

Brainstem Clinical Neuroanatomy Made Flabbergastingly Simple

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Introduction

Skills to Achieve

- Locate lesions (***)
- Predict functional deficits (in addition to the ones mentioned in the vignette) (**)
- Identify arteries involved (*) (less important since most of the time these textbook syndromes occur due to tumours or other lesions, and rarely due to such well-targeted strokes)

Why?

To motivate the forthcoming study plan and the previously stated target skills, we'll take a look at a table differentiating between common brainstem stroke syndromes.

Key Brainstem Syndromes Distilled

Syndrome	Region & Artery	Cranial Nerves	Key Features
Claude	Midbrain (red nucleus), PCA	CN III	i3 + contralateral ataxia
Weber	Midbrain (cerebral peduncle), Basilar (paramedian branches)	CN III	i3c7u + contralateral hemiparesis
Parinaud	Midbrain (tectum), SCA & posterior choroidal (PCA branch)	—	Vertical gaze palsy, light-near dissociation
Millard-Gubler	Ventral pons, Basilar artery	CN VI, CN VII	i6, i7 + contralateral hemiplegia
Wallenberg	Lateral medulla, PICA	CN V (spinal nucleus), CN IX, CN X	Ipsilateral face pain/temp loss, contralateral body pain/temp loss, dysphagia, vertigo
Dejerine	Medial medulla, Anterior spinal artery	CN XII	i12 + contralateral hemiplegia, proprioception loss

Skills-Oriented Study Plan

We have to master the following topics in order to hammer down the aforementioned skills:

- Know the **basic sensory and motor tracts** including their pathways and functions
 - Tracts:
 - * Corticospinal
 - * Spinothalamic
 - * Dorsal column-medial lemniscal system (DCMLS)
 - * Corticobulbar
 - Pathways: must know where each of these tracts
 - * Decussate (if it does)
 - * is located in
 - Cerebral cortex
 - Int. capsule
 - Midbrain
 - Pons
 - Medulla
 - Spinal cord
- Know the **locations of the cranial nerve nuclei**
- Know the clinically relevant **subdivisions** in **cross sections** of the different areas of the **brainstem**
- Know the **arterial supply** of the different parts

