Project Spinal Cord Injury Neurosexuality (SCIN) – Developing a biological understanding of sexual health following spinal cord injury.

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Sexual health rated by SCI individuals as one of their highest ongoing health priorities, but there currently are no evidence-based treatment plans. To create successful treatment strategies, we need to first understand the biological mechanisms of sexual function.

Our advanced imaging project aimed to examine the feasibility of functional magnetic resonance imaging (fMRI) to measure and map (sexual) dysfunction of the nervous system, at baseline, and under audio-visual stimulation, following SCI.

Not only did we develop a highly advanced neuroimaging pipeline for the assessment of sexual dysfunction following SCI but we also revealed a greater understanding of the injured nervous system and pathways involved in sexual function following SCI, by identifying and mapping activity, using fMRI.

1. Research purpose

Despite extensive research on spinal cord injury (SCI), there are currently no effective cures or treatments for ongoing secondary health problems, such as sexual dysfunction - a highly important aspect of overall health for both men and women with SCI. However, there is still a poor understanding of the biological mechanisms that underlie sexual dysfunction following SCI. To advance successful treatments for sexual function, we first need to develop and validate better techniques for diagnosis the causes of sexual dysfunction in the injured spinal cord. To address this issue, our study aimed to assess sexual function of men and women, both with and without a chronic SCI, by developing an audio-visual sexual stimulation (AVS) paradigm and an advanced functional magnetic resonance imaging (fMRI) neuroimaging pipeline.

2. Methodology

At the Clinical Research Imaging Centre (CRIC, SAHMRI), we performed imaging sequences to measure task-related signal changes in the brain and spinal cord. Participants underwent a brain and spinal cord MRI, as well as fMRI and diffusion tensor imaging (DTI) imaging protocols, while viewing erotic films in two 5-minute blocks, separated by 1.5-3 minute baseline conditions – all while lying in the MRI bore. We processed and analysed the data using a custom-made software which allowed us to normalise individual participant data to a standardised spinal cord and brain 'template'. This then created a 'sexual activity map' to identify regions of sexual activity (Figure 1). By analysing the fMRI scans of participants without an SCI, we were able to accurately assess causes of sexual dysfunction in participants with an SCI.

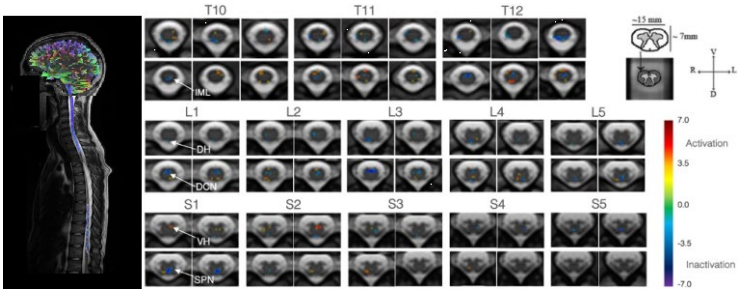

Figure 1.Spinal cord sexual function (fMRI signal intensity) changes during audio-visual stimulation (AVS) measured in the thoracic (upper-middle back), lumbar or sacral (lower back) spinal cord.

3. Findings

We developed a protocol for a novel stimulation paradigm to assess sexual function during an AVS fMRI sequence, which was confirmed by all participants, regardless of sex or injury, to induce both mental and physical sexual arousal. Next, we developed a neuroimaging pipeline which employed fMRI and DTI to assess neural activity in the spinal cord, and found differences in sexual function related fMRI signals among SCI participants, including activation and inactivation of specific brain and spinal cord regions. Particularly noteworthy was the significant neuronal activity in several spinal cord regions, below the level of injury, even in participants who reported no sensory or motor function preservation. Additionally, we discovered microstructural changes in the brain and spinal cord with DTI that correlated with changes in sexual function.

By providing an advanced and validated advanced imaging technique – we aim to help researchers, clinicians and rehabilitation specialists create evidence-based treatment plans that accurately diagnose and target sexual function recovery in individuals with SCI.