# Chapter 1

# Basic Anatomy

## The Cortex

The cerebral hemispheres have an outer layer, the cortex, which consists of grey matter and surrounds the inner white matter. The cortex is intricately folded with the convolutions or ridges called gyri and the fissures in between called sulci. The important sulci to remember are:

- The longitudinal fissure which separates the two hemispheres.
- The lateral (or Sylvian) fissure which separates the frontal and parietal lobes superiorly from the temporal lobe inferiorly.
- The central sulcus which separates the frontal lobe from the parietal lobe.

In the vast majority of people (virtually all right-handers and around 70% of left-handers) the left hemisphere is 'dominant' for language.

Each of the frontal, temporal, parietal and occipital lobes has specific functions:

### Frontal lobe

- Executive function, e.g. planning or decision making
- Behaviour
- Speech production (Broca's area) — dominant hemisphere
- Motor cortex

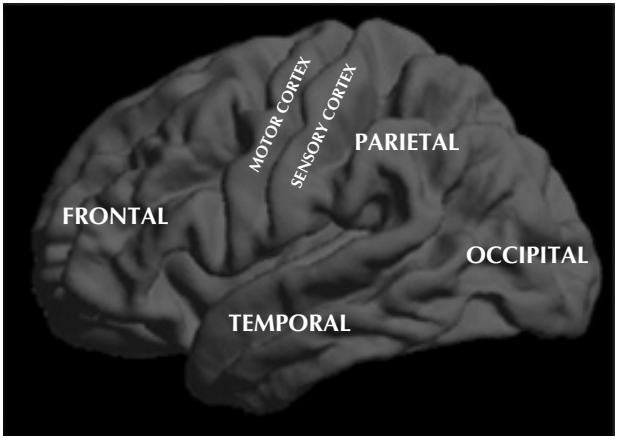


**Fig. 1.** Cerebral hemisphere showing the frontal, temporal, parietal and occipital lobes.

## Temporal lobe

- Episodic memory (medial temporal lobe)
- Semantic memory
- Speech comprehension (Wernicke's area) — dominant hemisphere
- Auditory cortex

## Parietal lobe

- Dominant hemisphere: calculation, reading, writing, limb praxis
- Non-dominant hemisphere: visuospatial/visuoperceptual skills
- Sensory cortex

## Occipital lobe

- Visual cortex

## Basal Ganglia

The basal ganglia are a group of deep grey matter nuclei: caudate, putamen, globus pallidus, substantia nigra and subthalamic nucleus.

They have a number of roles but the key group of neurological disorders associated with the basal ganglia are the movement disorders.

## Cerebellum

The cerebellum consists of two hemispheres joined in the middle by the vermis.

It is involved in motor control and damage leads to problems with coordination ipsilateral to the side of the lesion.

## Cranial Nerves

There are 12 cranial nerves. The olfactory (1st) and optic (2nd) nerves pass straight into the brain but the nuclei for cranial nerves 3 to 12 are situated in the brainstem and can be roughly split into:

- Midbrain: oculomotor (3rd), trochlear (4th)
- Pons: trigeminal (5th), abducens (6th), facial (7th) and vestibulocochlear (8th)
- Medulla: glossopharyngeal (9th), vagus (10th), accessory (11th) and hypoglosssal (12th).

This is a rough division as the sensory nuclei for the 5th nerve extend throughout the brainstem. The nuclei are either medial or lateral in the brainstem:

*Medial*: 3rd, 4th, 6th and 12th (i.e. those that are factors of 12)
*Lateral*: 5th, 7th, 8th, 9th, 10th, 11th

This basic cranial nerve anatomy is useful when identifying the cranial nerves that will be affected by lesions occurring at various points in the brainstem (e.g. the lateral medulla).

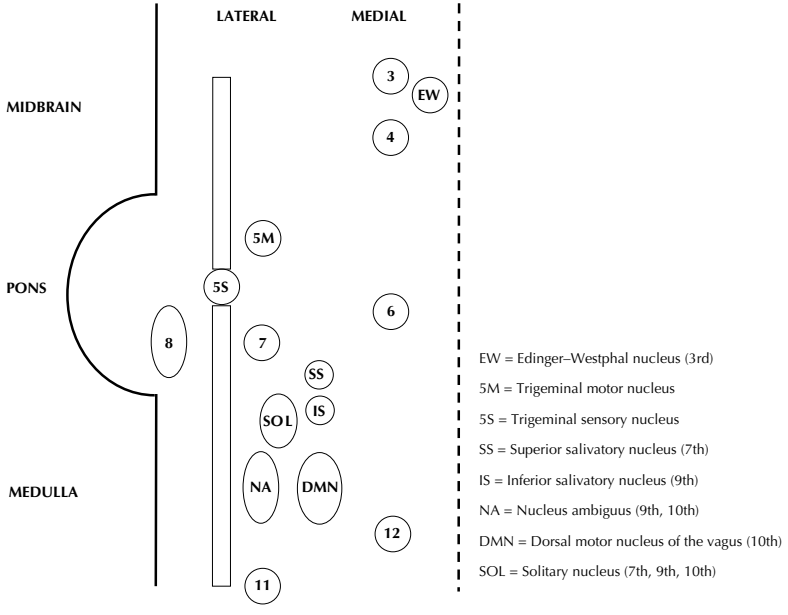


**Fig. 2.** A diagram of the brainstem showing the position of the cranial nerve nuclei.

## Motor Pathway

The motor pathway starts in the motor cortex with the upper motor neurone travelling down the corticospinal tract laterally in the brainstem, crossing to the opposite side in the medulla and down the spinal cord where it synapses with the lower motor neurone in the anterior horn. The lower motor neurone travels through the spinal roots, plexus then nerve to synapse with the muscle at the neuromuscular junction.