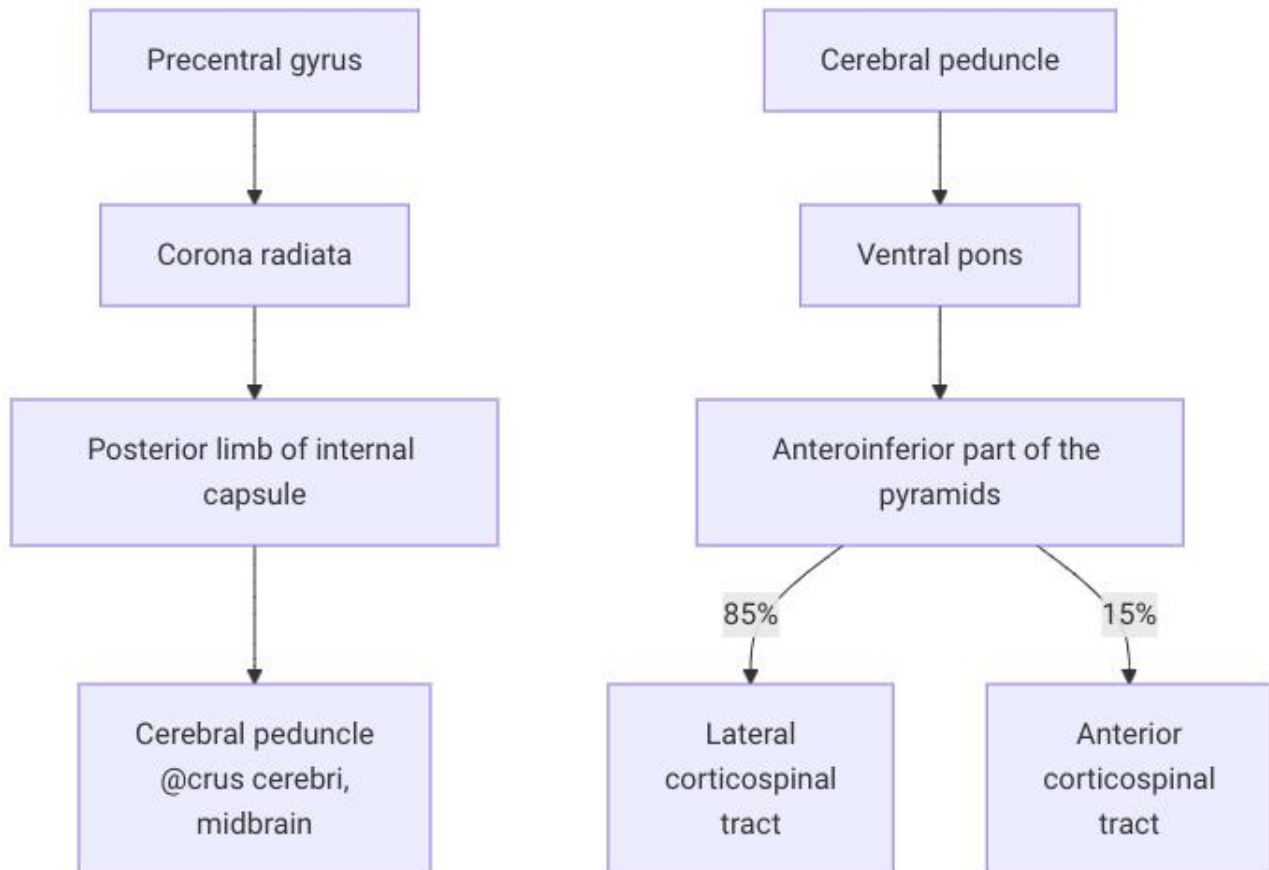
Tracts

Corticospinal Tract

Functions

- Convey all motor signals to voluntary muscles

Pathway - Simplified



Pathway - Detailed

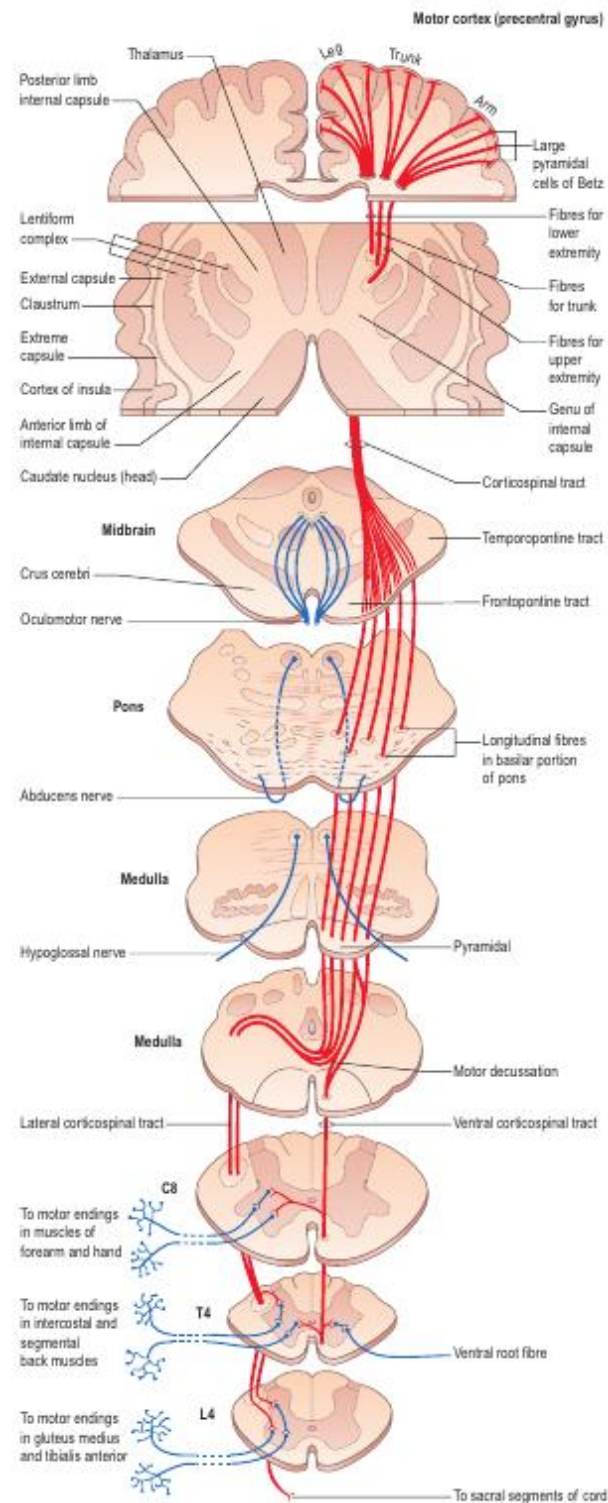


