**Identifying epileptogenic lesions using cortical thickness**

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**Introduction:** Focal cortical dysplasia (FCD) is a brain malformation that is frequently responsible for epilepsy in children. FCD is one of the most challenging lesions to detect on Magnetic Resonance Imaging (MRI) as the imaging features may be subtle and not infrequently missed. Abnormal cortical thickness is one of the features of FCD [2]. The aim of this study was to determine if using objective measure of cortical thickness could assist with identifying subtle FCD on MRI.

**Methods:** The volumetric T1-weighted imaging was acquired on 3T MRI in 32 children with focal epilepsy having subtle lesion that was suspected to be FCD. Five patients had focal cortical thickening that was visible on visual inspection of the MRI by a neuroradiologist. All patients underwent epilepsy surgery resection and had post-operative CT or MRI. Cortical thickness measurements were acquired using the Freesurfer software. The shortest distance from the pial surface to the gray-white matter junction is computed. The same is done from the gray-white matter junction to the pial surface. The average of these two values is taken to be the cortical thickness [1]. Cortical thickness measures were saved as a vector of values. These thickness values were sampled into a volume that could be read in MATLAB.

In MATLAB, for each case a 3D-Gaussian smoothing filter was applied followed by a gamma correction. Vertex points were selected that fell in the 95% confidence level. These vertexes were matched to their structure name and hemisphere using annotation files from Freesurfer. A threshold of 5 mm was applied to the cortical thickness values. The clusters of abnormal cortical thickness were classified into 8 possible locations: right and left frontal, temporal, parietal, and occipital. The location of clusters was compared to surgical resection site on post-operative CT or MRI.

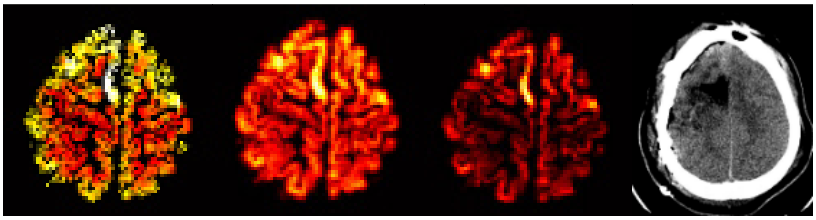

**Figure 1 [a, b, c, d] - Case NL036 Processing of volumetric T1 MRI:** (a) Showing raw non-filtered cortical thickness measurements, followed by the application of (b) Gaussian Smoothing (c) Gamma filtering. The cluster of abnormal signal corresponded to (d) surgical resection site on post-operative CT scan. Scan indicating location of lesion was removed.

**Results:** The mean age of the patients was 11.73 years. Of the 32 patients, clusters of abnormal cortical thickness were identified in all 32 patients and in 23 patients these corresponded to surgical resections sites. The overall sensitivity of cortical thickness measures to identify FCD was 70% and the specificity was 56%. Of the 5 patients that had focal cortical thickening by visuals inspection, objective measures of cortical thickness showed that the sensitivity and specificity were 100% and 74% respectively.

**Conclusions:** Objective measures of cortical thickness can be used to identify subtle FCD that may have been missed by visual inspection. Further research is need to reduce the false negative findings.

**References**: [1] Hong *et al.,* Automated detection of cortical dysplasia type II in MRI-negative epilepsy, Neurology 2014;83(1):48-55. [2] Lüsebrink *et al.*, Cortical thickness determination of the human brain using high resolution 3 T and 7 T MRI data, NeuroImage 2013;70: 122-131.