

## **"Form Follows Function": Anatomic and Functional Localization of Eloquent Cortex**

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### **APPROACH:**

Following retrospective review of all fMRI studies performed at our institution, 13 cases were selected for their particular educational value regarding patient diagnosis and imaging findings. Examinations were performed on a 3 Tesla magnet under the supervision of a dedicated functional neuroradiologist. A standard alternating block protocol was used for identification of primary/supplementary motor and language cortex. For each study, activation areas were correlated to anatomic findings on presurgical MR examinations. Visible anatomic landmarks were identified on axial T1 MPRAGE sequences by two neuroradiology attendings and a radiology resident (PGY-4).

### **FINDINGS:**

We present 7 anatomic landmarks on CT and MR, as described by Naidich et al. in normal brains [1]:

1. Superior frontal sulcus - precentral sulcus (85% sensitivity): Posterior end of SFS joins pre-CS
2. Sigmoidal hook (89% CT, 98% MR): Posterior precentral gyrus indents CS
3. Bifid postcentral sulcus (85% CT, 88% MR): Bifurcate post-CS encloses lateral pars marginalis
4. Thin postcentral gyrus (98%): Post-CG is thinner than pre-CG
5. Intraparietal sulcus - postcentral sulcus (99%): IPS intersects post-CS
6. Midline sulcus (70%): Sulcus extending closest to midline is CS
7. Pars bracket (96%): Paired pars marginalis on each side of interhemispheric fissure, behind CS

Next, we discuss the basic principles and techniques of fMRI. fMRI is used to determine the relationship between presurgical brain lesions and eloquent cortex, most importantly the primary motor and language areas. At our institution, a lesion is considered resectable at a distance of 1-1.5 cm from eloquent cortex. A location of less than 3-6 mm from eloquent cortex is considered a contraindication for gross total resection, and requires intraoperative cortical mapping (ICM) during surgery. [2]

As reported by Pujol et al., anatomic landmarks correlate well with fMRI, except when abnormalities are located close to the central sulcus. This can result in regional compression, distortion, and displacement secondary to mass effect, edema, and infiltration. [3] We compare anatomic and fMRI findings across a variety of lesion locations and etiologies. Technical and patient-related imaging artifacts are also discussed.

### **SUMMARY:**

The major teaching points of this exhibit are:

1. Anatomic localization with conventional CT/MR is effective for characterizing preoperative cerebral lesions with respect to the central sulcus and surrounding anatomic landmarks.
2. Pathologic lesions may severely distort normal anatomy. In particular, when abnormalities are located close to the central sulcus, fMRI and/or intraoperative mapping may be required to more precisely determine the relationship between eloquent cortex and the lesion of interest.
3. Awareness of limiting technical/patient factors is important for performing accurate anatomic and functional localization.