Which anatomical regions are activated by Deep Brain Stimulation as elucidated by high field diffusion weighted MRI?

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Parkinson's Disease

Symptoms

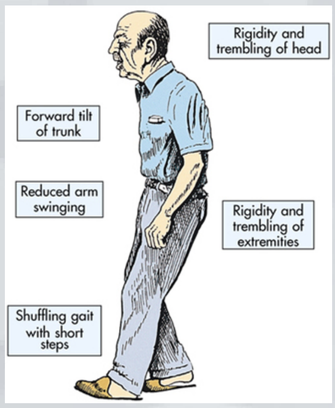

Figure 1: Parkinson's disease symptoms [1]

More than 10 million people live with Parkinson's disease world wide, dealing daily with such symptoms as tremor, slow movement, rigid muscles, and difficulty speaking. These symptoms can be greatly alleviated for many with deep brain stimulation (DBS).

Treatment

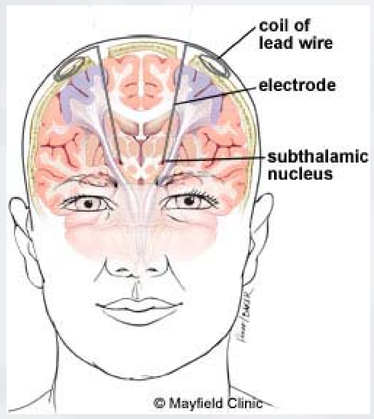

Figure 2: Deep brain stimulation for the treatment of Parkinson's [2]

High field (17T) diffusion tensor magnetic resonance imaging

Structural MRI [A]

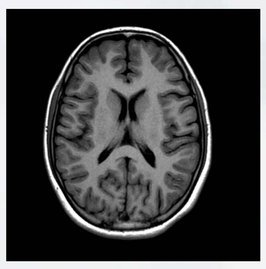

Figure 3: example of a structural or anatomical MRI image [3]

Diffusion weighted MRI [B]

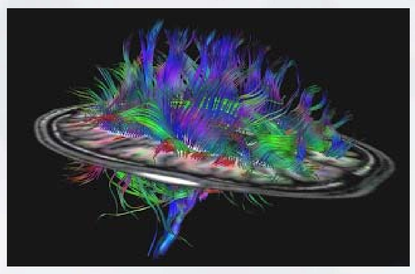

Figure 4: example of diffusion weighted imaging tensors [4]

High field DTI [C]

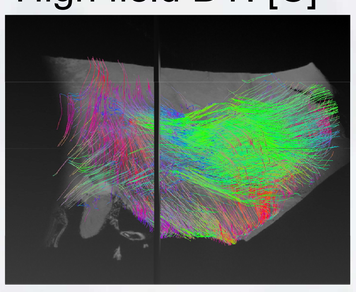

Figure 5: 17 tesla tensors produced for this subject

Although DBS is effective for many people with Parkinson's the exact mechanism is unclear, and targeting can be improved. We take a step forward from structural and anatomical targeting (A) toward high field diffusion weighted MRI (C) for clarification of the exact anatomical structures and tracts being activated by DBS in an individual.