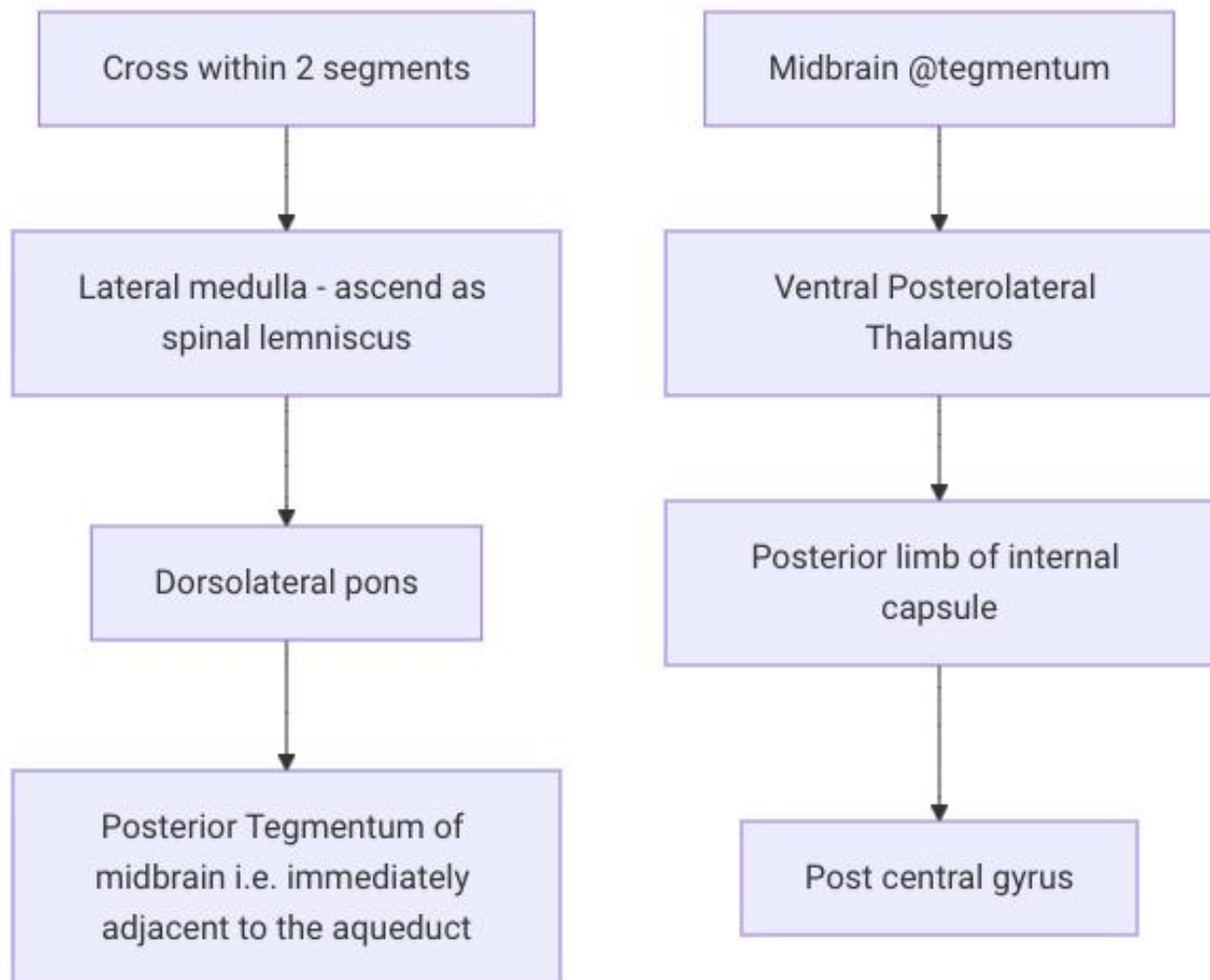
Fig. 20.16 The corticospinal tracts. (Redrawn with permission from Carpenter MB 1991 Core Text of Neuroanatomy, 4th edn. Baltimore: Williams and Wilkins.)

