Changes in Resting State fMRI and Corpus Callosal Volume Following Adult Brachial Plexus Injuries

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INTRODUCTION

• De-afferentation of sensorimotor input following adult brachial plexus injuries (BPI) results in reorganisation of sensory and motor cortices.[1,2]

• Resting state functional MRI can evaluate the basal connectivity of the brain without the performance of motor task, making it ideal for studying central reorganisation after BPI.[3,4,5]

• Obstetric BPI has been linked to white matter volume loss, a finding that remains unconfirmed in adults.[6]

• AIMS

1. To study the changes in resting state fMRI of the brain following brachial plexus injury in patients prior to surgery, and to compare these changes to healthy controls.

2. To compare the corpus callosum volume following brachial plexus injury in test subjects, as opposed to healthy controls.
METHODS

• Study arm- 23 adults with unilateral BPI, prior to surgical intervention.

• Control arm- 24 healthy adults.

• Inclusion criteria- Age 18-60 years; patients without history of traumatic brain injury, stroke or dementia.

• Subjects in both arms underwent resting state fMRI under predefined parameters in a 3 Tesla MRI scanner.

• fMRI images were pre-processed and independent component analysis done using FSL software (FMRIB Software Library v5.0) to extract spatial maps. Dual regression analysis was employed for comparing the two groups.

• Corpus callosum and its segmental volumes were obtained from T1 MPRAGE images by Hofer and Frahm parcellation technique [7] and statistically analysed using sample t-test on SPSS software (IBM).
RESULTS

• 8 resting state networks were identified after independent component analysis- Auditory Network (AN), Default Mode Network (DMN), Fronto-temporal Network (FTN), Left Attention Network (LAN), Right Attention Network (RAN), Lateral Visual Network (LVN), Medial Visual Network (MVN) and Sensorimotor Network (SMN).

• Significantly decreased functional connectivity was seen in the regions of DMN and RAN.

• No significant difference was noted in functional connectivity in the other networks between patients and controls.

• No statistically significant difference was seen in the mean volume of the corpus callosum or in the volume any of its segments between patients and controls.
Figure 1. Reduced connectivity in the DMN in patients with BPI
(see in panels 1-3, marked in blue)

Figure 2. Reduced connectivity in the RAN in patients with BPI
(see in panels 14-18, marked in blue)
Study Group
Controls

Figure 4. Comparison of segmental corpus callosum volumes between study group and controls

Figure 3. Hofer and Frahm parcellation technique was used to calculate segmental corpus callosum volumes
• Reduction of activity in the DMN (task negative network) and RAN indicates a widespread damage to the small world architecture of the brain.

• The reduced activity in DMN contrasts with findings from a previous study. The difference in these findings may be attributed to the variable time of presentation following trauma.

• A study of temporal changes in resting state fMRI after BPI can help in gaining further insights.

• Volume loss in corpus callosum is not seen following adult BPI, unlike paediatric BPI. This may be explained by the relative paucity of neural connections in children, increasing the dependence of each neuron on others for trophic support, leading to retrograde trans-neuronal degeneration.
REFERENCES


