Anatomy

Sheet

Lec No: 4

Subject: Descending motor pathways

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Descending motor pathways

Whenever we talk about any motor pathway, we should keep in mind that there are two groups of neurons controlling any motor activity:

1. Upper motor neurons.
2. Lower motor neurons.

☞ **The upper motor neurons:**

- They are responsible for producing commands and orders.
- Location : they are located supraspinally (above the spinal cord, but not necessarily in the cortex)

Examples:

- ✓ The corticospinal tract : its upper neurons are in area 4 and 6
- ✓ The extrapyramidal pathways:one of its tracts is the Rubrospinal tract: it starts in the red nucleus in the mid brain, and the red nucleus in the mid brain receives its orders from the cortex. ---- That's why the tract is named corticorubrospinal tract.

☞ **The lower motor neurons:**

- Also called (**alpha and gamma**) and (**the final common pathway**).
- Their axons will form the **ventral** root of spinal nerves.
- Location:
    1. In the spinal cord.
    2. In the brain stem.

There are two major motor pathways: (they both start from cortex)

1. Pyramidal
2. Extrapyramidal

	Give rise to	Function	Example
In the spinal cord	Spinal nerves of skeletal muscles (limbs)	Responsible for the movement of the limbs	Nerves to the arms and legs
In the brain stem	Motor parts of <u>certain cranial nerves</u>	Responsible for the movement of the eyes ,tongue ,and mastication muscles…	1. Hypoglossal nerve (it has alpha and gamma that are located in the medulla – brainstem. 2. The trigeminal nerve, it has a motor part in its branch (mandibular) – the alpha and gamma neurons of it is located in the pons --brainstem. 3. The oculomotor (responsible for the movement of the eyes, and the trochlear nerve --- they have their alpha and gamma in the mid brain – brainstem

- How are the upper motor neurons connected to the lower motor neurons?
  By a tract (axons --- nerve fibers)

- Regardless of their location (in the spinal cord or in the brain stem), alpha and [illegible] order to

Contractions:

- Minimal (muscle tone), it is needed in posture (standing and setting), walking, running ,and automatic involuntary movements)
- More contractions ----- movement

How do we stimulate alpha neurons?

1. Descending motor pathways
2. Stretch reflex from the muscle itself (by stimulating muscle spindle receptors)
3. Gamma loop (gamma will stimulate the spindle receptors which will stimulate alpha neurons)

Let's explain each one of the previous points:

i. **Descending motor pathways: (i.e. from upper motor neurons)**

They synapse into the alpha neurons.

Recall :The major pathways are the pyramidal and the extrapyramidal.

A. Corticospinal tract (a part of the pyramidal)
B. Cortico**bulbar** tract (apart of the pyramidal that synapses in the **nuclei in the brainstem** --- not in the spinal cord)
C. Corticorubrospinal tract (a part of the extrapyramidal)
D. Reticulospinal tracts

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ii. Stretch reflex of skeletal muscle.

- Skeletal muscles have receptors called muscle spindle receptors that have **1a** afferent fiber (very thick fibers ---- fast fibers) that travels with the dorsal root toward the alpha nucleus.
- The spindle recetor is stimulated as a reflex when the muscle stretches, and as a result it produces action potential that travels toward the alpha nucleus through the dorsal root.

• **Note : If the fiber synapses as a single synapse it is called monosynapse.**

<u>So, what is the stretch reflex?</u>

The muscle is stretched ⇒ the spindle receptors inside the muscle get stimulated ⇒ the muscle spindle sends signals to alpha ⇒ alpha gets stimulated ⇒ the axon of alpha will stimulate the muscle to contract

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The skeletal muscle is composed of:

- Extrafusal fibers 99% ---- innervated by alpha motor neurons.
- Intrafusal fibers ----- depend on the muscle spindle receptors that are located in a fusiform capsule inside the muscle.

How are the intrafusal fibers (muscle spindle receptors) stimulated?

1. Muscle stretch
2. Through the gamma nucleus ------ gamma loop:

☞ **What stimulates gamma?**Higher centers (cerebral cortex)

Contractions:

- **Fast** contraction: stimulate alpha nucleus to cause muscle contraction.
- **Slow** contraction: stimulate gamma (gamma loop ---- long way)

- Any contraction with a **low tone**and **long movement**must be done by simulating **alpha**nucleus, and that is done by:
  a) Descending motor pathways (pyramidal and extrapyramidal-- direct orders)
  b) Reflex from the muscle spindle as a result of stretching the muscle.
  c) Gamma stimulation.

❖ When the higher centers (cerebral cortex) send signals to stimulate the lower motor neurons, which one is easier to be stimulated? The alpha or the gamma?

Gamma is smaller in size, that's why it reaches the threshold of stimulation faster than alpha.

So, if the higher centers want to do **some muscle tone (little contraction)**, they stimulate **gamma**nucleus (because it responds easier and reaches the threshold faster than the alpha)

❖ If I want to do a continuous movement, what do I stimulate, alpha, gamma, or both?

Stimulation of alpha will cause a fast contraction (directly to the muscle). However, when the muscle is contracted, the spindle receptors will not work. So it needs gamma stimulation. {Both}

Example;

If I am standing, the quadriceps will help in the extension of the knee, and the muscles of the vertebral column will also be extended.

When these muscles are stimulated, they will contract causing the muscle tone, and the spindle will not work. That will cause the muscle to relax.

In order to keep these muscles contracted, we need the gamma nucleus stimulation.

That's mean that to do a continuous contraction, I have to stimulate alpha and gamma together (alpha, gamma co-activation)

Motor pathways:

There are two major descending motor pathways; pyramidal and extrapyramidal pathways.

