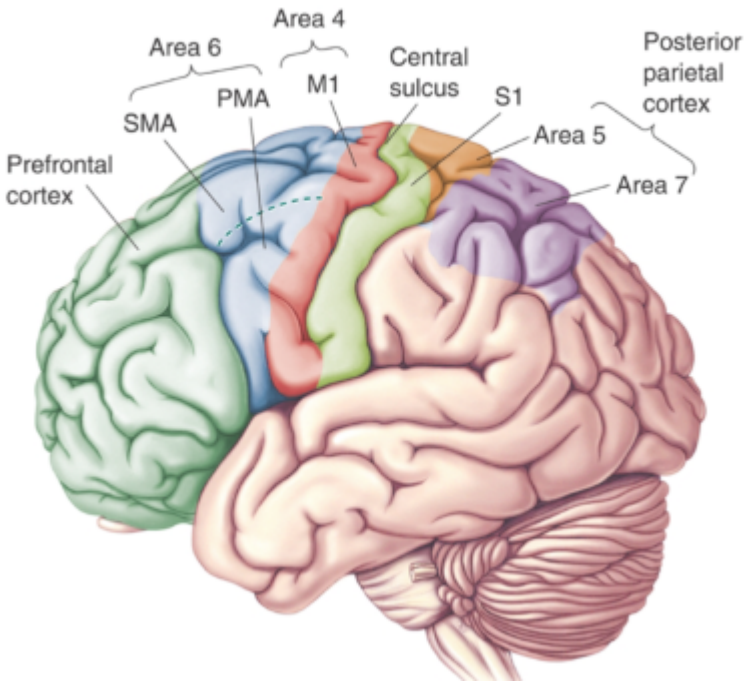
Supplementary motor area

The supplementary motor area (SMA) is frequently involved by brain tumours (particularly WHO grade II gliomas). Surgery in this area can be followed by the 'Supplementary motor area syndrome'.



Knowledge of the connections of the SMA can provide new insights on the genesis of the SMA syndrome, and a better understanding of the challenges related to operating in this region.

White matter connections of the SMA were studied with both postmortem dissection and advance diffusion imaging tractography. Postmortem dissections were performed according to the Klingler technique. 12 specimens were fixed in 10% formalin and frozen at -15°C for 2 weeks. After thawing, dissection was performed with blunt dissectors. For diffusion tractography, high-resolution diffusion imaging datasets from 10 adult healthy controls from the Human Connectome Project database were used. Whole brain tractography was performed using a spherical deconvolution approach.

Five main connections were identified in both postmortem dissections and tractography reconstructions:

(1) U-fibres running in the precentral sulcus, connecting the precentral gyrus and the SMA

(2) U-fibres running in the cingulate sulcus, connecting the SMA with the cingulate gyrus

(3) frontal 'aslant' fascicle, directly connecting the SMA with the pars opercularis of the inferior frontal gyrus

(4) medial fibres connecting the SMA with the striatum

(5) SMA callosal fibres. Good concordance was observed between postmortem dissections and diffusion tractography.

The SMA shows a wide range of white matter connections with motor, language and lymbic areas. Features of the SMA syndrome (akinesia and mutism) can be better understood on the basis of these findings [1)].

Penfield and Welch in 1951 first described SMA in the monkey brain and the human brain as a representation of the body on the medial wall of the hemisphere. Woolsey and colleagues in 1952 confirmed SMA in the monkey brain, describing it as a rough somatotopic map with the legs in a posterior location and the face in an anterior location. The representations of different body parts were found to overlap extensively. Stimulation of many sites evoked bilateral movements and sometimes movements of all four limbs. This overlapping somatotopic map in SMA was confirmed by many others.

Functions

see Supplementary motor area functions.

Pathology

see Supplementary motor area epilepsy.

see Supplementary motor area syndrome

Case reports

A professional right-handed painter with Parkinson's disease (PD) broke his right arm and continued to paint with his left hand, showing an intact intermanual transfer of skills. This neurocognitive process is related to the supplementary motor area, a brain region that has also been shown to be involved in PD. This observation raises questions about the exact neural underpinnings of intermanual transfer and the possible impact of neurodegenerative disease and medication [2].

1)
Vergani F, Lacerda L, Martino J, Attems J, Morris C, Mitchell P, Thiebaut de Schotten M, Dell'acqua F. White matter connections of the supplementary motor area in humans. J Neurol Neurosurg Psychiatry. 2014 Apr 16. doi: 10.1136/jnnp-2013-307492. [Epub ahead of print] PubMed PMID: 24741063.
2)
Kho KH, Janssen N. Intermanual transfer in an artist with Parkinson's disease. Neurocase. 2016 Feb;22(1):119-21. doi: 10.1080/13554794.2015.1053492. Epub 2015 Jun 8. PubMed PMID: 26050705.