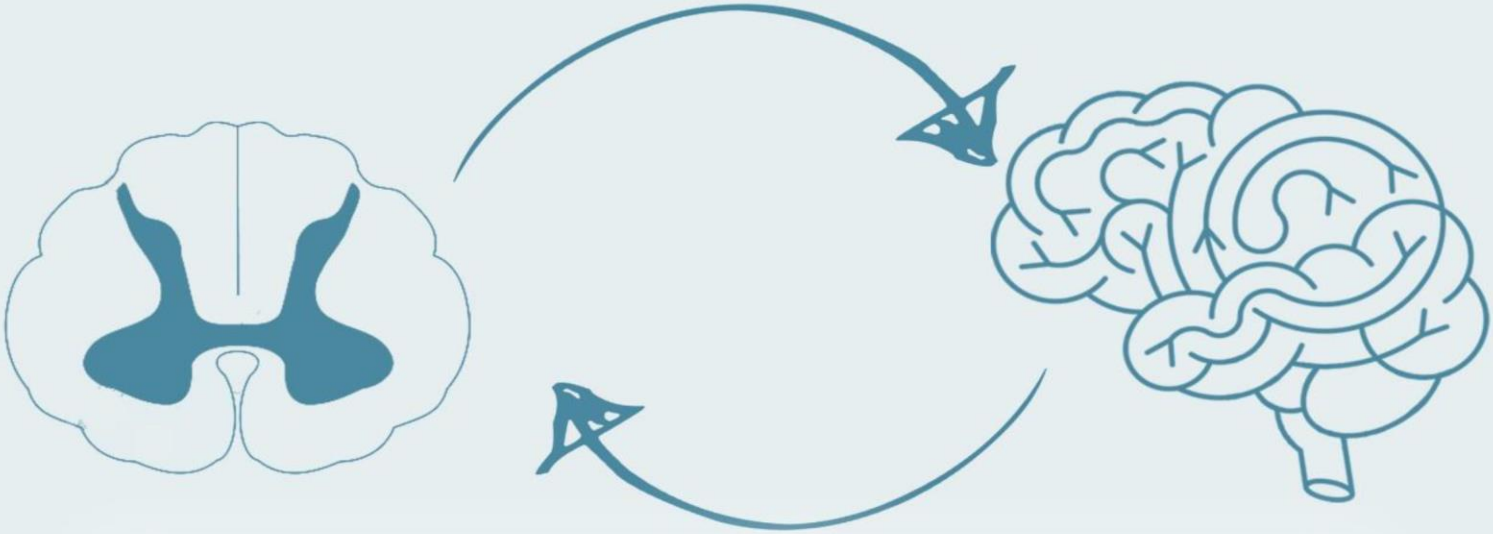

CNS

Anatomy

slides sheets

number	12
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Correction	Somaya Alkiswani
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The following sheet's sources:

-Recording → Section "2"
-Slides → All slides not mentioned by the doctor will also be included in the sheet.
-Wikipedia

• Inferior Surface of the Brain:-

The inferior surface of the brain is divided into two surfaces by the **stem of the lateral fissure** (sulcus) into:

[1] Orbital Surface – Small anterior part

[2] Tentorial Surface – Large posterior part

We said that the lateral fissure have four part
1. Stem
2. Posterior ramus
3. Anterior ramus
4. Ascending ramus

Now we will talk about sulci, gyri and functional areas on the inferior surface:

1. **Orbital Surface** – Contents – (Figures 1&2)

[A] Olfactory Sulcus:-

Anatomically it is running nearby and parallel to the median fissure.

Functionally it contains the **olfactory tract** & **bulb** -olfactory system-. The olfactory tract (which is a very important structure pass through this sulcus) has a major role in the smelling sensation. At the end of the olfactory tract, there is a bulge called the olfactory bulb which sends a narrow band of nerve fibers to the cribriform plate of the ethmoid bone, therefore contributing to the smelling sensation. Near the temporal pole, there is two division of olfactory tract called **olfactory stria** between them we find the anterior perforated substance (which perforated by anterior and middle cerebral arteries). We have **two** anterior perforated substance but only **one** posterior perforated substance in the location of posterior perforated interpeduncular fossa, but the anterior perforated located out the interpeduncular fossa on the periphery of the optic chiasm.

