Improving targeting accuracy in the treatment of secondary dystonia with DBS of GPi

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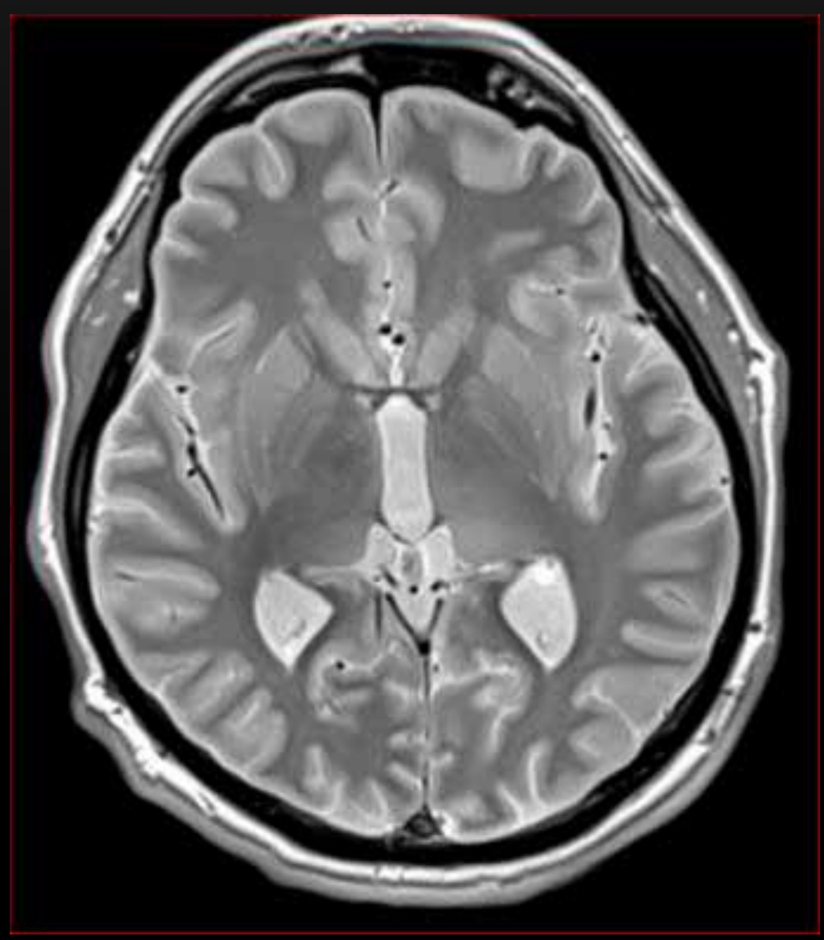

Figure 1. Preoperative 3T MRI protondensity image showing anatomical landmarks with high detail.

Objectives

Dystonia is a very disabling disease. Deep brain stimulation (DBS) of the globus pallidus internus (GPi) has been proven to be a successful treatment for primary dystonia. The evidence in DBS for primary dystonia is widespread discribed, but the results in secondary dystonia are unclear.
A crucial part of the surgical procedure contains the anatomical accuracy of the implanted electrode comparing with the obtained target.

