

# Neurological Test Regarding the Pyramidal System

**Pyramidal system (corticospinal tract)** is a descending tract originated from pyramidal cells of **motor cortex**. Is the pathway concerned with voluntary, discrete, skilled movements (especially at **distal part of limbs**). It predominantly promotes the activity of flexors of the legs and extensors of the arms. The **corticobulbar** tract is similar in function and features with the exception that is destined for face, head and neck. Its lower motor neurons have their nuclei located at the brainstem (nuclei of the **cranial nerves**) and not at the spinal cord as the corticospinal tract.

**Homunculus:** representation of body parts at the pre-central gyrus of the motor cortex.

*Pyramidal tract (obr.)*

**Pyramidal tract disorders:**

## 1) Upper motor neuron lesions

- If the motor cortex or internal capsule is damaged (ex: hemorrhagic or thrombotic stroke of middle cerebral artery) the impulses from the cortical tracts are interrupted. At the beginning spinal shock is present due to cessation of supraspinal innervation of  $\alpha$ -motoneuron. Muscles become flaccid and no reflexes are present (areflexia). In time (regeneration) synapses are established within the spinal cord. Reflexes become stronger under the influence of  $\alpha$ -motoneuron. As result there will be hyperreflexia and excessive activity of the extensors in the legs and flexors in arms.

Another feature of these lesions is hypertonia (spasticity) due to the influence of muscle spindles and Golgi tendon organs on  $\alpha$ -motoneuron. Sudden stretching of muscle stimulates muscles spindles (as consequence also  $\alpha$ -motoneuron) and massive contraction occurs. If the stretching is slow the Golgi tendon organs becomes predominant the muscle relaxes (via inhibition of  $\alpha$ -motoneuron). This way is possible to see the clasp-knife effect (muscle becomes flaccid after initial increase of tonus).

- Very important sign in these lesions is the Babinsky reflex (big toe flexes dorsally and the other toes fan outward in response to scratching skin along lateral area of foot sole). The normal response would be flexion of all toes. With the lesion the influence of other tracts becomes visible and a kind of withdrawal reflex takes place. Babinsky is present until the end of the first year of life.

**Example A:**

- **Brown-Sequard syndrome:** damage to one half of the spinal cord. Below the lesion there is motor loss on the same side and loss of pain and temperature on the opposite side.

*Why?* Because the ascending tracts (for pain and temperature, not for proprioception and vibration) cross immediately at the segment of the spinal cord. The pyramidal (descending tract) crosses at the brainstem level (pyramidal decussation).

**Example B:**

- **Brain stroke:** most common situation is the one already described above: motor cortex or internal capsule is damaged (ex: hemorrhagic or thrombotic stroke of middle cerebral artery).

The typical lesion pattern is hemiplegia (homolateral for face and counter lateral bellow the neck) with excessive activity of the extensors in the legs and flexors in arms.

## 2) Lower motor neuron lesions

- It interrupts the monosynaptic stretch reflex arch diminishing or making absent the muscle tone (atonia or hypotonia) and the same to the tendinous reflexes (areflexia or hyporeflexia).

**Example A:**

- **Guillain-Barré syndrome (GBS):** acute inflammatory polyneuropathy (usually after fever associated with viral infection or immunization). Thought to be an autoimmune disorder. Leads to segmental demyelination of spinal roots and axons. Loss of sensation in hands and feet, symmetrical progressive ascending motor weakness, paralysis, diminished reflexes, pain and autonomic disturbances. In severe cases assisted ventilation/tracheotomy may be required.

#### **Example B:**

- **Peripheral facial palsy (Bell's palsy):** Acute mononeuropathy characterized by paralysis of the facial nerve (facial muscles are affected) on homolateral side.

Facial nerve is an example of lower motor neuron for corticobulbar tract.

#### **Tendon reflexes:**

- Knee - jerk (L2, L3, L4)
- Achilles tendon (S1, S2)
- Tricipital (C6, C7, C8)
- Bicipital (C5, C6)