[B] Gyrus Rectus

Anatomically it lies medial to the olfactory sulcus & if extended it represents superior frontal gyrus on the orbital surface (so it is the continuation of the superior frontal gyrus).

Functionally it contributes to the sexual orientation of the person.

[C] H Shaped Orbital Sulcus

Anatomically it lies lateral to the olfactory sulcus and further divided the remaining part of the orbital surface into anterior, posterior, medial, and lateral gyri (so between it we find the orbital gyri). It looks like H letter.

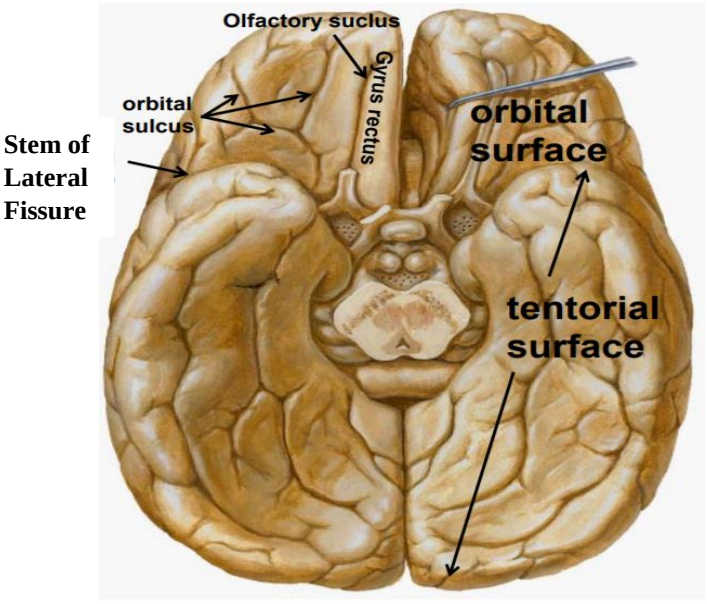


FIGURE 1

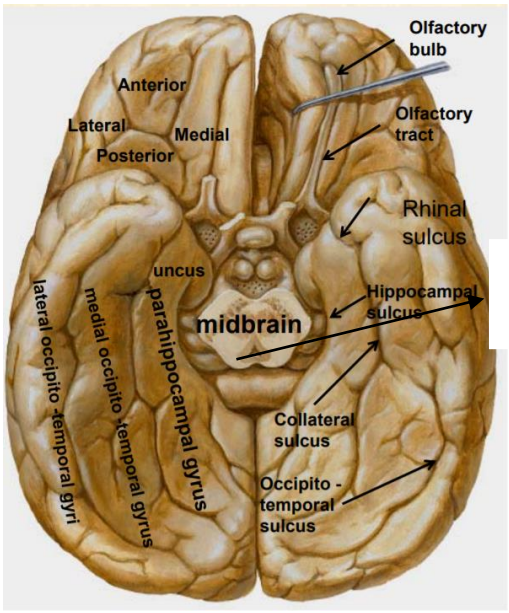
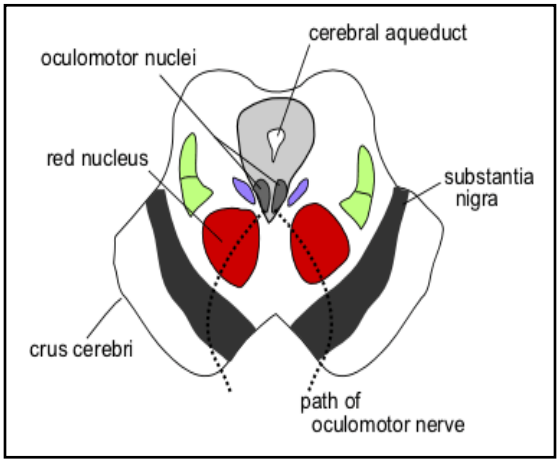


FIGURE 2

2. Tentorial Surface – Contents – (Figures 1&2)

In between the two tentorial surfaces, lies the first part of the brain stem, the midbrain. The tiny triangular opening in the midbrain is called the **cerebral aqueduct**. Surrounding the midbrain is the **crus cerebri** of the cerebral peduncle (Cerebral

peduncle larger than the crus cerebri, we can see cerebral peduncle on the front surface of the base of the brain around the interpeduncular fossa), behind the crus cerebri we can see **substantia nigra** behind it we found the **tegmentum** of the midbrain then **aqueduct** and finally the **tectum**.



