



# Structural and Functional MRI Characterization of Trial Spinal Cord Stimulation Responders in Failed Back Surgery Syndrome

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## Introduction

Chronic back pain is a burden to society and difficult to treat. Chronification of pain may involve structural and brain network connectivity changes that include transitions from somatomotorsensory to more emotionally-related brain networks. Spinal cord stimulation (SCS) can be effective in treating failed back surgery syndrome (FBSS) patients. Despite having a successful response to a brief SCS trial (SCSr), 30-50% of implanted patients fail to achieve satisfactory long-term pain relief. Improved pain control may be achieved with alternative, bursting patterns of SCS which may preferentially affect emotional components of chronic pain. Our goal is to begin to utilize functional imaging to help guide SCS management.

## Methods

Prior to SCS permanent implant, anatomical and resting state fcMRI were performed on 10 SCSr FBSS patients, and on 16 age-matched controls. Gray matter density (GMD)(1), brain inter-network function connection strengths (FCS) were calculated amongst motor (MTN), default model (DMN), salience (SAN), striatum (STM), temporal (TEP), hippocampus (HIP) and dorsal attention (DAN)

## Results

Significantly decreased GMD in bilateral precentral gyri (Fig 1A,B) and increased GMD in HIP/PHG areas (Fig 1A,C) were found in the SCSr FBSS group. The inter-network FCS of STM-MTN, STM-DMN, STM-TEP, STM-HIP and STM-DAN were significantly decreased in this group (Fig.2). The FCS of STM was negatively correlated with pain scores (Fig. 3).

## Conclusions

This is the first ever report in SCSr FBSS patients of decreased FCS between striatum and other functional networks that was also inversely correlated with pain scores, which may reflect mechanisms of pain chronification. The finding of increased HIP GMD in these patients is consistent with previous reports in animals (3) and humans (4), of hippocampal neurogenesis with persistent pain.

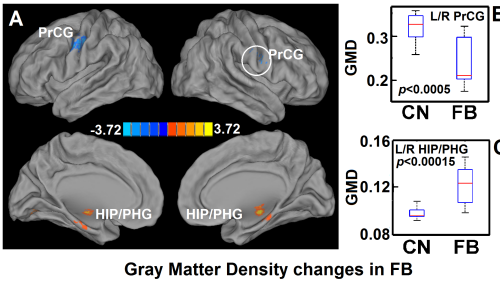
## Learning Objectives

By the conclusion of this session, participants should be able to describe the potential emerging role of functional imaging in the anatomical and functional characterization of chronic pain patients that are potential candidates for spinal cord stimulation which may, in turn, help optimize SCS therapies.

## References

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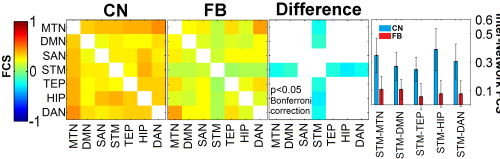
Figure 1



Gray Matter Density changes in FB

Gray matter density (GMD) changes in SCSr FBSS. A is the surface rendering figure shows the GMD changes in SCSr FBSS. Warm and cold color indicates the significant increasing and decreasing respectively. B shows the boxplot of GMD of L/R PrCG in CN and SCSr FBSS. C shows the boxplot of GMD of L/R HIP/PHG in CN and SCSr FBSS. PrCG: precentral gyrus. HIP: hippocampus. PHG: parahippocampal gyrus.

Figure 2



First, second and third matrix shows the inter-network functional connection strength (FCS) among MTN, DMN, SAN, STM, TEP, HIP and DAN networks in CN, SCSr FBSS and the difference respectively. The color bar shows the color and associated value of FCS. The forth figure shows the mean and standard deviation value of FCS between STRT and, MTN, DMN, TEP, HIP and DAN respectively for CN (Blue color) and SCSr FBSS (Red color).

Figure 3