Structural and Functional anatomy of cerebellum. More than a motor conception

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Learning objectives

Spreading the structural complexity of the cerebellum and multiple connections in the brain to better understand its involvement in motor and cognitive functions.

Background

The cerebellum is the organ responsible for motor coordination, posture and balance. It is considered a silent process information from other areas of the brain, spinal cord and sensor receptors for coordinated precise movements of the musculoskeletal system.

It is located in the posterior cranial fossa, dorsal to the brainstem and inferior occipital lobe and consists of two cerebellar hemispheres, united by a central mass (vermis).

Anatomically, can be divided from the point of view:

1. Morphologic
2. Phylogenetic
3. Functional

MORPHOLOGICAL DIVISION:
It is a descriptive division no functional basis and no application in clinical practice. The cerebellum is divided into three lobes: anterior, posterior and flocculonodular. (Scheme 1 and 2)

PHYLOGENETIC DIVISION:
From the phylogenetic standpoint, from oldest to most modern, the cerebellum is divided into three parts: arqueocerebellum, paleocerebellum and neocerebellum (Scheme 3):

1. Arqueocerebellum
It corresponds to the lobe flocculonodular and largely with vestibulocerebellum. Receives afferents from the vestibular nuclei and is responsible for controlling mainly the maintenance of equilibrium.
2. **Paleocerebellum**
This consists of the pyramid, uvula, central lobule, culmen and quadrangular lobule. From the functional point of view, corresponds to the spinocerebellum.
Receives afferents from the spinal cord and is going to control muscle tone, postural tone and motor coordination.

3. **Neocerebellum**
Formed by posterior lobe except pyramid and uvula. Corresponds to the cerebrocerebellum. Receives afferents from the cortex through the nucleus of the pons.

**FUNCTIONAL DIVISION (Scheme 4):**
From a functional standpoint, there are three distinct regions:

1. **Vestibulocerebellum**
The vestibulocerebellum, is formed by the lobe flocculonodular.
Receives afferents from the vestibular nuclei and visual cortex through nuclei of the pons and their efferents go straight to the vestibular nuclei.
Responsible for controlling and regulating the balance and eye movements.

2. **Spinocerebellum**
Formed by two parts of the cerebellar cortex:
**Band vermian:** formed by the superior and inferior vermis (except the nodule).
Receives somatosensory afferents from the spinal cord, vestibular, visual and acoustic and sends its efferents through the fastigial nucleus. Control muscle movement of the head, trunk, neck and proximal portions of limbs.

**Bands paravermians:** Found on both sides of the band vermian.
Receives somatosensory afferents from the spinal cord and trigeminal sensory nucleus and sends its efferents through the interpositum nucleus. Control movement of the distal portions of the limbs.

3. **Cerebrocerebellum:**
It consists of the lateral cerebellar hemispheres.
Receives afferents from most of the neocortex through the pons nuclei.
Sends efferents that reach the thalamus through the dentate nucleus, and thence to the cerebral cortex. Performs cognitive functions (visuospatial perception, language processing and modulation of emotions), general planning of motor activities and motor learning sequenced (Figure 1).
Body topographic representation in the cerebral cortex (Scheme 5)

STRUCTURE OF THE CEREBELLAR CORTEX

We divide the cerebellar cortex in three layers, from superficial to deep, are called: molecular layer, Purkinje cell layer and granular layer.
Among them we distinguish 5 different cell types (Scheme 6)
As afferent extracerebellar, we find:

Mossy fibers: from the spinal cord, medulla and pons, from the basal nuclei of the protuberance, entering through the body restiform and middle cerebellar peduncle. Most fibers are excitatory (glutamate) and synapse with granule cells.

Climbing fibers: They originate in the inferior olive contralateral amounts by the body restiform and excitatory synapses with cells Purkinje.

DEEP NUCLEUS

We distinguish four pairs of nuclei of gray matter medial to lateral, are: fastigial, globose, emboliform and dentate (Figure 2).
Receive signals from two sources: afferents and cerebellar cortex.
The vestibular nuclei of the medulla oblongata could also be considered deep cerebellar due to their direct connections flocculonodular lobe cortex.

WHITE MATTER

Formed:

Central mass

Histologically composed of:

• Axons:
  - Afferent fibers (mossy, climbing and from the serotonergic and noradrenergic system)
  - Efferent fibers
    F. Commissural: connecting the cerebellar hemispheres
    F. Arched or association: connecting adjacent gyri
  - Intrinsic
• Glial cells: astrocytes, oligodendrocytes.

