Cortical remapping

Cortical remapping, also referred to as cortical reorganization, is the process by which an existing cortical map is affected by a stimulus resulting in the creation of a 'new' cortical map. Every part of the body is connected to a corresponding area in the brain which creates a cortical map. When something happens to disrupt the cortical maps such as an amputation or a change in neuronal characteristics, the map is no longer relevant. The part of the brain that is in charge of the amputated limb or neuronal change will be dominated by adjacent cortical regions that are still receiving input, thus creating a remapped area.

Remapping can occur in the sensory or motor system. The mechanism for each system may be quite different.[2] Cortical remapping in the somatosensory system happens when there has been a decrease in sensory input to the brain due to deafferentation or amputation, as well as a sensory input increase to an area of the brain.

Motor system remapping receives more limited feedback that can be difficult to interpret.

Quinones et al. investigated changes in language lateralization between 2 fMRI studies in patients with brain tumors to elucidate factors contributing to cortical remapping.

The authors analyzed 33 patients with brain tumors involving eloquent language areas who underwent 2 separate presurgical, language task-based fMRI examinations (fMRI1 and fMRI2). Pathology consisted of low-grade glioma (LGG) in 15, and high-grade glioma (HGG) in 18. The mean time interval between scans was 35 ± 38 months (mean ± SD). Regions of interest were drawn for Broca's area (BA) and the contralateral BA homolog. The laterality index (LI) was calculated and categorized as follows: > 0.2, left dominance; 0.2 to -0.2, codominance; and < -0.2, right dominance. Translocation of language function was defined as a shift across one of these thresholds between the 2 scans. Comparisons between the 2 groups, translocation of language function (reorganized group) versus no translocation (constant group), were performed using the Mann-Whitney U-test.

Nine (27%) of 33 patients demonstrated translocation of language function. Eight of 9 patients with translocation had tumor involvement of BA, compared to 5/24 patients without translocation ($p < 0.0001$). There was no difference in LI between the 2 groups at fMRI1. However, the reorganized group showed a decreased LI at fMRI2 compared to the constant group (-0.1 vs 0.53, $p < 0.01$). The reorganized cohort showed a significant difference between LI1 and LI2 (0.50 vs -0.1, $p < 0.0001$) whereas the constant cohort did not. A longer time interval was found in the reorganized group between fMRI1 and fMRI2 for patients with LGG (34 vs 107 months, $p < 0.002$). Additionally, the reorganized cohort had a greater proportion of local tumor invasion into eloquent areas at fMRI2 than the constant group. Aphasia was present following fMRI2 in 13/24 (54%) patients who did not exhibit translocation, compared to 2/9 (22%) patients who showed translocation.

Translocation of language function in patients with a brain tumor is associated with tumor involvement of BA, longer time intervals between scans, and is seen in both LGG and HGG. The reduced incidence of aphasia in the reorganized group raises the possibility that reorganization supports the conservation of language function. Therefore, longitudinal fMRI is useful because it may point to reorganization and could affect therapeutic planning for patients [1).

1)

Quinones A, Jenabi M, Pasquini L, Peck KK, Moss NS, Brennan C, Tabar V, Holodny A. Use of longitudinal functional MRI to demonstrate translocation of language function in patients with brain tumors. J Neurosurg. 2022 Nov 25:1-9. doi: 10.3171/2022.10.JNS221212. Epub ahead of print. PMID: 36433876.