Central Nervous System

Sheet #

Subject | physiology

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Correction | ...

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Part two: Control of eye movement.

This part is independent from the first part so don't worry. This part begins from 14:57

Now we'll revise the muscles that move the eyes and their nerve supply:

1- Inferior rectus, superior rectus, medial rectus, inferior oblique: Oculomotor nerve
2- Lateral rectus: Abducent nerve
3- Superior oblique: Trochlear nerve

If damage happens to these nerves will end in:

1- 3rd nerve palsy: positioning of the eye **down and out** "trochlear and abducent nerves" function still intact.
2- 4th nerve palsy: rotation of the eye **outward the axes** of the intact eye; the patient tries **to tilt his head to the opposite side** and **tucks his chin** to correct this abnormal rotation; and prevent diplopia.
3- 6th nerve palsy: abnormal inward rotation of the eye "medially".

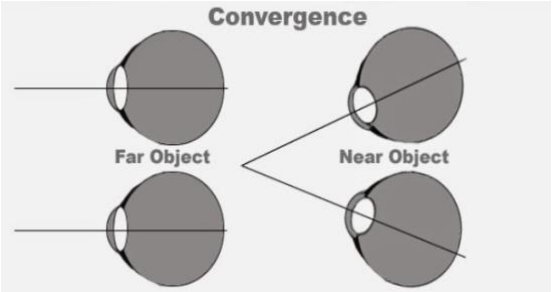
Now we'll discuss the types of movements of the eyes:

- We have **conjugate movement** of the eyes; meaning that both eyes will move in the same direction: both up, both down, etc. and this is achieved through:
  1- **Saccadic movement** (jumpy movement): now when someone tells you to move your eyes to the door or to pay attention for something "object for example" quickly and fixing them on it (target movement)
  2- **Tracking movement** (pursuit movement): there is smooth movement of the eyes; just like you're tracking something that moves.

Now the previous movements are **voluntary movements**, but there are other movements happen **involuntary**; like:

3- vistibulo-occular reflexes.
4- **optokinetic reflexes** (tectospinal tract)

- Also we have another type of movement called **disconjugate movements:**
  - **Vergence movement**: both eyes move opposite to each other; for example in eye accommodation and convergence.

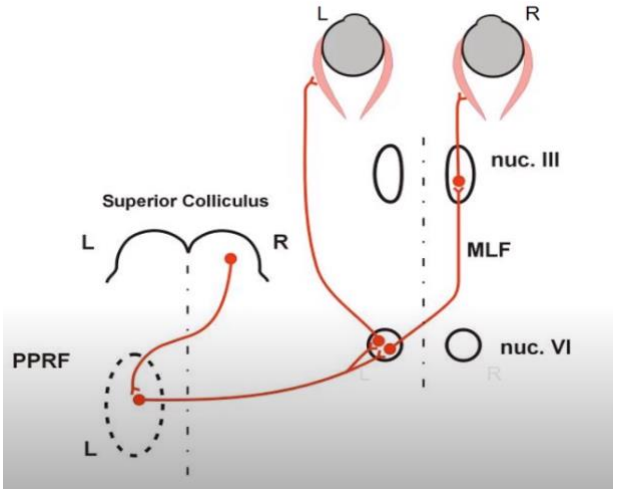


Control of the eyes movements: every motor output is under the control of the primary motor cortex and some premotor and association cortex. So we have ***1- direct*** descending fibers from the primary and secondary motor areas to control directly the nuclei that are responsible for eye movements. This direct connection responsible for **disconjugate eye movements**. In some people these connections are strong enough due to some developmental factors, training; to do these disconjugate movements voluntarly. The actor Bill Skarsgard is one of the people who can do these movements. See this link https://www.youtube.com/watch?v=w5hD6rlDGbs

But most of the eye movements under the control **"mainly" of frontal eye field area**, and to a lesser extend; **parietal eye field area; which is responsible for saccadic movement**. And both areas send ***2- indirect*** descending fibers to control the nuclei. So they must stop in their pathway in many centers in pontine centers like; superior colliculus, and then "more important" abducent nucleus which sends fibers to the contralateral oculomotor nucleus through MLF* to get the conjugate movement of the eyes.

Look at this figure. If we want to move our eyes to the right; the left frontal eye field sends fibers to left superior colliculus, and superior colliculus sends fibers to the right abducent nucleus which:

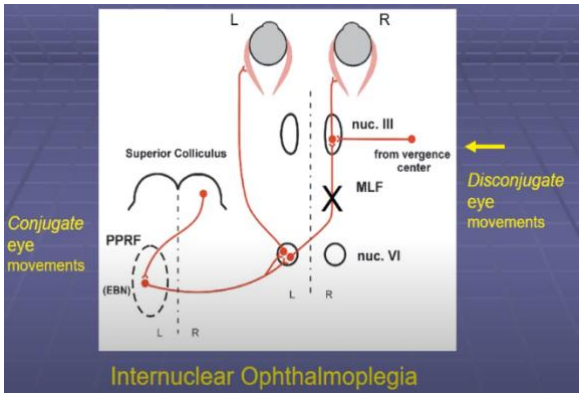
1- Sends fibers to the ipsilateral lateral rectus.
2- Sends fibers "through MLF" to the contralateral oculomotor nucleus which eventually sends fibers to the medial rectus.
- Remember vistibular eye movement from midterm material; it's almost the same concept.