Spinothalamic tract

Functions

- **Anterior:**
 - Crude touch
 - Pressure
- **Lateral:**
 - Pain
 - Temperature

Pathway - Simplified



Pathway - Detailed

Ventral Spinothalamic tract

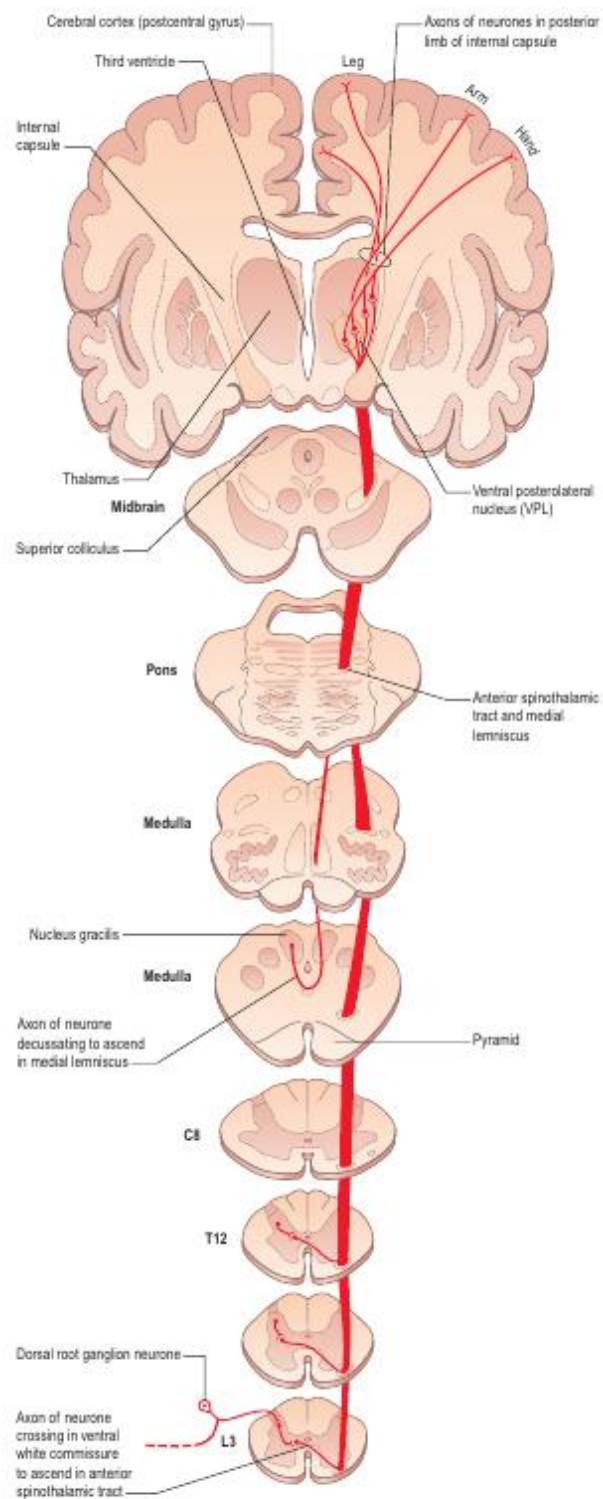


Fig. 20.13 The ventral (anterior) spinothalamic tract. (Redrawn with permission from Carpenter MB 1991 Core Text of Neuroanatomy, 4th edn. Baltimore: Williams and Wilkins.)

