Anatomy Team
MED 439

Revised & Approved

Abdullah Alsubaihi
Rania Almutiri

MED439
KING SAUD UNIVERSITY

Anatomy of the Cerebellum & Relevant Connections

CNS Block

Don't forget to check the Editing File

Color index:

Content
Male slides
Female slides
Important
Doctors notes
Extra information, explanation

Contact us:
Anatomy439@gmail.com

Objectives

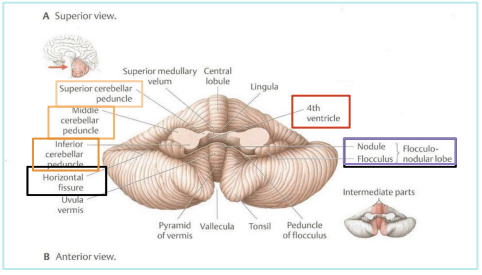
At the end of the lecture, students should be able to:

- Describe the external features of the cerebellum (lobes, fissures).
- Describe briefly the internal structure of the cerebellum.
- List the name of cerebellar nuclei.
- Relate the anatomical to the functional subdivisions of the cerebellum.
- Describe the important connections of each subdivision.
- Describe briefly the main effects in case of lesion of the cerebellum.

The Cerebellum

Origin & position

Origin: From hindbrain
Position: lies behind Pons & Medulla Separated from them by **Fourth ventricle**.

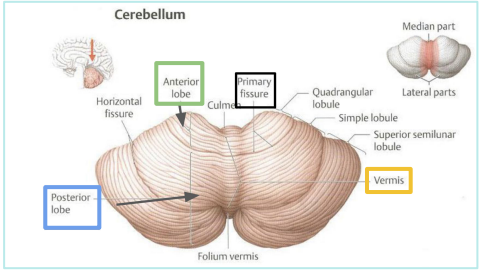


Connection To Brain Stem

By **inferior**, **middle** & **superior cerebellar peduncles**.

External Features

It consists of two cerebellar hemispheres joined in midline by the **vermis**.
Its surface is highly convoluted forming folia separated by fissures.

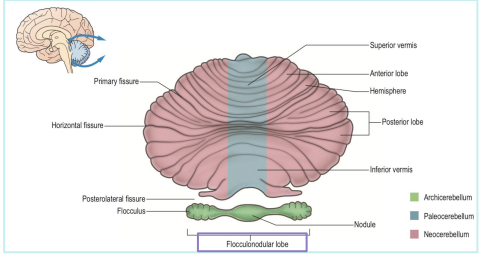


Anatomical Subdivision

Anterior lobe
In front of primary fissure on the superior surface.

Posterior lobe (Middle)
Behind primary fissure (Between Primary & Secondary fissures posterolateral)

Flocculonodular lobe
In front of secondary (Posterolateral) fissure on the inferior surface



How can we differentiate between the upper surface and the lower surface of the cerebellum ?

The upper surface: is continuous with the cerebellar hemisphere which makes it hard to distinguish the vermis

The lower surface: is separated by a deep groove called the VALLECULA which makes it easy to distinguish the vermis

The Cerebellum

Internal Structure and Nuclei of Cerebellum (CONSTITUENTS)

Note:
Climbing fibers DIRECTLY synapse with purkinje cells.

While mossy fibers are INDIRECTLY connected to the purkinje cells
(through granule cells)

Outer grey matter (cerebellar cortex)

Divided into 3 layers:
1. **Outer molecular layer**
2. **Intermediate Purkinje cell layer**
3. **Inner granular layer**

Inner white matter (cerebellar medulla)

Afferent Fibres:
· **Climbing fibres:** from inferior olivary nucleus, relay to **purkinje cells (direct route to purkinje cells)**
· **Mossy fibres:** rest of fibres:
1. From vestibular nuclei **2**. From spinal cord. **3**. From pons
They relay to **granule cells** which in turn relay to purkinje cells
Finally all afferent fibres passing through the medulla relay to purkinje cells in the cortex.