Crus Cerebri, Substantia Nigra, and **the Tegmuntum** of the midbrain all contribute in forming the **Cerebral Peduncle**, which is part of the tentorial surface, connect the midbrain with the base of the brain **(cerebellum).** Cross section here separate the brain stem from the brain.

[A] Hippocampal Sulcus:

Anatomically it is found lateral to the midbrain, near it we find a big gyrus called parahippocampal gyrus.

Functionally it separates the parahippocampal gyrus from the midbrain.

While dissecting the inferior surface of the brain, the **hippocampus** will be found in the parahippocampal gyrus. It is responsible for the short-term recent memory. The hippocampal lesion will lead to a short-term memory loss. [ذاكرة السمكة]

Part of the hippocampus is located in a structure called the dentate gyrus. The dentate gyrus is one of the few brain structures responsible for neurogenesis (new brain cells formation). Neuro analysis of dentate gyrus done to compare the function of neurogenesis and the memory of the organism.

[B] Collateral Sulcus: Lateral to the hippocampal sulcus, below & parallel to the calcarine sulcus

[C] Lingual Gyrus: Between the calcarine & the collateral sulcus

[D] Rhinal Sulcus: Separates the temporal pole from the uncus

[E] Occipital-temporal Sulcus: Between the medial and lateral occipitotemporal gyrus.

The medial occipitotemporal gyrus is also called the fusiform (fusiform in shape) or recognition gyrus; responsible for face/object recognition (which means when you see a person you recognize the face of this person and save it in the memory in this gyrus), because of that it binds with the occipital lobe where visual area locate, the person must seeing in the visual area firstly then make association, so when we see this person for the second time we know who was this person.

The lateral occipitotemporal gyrus is also called the inferior temporal gyrus which located on the temporal lope from the lateral surface (continuation).

13:00 Minutes

• Functional Cortical Areas:-

Neuroscientist made brain mapping and they give a number to each area in the brain (each gyri), there are very large differences between them.

The most popular, commonly used brain mapping classification is the **Broadman Classification**. Broadman divided the brain into 47 functional areas of 3 different localizations; (Motor, Sensory and Association).

The "association areas" do association functions; helps or gives a meaning to the stimulus.