- **Pyramidal:**It is composed of two tracts:
  - Coticospinal tract: it arises from the cortex and ends in the lower motor neurons of the spinal cord (alpha and gamma). It supplies the limbs (upper, lower)
  - Corticobulber tract: it arises from the cortex and ends in the brainstem. It supplies the muscles for mastication, closure of the eyes, face muscles, and the pharynx

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- Why is it called pyramidal (corticobulber and corticospinal) ?

Because when it descends downward it passes through the pyramid in the medulla.

Note: it is not named pyramidal because of its origin in the pyramidal cells in the cortex.(Only a small part of it originates from the pyramidal cells in the fifth layer of the cortex)

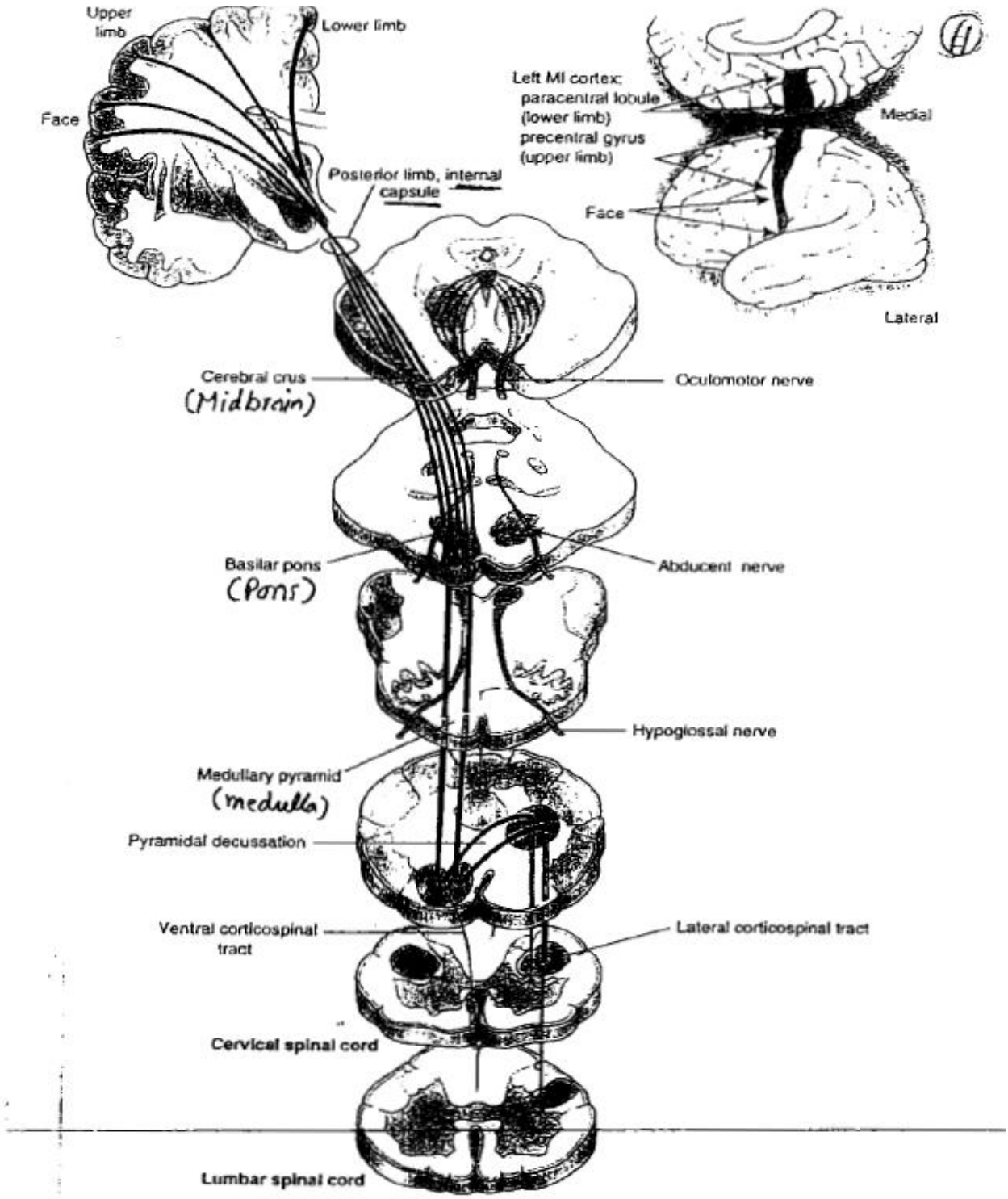


FIGURE 6–2. Schematic diagram of the pyramidal tract, showing its origin, course, and relations.

Pyramidal pathway

It starts in :

1- Area 4 : where the face and the limbs are represented
2- Area 6 : where the axial and the proximal muscles are represented

- The pyramidal pathway arises mainly from Area 4
- While the extra pyramidal pathway arises mainly from Area 6

Area 4

Is located in the frontal lobe in the **precentral gyrus**

- **How is the body presented in this area?**
  1-Upside down
  2-Precisely but disproportionally

☞ Upside down :

- The cells that control the lower limb are located upward
- The cells that control the upper limb are located in the middle
- The cells that control the face are located downward (near to the lateral fissure)
- Note that :
  1- The lower limb is presented on the medial surface (inner surface) of area 4 (paracentral lobule)
  2- The upper limb is presented on the lateral surface (outer surface of area 4) (on the precentral gyrus)
  3- The face is presented on the lower of area 4 near to the lateral fissure

☞ Precisely but disproportionately

- The area that represents the upper limb is a wide area why is that?