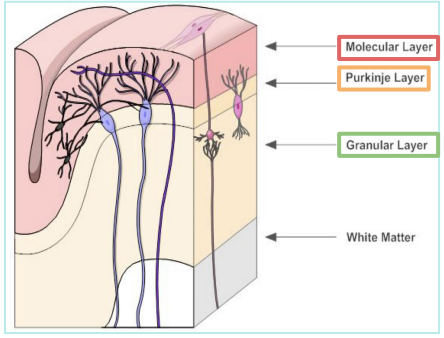
Axons of purkinje cells are the only axons to leave the cortex to medulla:
1. The great majority of axons do not leave cerebellum & end in deep **cerebellar nuclei**. specially Dentate nucleus.
2. Some of axons leave cerebellum as efferent fibres.

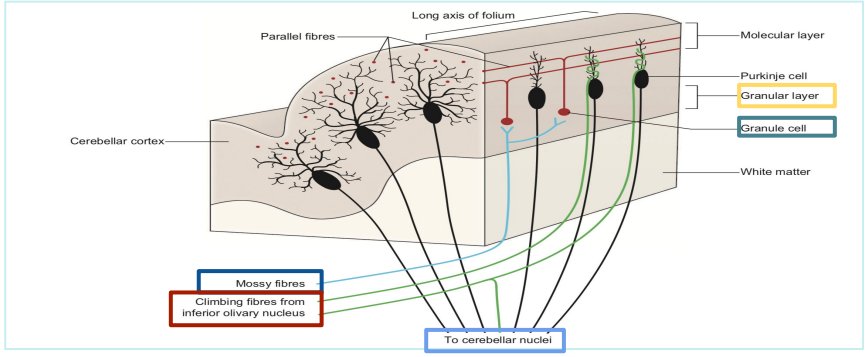
Efferent Fibres: Most of efferent fibres are axons of deep cerebellar nuclei.
Main efferents go to nuclei of brainstem & thalamus :
1. Vestibular nuclei (cerebello-vestibular tract).
2. Red nucleus (Dendato-rubro-thalamic tract).
3. Ventral lateral nucleus of thalamus (Dendato-thalamic tract).

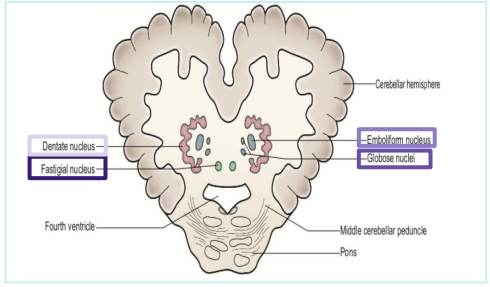
Deeply seated nuclei in white matter:

From medial to lateral:
1. **Fastigial nucleus:** Smallest one and most medial
2. **Globose nucleus**
3. **Emboliform nucleus**
4. **Dentate nucleus:** Largest one and most lateral .

Note:
Different color indicate different physiological function. (regarding the image below)