As stated, there are 3 different localizations for Broadman's Classifications

1) **Motor Areas :-** in the frontal lobe

1

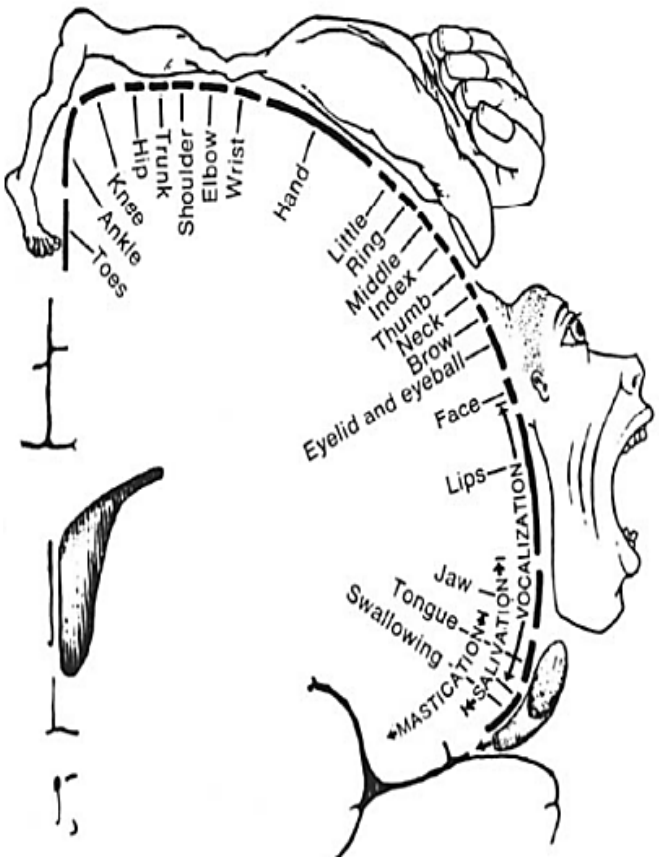
- **Primary Motor Area** (M I): Area 4

In front of the central sulcus, it is located in the precentral gyrus of the lateral surface. Its main function is fine discrete movements, especially in the extremities [Upper & Lower Limb].

The cerebral cortex has 6 layers, the primary motor area **originates** from the **Giant Pyramidal Cell of Betz**, which is the 5th layer of the cortex. This 5th layer cells have a pyramidal shape and its axons contribute to the formation of the **pyramidal**

tract. Cell bodies found in the precentral gyrus but the axons will form the pyramidal tract.

Body parts in this area are represented as a motor homunculus; an upside-down representation (head, muscles of the larynx, pharynx, and all articulation found down and then trunk and upper limb, and the uppermost part of the area represent the forepart of the lower limb which is the thigh), the right cerebral hemisphere controls the left side of the body and the left cerebral hemisphere controls the right side of the body so the lesion on this area will occur on the opposite side (contralateral hemiplegia). The size of the organ does not matter as much as the function/number of receptors. The more the number of the receptors, the greater its representation on this area. The lips and the fingers have a great representation compared to the minimal representation of the trunk for example. More usage of the muscle means more representation.



Motor Homunculus

As we said a lesion affecting the cerebral hemisphere will cause contralateral hemiplegia [شلل نصفي].

Complete Contralateral Hemiplegia including loss of motor function in the lower half of the face (because the pyramidal tract contains corticonuclear fibers responsible for innervation of muscles that are supplied by cranial nerves. Face muscles have bilateral corticonuclear representation except for lower facial nucleus and hypoglossal so the lower facial muscles for ex. are affected contralaterally), the other fibers of pyramidal tracts are corticospinal which controls trunk, upper limb & lower limb. Cortico-spinal lesion results in contralateral hemiplegia of one side of the body.

On the other hand, complete transection of the spinal cord, will **not** cause hemiplegia since all functions (sensory and motor) will be lost below the lesion.this depends on the level of the lesion, for example, if the cut occurs proximal to the nucleus which controls the phrenic nerve (c3-c5), the person will die due to cessation of respiration but if the lesion below the phrenic nerve nucleus the person will not die because he will depend on the diaphragmatic respiration.

Motor function of this area: it is bounded to the thalamus, it is connecter with the ventral posterolateral nucleus of the thalamus which is very important in controlling this pyramidal tract.

Thalamus is divided into nuclei some are anterior, some posterior, medial and lateral. Always anterior related to motor function so this area and the second one (premotor area) related to the ventrolateral nucleus, ventral posterolateral nucleus (which receive sensation from anterior spinothalamic and posterior spinothalamic and medial lemniscus) and ventral posteromedial nucleus (face) of the thalamus

pyramidal tract which passes through pyramid (we call it pyramidal because it go to the pyramid in the medulla part of it make crossing called lateral corticospinal and part of it descend directly called anterior or ventral corticospinal), and there are extrapyramidal tract which comes from another area behind the motor area called premotor area= area 6.

- **Premotor Area (PM):** Area 6 = secondary motor area

Anatomically located in front of Area 4.

It is the origin of the **extra-pyramidal tracts**.

Its afferents originate from the VL and the VPL nuclei in the thalamus. Afferents also include the cerebellum and the basal ganglia, because it is extrapyramidal so it must make connections with other subcortical structure like cerebellum and basal ganglion.

Tracts here will descend directly on the spinal cord, we will not find the cell bodies of it in area 6 and the axons directly descend to the spinal cord, but firstly it descends and control the subcortical structure and from this subcortical structure, fibers will pass on the extrapyramidal, like corticorubrospinal.