Although the muscles of the upper limb are smaller than the muscles of the lower limb, the muscles of the upper limb are represented in a wider area and that is because the presentation does not depend on the size but it depends on the accuracy of the movement (the movement of the muscles of the hands are more accurate than the movement of the lower limb that's why it is represented in a wider area)

- What do we mean by a wide area?

The number of the neurons that control the hands is much more than the number of neurons that control the lower limb

- What do we mean by precisely ?

That each muscle has certain neurons that control it

Wikipedia:

Corona radiata: the most prominent projection fibers which radiate out from the cortex and the come together in the brainstem

The projection fibers that make up the corona radiata also radiate out of the brainstem via the internal capsule

- What do we mean by disproportionately?

The number of neurons that controls each muscles doesn't depend on the size of the muscle but on the accuracy of the movement of that muscle
(example: the hand, the tongue, and the sides of the mouth are represented on a wide area – more neurons)

The fibers of the motor pathways descend from the cortex into the white matter and forms corona radiata, then they gather in a narrow path (the internal capsule)

Then these fibers descend down from the internal capsule to the brainstem through the midbrain, pons, and medulla.

The fibers in the internal capsule is very disposed to injuries like strokes

❖ In the lower part of the medulla crossing occurs (pyramidal decussation)

- What is the percentage of fibers that go through the pyramidal decussation (crossing) ?(70-90)% of the fibers

- How does it occur ?The fibers go posteriorly and cross

- What is the result of this 90% crossing of the fibers?

They produce a pathway (tract) that is called **<u>lateral</u>** corticospinal tract
(the most important tract)

LATERAL CORTICOSPINAL TRACT

- Corticospinal : from the cortex to the spinal cord
- Lateral : this means that it passes through the lateral column of the white matter of the spinal cord
- This lateral corticospinal tract represents the fibers that have crossed (maximum 90%)
- The 10% that haven't crossed form a tract called **ventral** cortiocospinal tract ,and we mean by ventral that it passes through the ventral column (anterior column)

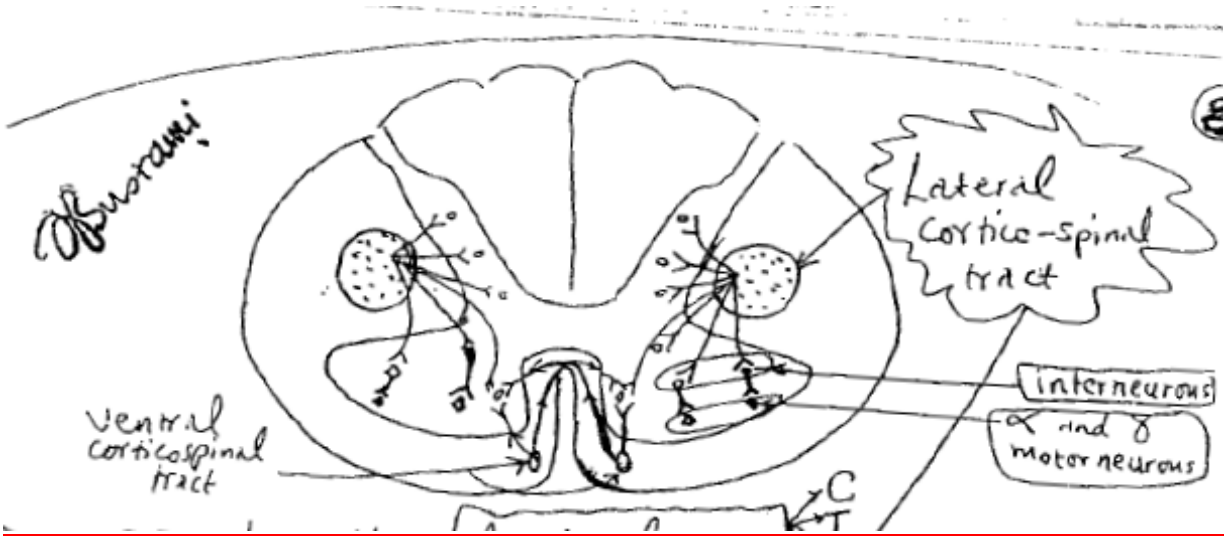
As mentioned before, the lateral corticospinal tract is the result of crossing, and it descends downward through the white matter, then continues to synapse into the executive system (the lower motor neurons – alpha and gamma)

- This tract connects the upper motor neurons (commands) with the lower motor neurons (execution – final common path)

The white matter of the spinal cord is composed of:

1. Dorsal column 2. Lateral column 3. Ventral column

The next part is very important



The figure shows the lateral corticospinal tract

It has been cut horizontally and each dot on the figure represents a fiber

- The lateral corticospinal tract descends the full length of the spinal cord (cervical, thoracic, lumber, and sacral regions)
- As the lateral corticospinal tract descends it synapses in the regions mentioned above.
- The largest synapse occurs in the alpha and gamma nuclei of the cervical region (55%)

This means that it has a great effect on the upper limb

Recall : The cervical region of the spinal cord gives rise to the nerves of the upper limb from the segments C5,6,7,8 and T1

The lateral cortionospinal tract has a proximal effect but mostly distal effect .

It facilitates (excites) mostly the distal flexor muscles (that what makes us hold things in our hands,write,draw…)

So it is responsible for skill movement

- When the lateral cortiocospinal tract synapses in the alpha and gamma, does it synapse directly in the alpha and gamma or through the interneurons ?

Through the interneurons

- Why doesn't most of the cortiocospinal tract synapse directly in the alpha and gamma? (what are the benefits of the interneurons?)