**Cerebellar peduncles**:

1. Superior cerebellar peduncle:
   • Connects the cerebellum with the midbrain
   • Principal cerebellar efferent system
   • Origin: dentate nuclei and interpositum

2. Middle cerebellar peduncle
   • Connects the cerebellum with the pons.
   • Principal cerebellar afferent system
   • Origin: nuclei of the pons.

3. Inferior cerebellar peduncle
   • Connects the cerebellum with the medulla oblongata
   • Formed by:
     - Body restiform (afferent system)
     - Body yuxtarrestiforme (efferent system)

All connections pass through the cerebellar peduncles (Table 1)

**CEREBELLUM NEURONAL CIRCUIT (Scheme 7)**

**VESTIBULOCEREBELLUM**

**Vestibulocerebellar afferents**

The main afferents come from the vestibular system by means of two tracts: vestibulocerebellar tract of Edinger and indirect vestibulocerebellar tract. These afferent fibers can be direct, from Scarpa ganglion, or indirect if they are first to make stops in the vestibular nuclei. Enter the inferior peduncle, not decussate in its path and transmit information from the head position, linear and angular accelerations of the body (Figure 3).

1. Vestibulocerebellar direct tract of Edinger
Consisting of extensions of neurons settled in the vestibular ganglion (Scarpa), preferably ending in the nodule and also in the band vermician. Bypasses the cerebellar nuclei.

2. Vestibulocerebellar indirect tract

It originates in the superior and medial vestibular nuclei and will finish in the flocculus and to a lesser extent, the band vermician.

3. Some fibers corticopontocerebellar tract

(Occipitopontocerebellar fibers) that transmit visual information.

**Vestibulocerebellum efferent (Table 2)**

The efferent vestibulocerebellum consist purkinje cell axons leaving the cerebellum without synapsing in the cerebellar nuclei. The main tracts are:

1. Cerebelovestibular tract

It originates from the flocculus and exits through the inferior peduncle to reach the medial and lateral vestibular nuclei. Regulates the activity of the medial and lateral vestibulospinal tracts.

2. Floculooculomotor tract

It originates from the flocculus and exits through the superior cerebellar peduncle to reach the oculomotor nerve nucleus, previously decussate within the cerebellum. It controls the movements of the abducens.

3. Russell uncinate tract

It originates from the flocculus and exits through the inferior cerebellar peduncle to the vestibular nuclei. On the way, side issues that come out the top stem and reach the nuclei of the ocular motor nerves, reticular formation and hypothalamus. Is responsible for controlling the movements of the abducens and the activity of the vestibulospinal tract. (Figure 4 and Scheme 8)

**SPINOCEREBELLUM**

The spinocerebellum transmitting somatosensory information from the trunk and limbs to the cerebellum (Scheme 9).
Spinocerebellum afferents

Afferents that reach the cerebellum may come from the spinal cord, medulla and midbrain (Figures 5 and 6).

In the spinal cord afferents arrive by:

1. Anterior spinocerebellar tract of Gowers

It originates in the dorsal horn of the spinal cord, at the height of the last lumbar and sacrococcygeal segments. Most of the fibers decussate the gray commissure and ascend through the contralateral lateral cord. Enter superior cerebellum peduncle to reach the vermis and paravermians bands on both sides. Transmits unconscious proprioceptive and esteroceptive information of lower extremity.

2. Posterior spinocerebellar tract of Flechsing

It originates in the thoracic spine (nucleus of Stilling-Clarke) and ascends the lateral cord, behind the anterior spinocerebellar tract. Enter the inferior cerebellar peduncle, synapse with neurons in the fastigial nuclei and interpositum and finishing in vermis and paravermian band on the same side of its origin. Transmits unconscious proprioceptive and esteroceptive information from the trunk and lower extremity.

The medulla afferents arrive by:

1. Cuneocerebellar Tract

It originates in the accessory cuneate nucleus and ascends without decussate along the posterior spinocerebellar tract. Enter through the inferior cerebellar peduncle, synapse with neurons of the fastigial nucleus and interpositum. and ends in vermis and paravermian band on the same side. Transmits unconscious proprioception and esteroceptive information the upper body.

2. Olivocerebellar Tract

The most important connection is established between medulla and cerebellum. It originates in the inferior olivary nucleus and accessory olivary nucleus. Completely decussate and enter the cerebellum through the inferior cerebellar peduncle, providing fiber for the entire cerebellar cortex. Transmits to the cerebellum somatostesic information, visual and of cerebral cortex in addition to receiving vestibular afferents.