Extrapyramidal tract in order to give function it need 2 consultants;
1) cerebellum; **2)** basal ganglia, which don't send any tract on the spinal cord but it send the input to the cortex in order to make coordination and have a smooth move.

The main function of this area is storing motor programs [actions] and coordination of coarse movement (coordination-storing- do it easily). Its function includes the movement of the trunk, shoulders and hip muscles, therefore, having a major contribution to maintaining posture. It controls axial when we are in standing position. On the other pyramidal move distal parts like upper and lower limbs.

The premotor area is responsible for inhibiting the muscle tone, lesion here will make a change to hyper (spasticity of hypertonicity); because normally it inhibits muscles, without it, firing to the tone will occur. Lesion on the pyramidal will make flaccid paralysis and combined lesion (area 6+4) will make hyperspasticity.

Lesion in Area 6 will cause:

[1] Motor Apraxia: Difficulty in motor planning to perform tasks when asked.
[2] Spasticity [Hypertonia]
[3] Loss of Postural Stability

32:00 Minutes

3 • **Supplementary Motor Area (SMA)**

In the medial surface of the brain (in the medial frontal gyrus) in front of the paracentral lobule, it considered extrapyramidal, if it continued on the lateral surface it will reach Area 6 (premotor area), so it is the continuation of it put one on the lateral and the other on the medial surface, behind it we found paracentral lobule. Anteriorly the motor part is found and posteriorly its sensory part is found.

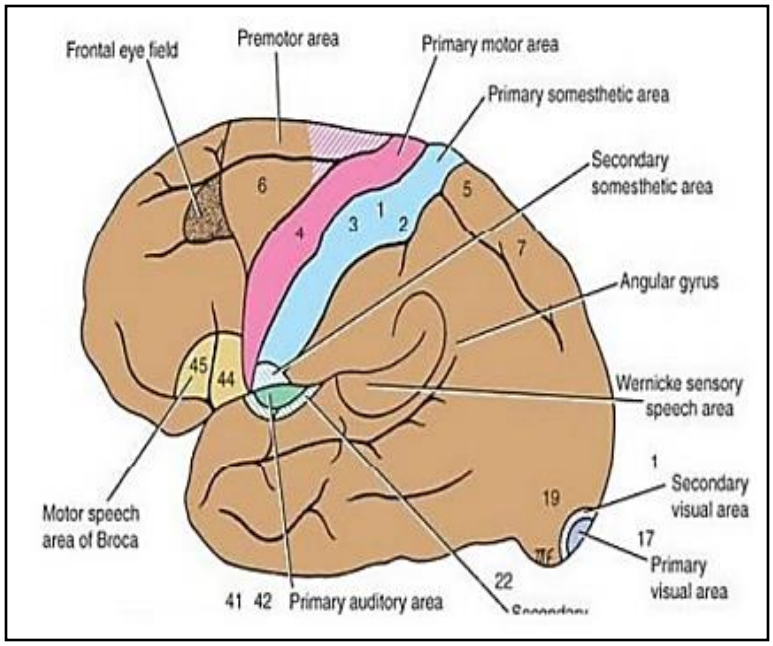
The function is quite similar to the premotor area (6), which is the postural stabilization of the body (control for trunk, hip, and shoulders). A distinct function of the SMA is the **control of a sequence of movements,** used in a dancer or a drummer. There are certain movements that need to be done sequentially (repeatedly) otherwise the function will not be done perfectly.

Injuring the SMA **alone** without injuring the Premotor Area [6] will **not** cause a definite lesion (we don't found a defect in a certain muscle nor paralysis, for example, also we don't found defect on shoulder and the person will not fall down) and it is very rare to have a lesion in this area alone (extra-pyramidal lesions) frequently injures both the Premotor Area [6] & SMA.

4

- **Frontal Eye Field**: Area [8]

It is located in front of the premotor area mainly in the middle frontal gyrus. It may extend to the superior frontal gyrus and we may found some book draw it on the superior medial gyrus and may be find mostly in the middle frontal gyrus and extends into the superior frontal gyrus.



