Age and Diffusion Tensor Anisotropy in Adolescent and Adult Patients With Schizophrenia

Jason S. Schneiderman, Monte S. Buchsbaum, Mehmet M. Haznedar, Lina Shihabuddin, Adam M. Brickman, Jesse G. Brand, Yulia Torosjan, Randall E. Newmark, Cheuk Tang, Jonathan Aronowitz, Reshmi Paul-Odougard

PET Neuroscience Laboratory, Dept. of Psychiatry, Mount Sinai School of Medicine., New York, NY 10029

Introduction

Diffusion Tensor Imaging (DTI) is a Magnetic Resonance Imaging (MRI) methodology that by measuring the direction of movement of water molecules can determine the directionality and integrity of axonal tracts. The measure used in DTI is anisotropy. In low anisotropy the movement of water molecules is random, whereas in high anisotropy the water molecules are moving in the same direction. Healthy myelinated axon bundles in which all the axons are going in the same direction have high anisotropy values because the movement of the water cells is restricted by the axonal membrane and the myelin sheath. Bundles in which the fibers are crossing, are oriented in many different directions, or in which the myelin or axons are unhealthy slow low anisotropy values. Previous studies have shown changes in the anisotropy in white matter during normal aging and in schizophrenia. This study looks at changes in white matter anisotropy in the aging of people with schizophrenia.

Methods

Subjects:
- 37 Adult Patients (27m, 10f, age mean=43, SD=11.9, range=20-66)
- 35 Normal Adults (21m, 14f, age mean = 42.7, SD = 13.6, range=22-85)
- 18 Adolescent Patients (11m, 7f, mean age=16.0, SD=2.00, range=13-20)
- 17 Normal Adolescents (9m , 8f, mean age=16.88, SD=2.39, age range=13-21)

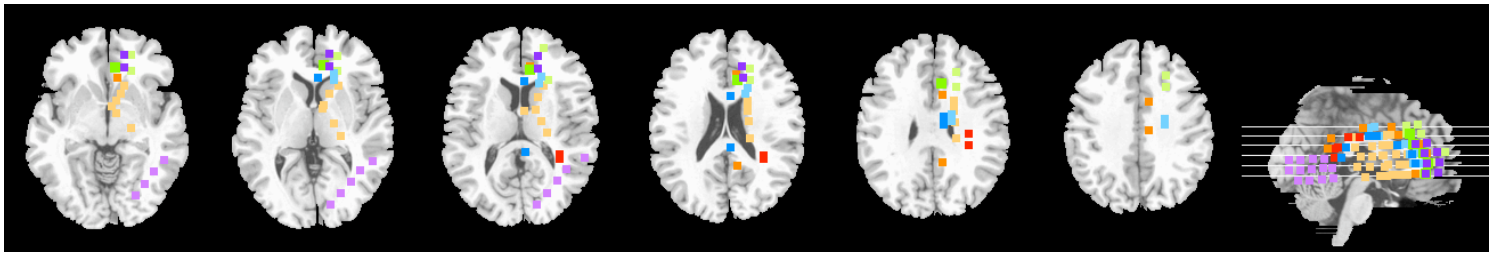
Imaging:
- 1.5 T Signa 5x MRI system (GE Medical Systems, Milwaukee, WI)
- T1-Weighted Scans: TR=24 ms, TE=5 ms, flip angle=40°, slice thickness=1.2 mm, pixel matrix=256x256, FOV=23cm
- Diffusion Tensor Sequence: 14 slices, TR=10s, TE=99ms, TI=2.2s, slice thickness=5mm, b=750s/mm, δ=31ms, Δ=73ms

Analysis:
- Talairach-Tournoux Atlas Locations of Schizophrenia Salient White Matter Tracts
- Multiway Repeated Measures MANOVA
  - Independent Groups: Age (Adult, Adolescent), Diagnosis (Normal, Schizophrenia)
  - Repeated Measures: Hemisphere, Dorsoventral Position, Anteroposterior Position

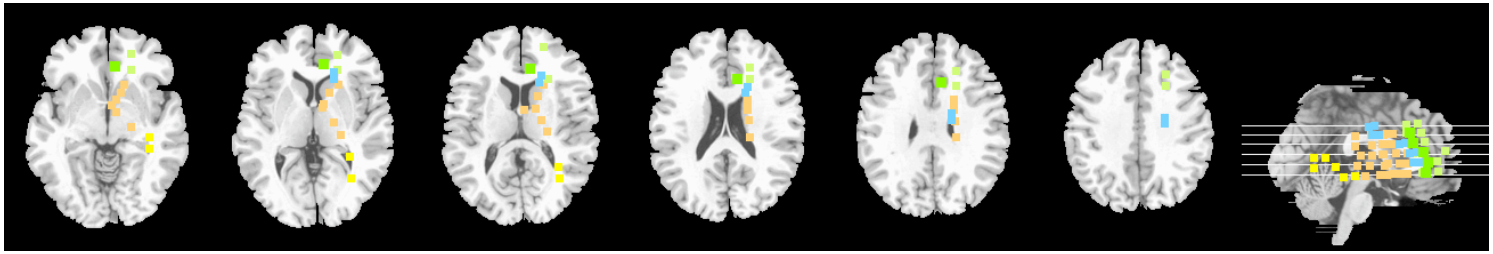
Research Supported by the Conte Center MH66392-01, NIMH 56489 and Lilly Research Laboratories

Results

Regions With Significant Age Effects in Normals:



Regions With Significant Age x Diagnosis Effects:



Key:

- Internal Capsule
- Frontal Anterior Fasciculus
- Frontal Occipital Fasciculus
- Frontal Superior Longitudinal Fasciculus
- Frontal Inferior Longitudinal Fasciculus
- Temporal Axis
- Cingulum
- Frontal Cingulate Bundle
- Corpus Callosum
- Anterior Thalamic Radiations

Note: All regions are shown in the Right Hemisphere only, all effects were found in both hemispheres

Conclusions

- Changes in white matter anisotropy in frontal, temporal and inter-hemispheric tracts between adolescence and adulthood
- Patients with schizophrenia show a different pattern of white matter anisotropy between adolescence and adulthood from normals in frontal but not temporal or inter-hemispheric tracts