3. Reticulocerebellar Tract
It originates from the bulbar and pontine reticular formation. Part of its fibers decussate and enters the inferior cerebellar peduncle to reach the spinocerebellum mainly. Some fibers are directed to cerebrocerebellum. Convey complex information, both of the periphery and the cerebral cortex and other parts of central nervous system.

Midbrain afferents arrive by:

1. Tectocerebellar tract

It originates in the superior and inferior colliculi. They enter the cerebellum through the superior peduncles same side and end in the vermis. Transmits visual and acoustic information from the cerebral cortex.

2. Trigeminocerebellar Tract

It originates in the trigeminal mesencephalic nucleus. Enter through the superior peduncle without decussate and terminate in the vermis and the vermian band on the same side of its origin. Transmits proprioceptive information from craniofacial region.

3. Rubrocerebellar Tract

It originates from the red nucleus and decussate in full before reaching the cerebellum through the superior peduncle.

**Spinocerebellum efferent**

__Arising from fastigial nucleus:__ leaving the cerebellum through inferior cerebellar peduncles

1. Descending reticulospinal and vestibulospinal tract

2. Ascending tract

Directed to the ventrolateral nucleus of the thalamus and the primary premotor cortex.

__Arising from interpositum nucleus:__ leaving the cerebellum through superior cerebellar peduncle mainly.

1. Interpositoreticular tract

Its fibers decussate partially, leaving the cerebellum though inferior cerebellar peduncles to achieve nuclei of the reticular formation.
2. Interpositoolivar Tract

Leaving the cerebellum though superior cerebellar peduncles. Decussate in full at the midbrain and descends to reach the inferior olivary nucleus.

3. Interpositotectal Tract

Partially decussate before exiting the superior cerebellar peduncles and goes up to the superior and inferior colliculi.

4. Interpositorubric Tract

Eference spinocerebellum most important and main discharge path interpositum nucleus. Leaving the cerebellum though superior cerebellar peduncles, its entirety decussate in the midbrain and reach the contralateral red nucleus (magnocellular division). Their axons go to the ventral intermediate nucleus of the thalamus and the sensory and motor cerebral cortex. Controls the activity of the motor pathways that descend to the spinal cord (Figures 7 and 8).

CEREBROCEREBELLUM

Cerebrocerebellum Afferents

All afferents are part of the tract corticopontocerebellar. It originates from a wide area of the cerebral cortex comprising the frontal, parietal, occipital and temporal lobes. Pass through the internal white capsule, to address the nuclei of the pons.

Comprising:

1. Frontopontine fibers (motor and premotor cortex)
2. Parietopontine fibers (primary and secondary somatosensory areas and visual areas)
3. Occipitopontine fibers (magnocellular stream of the visual pathway).
4. Temporopontine fibers

Fibers ranging from the nuclei of the pons to the cerebellum (Pontocerebellar fibers), follow a horizontal path by protuberance, decussate and enter through the middle cerebellar peduncle to finish in the globular nuclei and cerebellar hemispheres cortex.
**Cerebrocerebellum Efferents**

1. **Dentothalamic Tract:**

   It originates in the dentate nucleus, leaving the cerebellum through superior cerebellar peduncle and decussate in the midbrain (decussation Wernekink) to finish in the ventral intermediate nucleus of the thalamus. From the thalamus parts thalamocortical fibers that end in areas of the cerebral cortex.

2. **Dentorubic Tract:**

   It originates in the dentate nucleus, leaving the cerebellum through superior cerebellar peduncle, decussate and reach the contralateral red nucleus (parvocellular division) (Figure 9, 10 and Scheme 10)

**Monoaminergic Systems Afferents**

Its fibers do not behave as mossy fibers or as a climber but as projections difusas. El cerebellum, receives fibers from two monoaminergic systems:

- **Noradrenergic system: caeruleocerebellar tract**

   It originates from the locus caeruleus. Penetrates the superior cerebellar peduncle and ends in all the nuclei and the cerebellar cortex.

- **Serotonin System: Serotonincerebellar tract**

   Penetrates the middle cerebellar peduncles to finish distributed by all the nuclei and the cerebellar cortex.

