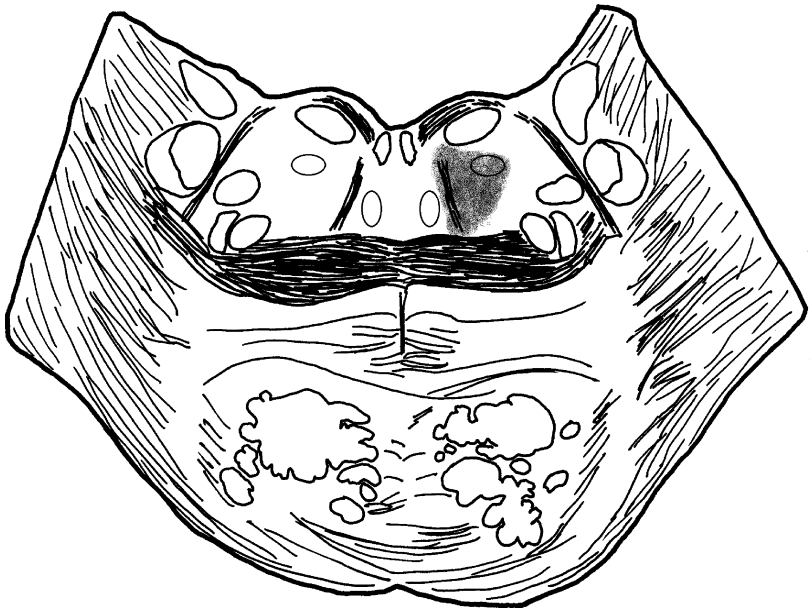


RIGHT LEFT

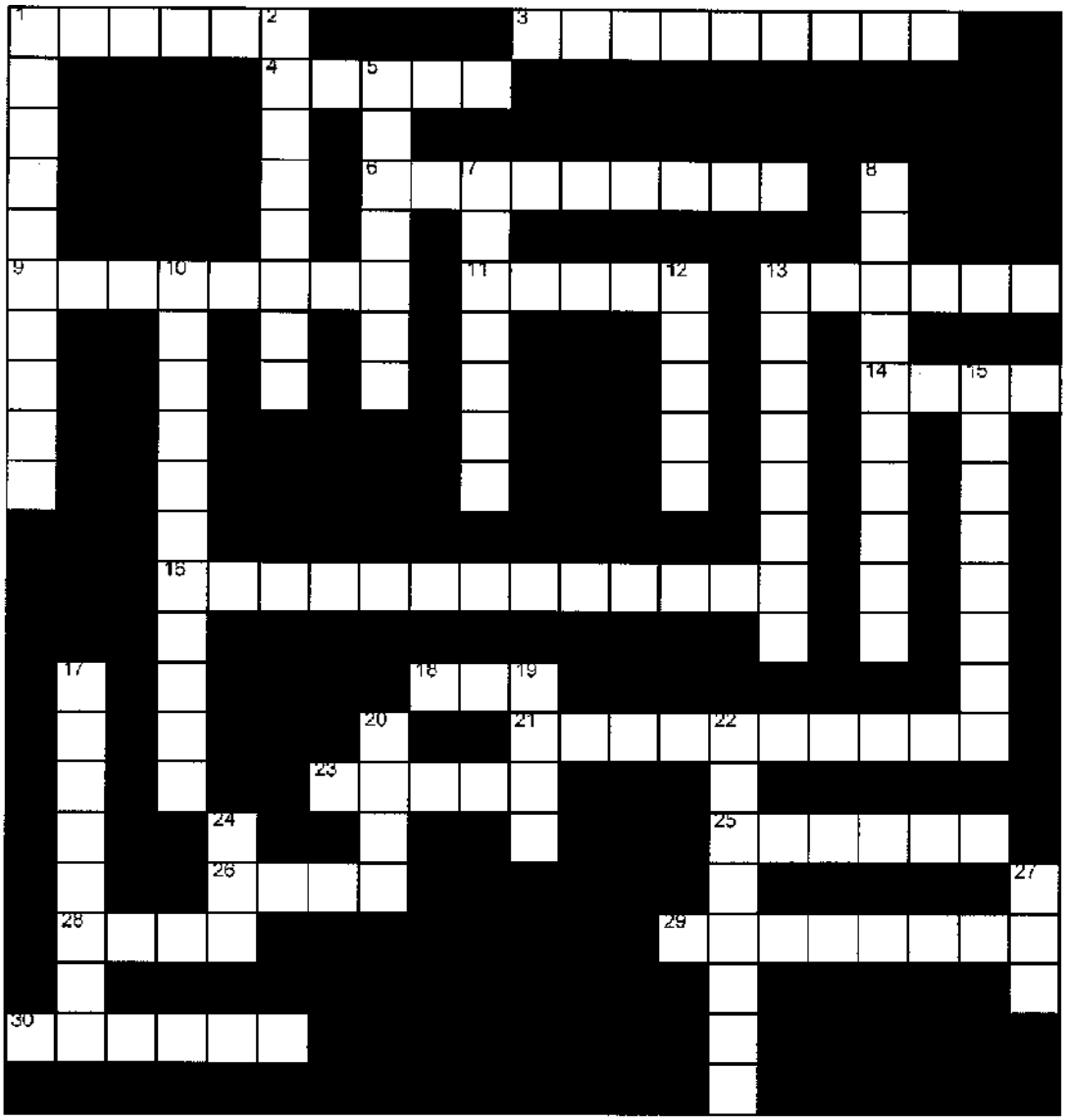
Shade in the location of a single, continuous, unilateral lesion in the above drawing that will account for the following neurological problems: (MAKE THE LESION AS SMALL AS POSSIBLE)

double vision, especially when turning the eyes to the left, loss of taste from the left side of the tongue

PROBLEM SOLVING ANSWER



RIGHT LEFT

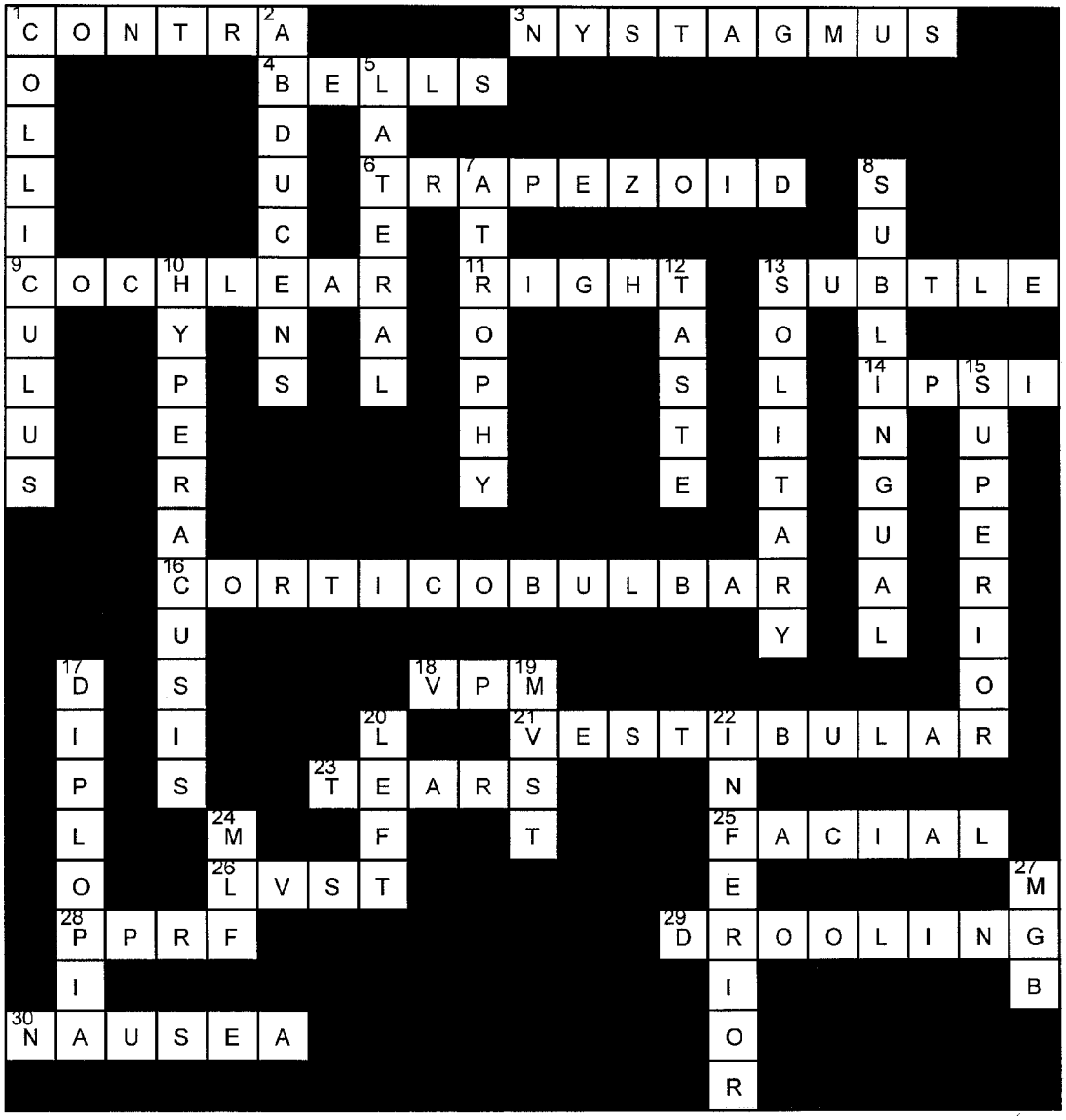


ACROSS

1. side of hemiplegia following cortical lesion
3. COWS test for caloric _____ (G; to nod)
4. _____ palsy (facial)
6. crossing fibers in auditory pathways (lies at bottom of pontine tegmentum)
9. nuclei containing cells that project to the superior olive
11. direction of stumbling with a lesion of the right vestibular nerve
13. _____ auditory deficits
14. side of incoordination with a lesion of the inferior cerebellar peduncle
16. projection innervates the dorsal portion of the ipsi motor VII, but not the
18. thalamic target of STT
21. apparatus that helps coordinate changes in the position of the head with eye position
23. related to the lacrimal nucleus
25. _____ colliculus
26. ipsilateral projection from one of the vestibular nuclei
28. receives input from the contra vestibular nuclei and projects to the ipsi abducens
29. problem with saliva that results from a lesion of motor VII
30. results from irritation or lesions involving the vestibular apparatus or pathways