Lateral Spinothalamic Tract

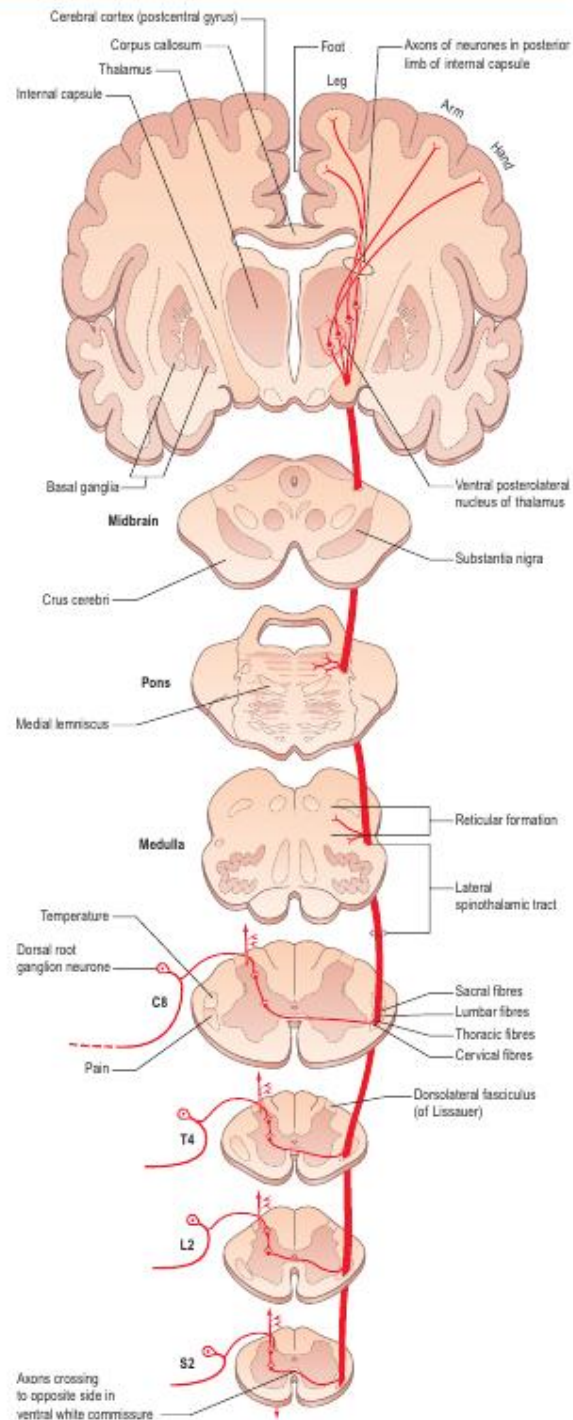


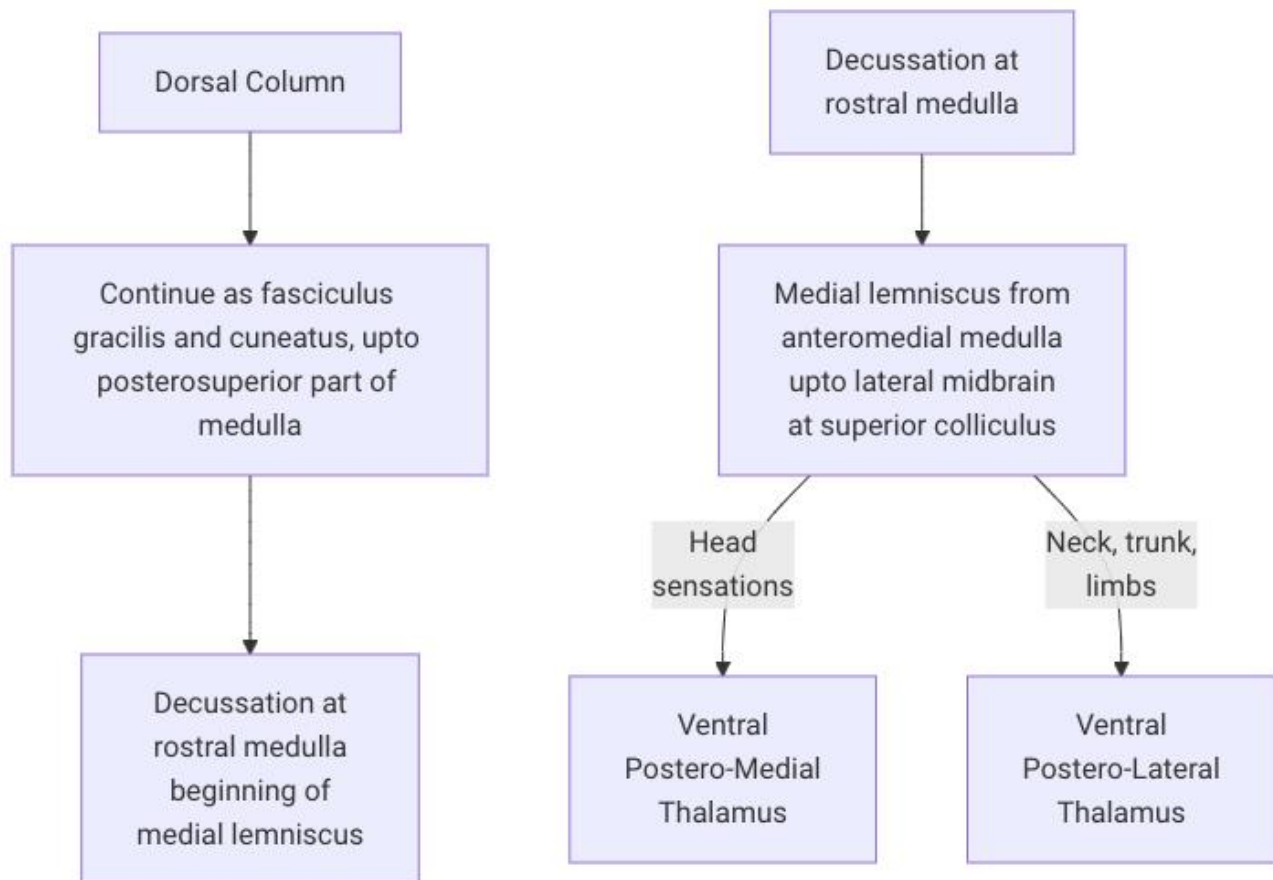
Fig. 20.12 The lateral spinothalamic tract. (Redrawn with permission from Carpenter MB 1991 Core Text of Neuroanatomy, 4th edn. Baltimore: Williams and Wilkins.)