The interneurons are excitatory which stimulate the muscles (for example : the biceps) , and next to these interneurons there are inhibitory neurons that inhibits the antagonist muscle (triceps)

(REMEMBER THAT if I want to stimulate a muscle (biceps),I have to inhibit it's antagonist muscle (triceps))

So, the lateral corticospinal tract facilitates (excites the alpha and gamma), which means that it increases the muscle tone (contraction)

If this tract was injured the tone will decrease

The ventral contricospinal tract(10% of the fibers)

affects mainly the axial and the proximal muscles **bilaterally**
(muscles of the vertebral column, shoulders and the hips)

- We mean by (bilaterally) that each ventral corticospinal tract supply alpha and gamma by both sides (the axial and proximal muscles)

That means that the right ventral corticospinal tract supply the alpha and gamma on the right and the left sides

And the left ventral corticospinal tract supply the alpha and gamma on the left and the right sides

- In the ventral horn, the cells that present medially are responsible for the movement of proximal muscles. While the cells on the lateral side are responsible for the distal muscles –

As mentioned, the corticospinal tract is supplying alpha and gamma mainly by the interneurons. However there are 3% of the fibers of the corticospinal tract that synapse **directly** in alpha and gamma

- Those 3% originate from the fifth layer of area 4 (giant cells of betz – large pyramidal cells described by betz)
- Those that synapse directly in alpha and gamma are responsible in accurate movements
- By synapsing into alpha and gamma without and interneurons they can stimulate one muscle from a group of muscles. While if they synapse using the interneurons they will simulate a group of muscles.

For example: stimulating the first and the second lumburicals in the hand without stimulating the third and the fourth. Also stimulating the interossei in the hands

- The lateral corticospinal tract synapses into the interneurons between the 4^{th},5^{th},6^{th},7^{th},and 8^{th} layers (laminea)

NOTE: laminea 4,5and 6 in the dorsal horn are sensory

- Why does the corticospinal tract synapse into sensory neurons?

To block certain sensations

For example: blocking a tract that transports pain (the mechanism will be explained later)

- Which means that the lateral corticospinal tract is a motor pathway ,but there is a part of that pathway that prevents certain types of sensations to reach into the brain (it blocks them)

  As a proof, when your hand touches something hot you will move it away and in a random way (for example : moving your hand upward and downward continuously), this movement is done by the activation of the conticospinal pathway . And by this movement there will be blocking of the sensory neurons by impulses that block the pain sensation and prevent it from going upwards.

- The lateral corticospinal tract is the most important motor pathway in our bodies :
  1- 55% of its fibers synapse into alpha and gamma in the cervical, mostly indirectly through interneurons
  2- 20% of its fibers synapse into alpha and gamma in the thoracic region (as the muscles of the thorax are small muscles)
  3- 25% of its fibers synapse into alpha and gamma to the supply the lower limb. (although the size of muscles of the lower limb is too big, example the gluteus maximus , however the nerves representation doesn't depend on the size it depends on the accuracy of movement) --- (the presentation in area 4 is upside down, precisely but disproportionately)

- What is the significance of the pyramidal decussation (motor decussation – crossing)?

The crossing occurs in the medulla, supposing that the lateral corticospinal tract was injured in the spinal cord; the effect of the injury will be below the level of injury. And the effect depends on the level of injury:

1- If the injury was beneath the crossing the effect will be on the same side (ipsilateral)
2- While if it was injured before (above) the area of crossing the effect will be on the opposite side (contra lateral)

Example: if I cut the spinal cord in the level of T12 , the lower limb will lose their motor and sensory supply (the sensory will not ascend upward and the motor will not descend downward)

- Pyramidal : corticospinal, corticobulbar.
- Extra pyramidal : corticorubrospinal, corticoreticulospinal , corticovestibulospinal, corticotectospinal tract

- The pyramidal and the extrapyramidal pathways are next to each other.
- The most disposed location for injury is the internal capsule where there are close to each other (in most cases if the pyramidal was injured, the extra pyramidal is injured too)

Example : A patient with a stroke that has affected the internal capsule , if the injury was on the right side of the internal capsule the effect (paresis , paralysis)will be on the left side. (the injury is above the crossing … contralateral)

In this patient the first sign for paresis and weakness will appear in his hand (for example : if he was an old man carrying something in his hand and he dropped it this is the first sign of stroke (weakness))

After days, he was diagnosed with a stroke and he was unable to do skill movements with his hand (such as holding something, tying a rope,…)

However, he can move his arm upward and downward (he can move the muscles of the shoulder) and this is done by the ventral corticospinal tract.

As the ventral corticospinal tract supplies both sides of alpha and gamma , so if it was injured in one side the other side will compensate to help the injured side . and that is the importance of the ventral corticospinal tract

REMEMBER THAT if the pyramidal was injured, the extra pyramidal will be injured too in most cases (because they are next to each other)

- Taking a section of the spinal cord in the cervical region we will find the largest size of the lateral corticospinal tract
- Going down to the sacral region the fibers will be smaller and less in number
- The lateral corticospinal tract synapses in alpha and gamma to stimulate the muscles of the upper and lower limbs
- The corticospinal tract is considered to be half the pyramidal tract (a major tract) . And it has an excitatory effect on the muscles of the distal flexor muscles (responsible for the skill movements)

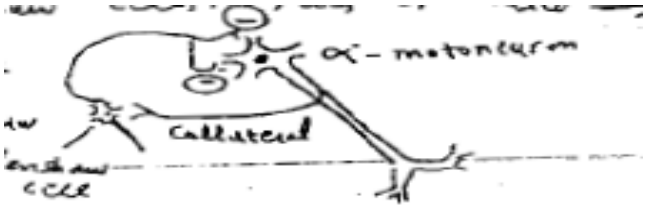
- Most of the injured of the CNS are vascular injuries
  1- Obstruction of the vessels with embolus or thrombus
  2- Cut of the artery.
- Causes of the stroke :
  1- Embolic
  2- Thrombotic
  3- Hemorrhage
- For the embolus to affect the brain it must ascend from the left side of the heart or from the common carotid (atherosclerosis, atherosclerotic plaque)