DOWN

1. facial _____
2. cells in this nucleus project to the contra oculomotor nucleus
5. another name for the horizontal semicircular canals
7. results from a lesion of any lower motor neuron
8. under the tongue
10. results from a lesion of motor VII
12. C.N.s 7,9 and 10 - rostral pole solitary complex-(ummm good)
13. alone, existing separately (hard to find)
15. ganglia associated with "ear"
17. head rotation towards the lesion helps ameliorate
19. bilateral tract associated with vestibular nuclei
20. direction of nystagmus with a lesion of the right vestibular nerve
22. ganglia associated with taste
24. lesion of structure results in INO (can't turn ipsi eye medially upon attempted horizontal gaze to the contra side)
27. thalamic target of inferior colliculus


1 C O N T R 2 A 3 N Y S T A G M U S
O 4 B E 5 L L S
L D A
L U 6 T R 7 A P E Z O I D 8 S
I C E T U
9 C O C 10 H L E A R 11 R I G H 12 T 13 S U B T L E
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L P S L P S L 14 I P 15 S I
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S R Y E T G P
A A U E
16 C O R T I C O B U L B A R A R
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I I 20 L 21 V E S T 22 I B U L A R
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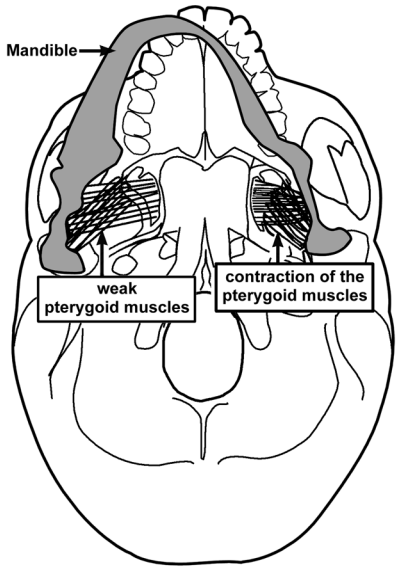
L 24 M F T 25 F A C I A L
O 26 L V S T E 27 M
28 P P R F 29 D R O O L I N G
I I B
30 N A U S E A O
R

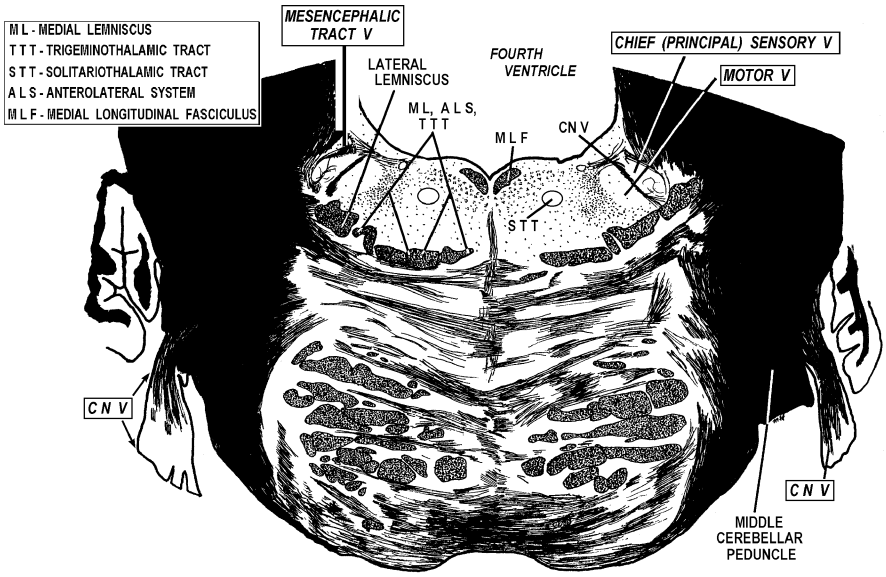
17 MOTOR, CHIEF SENSORY and MESENCEPHALIC NUCLEI of the TRIGEMINAL

MOTOR V

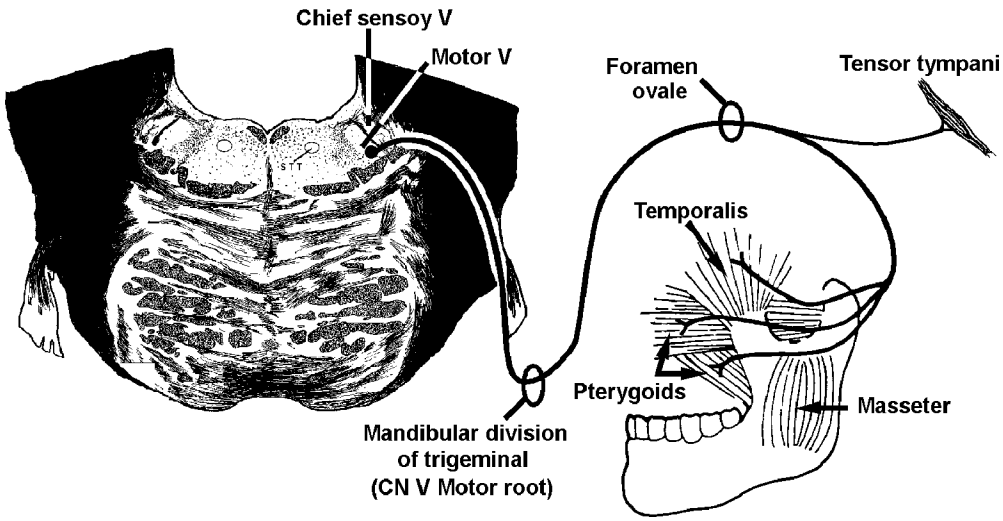
Axons arising from neurons in motor V constitute the bulk of the motor root of the trigeminal and supply the **muscles of mastication** (masseter, temporalis and lateral and medial pterygoid muscles), as well as the tensor tympani, tensor veli palatini, anterior belly of digastric and the mylohyoid muscles.

Lesions involving motor V or the motor fibers in the trigeminal nerve result in **ATROPHY** of the muscles listed above ipsilateral to the lesion. Since the pterygoids **OPEN** the jaw in concert with a downward and opposing inward motion, when they are weak on one side the inward vector of the opposing pterygoid is unopposed. Thus, the jaw deviates toward the **WEAK SIDE** (i.e., lesion side) upon opening.





LEVEL 6. PONS–LEVEL OF MOTOR V AND CHIEF SENSORY V

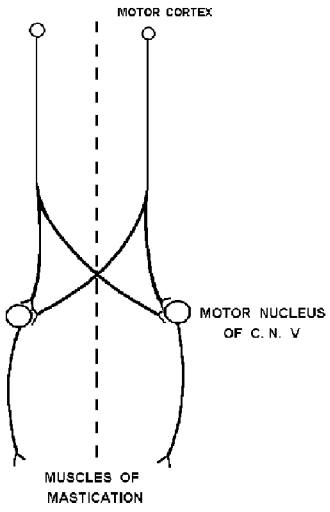


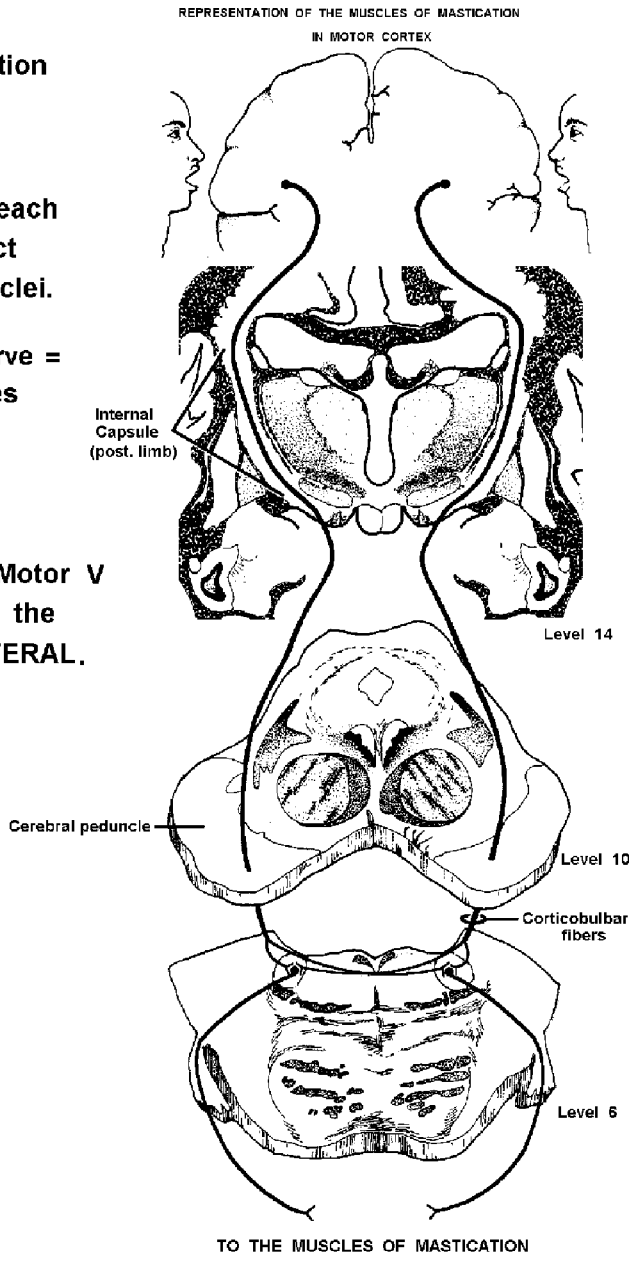
1. **Cells of origin - cortical representation of the muscles of mastication.**