Dorsal Column-Medial Lemniscus System (DCMLS)

Functions

- Fine touch
- Vibration
- Proprioception

Pathway - Simplified



Pathway - Detailed

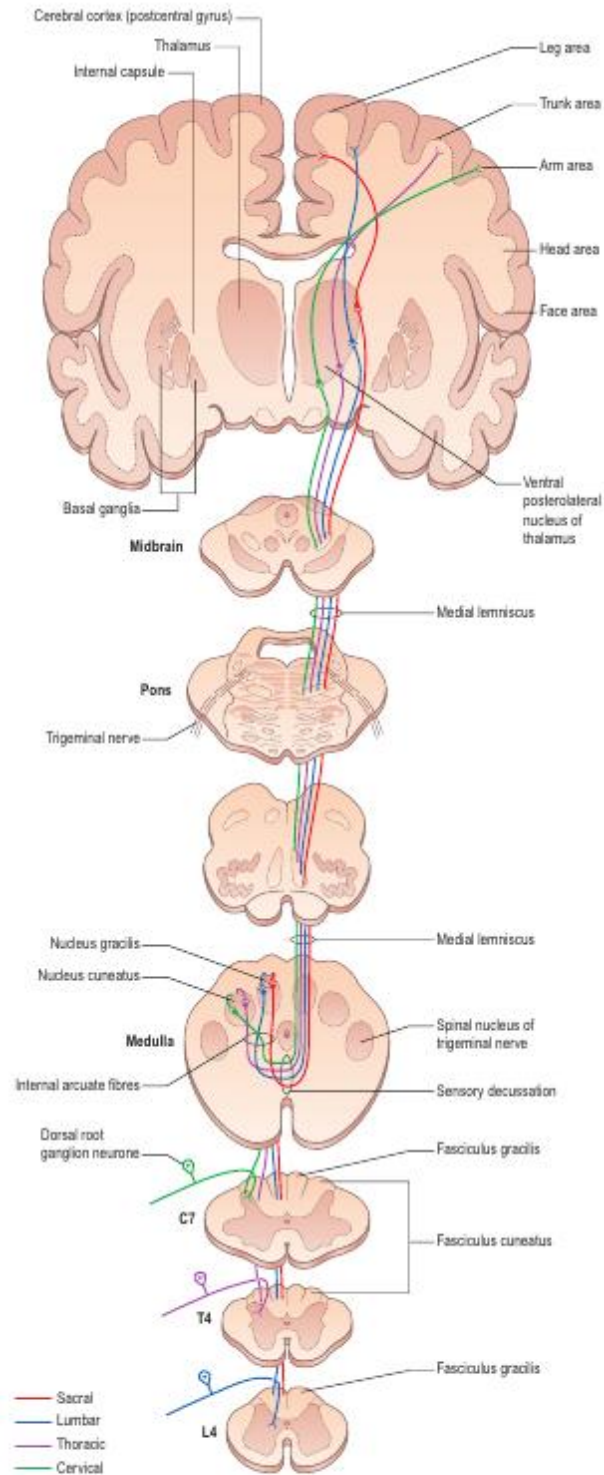


Fig. 20.10 The dorsal columns. Primary afferent fibres from different levels and their associated second- and third-order neurones are depicted in different colours.