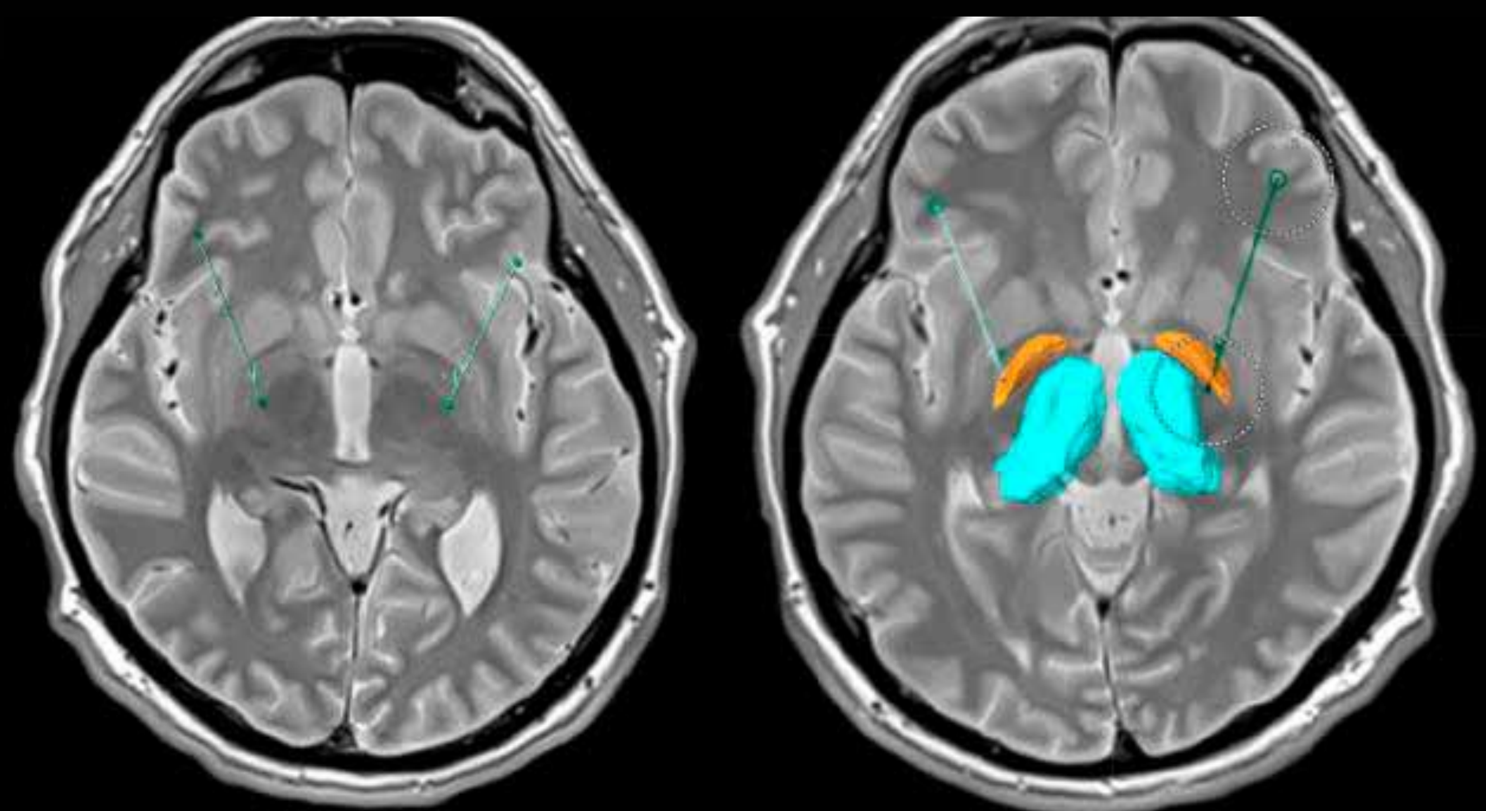

Figure 2 and 3. Preoperative 3T MRI T1 MPRAGE images showing the obtained target in bilateral GPI.

Methods

A 57-year old male patient developed a severe segmental dystonia with jerky movements, secondary to the longterm neuroleptic drug intake for Bipolar Disorder. Best medical treatment did not lead to satisfactory results. The patient was accepted for surgical treatment. Preoperative 3T MRI protondensity and T1 MPRAGE with gadolinium sequences images were made with a Siemens Skyra 3T MRI under general anesthesia. Direct targeting through visualization of the GPI in protondensity images was done. After attachement of a CRW frame, CT guided stereotactic images were made and fused with the MRI images. Bilateral DBS of the GPi was performed under general anesthesia. The anatomical target was the posteroventrolateral part of GPi. Peroperative microrecordings and macrostimulation were used to verify the correct electrophysiological location and estimate the threshold for especially capsular motor side effects. The typical neuronal discharges of the different layers during the microrecording are shown in Figure 4. There were no surgical or postoperative complications.