2. **Corticobulbar fibers course (with corticospinal fibers) caudally to reach the rostral pons where they project BILATERALLY to both Motor V nuclei.**

3. **Lesion of Motor V Nucleus or nerve = ATROPHY of the ipsilateral muscles of mastication. Jaw DEVIATION, upon opening = IPSILATERAL (to the side of the lesion).**

4. **Lesion of corticobulbar input to Motor V Nucleus = NO PROBLEM because the input from motor cortex is BILATERAL.**





Corticobulbar input to Motor Nucleus of C. N. V

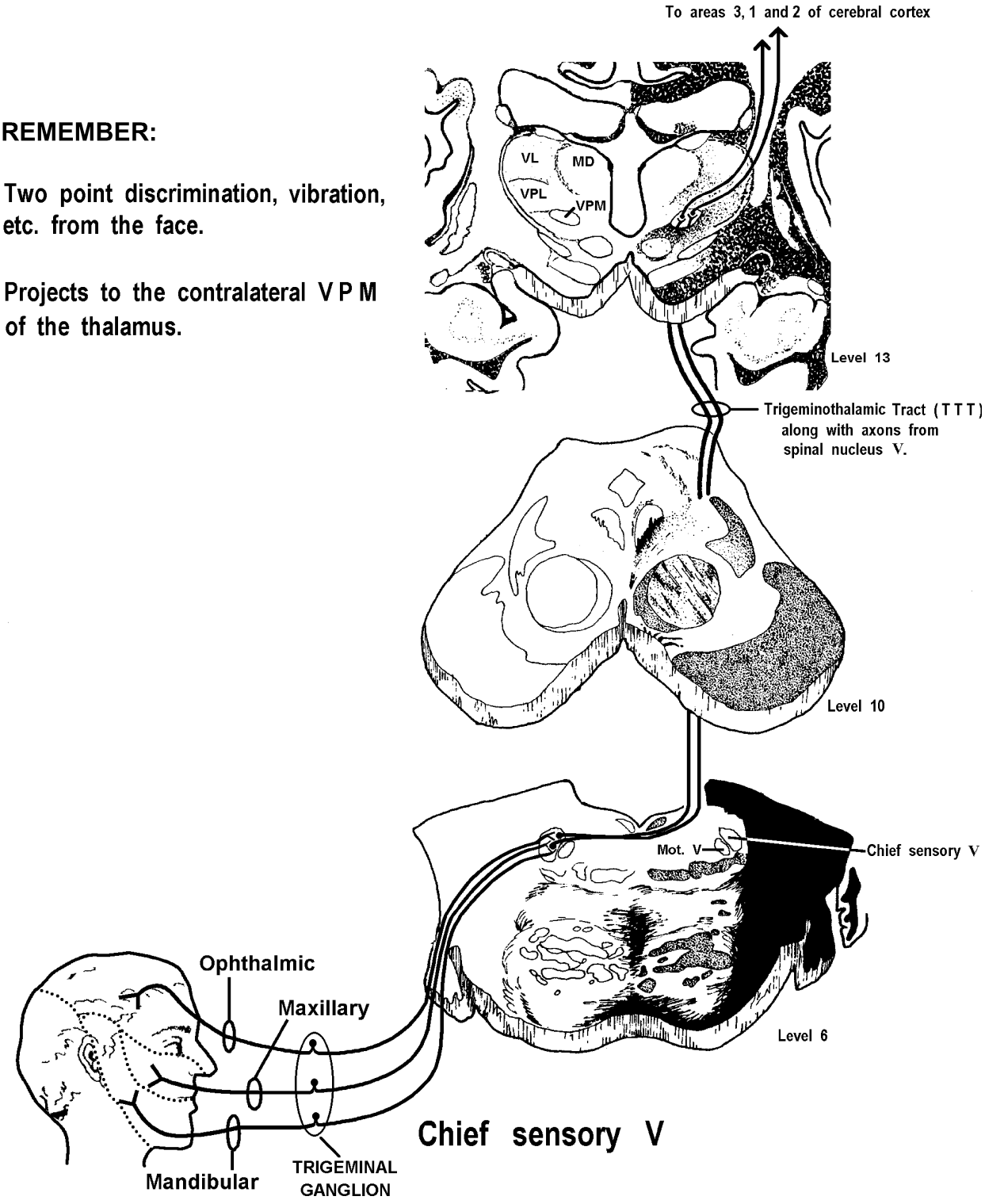
You Med 1s are lucky that **corticobulbar** input to motor V (like that to nucleus ambiguus) is **BILATERAL**. Therefore lesions of this system (i.e., in motor cortex) **DO NOT** cause obvious defects of jaw function. (Remember, lesions of the corticobulbar input to the **hypoglossal nucleus and motor VII DO** cause observable deficits, and you should know them **COLD**!)

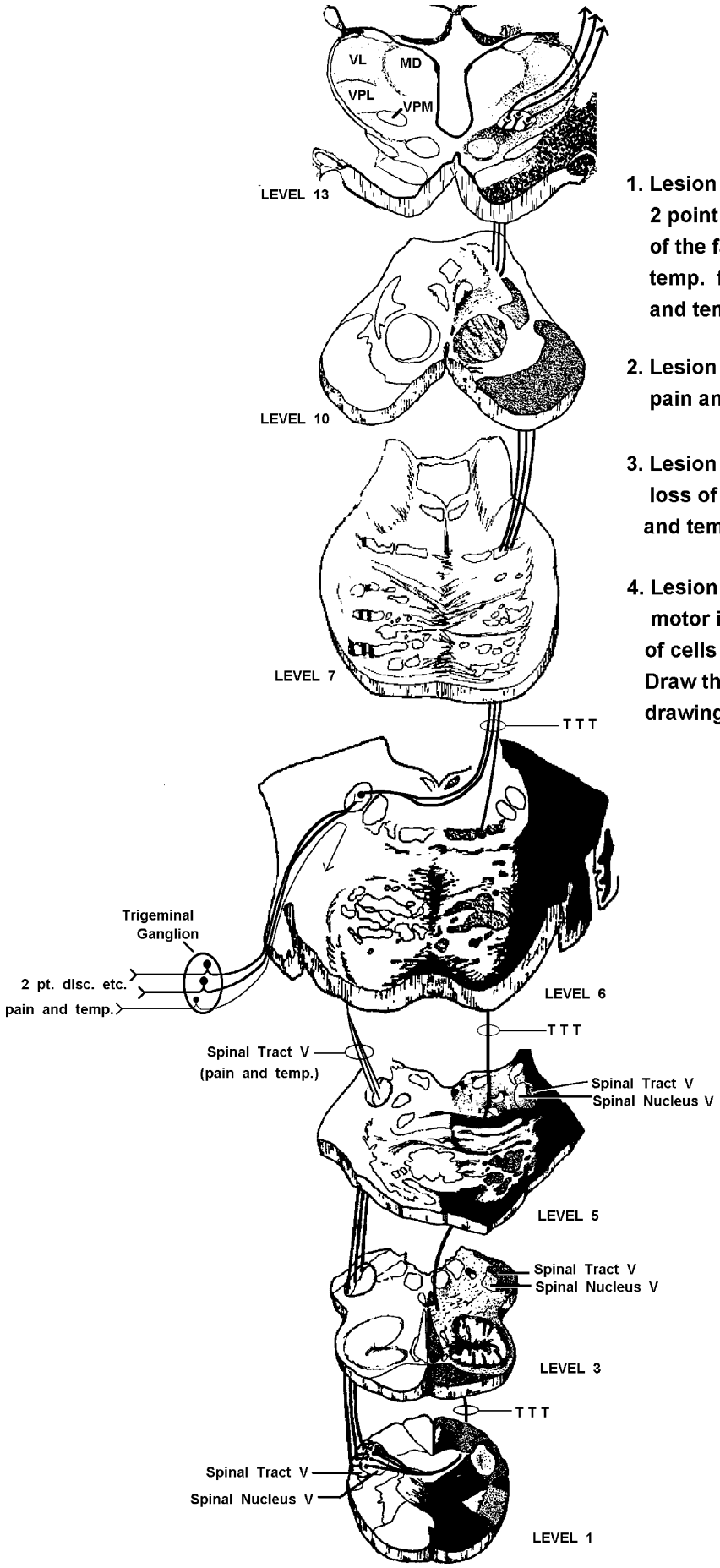
CHIEF SENSORY V

Discriminatory touch, as well as conscious proprioception and vibration information from the **face** do not "use" the spinal tract and nucleus V. Instead, they pass into the **CHIEF SENSORY NUCLEUS** (or principal sensory V). This nucleus lies LATERAL to motor V (**M**otor = Medial) in the pons at the level of the entering (and exiting) C.N. V fibers. Axons of cells in the chief sensory nucleus V cross and pass rostrally in the **trigeminothalamic tract** (TTT; along with the pain and temperature fibers from the caudal spinal nucleus V) to the ventral posteromedial **(VPM)** nucleus of the thalamus.