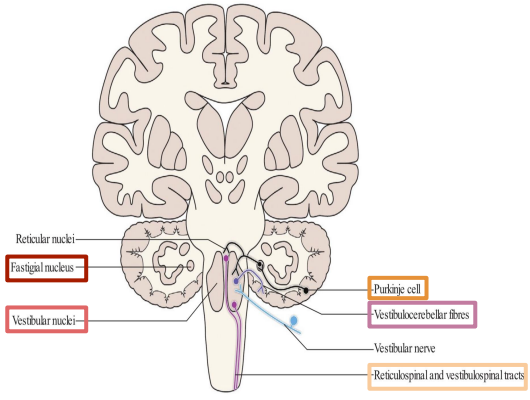


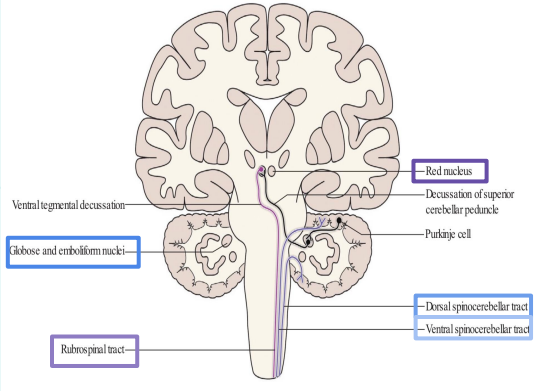


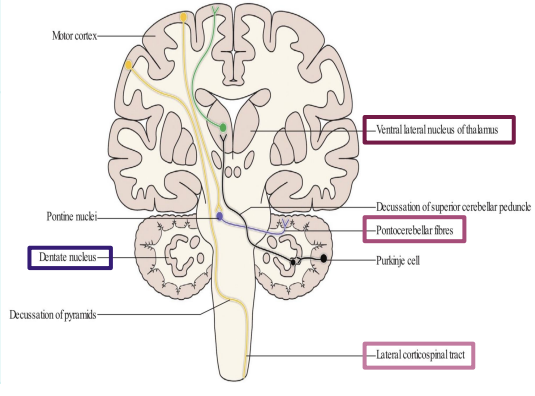


Functional subdivisions of the cerebellum

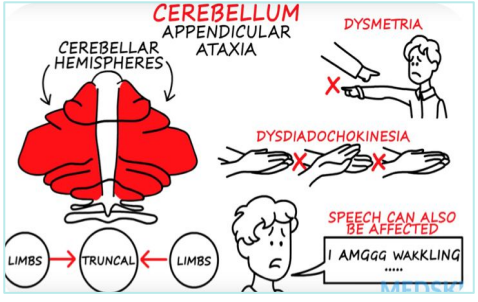
	Archi-Cerebellum Vestibular Part	**Paleo-Cerebellum** Spinal Part	**Neo-cerebellum** Cerebral Part
Part of cerebellum	Flocculonodular lobe	Vermis & Paravermis	Rest of cerebellum
Nuclei	**Fastigial**	**Globose & Emboliform**	**Dentate**
Afferent	From **Vestibular nuclei** (**Vestibulo-Cerebellar fibres**) Through ICP	From spinal cord (**dorsal** & **ventral spinocerebellar tracts** through ICP & SCP , respectively	From pons (**Pontocerebellar fibres**) through MCP
Efferent	To cortical (**purkinje cell**) Fibres project : to Fastigial nucleus, which projects to vestibular nuclei through ICP + to Reticular formation	To globose & emboliform nuclei which project to **red nucleus** through SCP Note: The globose and emboliform nuclei have SIMILAR physiological function but different ANATOMICAL structure.	To Red nucleus but mostly to **Ventral lateral nucleus of Thalamus** (through SCP) then to motor cortex
Function	-Controls body Balance (**via vestibulospinal & reticulospinal tracts**) -Control of eye movement (via VO vestibulo-ocular reflex)	Controls and influence posture & muscle tone (Via **Rubrospinal tract**)	Coordination of voluntary movements (Via descending **corticospinal** & corticobulbar tracts or rubrospinal tract)







Cerebellar Lesions



Cerebellar ataxia causes ipsilateral:

- **Incoordination of arm:** intention tremor (on performing voluntary movements)
- **Incoordination of leg:** unsteady gait
- **Incoordination of eye movements:** nystagmus
- **Slowness of speech:** dysarthria (difficulty of speech)

Why the lesion is ipsilateral ?

Because decussation occurs TWO times. So they eliminate each other

The 1st one occurs when the corticospinal tract **cross** to the other side.

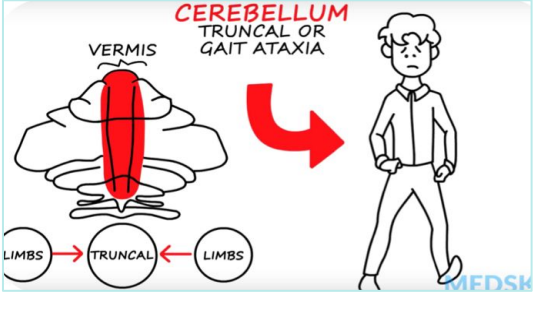
The 2nd one occurs when the pontocerebellar fibers pass **contralaterally in the cerebellum**

Unilateral Lesion

Midline Lesion

(the vermis and the paravermis are affected)

- Loss of postural control



MCQ

Q1: Where does the cerebellum originate?			
A: Forebrain	B: Midbrain	C: Hindbrain	D: None of the above

Q2: The 2 cerebral hemispheres are joined in the midline by ?			
A: Superior cerebellar peduncle	B: Vermis	C: 4th ventricle	D: Horizontal fissure