ALPHA NUCLEOUS

- It is important as we can't move our hands and feet without it.However, if it was not controlled it will produce a very great action potential that can cause convulsions (excessive firing action potential)

- What controls alphas activity?
  It is controlled by an inhibitory cells that are located near to alpha in **lamina 7**

Those cells are called renshwa cells



- You can see the axon of alpha motoneuron (located in **lamina 9**), from this axon a collateral fiber rises , this fiber secretes acetylcholine to excite and stimulate the renshwa cells (located in lamina 7)
- The ranshwa cells secrete glycine and inhibit the alpha motoneuron (decrease it's activity)

  - ✓ If we give a patient a drug called strychnine that inhibits the ranshwa cells and prevents them from secreting glycine , alpha will cause excessive firing (continuous action potential generation), and that will cause a lot of contractions – convulsions (continuous tone)
  - ✓ This drug (strychnine) was used before the invention of Viagra (a drug used for erection) , the patient must use a little amount of strychnine , if he used more of this drug , it will cause convulsions

To sum up, any motor neuron must be controlled , as most of the neural cells have an extreme activity , which must be controlled.

The corticobulbar tract

- This tract will stimulate alpha and gamma that are located in the brainstem
- These alpha and gamma are the origin of the motor part of certain cranial nerves (not all the cranial nerves have a motor part – the olfactory and the optic are sensory nerves)

	Origin	Function	Main Difference
Corticospinal tract	Area 4 and 6	Responsible for the movement of our limbs(upper and lower)	On each side it supplies the opposite side. (the right supplies the left)
Cortiocobulbar tract	Area 4 and 6 (The fibers descends into the brain stem)	Responsible for the movement of the face, tongue,...	Supplies both sides (the corticobulbar on the right supplies both the right and the left)

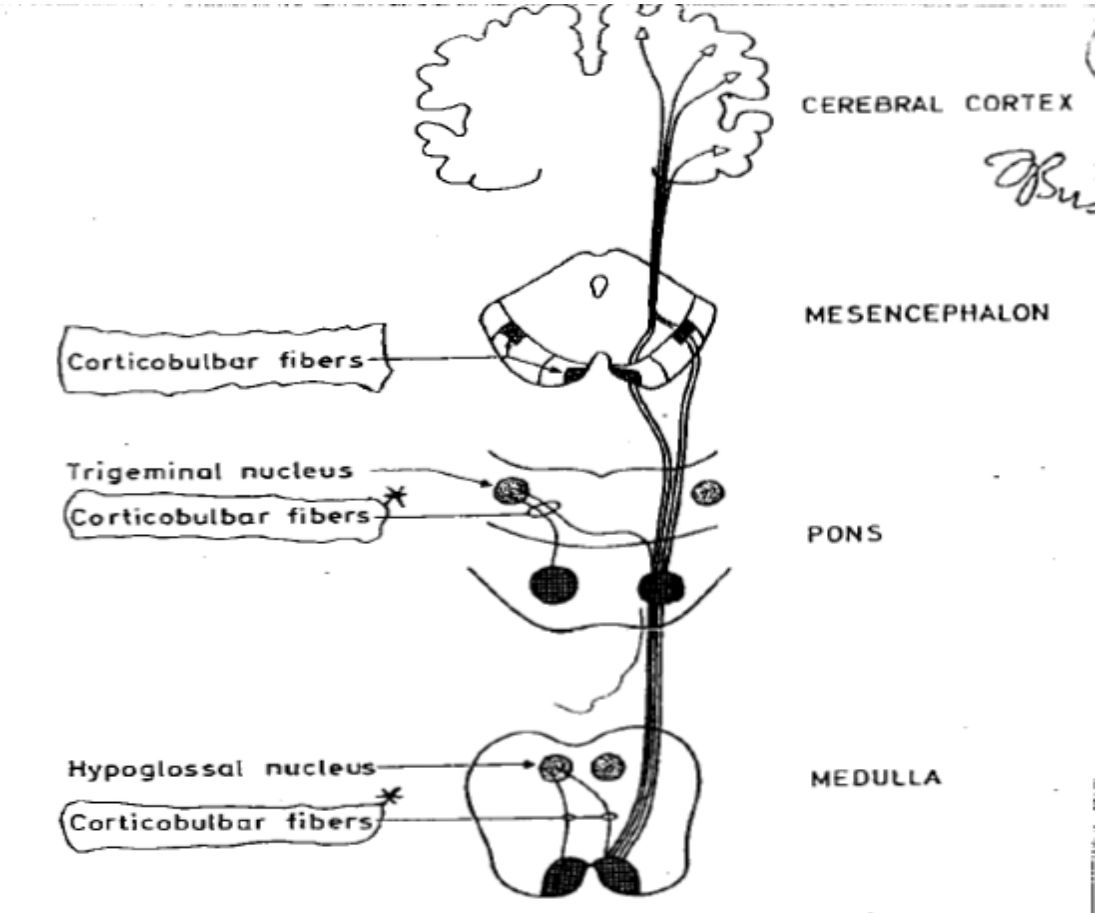


Figure 12.8. Schematic diagram of the corticobulbar pathway.

The trigeminal nerve has 3 branches (ophthalmic, maxillary, and mandibular)

It is mostly sensory . However, a part of the mandibular is motor and supplies the muscles of mastication (masseter,temporalis,medial and lateral pterigoid)

From the nucleus of trigeminal, the motor part of the mandibular arises .