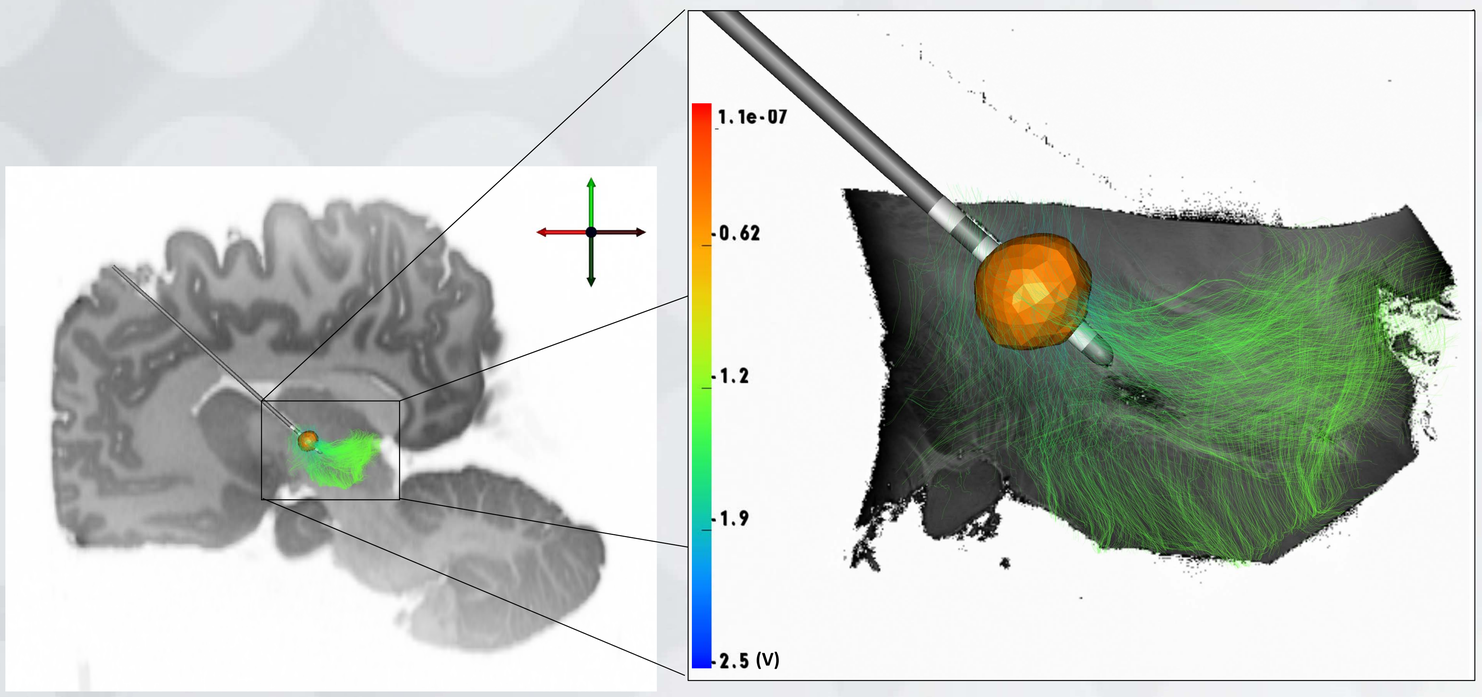

Figure 6: 3T post-mortem anatomical MRI with overlaid 17T tracts and anatomical section. Area of activation is shown in orange.

17T Diffusion Weighted MRI
Tracts Calculated in DSI Studio

Overlay & Alignment: SCIRun is used to overlay the 17T data on 3T anatomical MRI image

A DBS Electrical Field Model is calculated in SCIRun and the subject's specific activation settings are applied to produce an area of activation (Figure 6).

Anatomical regions in the imaged section were physician segmented and applied to the SCIRun model. (Figure 7, section B)

Electric field results were applied to depict voltage values along the tracts and to create a volume of activation. (Figure 7, section A)

Tracts were filtered based on the region of activation as well as the anatomical region, and are shown with only the tracts that would be activated under patient specific settings. (Figure 7).