In conclusion, afferent white matter pathways at cerebellar level are mainly the inferior and the middle cerebellar peduncles. The dorsal component of ICP is composed of spinocerebellar tracts. Vestibular white matter pathways and fibers arising from the contralateral inferior olive, which is connected to the red nucleus and the basal ganglia, are also present in the ICP. The large middle cerebellar peduncle collects projections from the different parts of the contralateral brain including white matter tracts that arise in the contralateral frontal, temporal and occipital lobes and form synapses in the diffuse pontine nuclei before crossing the midline at this level. The main efferent cerebellar white matter pathway is the superior cerebellar peduncle which receives fibers from the main
cerebellar nuclei, including the left and right dentate nuclei, the left and right emboliform nuclei and, near the midline, the small nuclei interpositum.

CEREBELLUM: BEYOND THE MOTOR COORDINATION:

Although the cerebellum has been linked forever with the control and coordination of movement, in the last two decades, suggesting their involvement in higher cognitive processes. The advance in the understanding of the cerebellum, is due to neuroimaging (fMRI, PET, SPECT) and the study of what patients with cerebellar pathology (post-trauma, resection, stroke, degenerative diseases ..) After neuroimaging studies have shown activation of the cerebellum in functions such as word generation, compression and semantic processing, covert joint, immediate verbal memory, verbal recognition and nonverbal cognitive planning, imagination, motor, rotating dental, sensory acquisition and discrimination and attention.

From the standpoint motor the cerebellum is involved in control of balance, control of posture and gait and rapid coordinated movements. Functional neuroimaging studies demonstrate the activation of the ipsilateral cerebellar hemisphere in motor tasks, and bilateral cooperation in planning and fine motor coordination. Lesions in the cerebellum can produce two cerebellar syndromes:

Syndrome of cerebellar vermis:

By commitment of flocculonodular lobe characterized by static instability, gait disorders and language disorders.

Cerebellar hemisphere syndrome:

Symptoms and signs are unilateral and affect the muscles ipsilateral cerebellar hemisphere ill. It is characterized by the appearance of dysmetria, discronometría, asynergy, adiadochokinesia, tremor, hypotonia, and writing disorders.

Injuries to the posterior lobe vermis and the cerebellum are characterized by:

Cognitive / behavioral changes

- Changes in executive functions: planning, flexibility, verbal fluency, abstract reasoning and working memory.
- Difficulties in spatial abilities, visuospatial organization and memory.
- Changes in personality: affective flattening or disinhibition, inappropriate behavior.
- Linguistic deficit: agrammatism, dysprosody.
Anterior lobe lesions:

- Changes in executive functions and visuospatial.

Because disruption of the modulation exerted by the cerebellum on Circuits neurons that connect to the prefrontal cortex, posterior parietal, temporal Limbic superior.

**CEREBELLAR DIFFUSION TENSOR IMAGING**

Cerebellar Diffusion tensor imaging (DTI) fiber tractography has considerable significance because the cerebellum makes neurologically important connections with the brain stem, the spinal cord and the cerebral hemispheres.

The cerebellar structures that could be visualized with DTI were always comparable at the level of the cerebellar peduncles, of the white matter tracts around the dentate nucleus, of the cerebellar hemispheres and of the vermis. DTI color map and fiber tractography substantially complements the images produced by other MRI techniques by displaying the spatial orientation of the major white matter fiber bundles that project and emerge from the cerebellum and that lie within the cerebellum. It is therefore likely that DTI will be useful for evaluating the various cerebellar ataxias and lesions in concert with genetic studies, neurologic examination and conventional MRI examination.

**Images for this section:**
SCHEME 1: MORPHOLOGICAL DIVISION

Anterior lobe

Superior vermis

Hemispheres cerebellar

Posterior lobe

Flocculus

Nodule

Inferior vermis

Tonsils

Flocculonodular lobe

Netter atlanto anatomy

Fig. 1
SCHEME 2

ANTERIOR LOBE:

Lingula (I)
Central lobule (II y III)
Culmen (IV y V)

POSTERIOR LOBE:

Declive (VI)
Folium (VII- A)
Tuber (VII-B)
Pyramid (VIII)
Uvula (IX)

FLOCCULONODULAR LOBE:

Nodulus (X), corresponds to the vermis
Flocculus, corresponds to the cerebellar hemispheres.