This nucleus receives corticobulbar innervation from both sides

NOTICE:

- Hypoglossal nucleus :
  In old books it is mentioned it receives the corticobulbar innervation from both sides , while in new books it is mentioned that it receives the corticobulbar from one side only.

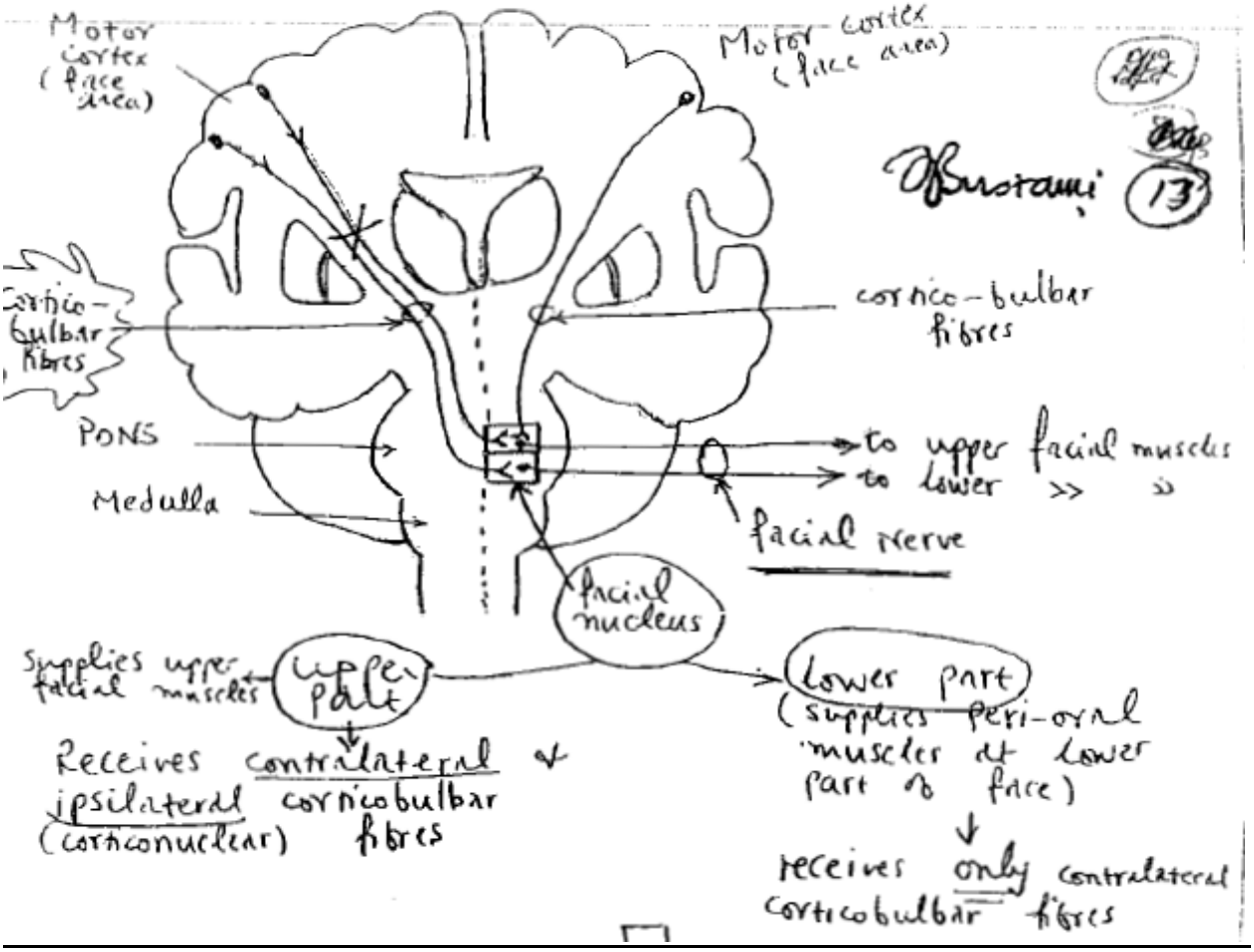
If the muscles of the pharynx and the larynx were not working as a result of any injury we will not be able to swallow anything .

If the corticobulbar was injured in one side the other side can compensate the injured one and we can swallow easily .

- If you have a patient with a stroke and you have to examine him/her neurologically, you have to examine :
  1- The reflexes
  2- The power
  3- The tone
  4- The sensation
  5- <u>The cranial nerves</u>
- You have to examine the cranial nerves, even if they were injured on one side the corticobulbar will compensate from the other side.
- Each motor nucleus of cranial nerves receives a corticobulbar supply from both sides and if one was injured the other side will compensate .
- If the injury was bilateral, this will cause paresis (weakness) or paralysis and that is **<u>rare</u>** (ususally, if there is a stoke that affects the corticobulbar tract is affects one side only)

- The exceptions of this rule are:
    1- A part of the nucleus of the facial nerve
    2- The hypoglossal nucleus (as mentioned in some books)

THE FACIAL NEUCLEUS:



- The facial nerve has :
    1- Motor fibers for the muscles of the face (facial expressions – mimetic muscles)
    2- Parasympathatic
    3- Sensory (taste)

- This is the motor nucleus of the facial nerve, it supplies the muscles of the face:

  1- The upper facial muscles (orbicularis oculi) (closure of the eyes with it's parts : palpebral, orbital)
  2- The lower facial muscles (perioral : orbicularis oris, levator anguli oris , and depressor anguli oris)

  ✓ The orbicularis oculi (the palpebral part) helps you blink and that is important to spread tears on the surface of the cornea to protect it from dryness
  ✓ The lower facial muscles : each muscle pulls the angle of the mouth toward itself , if one of them was injured and became weak the angle of the mouth will move to the opposite side.

