

# Inter-hemispheric connectivity (functional homotopy) is reduced in pediatric epileptic patients with corpus callosotomy

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**INTENDED AUDIENCE** Clinicians and scientists interested in brain connectivity.

**INTRODUCTION** Many studies have used resting-state fMRI (rs-fMRI) to measure functional connectivity between brain hemispheres. This phenomenon was first reported in 1995<sup>1</sup>, where the fMRI signal from one hemisphere's motor cortex at rest was found to correlate with the signal from the contra-lateral motor cortex. Since this was reported, thousands of studies have

utilized rs-fMRI as a tool to measure the brain's functional connectivity.

A new method for measuring the regional strength of inter-hemispheric connectivity, called functional homotopy, has recently been proposed and used to measure age related changes in inter-hemispheric connectivity<sup>2</sup>. This technique measures the correlation between analogous contra-lateral voxels and then paints the correlation parameters onto one hemisphere for group comparison.

Previously, one patient has been shown to lose inter-hemispheric connectivity following a corpus callosotomy for seizure treatment<sup>3</sup>. This result has however, never been replicated. Functional homotopy has likewise never been explored in patients with corpus callosotomy. In this study we compare the functional homotopy in pediatric patients following corpus callosotomy to a population of control subjects.

## METHODS

**Patient Population** For this study, two pediatric

patients were recruited who had previously underwent corpus callosotomy and functional MRI for epilepsy surgical planning. They underwent high-resolution structural imaging and an additional resting-state fMRI scan. Both patients were anesthetized for the duration of their MRI. For comparison, the data from fifteen adult patients with similarly acquired structural imaging and resting state fMRI was acquired and processed from a public imaging repository.

**Image Processing** High-resolution structural MPRAGE scans were processed using Freesurfer (surfer.nmr.mgh.harvard.edu) for cortical based functional analysis<sup>4</sup>. Rs-fMRI data was motion corrected, and smoothed with a 6mm fwhm Gaussian kernel. Data was then co-registered to the structural image and projected onto each cortical surface. A spherical transformation then brought the individual data into MNI template space. The rs-fMRI data from the left hemisphere was spherically transformed to the right hemisphere using internal Freesurfer commands. The surfaces were then loaded into Matlab and inter-hemispherically compared using custom developed in-house software.

**Functional Homotopy Calculation** A Pearson correlation was calculated between each hemisphere's rs-fMRI signal now both projected onto the right hemisphere. Fisher Z transformed correlation coefficients were then compared between the patients and the control group using a two sample T-test. Clusters greater than 10 contiguous voxels with p-values < 0.05 were considered significant.

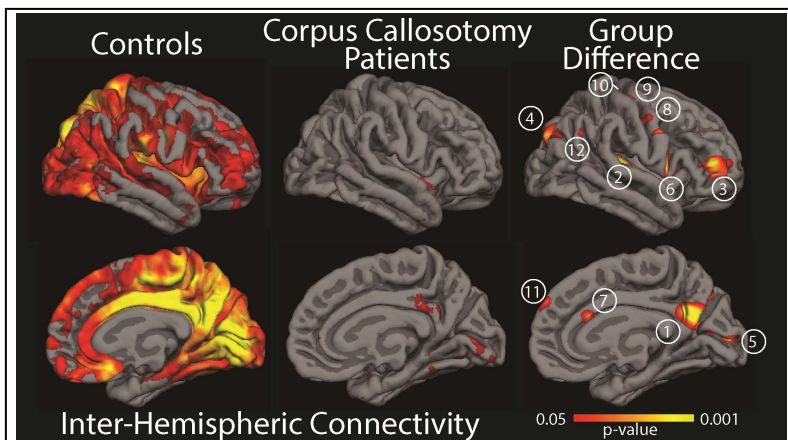
**RESULTS** Figure 1 shows both the mean group functional homotopy and the group difference. Clusters of significantly different voxels are shown in Table 1. Notably, clusters 1, 12, 7, and 11 are part of the 'default mode network'<sup>5, 6</sup>, while clusters 8, 9, and 10 represent the motor and sensory cortex.

**DISCUSSION** This is the first study to apply functional homotopy to patients following corpus callosotomy. We find that severing the corpus callosum profoundly reduces inter-hemispheric functional connectivity as measured with rs-fMRI.

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## REFERENCES

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**Figure 1.** Mean inter-hemispheric connectivity (functional homotopy) for 15 control subjects (Left) and two pediatric corpus callosotomy patients (Middle). The group difference (Right) indicates regions where controls have more inter-hemispheric connectivity compared to the patients ( $p < 0.05$ ). Clusters are numbered corresponding to Table 1.

Cluster	Voxels	MNI			Peak T
1	1069	9	-56	27	3.42
2	476	44	-29	7	3.2
3	435	38	44	10	3.19
4	308	24	-85	31	2.88
5	200	10	-88	8	3.4
6	175	50	5	10	3.32
7	118	7	22	24	2.82
8	102	36	-21	58	2.7
9	86	51	-5	43	2.68
10	82	35	-30	61	2.58
11	54	7	53	33	2.68
12	50	38	-75	30	2.4

**Table 1.** Group Difference Clusters.