

CEREBRAL PLASTICITY: NEW ACQUISITIONS GAINED FROM FUNCTIONAL MAPPING OF LESIONS IN ELOQUENT AREAS AND THEIR PROGNOSTIC AND THERAPEUTIC IMPLICATIONS

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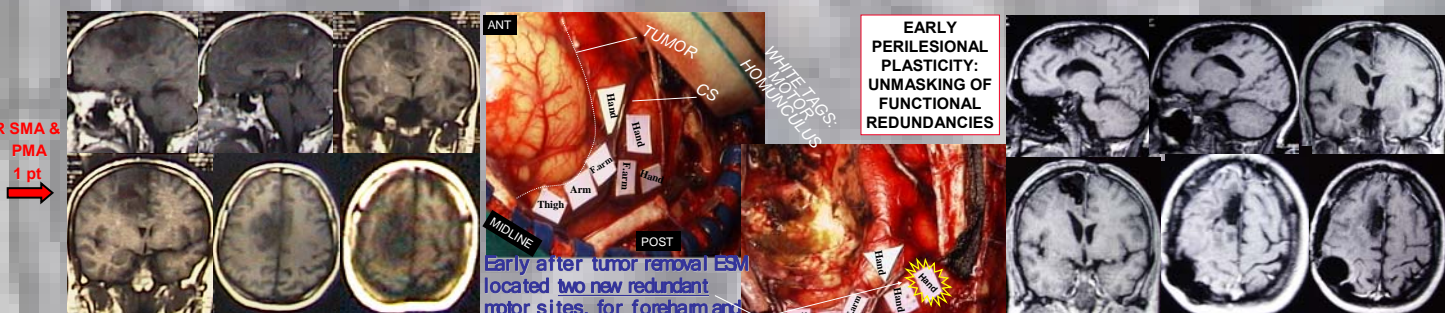
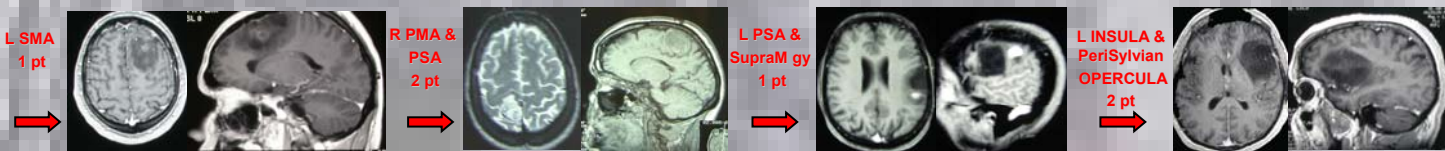
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BACKGROUND Tumors infiltrating highly functional structures like sensorimotor and language cortical areas and pathways cause a reorganization of cortico-subcortical functional maps. Mechanisms of cerebral plasticity take place as a result of surgical removal of lesions and determine a remodeling of neuronal circuitry, which correlates to clinical evolution. Privileged tools for studying mechanisms of cerebral plasticity are **functional MRI (fMRI)** and **cortico-subcortical electrical stimulation mapping (ESM)**.