REMEMBER:

1. **Two point discrimination, vibration, etc. from the face.**
2. **Projects to the contralateral V P M of the thalamus.**





1. **Lesion in the RIGHT Chief Sensory V = loss of 2 point discrimination etc. from the RIGHT side of the face. Lesion may also damage pain and temp. fibers before they descend = loss of pain and temp. from the RIGHT side of the face.**

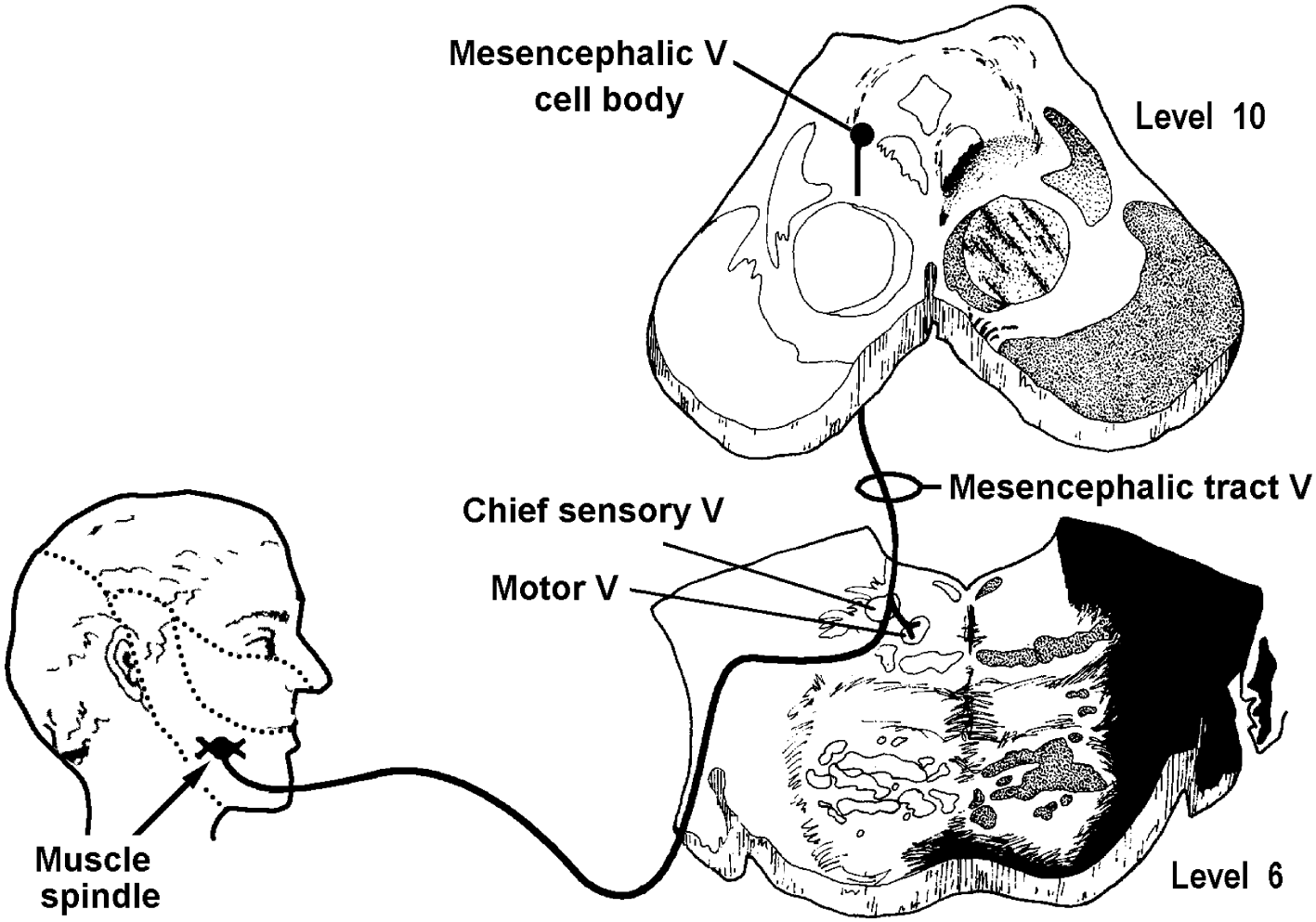
2. **Lesion in the RIGHT TTT at Level 6 = loss of pain and temp. from the LEFT side of the face.**

3. **Lesion of the LEFT TTT at Levels 7 + 10 = loss of 2 point discrimination etc. and pain and temp. from the RIGHT side of the face.**

4. **Lesion of C.N. V = loss of all sensory AND motor information. REMEMBER, the axons of cells in Motor V are exiting in the nerve. Draw these cells and axons in the adjacent drawing.**

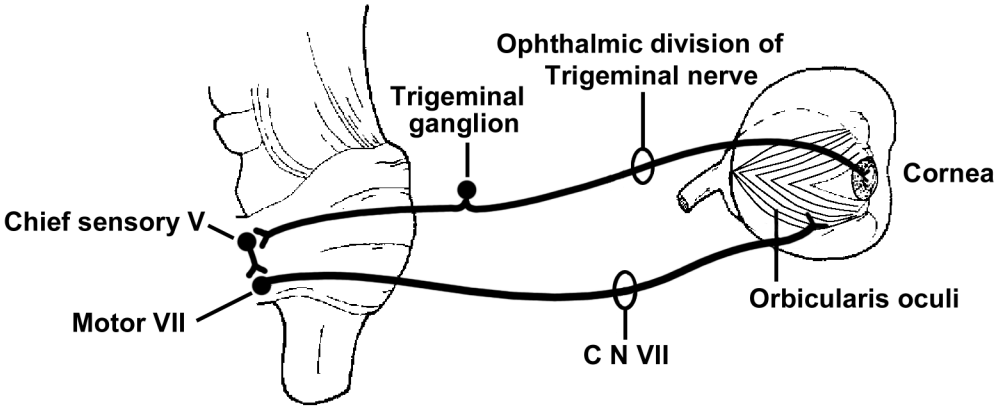
MESENCEPHALIC NUCLEUS V

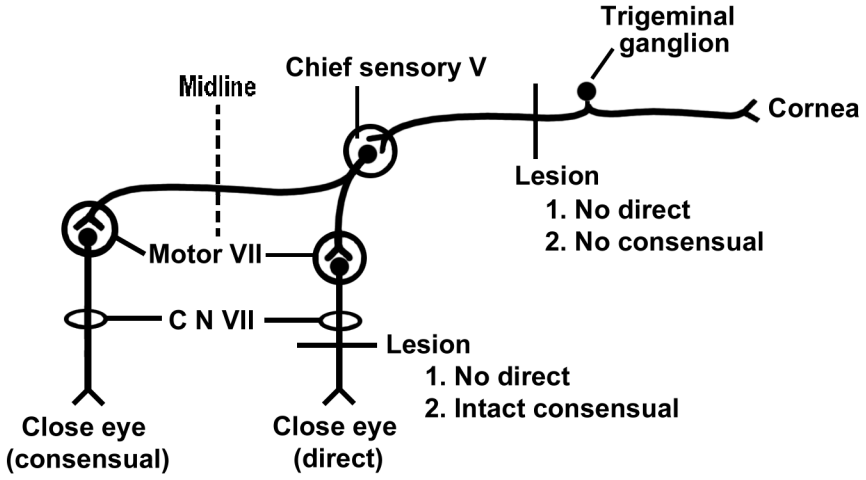
This nucleus consists of a slender strand of cells extending from the chief sensory nucleus through the midbrain. The nucleus is located beneath the lateral edge of the floor of the fourth ventricle in the pons and in the lateral region of the periaqueductal grey matter in the midbrain. These cells are incorporated into the neuraxis, rather than being in the cerebrospinal ganglia (i.e., the trigeminal ganglion, the geniculate ganglion, etc.). Most of the peripheral processes of mesencephalic V neurons occupy the motor root of the trigeminal nerve and are distributed to muscle spindles in the muscles of mastication. The central processes of mesencephalic V neurons terminate within motor nucleus V. This connection establishes the stretch reflex originating in the muscle spindles of the masticatory muscles, together with a reflex for the control of the force of the bite. The mesencephalic nucleus V may be thought of as being similar to Clarke's column and the accessory cuneate nucleus (i.e., unconscious proprioception).



Damage to the C.N. V results in problems with the **CORNEAL REFLEX**. This reflex involves **C.N. V** (on the sensory side) and **C.N. VII** (on the motor side). Stimulation of the cornea of one eye results in the closing of **BOTH** eyelids. The pathways involved include touch fibers in the ophthalmic division of C.N. V (innervate cornea) that pass into the chief sensory nucleus V. Some pain fibers probably pass into spinal tract V, but let's concentrate on the touch fibers to the **CHIEF**. Cells in the **CHIEF** project **BILATERALLY** to motor VII (we cannot identify these axons in our sections). The result is closing of **BOTH** eyelids upon stimulation of **ONE** cornea.

