Spatial convergence

Cortical folding places regions that are separated by a large distance along the cortical surface in close proximity. This process is not homogeneous; regions such as the insular operculum have a much higher cortical surface distance (CSD) to euclidean distance (ED) than others.

Bush et al. explored the hypothesis that in the folded brain the CSD, and not the ED, determines regions of common irrigation, because this measure corresponds more closely with the distance along the prefolded brain, where the subarachnoid arterial vascular network starts forming.

They defined a convergence index that compared the ED to the CSD and applied it to the cortical surface reconstruction of an average brain. They then compared cortical convergence to the irrigation patterns of major sulci and fissures of the brain, by assessing whether these structures were crossed or not crossed by arterial vessels in 20 fixed hemispheres.

The regions of highest convergence (top 1%) were clustered around the sylvian fissure, which is the only brain depression with high convergence values along its edges. Arterial crossings were commonly observed in every major sulcus of the brain, with the exception of the sylvian fissure, constituting a highly significant difference ($p < 10\text{-}4$).

Arteries do not cross regions of high convergence. In the adult brain the CSD, rather than the ED, predicts the regional irrigation pattern. The distant origin of the frontal and temporal lobes creates a region of high cortical convergence, which explains why arteries do not cross the sylvian fissure [1].

1)
Bush A, Nuñez M, Brisbin AK, Friedlander RM, Goldschmidt E. Spatial convergence of distant cortical regions during folding explains why arteries do not cross the sylvian fissure. J Neurosurg. 2019 Nov 22:1-10. doi: 10.3171/2019.9.JNS192151. [Epub ahead of print] PubMed PMID: 31756705.