Function: It is connected to the visual area in the occipital lobe in order to function, so the function of the vision must be normal then this area will work in the "voluntary tracking movement (conjugate movement) of both eyes to the opposite side". To the opposite side because the right control the left and vise versa, tracking: following. Example: there is an object that moves to the right within the field of your vision, your eyes follow the movement of it; the lateral rectus work with the medial rectus of the opposite side they move with each other until this object comes out of the field of vision.

A lesion to Area [8] will cause deviation of both eyes to the **same** side of the lesion. Ex: lesion on the left both eyes go to the left

5

- **Broca's Area**: – Area [44, 45]

Located in the inferior frontal gyrus (the presence of ascending ramus and anterior ramus on the inferior frontal gyrus divide this region into 3 small gyri: orbital, triangular and opercular gyrus, these three areas represent Broca's area), mainly on the dominant left hemisphere. It is connected to receptive area (Wernicke's Area) [22, 39, 40] through a bundle called arcuate fasciculus.

It is also called Area of Speech, which is responsible for the coordination of the muscles that produce articulation like the muscle of the rib, pharynx, larynx, mouth, tongue, and palate. These muscle coordinated by the pyramidal tract but who make the coordination? This area.

A lesion injuring this area will cause non-fluent aphasia [expressive aphasia], in which the patient is fully conscious & can understand what he is being told as there is NO muscle paralysis, but **can't coordinate** the muscles therefore only speaks no more than 2-3 words. He can't speak because the brain is unable to combine words and get a useful sentence. Conscious patient opposite to Wernicke's patient.

Other names: Motor aphasia, expressive aphasia, non-fluent aphasia (fluent = flow of speech without any problems and the person is wise in his words but non-fluent is the opposite; no articulation)

Recall that this area is supplied by the pyramidal motor tract & that's why **NO** muscle paralysis will occur in Broca's Area lesion.

40:00 Minutes

2) Sensory Areas in the parietal lobe mostly

1

- **Primary Sensory:** Areas [3, 1, 2]

Is the most important area in the sensory area we found it in the post central gyrus, why 3 then 1 then 2? Because he discover the middle part which is anterior in the beginning so he gave it number 1, then he discover number 2, then the upper most part given number 3. As stated previously, it is found in the postcentral gyrus. It extends on the paracentral lobule.

It gives 20% of pyramidal tract fibers although it is sensory there are sensorimotor connections, link between the sensation and the motor function that will occur according to this stimulus.

Its function is to localize, and discriminate different types of sensations. Only sense but how to understand this sense? By the association areas which is the third category.

Body represented upside down, similar to the Primary Motor Area [4], the body is represented as a homunculus. Ex: because of the difference in the number of receptors, two point discrimination on the hand much easier than the back.

Lesion affecting Area [3, 1, 2] will cause contralateral hemianesthesia, loss of **all** types of sensations (mechanical, thermal, nociceptive) on the opposite side of the injured side.

2

- **Secondary Sensory Area:**

Injury to this area will not cause a definite lesion (if the lesion occur here that will not lead to loss of sensation but in primary if we found a lesion, loss of sensation will happen in the part related to the gyrus), we find it in the inferior surface of the postcentral gyrus; lowermost part of the postcentral gyrus, on the side of the later fissure (posterior ramus), the part above the posterior ramus is which called secondary somesthetic area.

- **Other sensory areas:**
  1. Visual area (vision), [VI, VII]
  2. Auditory area (hearing), [AI, AII]
  3. Vestibular area (equilibrium)
  4. Gustatory area (taste)
  5. Olfactory (smell)

Visual Cortex (very important)

- **Striate Cortex [Area 17], V1 :**

Located around the lips of the calcarine sulcus in the occipital lobe.

Parieto-occipital fissure separate between parietal and occipital mostly seen on the medial surface also there is another sulcus come from under splenium of the

corpus callosum called calcarine which represent the visual area around the libs of the calcarine. Above is the cuneus and below is the lingual.

If the lesion occur on the on the occipital field that located in the lingual gyrus what will happen? The lower one control the upper visual field and the upper one (in cuneus above calcarine) control the lower.

It receives visual radiations from the lateral geniculate body therefore having a major contribution in vision interpretation [perception].