The response on the side that is stimulated is called the **DIRECT** corneal reflex while that on the opposite side is called the **CONSENSUAL** corneal reflex (analogous to the gag reflex). Go over the diagram and think about the results of lesions of the various components.

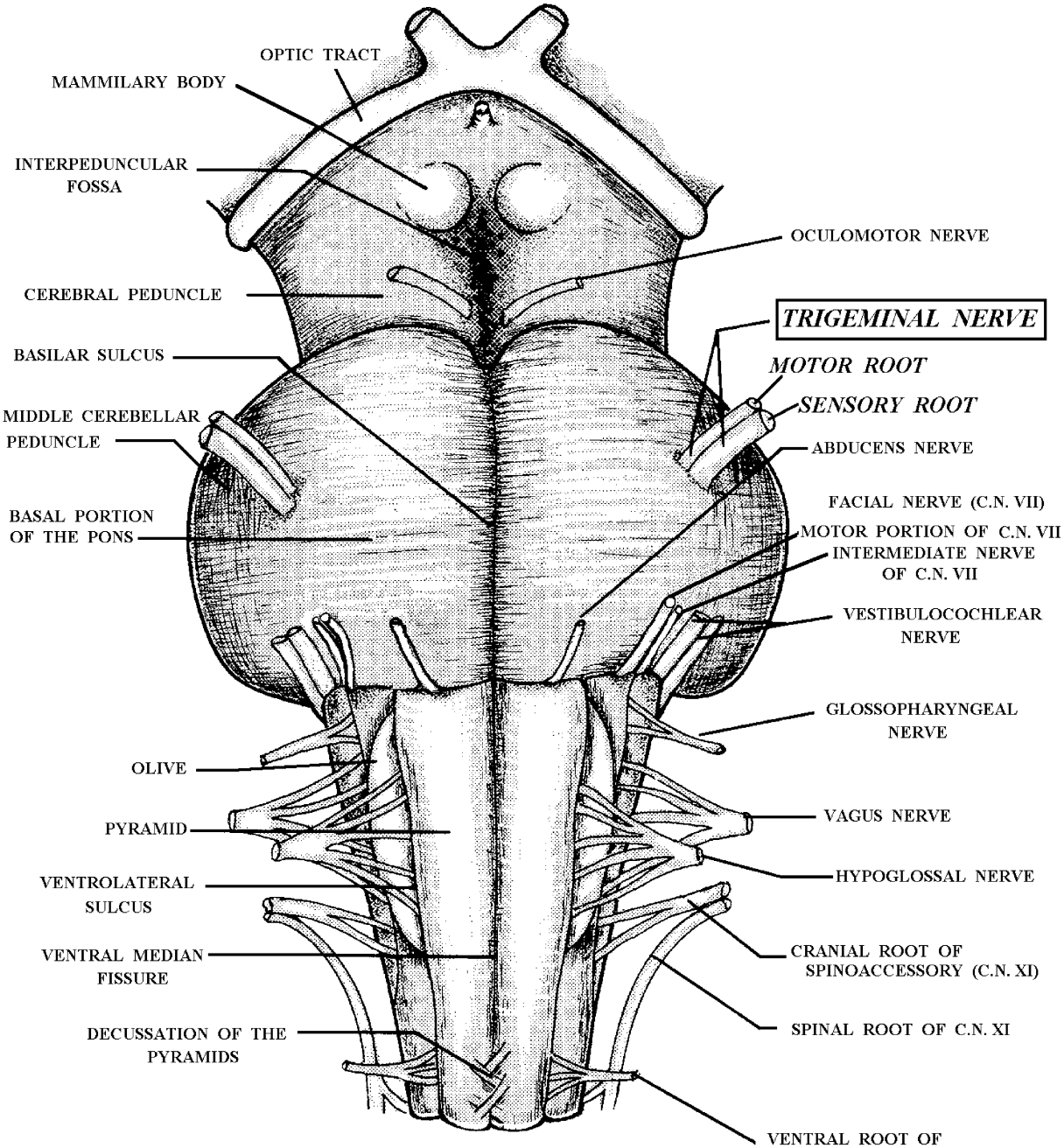




REMEMBER:

a)	Pain and temperature	Spinal tract & nucleus V
b)	2-pt. discrimination, vibration, conscious proprioception	Chief sensory nucleus V
c)	unconscious proprioceptive from muscle spindles	Mesencephalic nucleus V
d)	Motor innervation of muscles of mastication	Motor nucleus V

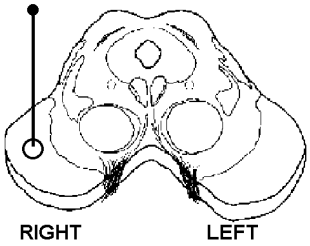
KNOW THE LOCATION OF THE SENSORY AND MOTOR ROOTS OF CN V



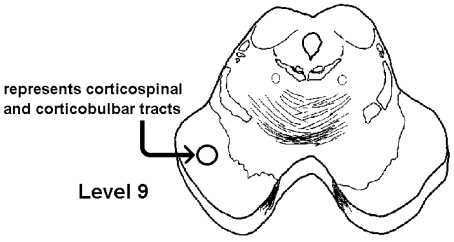
VENTRAL VIEW

JKH's Perspective of those DARN CORTICOBULBARS

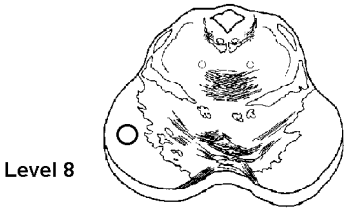
Cortical motor neurons
AREA 4



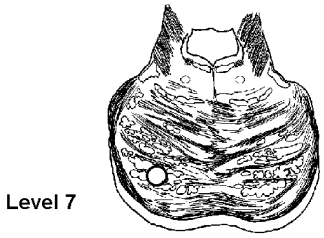
Pathways involved	Deficits
1. Corticospinal tract	LEFT hemiplegia
2. Corticobulbars to Hypoglossal	tongue deviates to LEFT
3. Corticobulbars to Nucleus Ambiguus	none
4. Corticobulbars to Motor VII	weakness lower LEFT face
5. Corticobulbars to Motor V	none



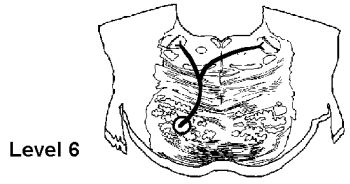
Same tracts and deficits as Level 10



Same tracts and deficits as Level 10

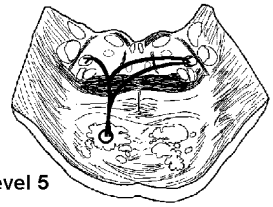


Same tracts and deficits as Level 10



1. Corticospinal tract	LEFT hemiplegia
2. Corticobulbars to Hypoglossal	tongue deviates to LEFT
3. Corticobulbars to Nucleus Ambiguus	none
4. Corticobulbars to Motor VII	weakness lower LEFT face

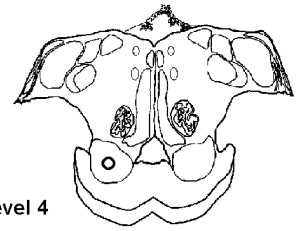
Corticobulbar fibers exit basilar pons between Levels 7 and 6 to enter Motor V ***BILATERALLY***.
Provides cortical input to the lower motor neurons that innervate the muscles of mastication.



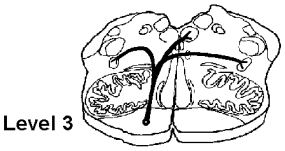
1. Corticospinal tract	LEFT hemiplegia
2. Corticobulbars to Hypoglossal	tongue deviates to LEFT
3. Corticobulbars to Nucleus Ambiguus	none

Corticobulbars fibers exit basilar pons between Levels 6 and 5 to enter Motor VII .

Provides ***BILATERAL*** cortical input to lower motor neurons that innervate the muscles of facial expression to the forehead and upper face, while providing ***UNILATERAL*** cortical input to lower motor neurons that innervate the muscles of facial expression of the ***CONTRALATERAL*** lower face.



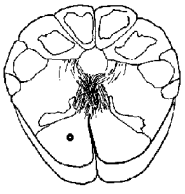
1. Corticospinal tract	LEFT hemiplegia
2. Corticobulbars to Hypoglossal	tongue deviates to LEFT
3. Corticobulbars to Nucleus Ambiguus	none



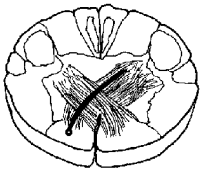
1. Corticospinal tract — LEFT hemiplegia

Corticobulbar fibers exit the pyramid between Levels 4 and 3 to enter the Nucleus Ambiguus ***BILATERALLY***.
Provides cortical input to lower motor neurons that innervate musculature of the soft palate, pharynx and larynx.

Corticobulbar fibers also exit the pyramid between Levels 4 and 3 to enter the ***CONTRALATERAL*** hypoglossal nucleus.
Provides ***UNILATERAL*** cortical input to the lower motor neurons that innervate the contralateral side of the tongue.