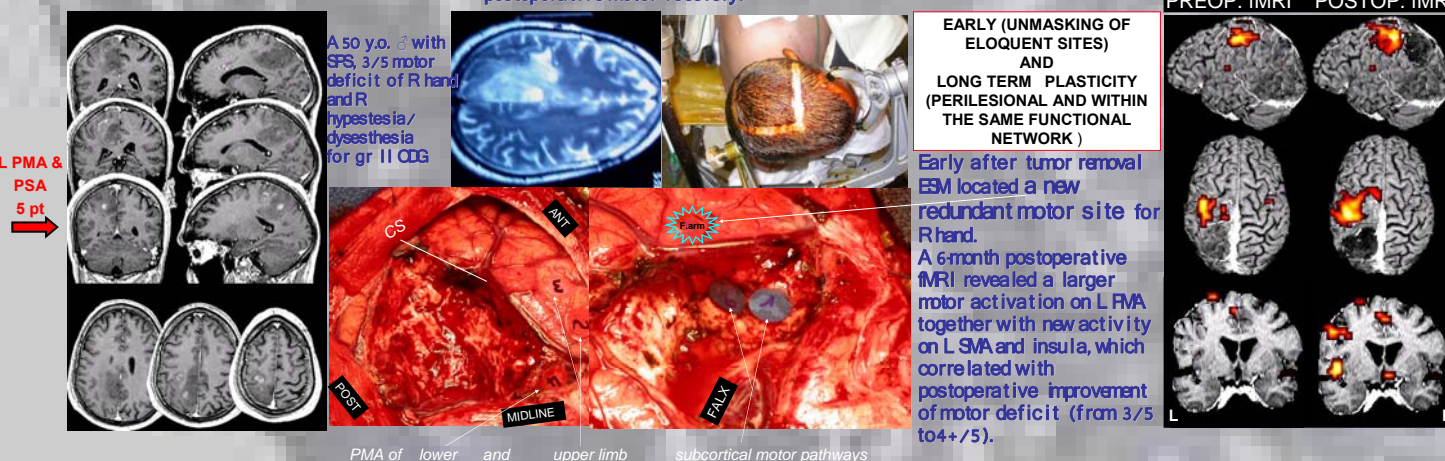
MATERIAL AND METHODS We retrospectively analyzed clinical data of 12 patients (5 ♀ 8 ♂), mean age 49 (30-65) y.o., operated on with the aid of ESM. The preoperative clinical-radiological evaluation included determination of hemispheric dominance for speech, neuropsychological assessment, Boston Diagnostic Aphasia Evaluation and fMRI. All patients presented with epileptic seizures (2 grand mal and 10 partial, 6 of which complex and 4 simple, with secondary generalization in 2 cases). Two patients showed motor deficits (3/5 and 4/5), while one patient had mild phasic troubles, not hindering intraoperative ESM. Patients harboring lesions in or near language areas underwent awake craniotomy for language mapping, while the others displaying lesions involving motor areas were operated on in general anesthesia with the aid of ESM for locating motor pathways. We obtained 6-month postoperative MRI in 8 cases.

Abbreviations: SMA-Supplementary Motor Area; PMA-Primary Motor Area; PSA-Primary Sensory Area; SupraM gy-Supramarginal gyrus; HGG-High Grade Glioma; LGG-Low Grade Glioma; CPS-complex partial seizures; SPS-simple partial seizures; CS-central sulcus.



A 42 y.o. ♀ with CPS and impaired dexterity and 4/5 motor deficit of L hand for gr II CDG.

Early after tumor removal ESM located two new redundant motor sites, for forearm and hand. This phenomenon correlated with a complete postoperative motor recovery.



PMA of lower and upper limb subcortical motor pathways

RESULTS All patients had infiltration of eloquent sites according to anatomical criteria and clinical presentation (4 lesions in language areas and 8 involving motor pathways). Nonetheless, just 5/12 had ESM-confirmed infiltration of functional sites, 4 of which were neurologically intact. There were 3 high grade and 9 low grade gliomas. All patients had immediate post-operative neurological aggravation. Recovery occurred within 3 months in all of them and all 3 patients with a preoperative deficit improved. Nine lesions were either totally or subtotally resected on post-operative MRI. At a mean F.U. of 45 months all patients are alive and have a KPS \geq 70%, with a subjective improvement of QoL (FACT-G, FACT-B) for 7 of them.

DISCUSSION There are mechanisms of cerebral plasticity taking place before the treatment of the lesion and both in an acute stage and at distance from surgical intervention. This could be explained by the fact that sensorimotor and language functions seem to be organized with in multiple parallel networks. Beyond the recruitment of areas adjacent to the surgical cavity, the long term reshaping could be related to progressive involvement of remote regions within the hemisphere contralateral to the lesion and of the contralateral hemisphere. However, mechanisms of compensation are limited. One of such limits is that reorganization seems to be more effective in secondary than in primary areas, as for SMA. Moreover, if a damaged area is compensated by another region, a lesion of this newly recruited region will induce a permanent deficit, as it is the case for dominant insulo-opercular gliomas. On the other hand, surgical resection should avoid infringement of an eloquent structure if its compensatory area(s) is (are) not perfectly functional. Taking into account these data may guide treatment of cerebral tumors in eloquent areas and be useful for defining prognosis and rehabilitation programs.