

# Cerebellar and Brainstem Displacement Measured with DENSE MRI in CMI Following Decompression Surgery

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## Purpose

DENSE is an advanced MRI technique that can measure even small amounts of tissue motion extremely accurately. Previous DENSE research has shown that CMI patients have increased motion of the cerebellum and brainstem during the cardiac cycle compared to health controls. This study used DENSE MRI to measure the motion (displacement) of the cerebellum and brainstem of CMI patients before and after decompression surgery.

## Methods

DENSE MRI was performed pre and post surgery on 23 CMI patients. Peak tissue displacement of the cerebellum and brainstem was quantified over the cardiac cycle. The pre and post average and peak displacements for each structure were compared.

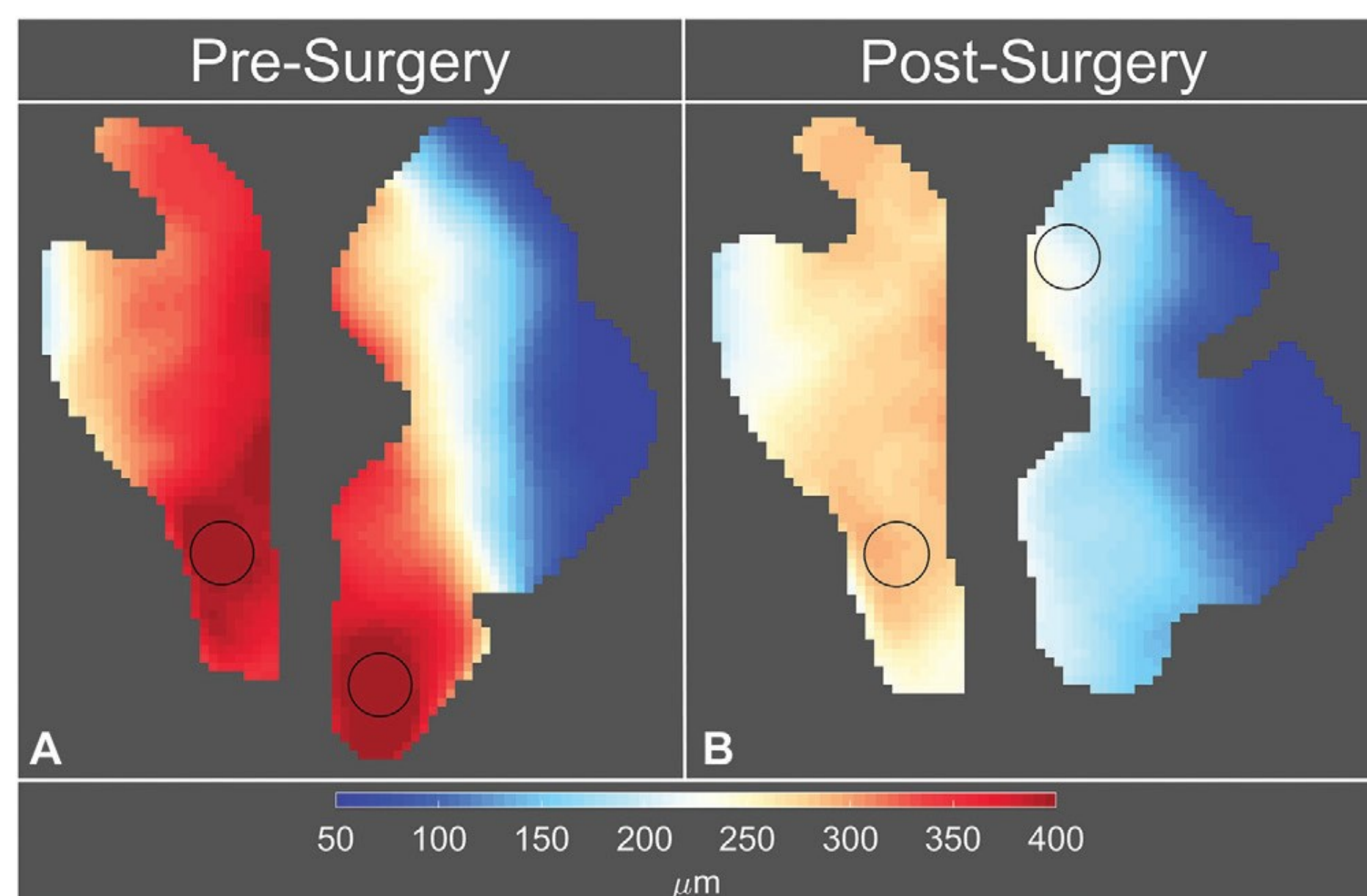
## Results

Average peak displacement was reduced post-surgically by 46% in the cerebellum and 22% in the brainstem. Maximum peak displacement decreased by 64% in the cerebellum and 33% in the brainstem. No significant correlations were found between displacement and selected symptoms.

## Conclusions

This study used an advanced MRI technique to show that motion of the cerebellums and brainstems of Chiari patients is significantly reduced after decompression surgery. This indicates that Chiari surgery changes the biomechanics brain regions involved with Chiari related symptoms. While this study was unable to quantitatively link motion with specific symptoms, with more research DENSE may prove to be a valuable tool in planning and evaluating Chiari surgery and in understanding Chiari symptoms.

## Peak Brainstem & Cerebellum Displacement Map of a CMI Subject



### Notes:

- Brainstem is on the left, cerebellum is on the right
- $\mu\text{m}$  = one millionth of a meter; for comparison spider silk is 3-8  $\mu\text{m}$  thick and paper is 70-180  $\mu\text{m}$  thick

## Definitions

**Brainstem** - part of the brain that connects to the spinal cord and regulates many automatic functions such as heart rate, sleep, and breathing. Also relays information from the cerebellum to the body.

**Cerebellum** - part of the brain located in the back and is responsible for motor control, balance, and walking. Recently found to also be important in higher order cognitive functions.

**DENSE** - Displacement Encoding with Stimulated Echoes. An MRI protocol that can very accurately measure tissue movement.

## Displacement Maps of the Cerebellum and Brainstem of all CMI Subjects Pre and Post Surgery