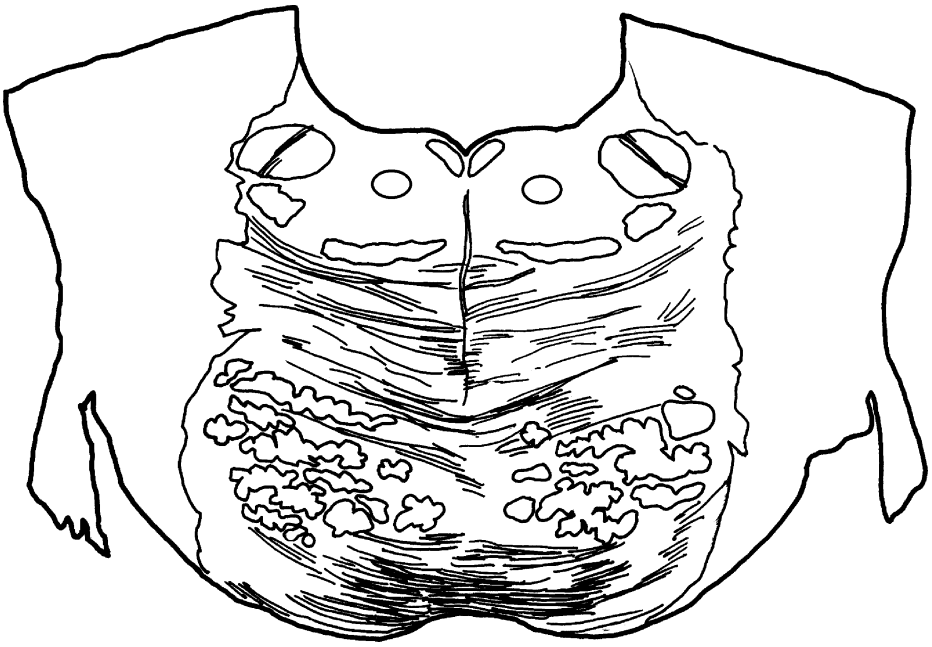


1. Corticospinal tract — LEFT hemiplegia



1. Corticospinal tract — LEFT hemiplegia

PROBLEM SOLVING

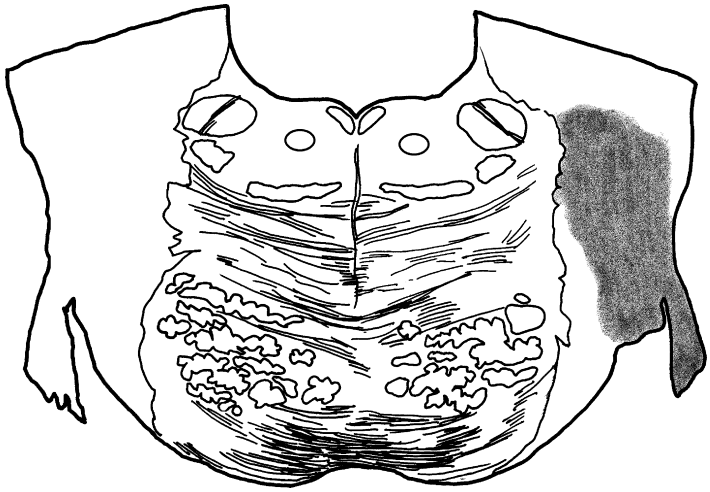


RIGHT LEFT

Shade in the location of a single, continuous, unilateral lesion in the above drawing that will account for the following neurological problems: (THE LESION DOES NOT INVOLVE ANY NUCLEI)

incoordination of left arm and leg, loss of the corneal (blink) reflex of both eyelids upon stimulation of the left cornea, deviation of the jaw to the left upon jaw opening, loss of pain and temperature from the left side of the face, loss of vibratory sense from the left side of the face

PROBLEM SOLVING ANSWER



RIGHT LEFT

PROBLEM SOLVING MATCHING

Match the best choice in the right hand column with the pathway or cell group in the left hand column

____1. vestibular portion of the left cranial nerve VIII

____2. right trigeminothalamic tract (TTT)

____3. left chief sensory V

____4. left middle cerebellar peduncle

____5. left motor nucleus V

A. lesion results in deviation of the jaw to the right

B. axons terminate in the right side of the cerebellum

C. lesion results in a loss of pain and temp from the entire left side of the tongue

D. lesion results in stumbling to the left

E. lesion results in a loss of vibration sense from the left side of the face

F. lesion results in a loss of taste from the right side of the tongue

G. cells project to the left stapedius muscle

H. cells receive corticobulbar input from the right motor cortex

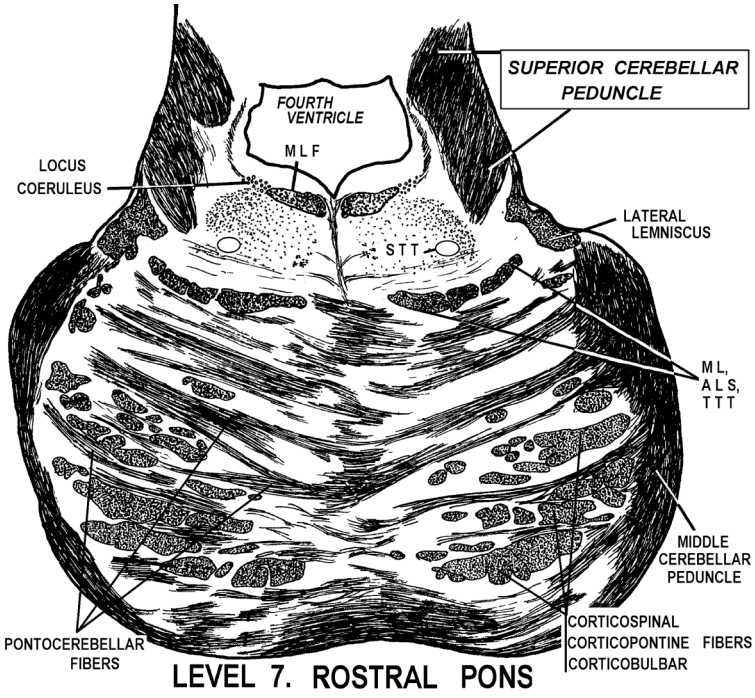
I. axons terminate in the left side of the cerebellum

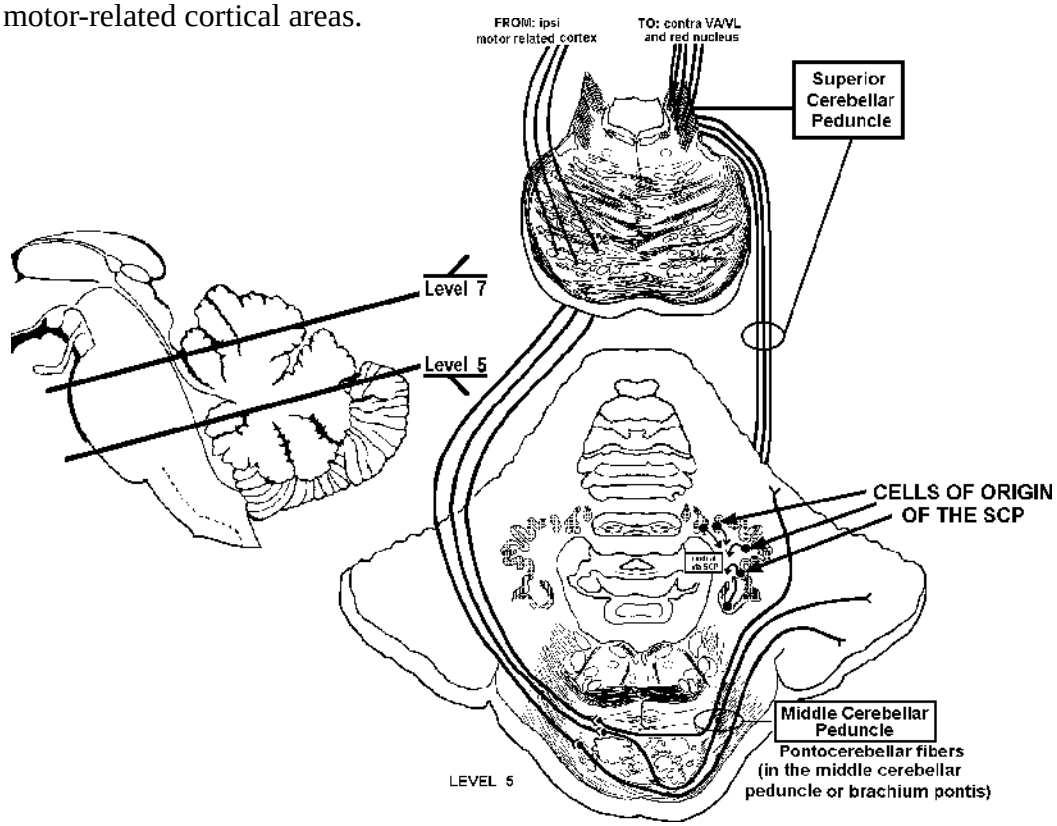
J. lesion results in the inability to close the left eyelid

18 SUPERIOR CEREBELLAR PEDUNCLE (Brachium Conjunctivum)

The cerebellum plays a very important role in motor coordination. We know many of its inputs (dorsal spinocerebellar, cuneocerebellar, pontocerebellar). Now we need to understand how information **EXITS** the cerebellum in order to influence overall motor activity.

