Anatomic Investigation of the Laser Pathway for Stereotactic Laser Amygdalohippocampotomy

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CNS 2016 ANNUAL MEETING San Diego CALIFORNIA SEPTEMBER 24-28, 2016

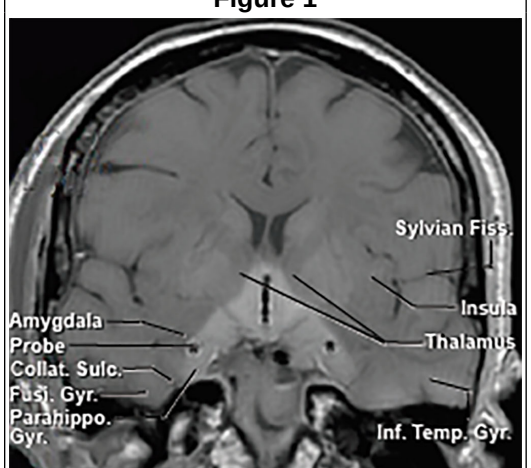
Introduction

MRI Guided Laser interstitial thermal therapy (LITT) has emerged as a promising treatment for mesial temporal lobe epilepsy. Surgeons must understand the relevant anatomy that is traversed by the catheter, and potentially affected by ablation.

Methods

Three human cadaveric heads were implanted with laser catheters using a frameless stereotactic technique. MRI confirmed the satisfactory location of the catheter (Figure 1). The laser was utilized to ablate along the trajectory. Coronal and oblique axial slices were created. Fiber tract dissections were performed in a lateral-medial and inferior-superior scheme. Magnetic resonance tractography was acquired to illustrate the tracts dissected in relation to the catheter.

Figure 1

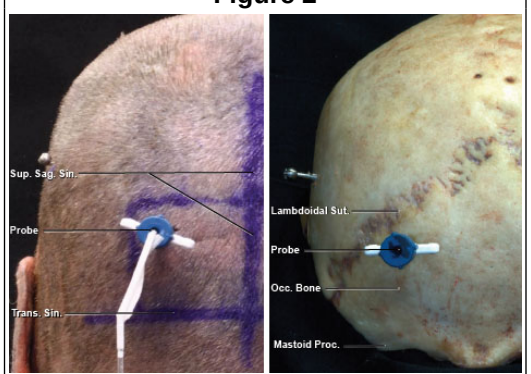


MRI showing the correct targeting.

Results

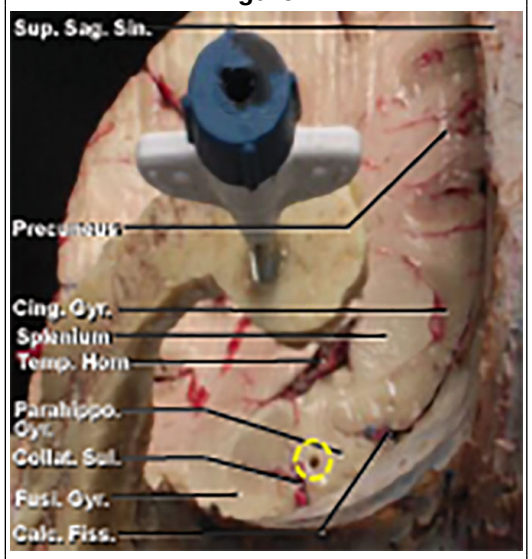
Entry points occurred within 4 cm of the transverse and sagittal sinus, inferior to the lambdoid suture (Figure 2). The cortex of the inferior occipital gyrus was crossed in the region of the middle occipital sulcus (Figure 3). The vertical occipital fasciculus was crossed en route to passing through the optic radiations. Much of the trajectory passed superior to the inferior longitudinal fasciculus. The catheter crossed through or inferior to the optic radiations before piercing the parahippocampal gyrus at about 4cm from the skull (Figure 4). The catheter entered the hippocampus as it pierced the superior margin of the parahippocampus at 6cm (Figure 5). The catheter pierced the head of the hippocampus to lie inferolateral to the amygdala in the last centimeter of the trajectory (Figures 6). Lateral deviation at the head may affect Meyer's loops during ablation.

Figure 2



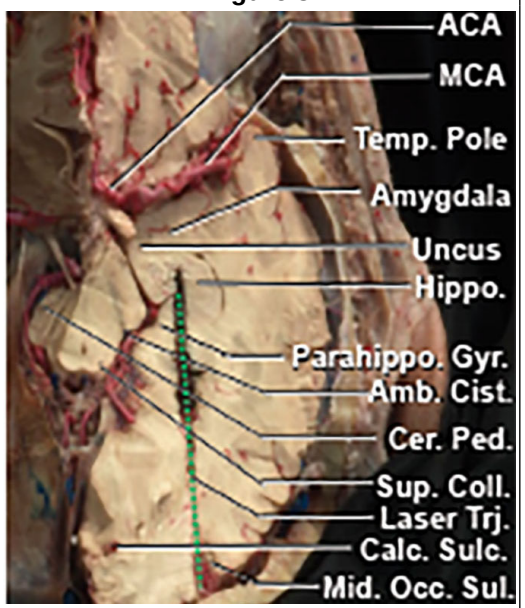
Entry point through the skin and skull.

Figure 4



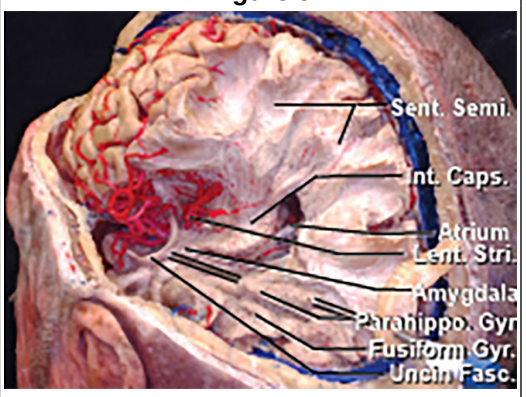
Coronal cut. The yellow circle is highlighting the laser trajectory.

Figure 3



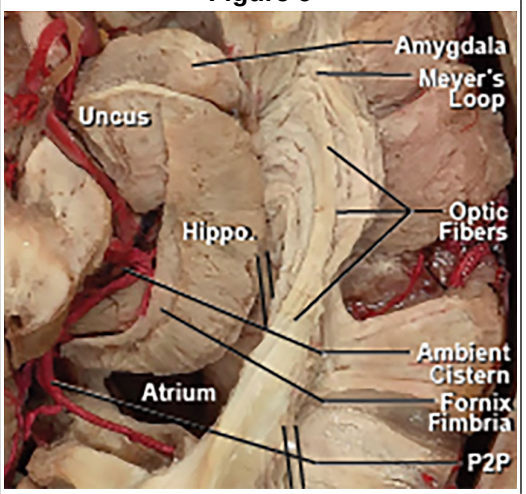
Axial-oblique cut showing the laser trajectory.

Figure 5



Lateral to medial dissection.

Figure 6



Inferior to superior dissection.

Conclusions

A strong understanding of the anatomic principles of laser trajectories will improve the ability to perform this procedure. This is the first study to examine the anatomy of the laser trajectory, and will create a foundation for future studies. This is one of the final projects conducted in the Dr. Albert Rhoton's lab, and it was his vision to see this project in its completion.