Cerebellar Afferent Fibers From the Cerebral Cortex

The cerebral cortex sends information to the cerebellum by three pathways: (1) the corticopontocerebellar pathway, (2) the cerebro-olivocerebellar pathway, and (3) the cerebroreticulocerebellar pathway.

Corticopontocerebellar Pathway

The corticopontine fibers arise from the nerve cells in the frontal, parietal, temporal, and occipital lobes of the cerebral cortex and descend through the corona radiate and internal capsule and terminate upon the pontine nuclei. The pontine nuclei give rise to the transverse fibers of the pons, which cross the midline and enter the opposite cerebellar hemisphere as the middle cerebellar peduncle.

Cerebro-olivocerebellar Pathway

The cortico-olivary fibers arise from nerve cells in the frontal, parietal, temporal, and occipital lobes to the cerebral cortex and descend through the corona radiate and internal capsule to terminate bilaterally upon the inferior olivary nuclei. The inferior olivary nuclei give rise to fibers that cross the midline and enter the opposite cerebellar hemisphere through the inferior cerebellar peduncle.

Cerebroreticulocerebellar Pathway

The corticoreticular fibers arise from nerve cells from many areas of the cerebral cortex, particularly the sensorimotor areas. They descend to terminate in the reticular formation on the same side and on the opposite side in the pons and medulla. The cells in the reticular formation give rise to the reticulocerebellar fibers that enter the cerebellar hemisphere on the same sid ethrough the inferior and middle cerebellar peduncles.

This connection between the cerebrum and cerebellum is important in the control of voluntary movement. Information regarding the initiation of movement in the cerebral cortex is probably transmitted to the cerebellum so that the movement can be monitored and appropriate adjustments in the muscle activity can be made.

Cerebellar Afferent Fibers From the Spinal Cord

The spinal cord sends information to the cerebellum from somatosensory receptors by three pathways: (1) the anterior spinocerebellar tract, (2) the posterior spinocerebellar tract, and (3) the cuneocerebellar tract.

Anterior Spinocerebellar Tract

The axons entering the spinal cord from the posterior root ganglion terminate by synapsing with neurons in the **nucleus dorsalis** (Clark's column) at the base of the posterior gray column. Most of the axons of these neurons cross to the opposite side and ascend as the **anterior spinocerebellar tract** in the contralateral white column; some of the axons ascend as the anterior spinocerebellar tract in the lateral white column of the same side. The fibers enter the cerebellum through the superior cerebellar peduncle and terminate the cerebellar cortex.

The fibers of the anterior spinocerebellar tract convey muscle joint information from the muscle spindle, tendon organs, and joint receptors of the upper and lower limbs. It is also believed that the cerebellum receives information from the skin and superficial fascia by this tract.

Posterior Spinocerebellar Tract

The axons entering the spinal cord from the posterior root ganglion enter the posterior gray column and terminate by synapsing on the neurons at the base of the posterior gray column. These neurons are known collectively as the nucleus dorsalis (Clark's column). Axons of these neurons enter the posterolateral part of the lateral white column on the same side and ascend as the **posterior spinocerebellar tract** to the medulla oblongata. Here the tract enter the cerebellum through the inferior cerebellar peduncle and terminate in the cerebellar cortex. The posterior spinocerebellar tract receives muscle joint information from the muscle spindle, tendon organs, and joint receptors of the trunk and lower limb.

Cuneocerebellar Tract

These fibers originate in the nucleus cuneatus of the medulla oblongata and enter the cerebellar hemisphere on the same side through the inferior cerebellar peduncle. The fibers terminate in the cerebellar peduncle. The cuneocerebllar tract receives muscle joint information from the muscle spindles, tendon organs, and joint receptors of the upper limb and upper part of the thorax.

Cerebellar Afferent Fibers From the Vestibular Nerve

The vestibular nerve receives information from the inner ear concerning motion from the semicircular canals and position relative to the gravity from the utricle and saccule. The vestibular nerve sends many afferent fibers directly to the cerebellum through the inferior cerebellar peduncle on the same side. All afferent fibers from the inner ear terminate in the focculonodular lobe of the cerebellum.

Cerebellar Efferent Fibers

Globose-Emboliform-Rubral Pathway

Axons of neurons in the globose and emboliform nuclei travel through the superior cerebellar peduncle and cross the midline to the opposite side in the decussation of the superior cerebellar peduncles. The fibers end by synapsing with the cells of the contralateral red nucleus, which give rise to axons of the rubrospinal tract. By this means, the globose and emboliform nuclei influence motor activity on the same side of the body.

Dentothalamic Pathway

Axons of neurons in the dentate nucleus travel through the superior cerebellar peduncle and cross the midline to the opposite side in the **decussation of the superior cerebellar peduncle**. The fibers end by synapsing with the cells in the contralateral **ventrolateral nucleus of the thalamus**. The axons of the thalamic neurons ascend through the internal capsule and corona radiate and terminate in the primary motor area of the cerebral cortex. By this pathway, the dentate nucleus can influence motor activity by acting upon the motor neurons of the opposite cerebral cortex; impulses from the motor cortex are transmitted to the spinal segmental level through the corticospinal tract. Most of the fibers of the corticospinal tract cross to the opposite side in the decussation of the pyramids or later at the spinal segmental level. Thus dentate nucleus is able to coordinate muscle activity on the same side of the body.

Fastigial Vestibular Pathway

The axons of neurons in the fastigial nucleus travel through the inferior cerebellar peduncle and end by projecting on the neurons of the **lateral vestibular nucleus** on both sides. The neurons of the lateral vestibular nucleus form the vestibulospinal tract. The fastigial nucleus exerts a facilitatory influence mainly on the extensor muscle tone.

Fastigial Reticular Pathway

The axons of neurons in the fastigial nucleus travel through the inferior cerebellar peduncle and end by synapsing with the neurons of the reticular formation. Axons of these neurons influence spinal segmental motor activity through the reticulospinal tract.