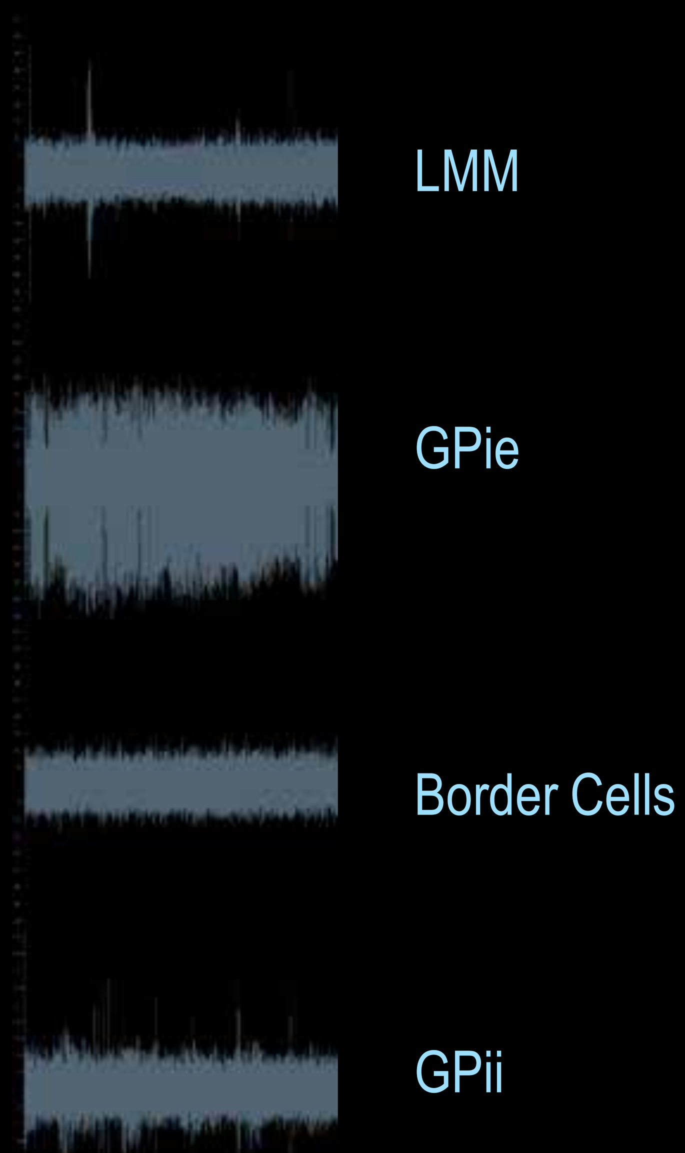

Figure 4. The typical neuronal discharges of the lamina medullaris medialis, GPie, Border Cells and GPii on intraoperative microrecording were used as guidance to verify the aimed electrophysiological location.
LMM: Lamina Medullaris Medialis; GPie: External part of GPi; GPii: Internal part of GPi

PRE OPERATIVE PATIENT VIDEO

POST OPERATIVE PATIENT VIDEO

Results

The patient developed 90% relief of the symptoms, starting the days after surgery without any side effects. Both the segmental dystonia and the jerky movements improved. The beautiful result of this treatment can be seen on the preoperative and postoperative video.

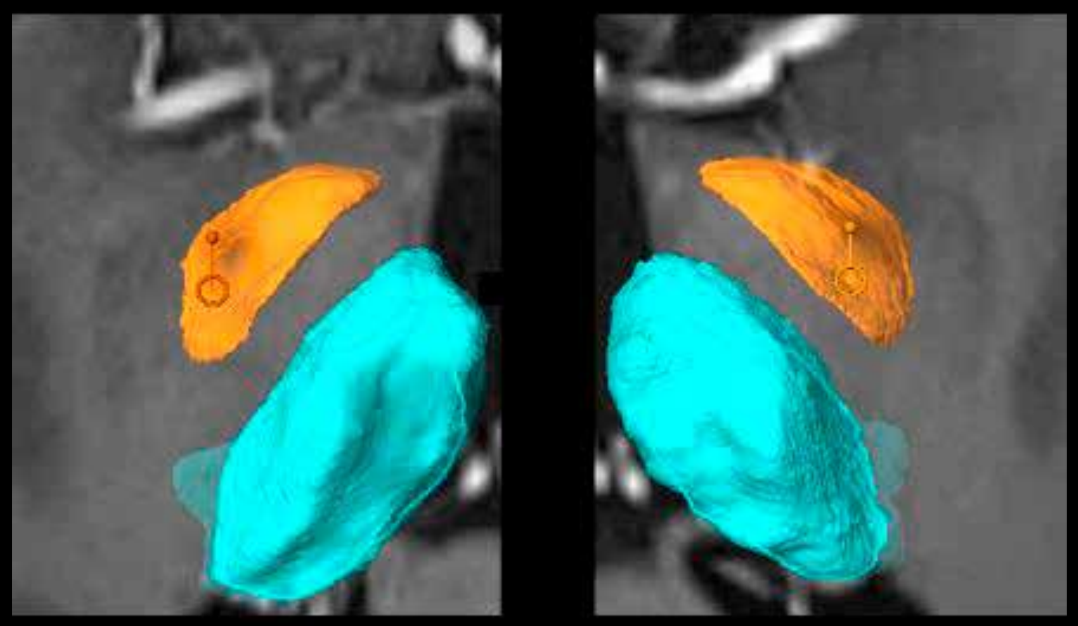

Figure 5. Preoperative 3T MRI protondensity image fused with postoperative CT images showing the positioning of the leads at the obtained target in bilateral GPI.

Conclusion

The success of DBS correlates with the anatomical accuracy of the implanted electrode. The error between anatomical target and the final electrode trajectory can be decreased by improving the quality of the preoperative MRI images. Anatomical landmarks are better defined with specialised MRI settings. General anesthesia avoids motion artifacts during the MRI and the surgical treatment. More evidence has to be obtained for surgical treatment with DBS in secondary dystonia.