The majority of fibers that pass **OUT** of the cerebellum to the brain stem do so via the **SUPERIOR CEREBELLAR PEDUNCLE**. This peduncle is formed by axons that arise from certain deep cerebellar nuclei. These nuclei lie deep in the cerebellum. The "most famous" of these deep cerebellar nuclei resembles the inferior olive and is called the **dentate nucleus** (the remaining will be discussed later). This bundle passes rostrally into the dorsal pons where it forms a compact bundle along the dorsolateral wall of the fourth ventricle. At the level of the inferior colliculus all fibers of the superior cerebellar peduncle decussate. The majority of these crossed fibers ascend and either terminate in the red nucleus or continue rostrally to end within the **MOTOR NUCLEI OF THE THALAMUS**, the **VENTRAL LATERAL** and **VENTRAL ANTERIOR** nuclei. These thalamic nuclei project to motor-related cortical areas.





Further details of the pathways connecting the cerebellar cortex with the brain stem and thalamus will be discussed during the lectures on the cerebellum.

You know that lesions of the cerebellar hemisphere result in **IPSILATERAL** incoordination/ ataxia. For instance, a lesion in the **RIGHT** cerebellar hemisphere will result in motor incoordination/ataxia of the **RIGHT** arm and leg. A lesion of the **RIGHT** superior cerebellar peduncle **CAUDAL TO** (before) the decussation will also result in motor incoordination/ataxia on the **RIGHT** side. In contrast, a lesion **ROSTRAL** to the decussation of the superior cerebellar peduncle will result in **CONTRALATERAL** motor deficits. PLEASE UNDERSTAND THIS!

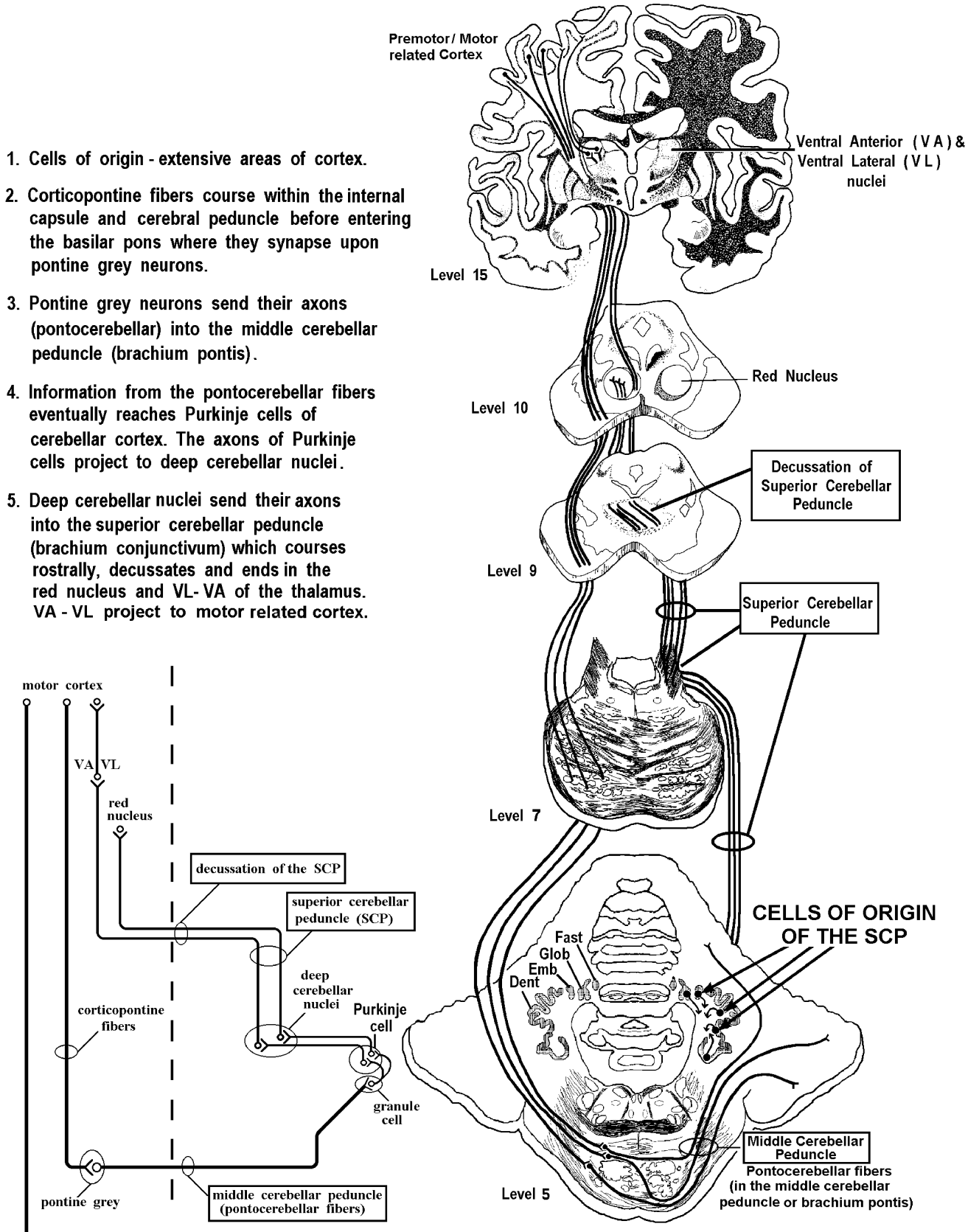
There would NOT be a Romberg sign. You cannot stand with your heels together to begin with!! The superior cerebellar peduncle is a cerebellar efferent!!

REMEMBER:

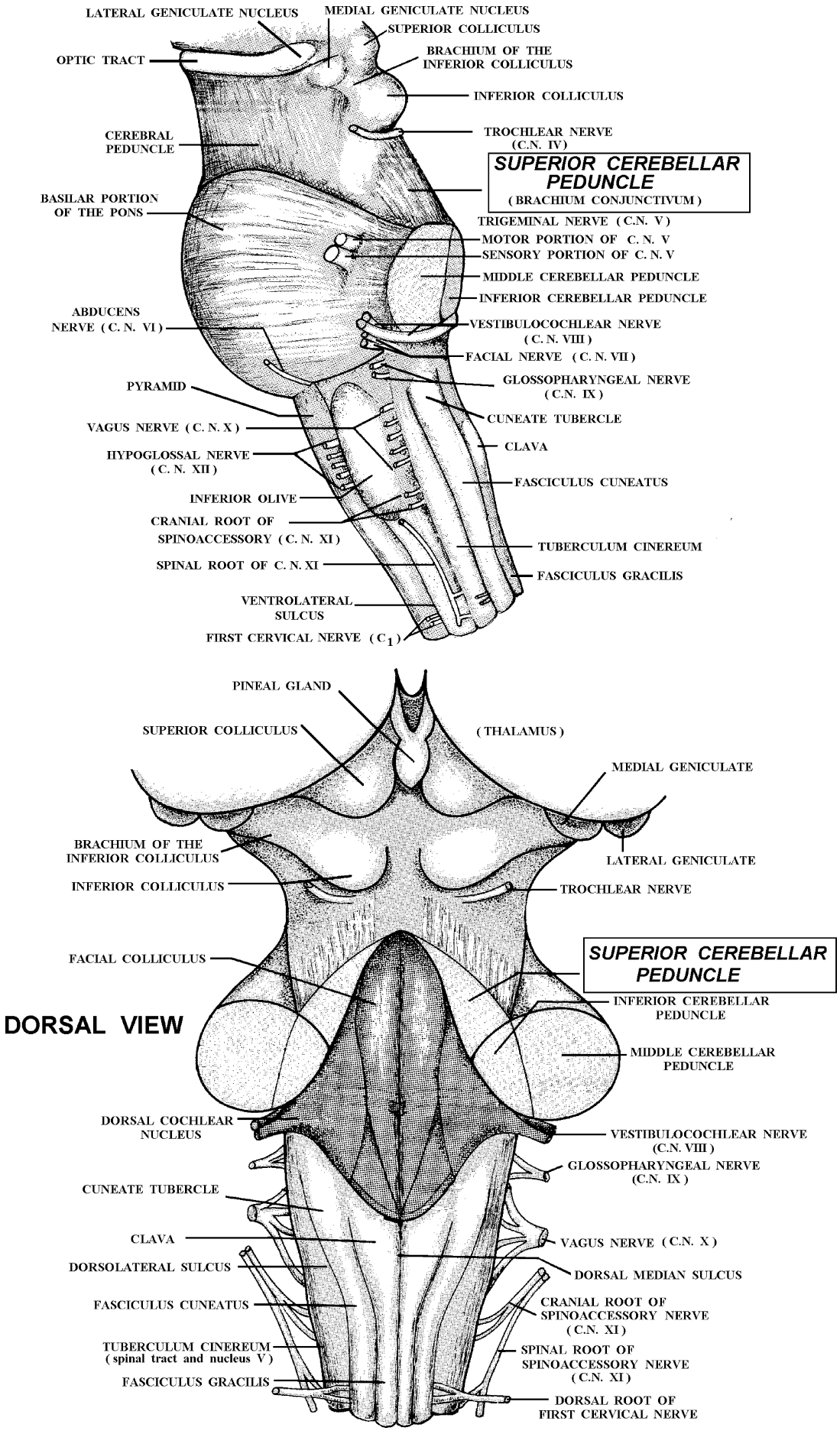
1) The cells of origin of fibers of the superior cerebellar peduncle lie in the **deep cerebellar nuclei**. These nuclei lie deep in the white matter of the cerebellum, under what is called the cortex of the cerebellum.
2) The superior cerebellar peduncle is the principal **efferent** bundle of the cerebellum, unlike the other two peduncles (inferior or restiform body; middle or brachium pontis) that are conveying information *to* the cerebellum.
3) The superior cerebellar peduncle crosses at **caudal midbrain** (inferior colliculus) levels, after which most of the fibers ascend to the red nucleus (rostral midbrain) and dorsal thalamus (ventral lateral and ventral anterior nuclei).
4) The fibers cross (in the caudal midbrain) at the **decussation of the superior cerebellar peduncle** (brachium conjunctivum).