Midbrain

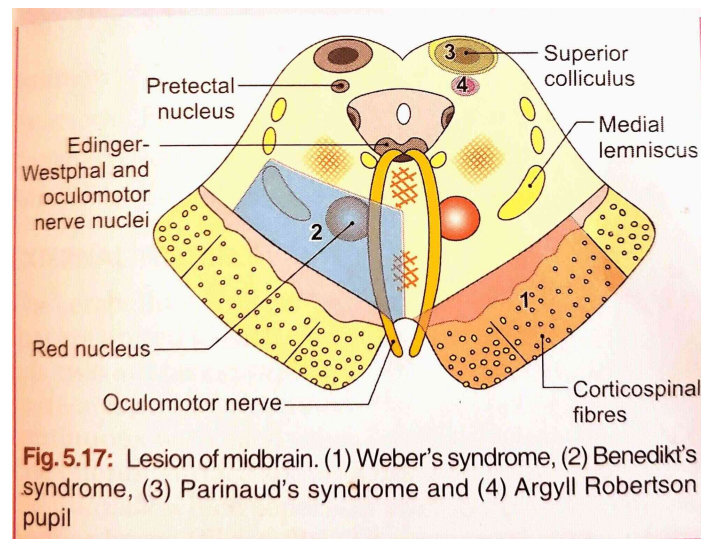


Figure 1: Midbrain

Region 1: Crus cerebri (Weber's Syndrome)

(cerebral peduncle = crus anteriorly and tegmentum posteriorly)

- *Artery:* Ventral paramedian branches of PCA
- *Lesion:* **Weber's**
- Clinically relevant *structures*:
 - Corticospinal and corticobulbar fibres in the cerebral peduncles
 - Oculomotor nerve fibres exiting from interpeduncular fossa
- Clinical *syndrome*: **i3 + c7u + CHP**
 - Ipsilateral: Oculomotor palsy ("down and out")
 - Contralateral: UMN facial, hemiplegia

Region 2: Tegmentum (Claude's Syndrome)

- *Artery:* Dorsal paramedian branches of PCA
- *Lesion:* **Claude's**
- Clinically relevant *structures*:
 - Red nucleus containing fibres from contralateral dentate nucleus of cerebellum (part of dentato-rubro-thalamic pathway)
 - Oculomotor nerve fibres in the central tegmental region
- Clinical *syndrome*: **i3 + CCA_t**
 - Ipsilateral: Oculomotor palsy (CN3)
 - Contralateral: Cerebellar ataxia

Region 3: Tectum (Parinaud's Syndrome)

- *Artery*: Posterior choroidal artery (br. of PCA) at sup. colliculus, superior cerebellar artery (SCA) at inf. colliculus
- *Lesion*: **Parinaud's**
- Clinically relevant *structures*:
 - Interstitial nucleus of Cajal at superior colliculus aka rostral interstitial nucleus of the MLF (riMLF) which is the vertical gaze centre
 - Pretectal nucleus: relays light reflex input arm signals to Edinger-Westphal nucleus, which then relays it to oculomotor nucleus
- Clinical *syndrome*:
 - Vertical gaze palsy (due to riMLF lesion)
 - Pupillary disorders (e.g. light-near dissociation) (due to pretectal nucleus lesion)

Pons

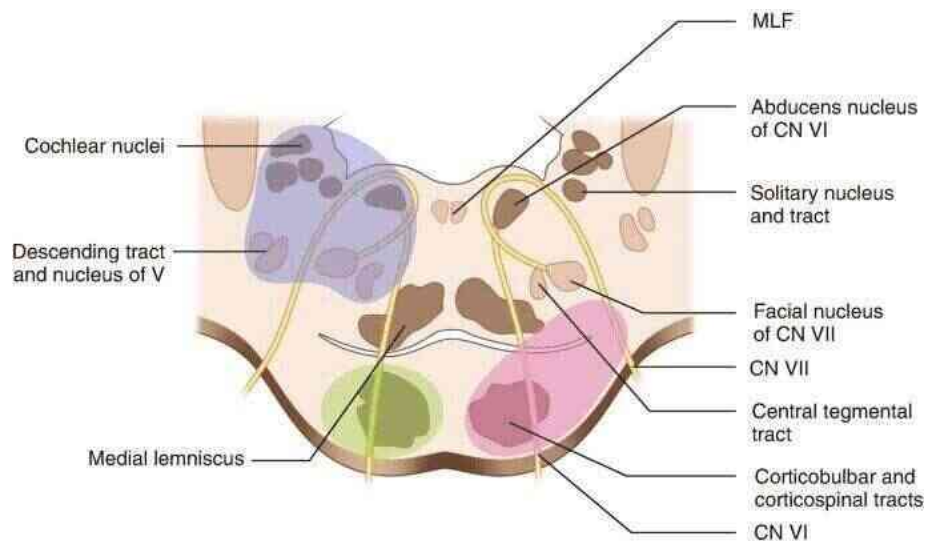


Figure 2: Pons

Ventral (Basilar) Pons (Millard-Gubler Syndrome)