## Sensory Pathway

Sensation is carried from receptors via sensory nerves, the plexus and roots to the spinal cord where it ascends in two main tracts: the spinothalamic tract which is anterior in the cord and carries pain and temperature sense, and the dorsal columns which is posterior in the

| Upper Limb Movement | Roots | Nerves | Muscles |
|---|---|---|---|
| Shoulder abduction | C5 | Axillary | Deltoid |
| Shoulder adduction | C6/C7 | Lateral/medial pectoral | Pectoralis major |
| | | Thoracodorsal | Latissimus dorsi |
| | | Lower subscapular | Teres major |
| Elbow extension | C7/C8 | Radial | Triceps |
| Elbow flexion (supinated) | C5/C6 | Musculocutaneous | Biceps |
| Elbow flexion (mid-prone) | C5/C6 | Radial | Brachioradialis |
| Wrist extension | C6 | Radial | Extensor carpi radialis |
| | C7 | Posterior interosseous | Extensor carpi ulnaris |
| Wrist flexion | C6/C7 | Median | Flexor carpi radialis |
| | C8 | Ulnar | Flexor carpi ulnaris |
| Finger extension | C7 | Posterior interosseous | Extensor digitorum, indicis and digiti minimi |
| Finger flexion (MCP joints) | C8/T1 | Median/ulnar | Lumbricals |
| | C8/T1 | Ulnar | Flexor digiti minimi |
| Finger flexion (PIP joints) | C8 | Median | Flexor digitorum superficialis |
| Finger flexion (DIP joints) | C8 | Anterior interosseous/ulnar | Flexor digitorum profundus |
| Finger abduction | T1 | Ulnar | Dorsal interossei |
| | C8/T1 | Ulnar | Abductor digiti minimi |
| Finger adduction | T1 | Ulnar | Palmar interossei |
| Thumb abduction | T1 | Median | Abductor pollicis brevis |

| Lower Limb Movement | Roots | Nerves | Muscles |
|---|---|---|---|
| Hip flexion | L1/L2/L3 | Femoral, Branches from L1-3 | Iliopsoas |
| Hip extension | L5/S1 | Inferior gluteal | Gluteus maximus |
| Hip abduction | L4/L5/S1 | Superior gluteal | Gluteus medius/minimus |
| Hip adduction | L2/L3/L4 | Obturator | Adductors |
| Knee flexion | L5/S1 | Sciatic | Hamstrings |
| Knee extension | L3/L4 | Femoral | Quadriceps |
| Ankle dorsiflexion | L4/L5 | Deep peroneal | Tibialis anterior |
| Ankle plantarflexion | S1/S2 | Tibial | Gastrocnemius, soleus |
| Foot inversion | L4/L5 | Tibial | Tibialis posterior |
| Foot eversion | L5/S1 | Superficial peroneal | Peroneus longus/brevis |
| Big toe extension | L5 | Deep peroneal | Extensor hallucis longus |

cord and carries vibration sense and proprioception (joint position sense). Light touch is carried by both tracts. The spinothalamic tract crosses to the other side (decussates) almost as soon as it enters the spinal cord whilst the dorsal columns do not cross until the medulla. Neurones in both tracts synapse in the thalamus with the final neurone passing from there through the internal capsule to the sensory cortex.

It is important to remember the dermatomal sensory representation:

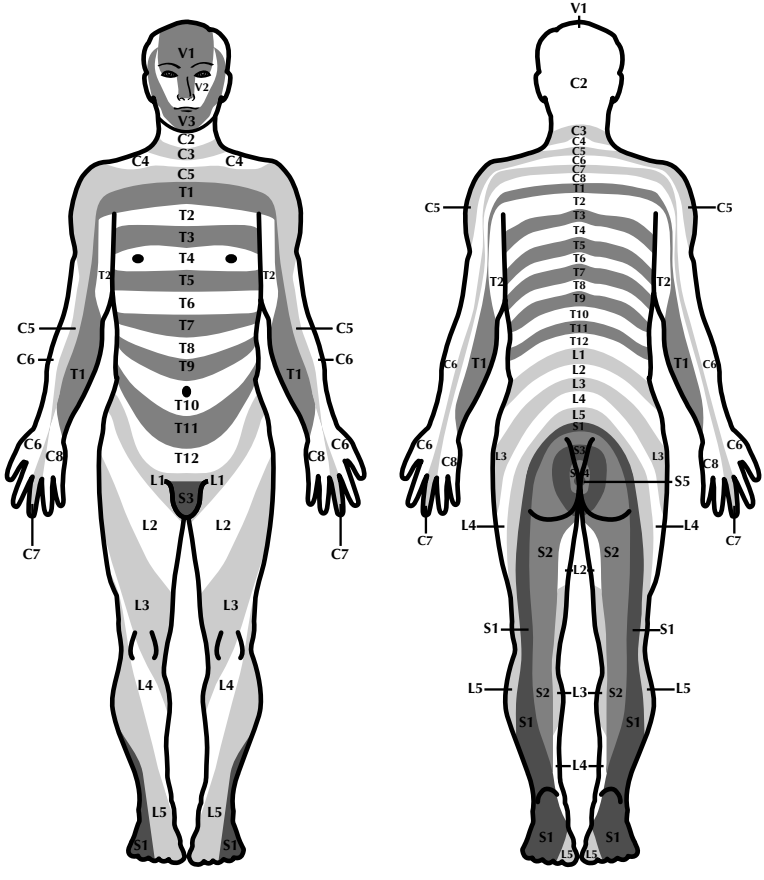


**Fig. 3.** Anterior and posterior dermatomal map.