5) LESIONS OF THE SUPERIOR CEREBELLAR PEDUNCLE BEFORE (CAUDAL) THE DECUSSATION RESULT IN **IPSILATERAL** DEFICITS IN MOTOR COORDINATION, WHILE INTERRUPTION OF THE FIBERS AFTER (ROSTRAL) TO THE DECUSSATION RESULTS IN **CONTRALATERAL** DEFICITS.

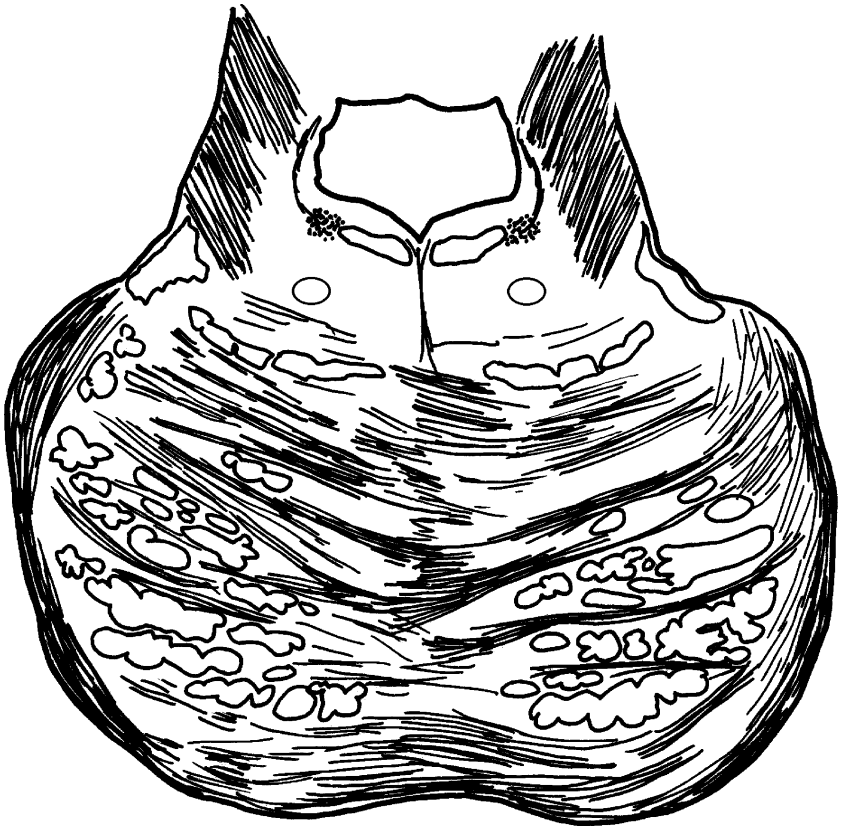
1. Cells of origin - extensive areas of cortex.
2. Corticopontine fibers course within the internal capsule and cerebral peduncle before entering the basilar pons where they synapse upon pontine grey neurons.
3. Pontine grey neurons send their axons (pontocerebellar) into the middle cerebellar peduncle (brachium pontis).
4. Information from the pontocerebellar fibers eventually reaches Purkinje cells of cerebellar cortex. The axons of Purkinje cells project to deep cerebellar nuclei.
5. Deep cerebellar nuclei send their axons into the superior cerebellar peduncle (brachium conjunctivum) which courses rostrally, decussates and ends in the red nucleus and VL- VA of the thalamus. VA - VL project to motor related cortex.



Cortico - Ponto - Cerebello - Thalamo - Cortical Pathway


LATERAL GENICULATE NUCLEUS
MEDIAL GENICULATE NUCLEUS
SUPERIOR COLLICULUS
OPTIC TRACT
BRACHIUM OF THE INFERIOR COLLICULUS
INFERIOR COLLICULUS
CEREBRAL PEDUNCLE
TROCHLEAR NERVE (C.N. IV)
SUPERIOR CEREBELLAR PEDUNCLE
(BRACHIUM CONJUNCTIVUM)
BASILAR PORTION OF THE PONS
TRIGEMINAL NERVE (C.N. V)
MOTOR PORTION OF C. N. V
SENSORY PORTION OF C. N. V
MIDDLE CEREBELLAR PEDUNCLE
INFERIOR CEREBELLAR PEDUNCLE
ABDUCENS NERVE (C. N. VI)
VESTIBULOCOCHLEAR NERVE (C. N. VIII)
FACIAL NERVE (C. N. VII)
GLOSSOPHARYNGEAL NERVE (C.N. IX)
PYRAMID
CUNEATE TUBERCLE
VAGUS NERVE (C. N. X)
CLAVA
HYPOGLOSSAL NERVE (C. N. XII)
FASCICULUS CUNEATUS
INFERIOR OLIVE
CRANIAL ROOT OF SPINOACCESSORY (C. N. XI)
TUBERCULUM CINEREUM
SPINAL ROOT OF C. N. XI
FASCICULUS GRACILIS
VENTROLATERAL SULCUS
FIRST CERVICAL NERVE (C_1)
PINEAL GLAND
SUPERIOR COLLICULUS
(THALAMUS)
MEDIAL GENICULATE
BRACHIUM OF THE INFERIOR COLLICULUS
LATERAL GENICULATE
INFERIOR COLLICULUS
TROCHLEAR NERVE
FACIAL COLLICULUS
SUPERIOR CEREBELLAR PEDUNCLE
INFERIOR CEREBELLAR PEDUNCLE
DORSAL VIEW
MIDDLE CEREBELLAR PEDUNCLE
DORSAL COCHLEAR NUCLEUS
VESTIBULOCOCHLEAR NERVE (C.N. VIII)
GLOSSOPHARYNGEAL NERVE (C.N. IX)
CUNEATE TUBERCLE
CLAVA
VAGUS NERVE (C.N. X)
DORSOLATERAL SULCUS
DORSAL MEDIAN SULCUS
FASCICULUS CUNEATUS
CRANIAL ROOT OF SPINOACCESSORY NERVE (C.N. XI)
TUBERCULUM CINEREUM (spinal tract and nucleus V)
SPINAL ROOT OF SPINOACCESSORY NERVE (C.N. XI)
FASCICULUS GRACILIS
DORSAL ROOT OF FIRST CERVICAL NERVE

PROBLEM SOLVING

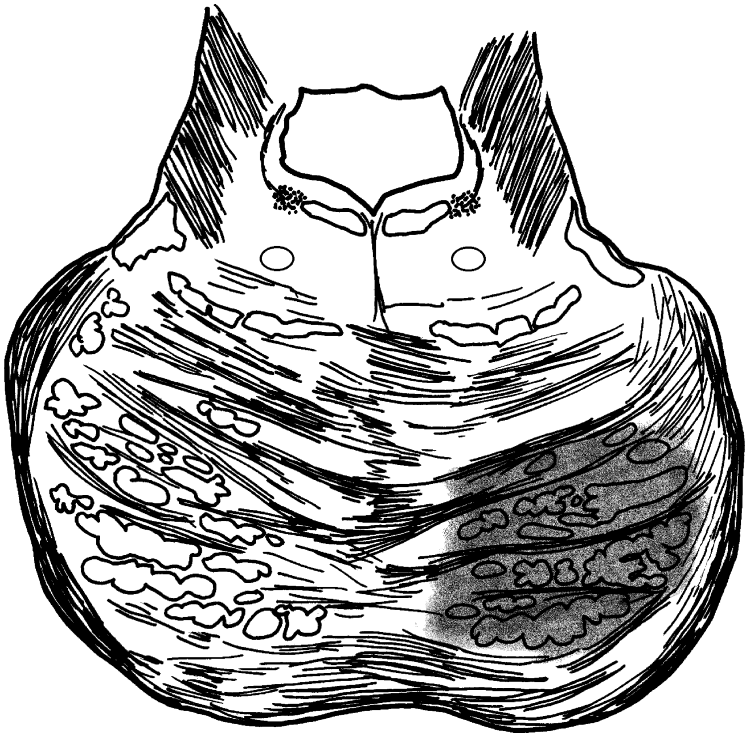


RIGHT LEFT

Shade in the location of a single, continuous, unilateral lesion in the above drawing that will account for the following neurological problems:

right hemiplegia, deviation of the tongue to the right upon protrusion, drooling from right side of the mouth

PROBLEM SOLVING ANSWER



RIGHT LEFT

PROBLEM SOLVING MATCHING

Match the best choice in the right hand column with the pathway or cell group in the left hand column

____1. right pontine grey

____2. right chief sensory V

____3. left inferior olivary nucleus

____4. left abducens nucleus

____5. right superior cerebellar peduncle

A. lesion results in atrophy of the right lateral rectus and the left medial rectus

B. lesion results in atrophy of the right temporalis muscle

C. receives input from the left PPRF

D. sends “mossy fibers” to the right side of the cerebellum

E. axons terminate in the left VA,VL and red nucleus

F. lesion results in a loss of vibrational sense from the right side of the face

G. sends “climbing fibers” to the right cerebellar hemisphere

H. axons terminate in the right medial geniculate body

I. comprised of axons that convey vibrational sensation from the right arm

J. lesion results in incoordination of the left side of the body