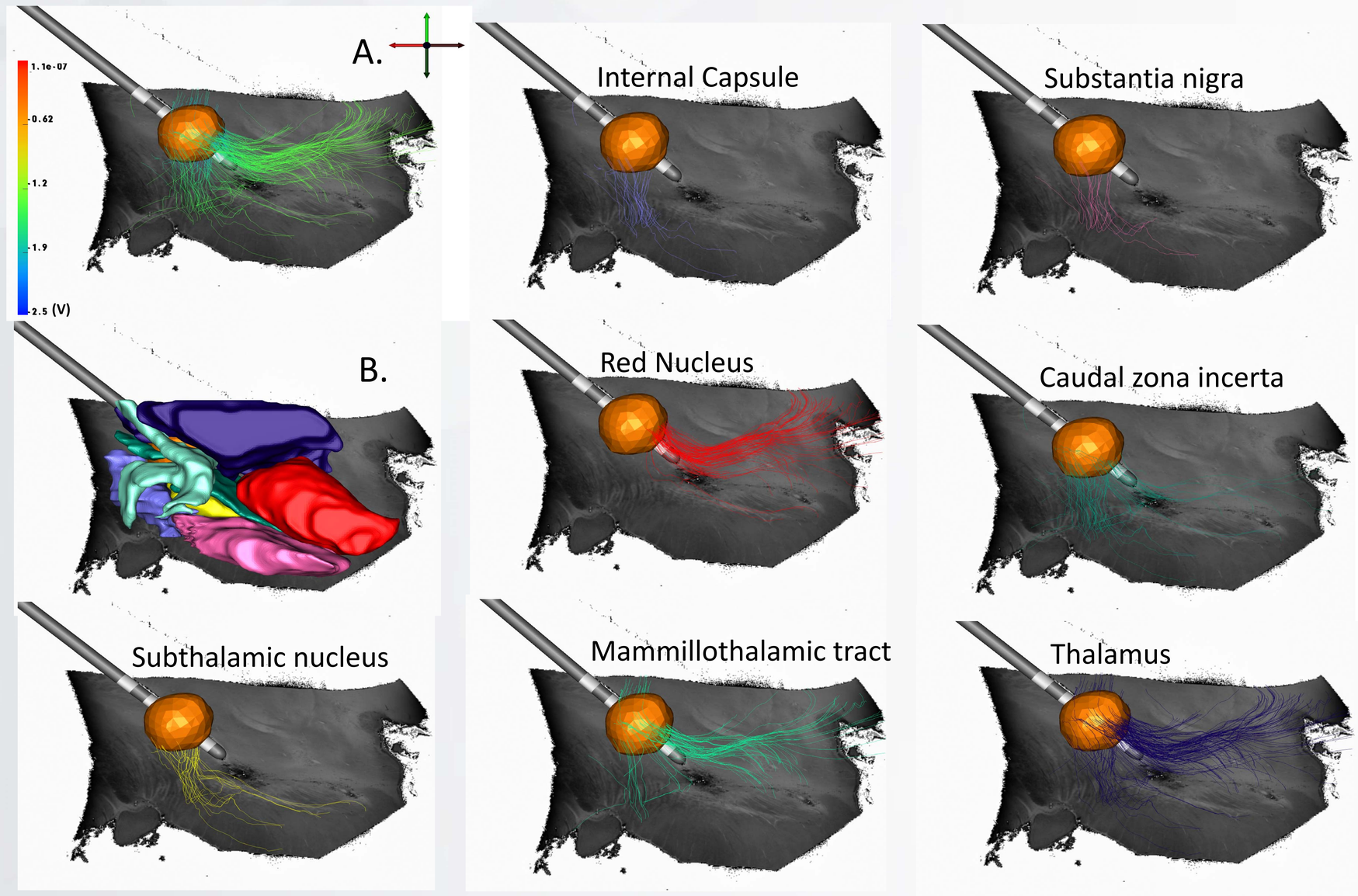

Figure 7: Activated tracts (A), segmented regions (B), and tracts filtered by both anatomical region and activation

Sources
1. *Parkinson's Disease Symptoms*. Digital image. *Science Times*. N.p., n.d. Web.
2. *DBS for Parkinson's*. Digital image. *Mayfield Clinic*. N.p., n.d. Web.
3. *Structural MRI*. Digital image. *Indian Journal of Radiology and Imaging*. N.p., n.d. Web.
4. *Diffusion Tensor Imaging*. Digital image. *My E-MRI*. N.p., n.d. Web.