Fig. 2
**Fig. 3**

## Scheme 3: Phylogenetic Division

<table>
<thead>
<tr>
<th>FORMED</th>
<th>ARQUEOCEREBELLUM</th>
<th>PALEOCEREBELLUM</th>
<th>NEOCEREBELLUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flocculonodular lobe</td>
<td>Pyramid, uvula, central lobule, culmen, Quadrangular lobule</td>
<td>Posterior lobe (except pyramid and uvula)</td>
<td></td>
</tr>
<tr>
<td>CORRESPONDS</td>
<td>Vestibulocerebellum</td>
<td>Spinocerebellum</td>
<td>Cerebrocerebellum</td>
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<tr>
<td>AFFECTENTS</td>
<td>Vestibular nuclei</td>
<td>Spinal Cord</td>
<td>Cerebral cortex</td>
</tr>
<tr>
<td>ROLE</td>
<td>Maintaining balance</td>
<td>Tone muscle control, postural tone and Motor coordination</td>
<td>Cognitive functions</td>
</tr>
<tr>
<td>SCHEME 4: FUNCTIONAL DIVISION</td>
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<td></td>
<td></td>
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<tr>
<td>FORMED</td>
<td>AFFERENT</td>
<td>EFFERENTS</td>
<td>FUNCTION</td>
</tr>
<tr>
<td>--------</td>
<td>----------</td>
<td>-----------</td>
<td>----------</td>
</tr>
<tr>
<td>VESTIBULOCEREBELLUM</td>
<td>Flocculonodular Lobe</td>
<td>Vestibular nuclei Ponds nuclei (visual cortex)</td>
<td>Vestibular Nuclei</td>
</tr>
<tr>
<td>ESPINO CEREBELLUM:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BAND VERMIAN</td>
<td>Superior and inferior vermis (except node)</td>
<td>Somatosensory (Spinal cord, vestibular, visual and acoustic)</td>
<td>Fastigial Nuclei</td>
</tr>
<tr>
<td>BANDS PARA VERMIANS</td>
<td>both side of the band vermis</td>
<td>Somatosensory Spinal cord and trigeminal sensory nuclei</td>
<td>Interpositum nuclei</td>
</tr>
<tr>
<td>CEREBROCEREBELLUM</td>
<td>Cerebellar Hemispheres</td>
<td>Pons nucleus</td>
<td>Dentate nuclei (cerebral cortex)</td>
</tr>
</tbody>
</table>

* visuospatial perception, language processing and modulation of emotions), general planning of motor activities and motor learning sequenced

Fig. 4
FIGURE 1:

Brain Stem

Spinocerebellum

Cerebrocerebellum

Regulation of muscle tone, coordination of skilled voluntary movements

Vestibulocerebellum

Planning and modulation
Voluntary activity, storage of procedural memories

Maintenance of Balance, control of eye movements

Unfolded

Fig. 5
SCHEME 5: BODY TOPOGRAPHIC REPRESENTATION IN THE CEREBRAL CORTEX

Head, trunk, neck and Proximal portions of the limbs

Vermis

Fastigial nuclei

Facial regions and Distal portions of the limbs

Bands paravermians

Interpositum nuclei

The side portions of the cerebellar hemispheres (cerebrocerebellum) and the lobe flocculonodular (vestibulocerebellum), do not have a topographic representation of the body.

Fig. 6
SCHEMES 6: STRUCTURE OF THE CEREBELLAR CORTEX

Three layers (superficial to deep):

- Molecular layer
- Purkinje cell layer
- Granular layer

5 cell types:

<table>
<thead>
<tr>
<th>Cell types</th>
<th>Synapse Type</th>
<th>Location</th>
<th>Postsynaptic connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purkinje</td>
<td>Inhibitory</td>
<td>Purkinje</td>
<td>Deep nucleus, Vestibular nuclei</td>
</tr>
<tr>
<td>Granular</td>
<td>Excitatory</td>
<td>Granular</td>
<td>Purkinje, basket cell and stellate</td>
</tr>
<tr>
<td>In Basket</td>
<td>Inhibitory</td>
<td>Molecular</td>
<td>Purkinje neurons</td>
</tr>
<tr>
<td>Stellate</td>
<td>Inhibitory</td>
<td>Molecular</td>
<td>Purkinje neurons</td>
</tr>
<tr>
<td>Golgi</td>
<td>Inhibitory</td>
<td>Granular</td>
<td>Granular neurons</td>
</tr>
</tbody>
</table>

Fig. 7
FIGURE 2: DEEP CEREBELLAR NUCLEI

4 pairs of nuclei of gray matter (medial to lateral):