Now we'll discuss the consequences if a damage happens to this pathway:

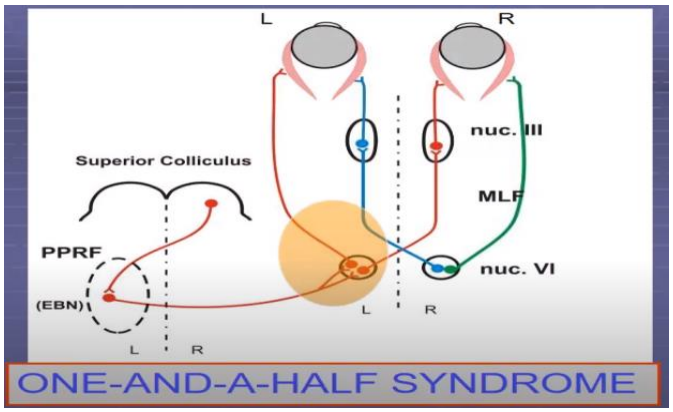
1- If there is damage of **the whole MLF bundle "bilateral damage"** the response of both eyes will be affected. If the patient want to move his eyes to the right; medial rectus in the left eye will not be functioning. And also if the patient want to move his eyes to the left; medial rectus in the right eye also, will not be functioning. " go back to the vestibular system; sheet 9"

2- **Unilateral damage of the MLF "vascular damage"**: let's assume that there **is damage of the right MLF bundle** "look at the figure", and you asked the patient to move his eyes to the right; the order will reach right abducent nucleus, sends fibers to the ipsilateral lateral rectus, and sends fibers through left MLF to the contralateral oculomotor nucleus which supplies medial rectus, and eventually moving both eyes to the right normally. But if you asked the patient to move his eyes to the left; left abducent nucleus will send fibers to the ipsilateral lateral rectus, and fibers to the contralateral oculomotor nucleus through the damaged right MLF; so the order to oculomotor nucleus won't reach and the patient won't move his right eye to the left and it will stay on its position. This condition is called **internuclear ophthalmoplegia**. Keep in your mind that just the conjugated movement only, is affected. https://www.youtube.com/watch?v=pIv4S8F6nYQ



3- **Unilateral MLF damage "demyelination"**: the same concept happens here but the affected eye will move but; slower, weaker, will not reach the extreme left " if the right MLF is affected"; because in demyelinating damage, there is less, slow order will come through it.

4- **One and a half syndrome**: "see the figure" happens if there is a lesion large enough to damage both left abducent nucleus and left MLF. If we ask the patient to move his eyes to the left; both eyes **won't move** "left abducent nucleus is damaged". And if we asked him to move his eyes to the right; the right eye will move and the left eye won't "left MLF damage".



Frontal eye field damage will result in inability to move the eyes to the contralateral side. So if the left frontal eye field is damaged; the patient won't be able to move his eyes to the right, and if he is looking straight forward his eyes are slightly shifted to the left "order from the right frontal field is stronger than the left one".

Damage in parietal eye field almost comes alongside a damage to other near areas. Unilateral "right or left" damage will cause delay in saccadic movement "losing its quick properety". Bilateral damage to this area "and onlyyy to this area" is very rare.

Now parietal lope is a watershed area; area that there is an anastomoses between 2 blood supplies or arteries. Any decrease in the blood supply; hypotension, will result in decrease in the blood supply to these terminal blood vessels. So a bilateral stroke to the posterior parietal area is common.

Bilateral damage to posterior parietal lope "posterior parietal eye field and the areas surround it" results in multi-symptomes.

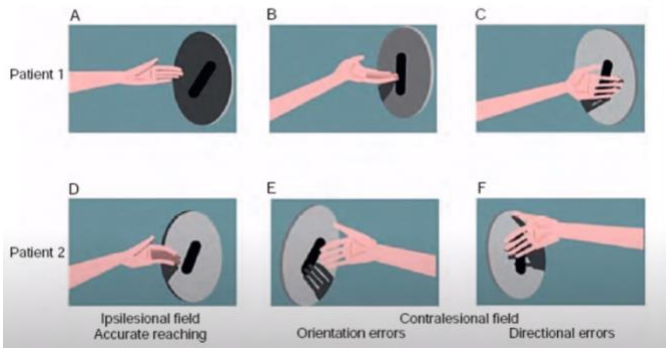
If all of these symptoms are found leads to Balint's syndrome:

1- **Ocular apraxia**: difficulty in voluntary movement in the eyes and, which is more common, difficulty in fixating the eyes in one object " remember fixing the eyes in one object is property of saccadic eye movement"

2- **Simultanagnosia**: inability to see the whole picture, or inability to interrupt the totality of a picture; look at the figure bellow, the letter H is composed from a group of T letters forming one big H letter. This patient can see the letter H but he can't see what make it, or can see there is one T letter and ignore the others, and eventually can't see the letter H. Another example is he can focus on the children and doesn't pay attention for the wife, or he can focus on the wife and doesn't pay attention for the children.

- **From Wikipedia**: the inability of an individual to perceive more than a single object at a time.

3- **Optic ataxia**: there is no coordination between visual sensory input and motor movement "visually guided hand movement". In this figure the patient can't orient his hand in a right way, or he can't direct it in a proper way. https://www.youtube.com/watch?v=4odhSq46vtU



This sheet was made with love.

Sorry for mistakes and feel free to contact me if you face any problem.

Good luck.