- The motor nucleus of the facial is composed of 2 layers:
  1- The upper layer : it supplies the upper facial muscles
  2- The lower layer : it supplies the lower facial muscles
- The upper part of the nucleus :
  It receives a supply from the corticobulbar from both sides
- The lower part of the nucleus
  It receives a contralateral supply of the corticobulbar (from the opposite side) – it doesn't receive an ipsilateral supply of the corticobulbar

This means that if these fibers were injured, the lower facial muscles will become paresis (weakness)

If the injury was in the facial nucleus of the right side, the angle of the mouth will move to the left.

And that was the exception of the corticobulbar (half of the motor nucleus of the facial)

- A stroke in the internal capsule in the left side : here there are descending fibers:
  1- Extrapyramidal
  2- Pyramidal
     A- Corticospinal tract (supplies the cervical, thoracic,lumber,and sacrum regions) – the full length of the spinal cord
     B- Corticobulbar tract (supplies bilaterally to all motor nucleus of certain cranial nerves (except the lower part of the facial)

If the previous tracts were injured:

✓ Corticospinal : the patient from paresis or paralysis of one hand and one leg (half of his body) (hemiplegia or hemiparesis)

That's why if there's a patient with hemiplegia, you have to look at his face (the oral part mainly)

➢ Going back to the previous case of stroke, we said that you have to examine the cranial nerves. You can do that by asking the patient to smile for example, and you will notice that there will be a deviation in his mouth.
➢ A patient with hemiplegia/hemiparesis: we have to concentrate on the lower half of the facial nerve.

Hemiplegia = hemi face (the lower part)

➢ Will the upper part of the face stay unaffected?

It will be affected, but not like the lower muscles

Because the lower muscles have lost the total nerve supply, while the upper muscles have lost the supply from one side and the other side will compensate, so a very little effect on these muscles will appear.

- If the injury was in the facial nerve itself, will the paralysis be on the upper part, the lower part , or both?

It will cause pills palsy, both muscles of the upper and the lower part of the face will be affected.

☞ The injury of the facial nerve:
1- In the parotid gland (carcinoma)
2- At the stylomastoid foramen, if there is an infection in the membrane, the nerve will be compressed.

- To identify if the patient has a stroke or an injury in the nerve itself:

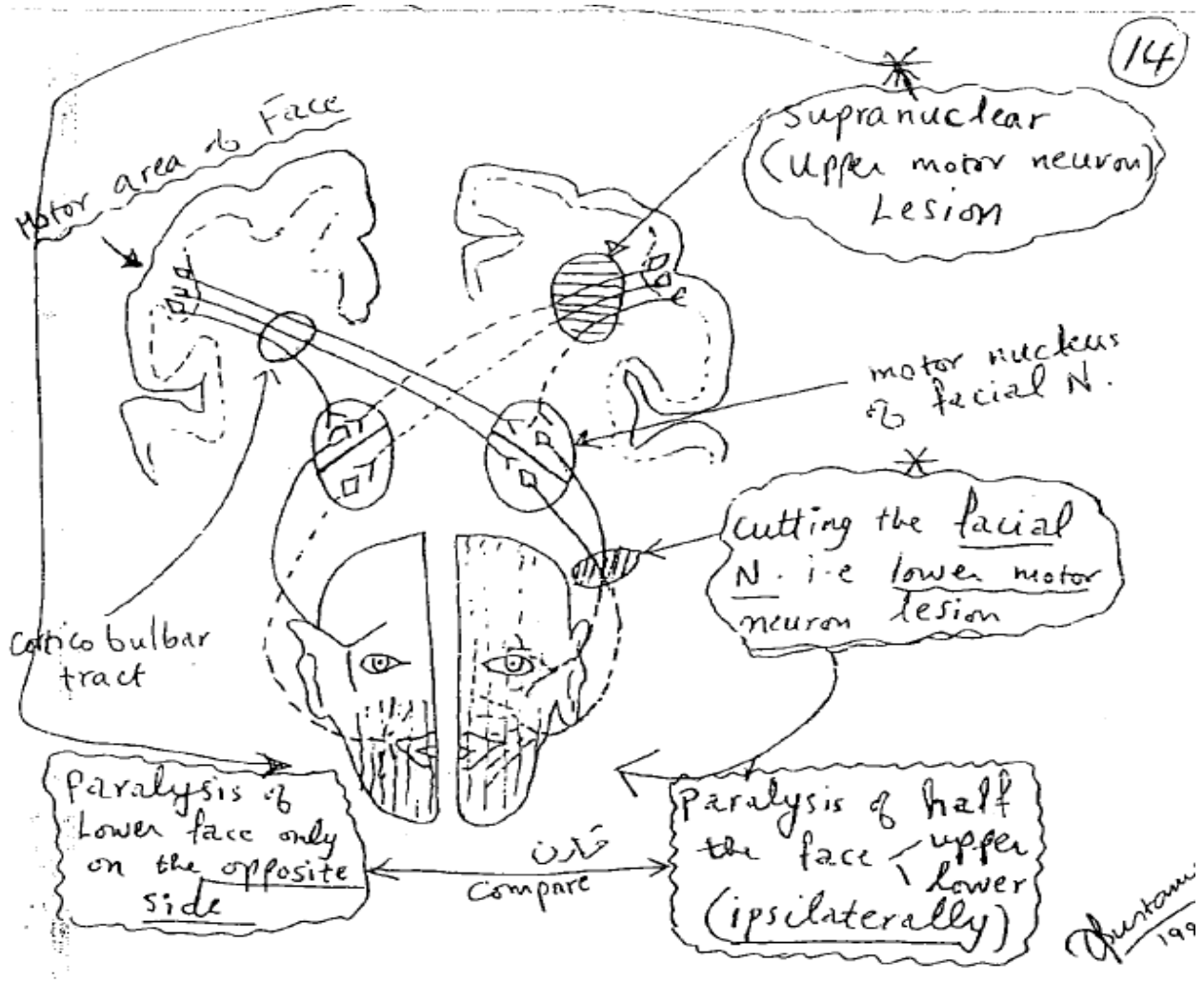
Firstly:

1- If the injury was a supranuclear legion.(above the nucleus) – stroke
2- If the injury was an infranuclear legion.(beneath the nucleus) – an injury in the nerve itself

Secondly:

1- Stroke : only the mouth is affected.(deviation) (hemi face)
2- The mouth will be affected (deviation) , and the patient won't be able to close his/her eye.