- Fastigial
- Globose
- Emboliform
- Dentate

Netter atlas anatomy

Fig. 8
# TABLE 1

<table>
<thead>
<tr>
<th>CEREBELLAR PEDUNCLES</th>
<th>AFFERENTS</th>
<th>EFFERENTS</th>
</tr>
</thead>
</table>
| SUPERIOR             | Ventral spinocerebellar tract  
Tectocerebellar tract  
Trigeminocerebellar tract  
Rubrocerebellar tract  
Caeruleocerebellar tract. | Flocculooculomotor tract  
interpositoolivar, interpositorubric,  
interpositototectal  
dentothalamic tract  
dentaterrubric tract  
Uncinate Russell | |
| MIDDLE               | Corticocerebellar tract  
Serotonergic cerebellar tract | Do not leave important fiber | |
| INFERIOR             | Dorsal Spinocerebellar tract  
Cuneocerebellar tract  
Vestibulocerebellar tract  
Reticulocerebellar tract  
Olivocerebellar tract | Cerebelovestibular tract  
Uncinate Russell  
Interpositotoreticular tract | |

All connections pass through the cerebellar peduncles

Fig. 9
Fig. 10
FIGURE 5  SPINOCEREBELLUM AFFERENTS

CEREBELLUM

MEDULLA OBLONGATA

- Inferior olivary nucleus
- Corticospinal tract
- Cerebellar nuclei
- Reticulocerebellar tract
- Olivocerebellar

Fig. 11
<table>
<thead>
<tr>
<th>TRACT</th>
<th>ORIGIN</th>
<th>PATH</th>
<th>ENDS</th>
<th>FUNCTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerebelovestibular</td>
<td>Flocculus</td>
<td>Inferior Penduncle</td>
<td>Medial and lateral vestibular nuclei</td>
<td>Regulates activity medial and lateral vestibulospinal tracts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Penduncle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floculooculomotor</td>
<td>Flocculus</td>
<td>Superior Peduncle</td>
<td>Oculomotor nerve nucleus</td>
<td>Controls movements abducens nerve</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Peduncle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Russell Uncinate</td>
<td>Flocculus</td>
<td>Inferior Peduncle</td>
<td>Vestibular nuclei</td>
<td>Controls movements abducens nerve and activity vestibulospinal tract</td>
</tr>
<tr>
<td>Colaterals:</td>
<td></td>
<td>Superior Peduncle</td>
<td>Ocular motor nerve nuclei, RF and</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>hypothalamus</td>
<td></td>
</tr>
</tbody>
</table>

RF: Reticular Formation

Fig. 12
Fig. 13
Fig. 15
Fig. 16
SCHEME 9

SPINOCEBELLUM

Ventral/Dorsal spinocerebellum tract

Vermis

Fastigial nuclei

Vestibular nuclei and Reticular Formation

Spinal Cord

Intermediary hemispheres

Interpositum Nuclei

Red Nucleus

Thalamus

Spinal Cord

Cortex

Fig. 17
FIGURE 7: SPINOCEPHALUM EFFERENTS

HYPOTHALAMUS

Vestibular Nuclei

Interpositum Nuclei

MIDBRAIN

Interpositoreticular tract

CEREBELLUM

Interpositotectal tract

1 Reticular Formation
2 Superior Cerebellar Peduncle
3 Inferior Cerebellar Peduncle

MEDULLA OBLONGATA

Fig. 18
FIGURE 8: SPINOCEREBELLUM EFFERENTS

1. Inferior olivary nuclei
2. Red Nucleus
3. Interpositotoollivar tract
4. Interpositorubric tract

1 Interpositum Nuclei
2 Superior cerebellar peduncle

Fig. 19
Fig. 20

**FIGURE 9  CEREBROCEREBELLUM AFFERENTS AND EFFERENTS**

- Red Nucleus
- Dentate Nucleus
- Dentothalamic tract
- Dentorrubic tract

1  Superior cerebellar peduncle
2  Thalamocortical Fibers
Fig. 21
Fig. 22
Imaging findings OR Procedure details

We review the complex anatomy and the function of the cerebellum. We will use comprehensible schemes and propose other advances MRI techniques, as tractography, will be useful for evaluating some cerebellar lesions.

Conclusion

Knowledge of structural and functional anatomy of the cerebellum is essential to give meaning to the clinical and imaging findings of different cerebellar lesions with the radiologist should be familiar for proper patient management.

Personal Information

References

• Salamon, N; Sicotte, N; Drain, A; et al. White matter fiber tractography and color mapping of the normal human cerebellum with diffusion tensor imaging. J. Neuroradiol 2007; 34 (2), 115-128