Q3: Which subdivision of the cerebellum is In front of primary fissure on the superior surface ?			
A: Anterior lobe	B: Posterior lobe	C: Lateral lobe	D: Flocculonodular lobe

Q4: Which of the following is the smallest nuclei of the white matter?			
A: Dentate nucleus	B: Globose nucleus	C: Emboliform nucleus	D: Fastigial nucleus

Q5: Which of the following is the most lateral nuclei?			
A: Globose nucleus	B: Dentate nucleus	C: Fastigial nucleus	D: Emboliform nucleus

Q6: Axons of purkinje cells are the only axons to leave the cortex to ?			
A: Pons	B: Midbrain	C: Medulla	D: A & B

Answer key:
1 (C) , 2 (B) , 3 (A) , 4 (D) , 5 (B) , 6 (C)

MCQ

Q7: Which one of the following is nuclei of Neocerebellum ?			
A: Globose	B: Emboliform	C: Dentate	D: Fastigial

Q8: The Paleo-Cerebellum controls?			
A: Influence posture	B: Body Balance	C: Muscle tone	D: Both A & C

Q9: The Midline Lesion of cerebellum is :			
A: Intention Tremors	B: Unsteady Gait	C: Nystagmus	D: Loss of postural control

Q10: The Archi-Cerebellum control eye movement via:			
A: Red nucleus	B : Vestibulo Ocular reflex	C: Rubrospinal tract	D: Reticulospinal tracts

Q11: Which one of the following control voluntary movements ?			
A: Paleo-Cerebellum	B: Neo-cerebellum	C: Archi-Cerebellum	D: Both A & B

Q12: The affrent of Archicerebellum from :			
A: Pontocerebellar fibres	B: Purkinje cells	C: Vestibulocerebellar fibres	D: None of them

Answer key:
7(C) , 8(D) , 9(D) , 10(B) , 11(B) , 12(C)

SAQ

Q1: List the anatomical divisions of the cerebellum.

Q2: Enumerate the layers of the outer grey matter.

Q3: List the effects of unilateral cerebellar lesion?

Q4: Damage to the cerebellum results in effects on which side of the body?

Answers

1 : 1. Anterior lobe 2. Posterior lobe 3. Flocculonodular lobe

2 : 1. Outer molecular layer 2. Intermediate purkinje cells layer 3. Inner granular layer

3 : 1.Intention Tremors 2.Unsteady Gait 3.Nystagmus 4.Dysarthria

4: ipsilateral

Team leaders

Rayan jabaan

Abeer Awwad

A special thanks to Mohamed Alquhidan

Reviser
Abdulaziz Alkraida

Organizer
Abdulaziz Alghuligah

Note taker
Mohammed Aldehaim

Team Members

- Alaa Assulmi
- Albandari Alanazi
- Aljoud Algazlan
- Afnan Almohsen
- Arwa Alqahtani
- Aseel Alshehri
- Asma Alamri
- Bodoor Almubarak
- Deemah Alotaibi
- Fatimah Saad
- Ghada Alabdi
- Ghaida Alassiry
- Joud Alnujaidi
- May Barakah
- Norah Alasheikh
- Nouf Alsubaie
- Raghad Alasiri
- Raghad Soaeed
- Renad Alosaimi
- Sara Alharbi
- Sarah Almuqati
- Sarah Alqahtani
- Shaden Alsaiedan
- Shahad Almezel
- Shayma Alghanoum
- Sumo Alzeer

- Abdullah Alburikan
- Abdullah Aldosari
- Abdulaziz Alghuligah
- Abdulaziz Alkraida
- Abdulaziz Alomairy
- Abdulaziz Alrabiah
- Abdulaziz Alsuhaim
- Abdulrahman Almugren
- Ahmed Alkhayatt
- Bader Alrayes
- Basel Fakeeha
- Fahad Alajmi
- Faisal Alotaibi
- Fayez Altabbaa
- Feras Alqaidi
- Hadi Alhemsi
- Hesham Alsqabi
- Mohammed Aldehaim
- Mohamed Alquhidan
- Mohammed Beyari
- Mubarak Alanazi
- Musab Alamri
- Nawaf Alghamdi
- Osama Alharbi
- Raed Alnutaifi
- Saad Aldohaim
- Saleh Algarni