- *Artery*: Basilar artery (lodges in the median sulcus between the two sides of pons)
- *Lesion*: **Millard-Gubler's**
- Clinically relevant *structures*:
 - Corticospinal tract in the paramedian area
 - Axons of CN6 and CN7
- Clinical *syndrome*: **i6, i7 + CHP**
 - Ipsilateral lateral rectus (CN6) and LMN facial palsy (CN7)
 - Contralateral hemiplegia

Medulla

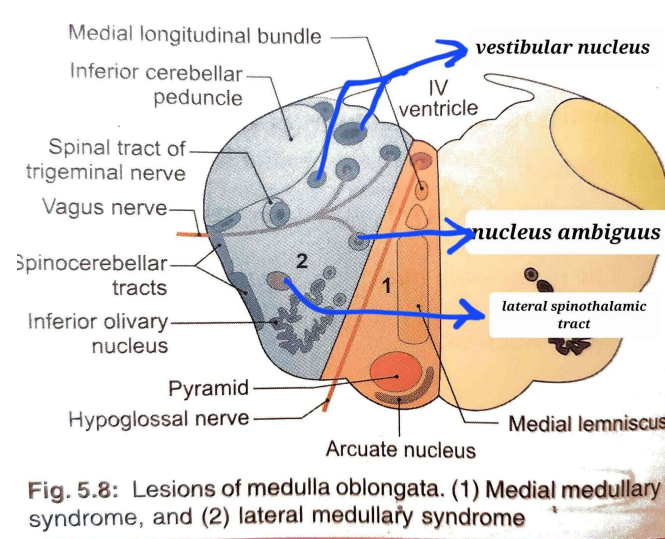


Figure 3: Medulla

Posterolateral Medulla (Wallenberg / lateral medullary syndrome)

- *Artery:* PICA (posteroinferior cerebellar artery, br. of vertebral)
- *Lesion:* **Wallenberg / lateral medullary syndrome**
- Clinically relevant *structures*:
 - Nucleus ambiguus: motor nucleus of CN 9, 10, 11 - ipsilateral soft palate, pharynx, larynx
 - Spinal trigeminal nucleus and tract: ipsilateral face - pain and temperature senses
 - Lateral spinothalamic tract: contralateral body - pain and temperature senses
 - Vestibular nucleus
 - Spinocerebellar tracts - coordinate ipsilateral limb movements
 - Descending sympathetic fibres from hypothalamus - ipsilateral Horner
- Clinical syndrome: **i5, 9-11 + CPT**
 - Ipsilateral - 5 (pain and temperature lost at ipsilateral face), [9, 10, 11] (bulbar palsy) lesion; dysequilibrium (vestibular nucleus); ataxia (spinocerebellar tract); Horner's (ptosis, miosis, anhidrosis, enophthalmos)
 - Contralateral - pain and temperature lost (lateral spinothalamic) at contralateral body

Anteromedial Medulla (Dejerine syndrome)

- *Artery:* Anterior spinal artery
- *Lesion:* **Dejerine syndrome**
- Clinically relevant *structures*:
 - Pyramidal tract
 - Medial lemniscus
 - Hypoglossal nucleus and nerve
- Clinical *syndrome:* **i12, dc + CHP**
 - Ipsilateral: fine touch, vibration (DCMLS); tongue paralysis (CN12)
 - Contralateral: hemiplegia (pyramidal)

High-Yield Summary

Region	Artery	Syndrome	Key Features
Midbrain (crus)	PCA (ventral paramedian)	Weber's	i3 + contralateral hemiplegia + c7 UMN
Midbrain (tegmentum)	PCA (dorsal paramedian)	Claude's	i3 + contralateral ataxia
Midbrain (tectum)	Post. choroidal, SCA	Parinaud's	Vertical gaze palsy + pupillary light-near dissociation
Pons (ventral)	Basilar	Millard-Gubler	i6, i7 + contralateral hemiplegia
Medulla (anteromedial)	Anterior spinal	Dejerine's	i12 + contralateral hemiplegia + DCMLS loss
Medulla (posterolateral)	PICA	Wallenberg	i5, i9–11, Horner + contralateral pain/temp loss