- Example: if the patient can't close his right eye, the injury will be in the right nerve , and his mouth be deviated toward the left side (weakness in the right side) .



This patient has a stroke in the left side (shown in the circle with lines inside) … supranuclear legion

- This stroke has affected the corticospinal tract in the left side, the patient will suffer from right hemiparesis or hemiplegia (the right hand and leg)
- The corticabulbar :

  Notice that the motor nucleus of the facial nerve (the upper part is supplied by ipsilateral and contralateral corticobulbar)
  Notice that the contralateral was injured, so the ipsilateral will compensate

  While the lower part receives contralateral corticobulbar only, and if it was injured the patient will suffer from paresis or paralysis of the lower muscles of the face.
- Notice that the injury was on the left side, the weakness was on the right side of the lower muscles, and the mouth deviation will be toward the left side. The upper side will not be affected much.
- If the injury was in the nerve itself (below the motor nucleus), the paralysis will be in the upper and the lower parts of the face.

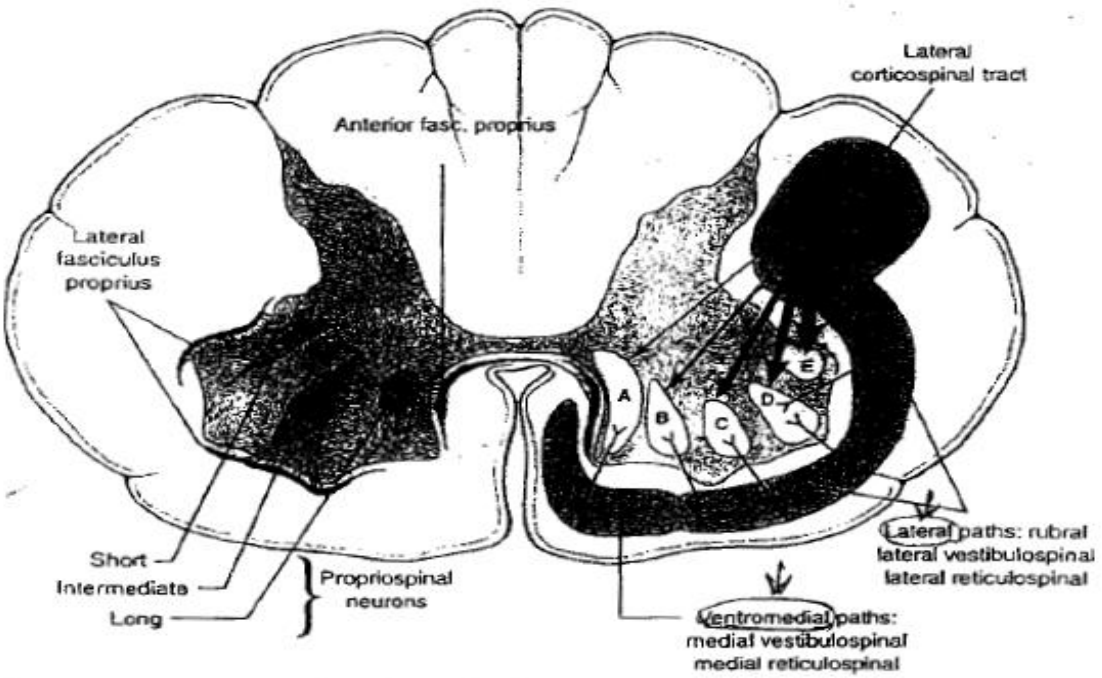


Figure 7-1 Motor organization of a spinal cord segment in the cervical enlargement (A, axial; B, shoulder; C, arm; D, forearm; E, hand; fasc, fasciculus).

- Notice that there are many fibers that arise from the later corticospinal tract, and they differ in their thickness.
- Notice that the fibers mainly go laterally to supply the motor neurons distally. (hands and feet)
- Also, there are some fibers that supply the more proximal muscles
- The lateral corticospinal tract supplies the distal flexor muscles mainly, and it facilitates these muscles. (increase the tone of the muscles.)
- If it was injured, the tone will decrease.

THIS PART IS IMPORTANT

- If the **pyramidal** was injured the tone will **decrease**

- If the **extra pyramidal** (has many tracts) was injured, the tone will **increase**

- Pyramidal (corticospinal) – (facilitator) , if injured the tone will decrease (inhibition) – **HYPOTONIA**
- Extrapyramidal (the main tracts of the extrapyramidal are inhibitory ; they decrease the tone) if it was injured , the tone will increase (continuous contraction , spasticity – **HYPERTONIA**)
- If the pyramidal was injured , the extrapyramidal will be injured too.
- The injury in the extrapyramidal lasts longer. (hypertonia – continuous contraction) – the tone will increase in the flexors and the extensors
- The flexors of the upper limb and the extensors of the lower limb are anti-gravity muscles, so they are exposed to spasm(higher tone) more than other muscles.

THE END

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