So Lesions affecting this cortex are mainly divided into two parts:

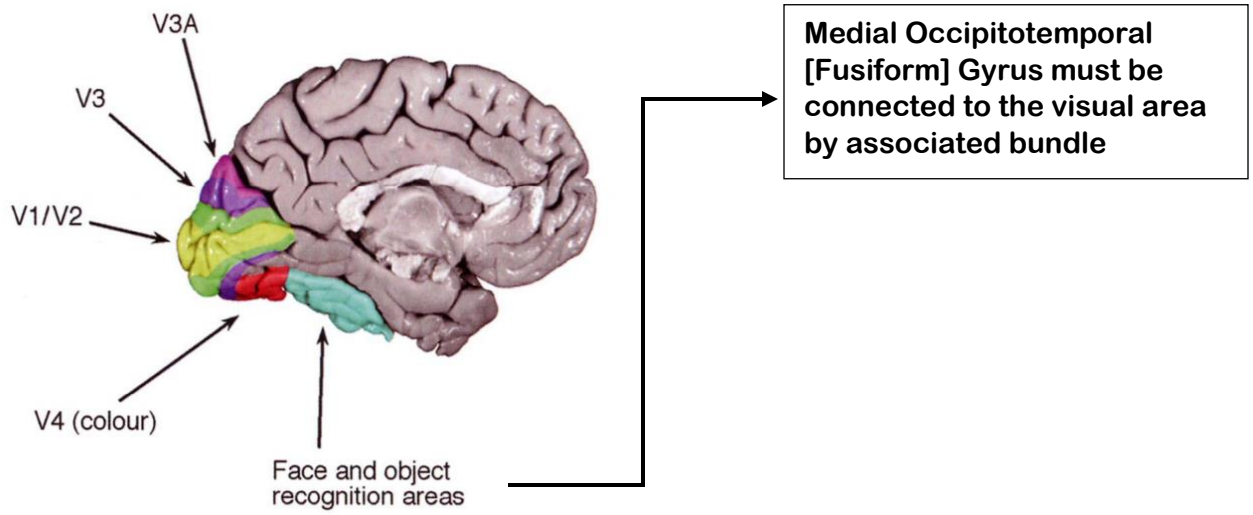
[1] Cuneus Lesion
Contralateral homonymous **quadrinopia** of the **lower** visual field, with macular sparing.

[2] Lingual Lesion
Contralateral homonymous **quadrinopia** of the **upper** visual field, with macular sparing.

Visual Association Area [Area18,19] VII :

Located in the remaining part of the cuneus and lingual gyri. It interprets visual stimulus with past experience.

Lesion of this area will cause visual agnosia (is a condition in which the patient can see but cannot recognize or interpret visual information) and color blindness.



Auditory Area

- **Primary auditory area [41, 42], A I :**

This is the auditory center (any auditory stimulus will progress until reach this area as it found in the middle part of the superior temporal lobe).

- **Association auditory area [22], A II :**

It is found in the surrounding part of the auditory center [41, 42], which is also the remaining part of the superior temporal lobe.

Understanding the auditory stimulus is a function of this area.

Posterior part of this auditory associated area is called 22 and it share in the formation of the **Wernicke's Area** which made up of the:

[1] Posterior end of Area 22

[2] Supramarginal Gyrus (on the upper border of posterior fissure of the lateral fissure)

[3] Angular Gyrus (on the posterior end of superior temporal)

It is responsible for the comprehension of speech, and the understanding of written and spoken words. Don't confuse; Broca's area is responsible for the coordination and production of speech while Wernicke's Area is responsible for comprehension of speech.

Lesion of Wernicke's Area will cause receptive [fluent] aphasia. Even though they can speak long sentences, it is not meaningful at all. The patient is unaware of his problem and this means that they have a trouble in explaining themselves.

3) Association Areas:

The rest of the lobe so we have parietal association, temporal association, occipital association. Each one have an associated function.

Prefrontal (frontal) cortex

- Thinking and learning
- Judgment, foresight.

"اللَّهُمَّ انْفَعْنَا بِمَا عَلَّمْتَنَا،
وَعَلِّمْنَا مَا يَنْفَعُنَا،
وَزِدْنَا عِلْمًا إِلَى عِلْمِنَا"