High resolution imaging of the hippocampus with spatially selective excitation and a reduced FOV readout at 7T

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MOTIVATION Imaging of the hippocampal formation is of great interest for the study of neuropsychiatric diseases. With the advent of high field (7T) MRI systems it has become possible to make high resolution images of this formation. A study exploring the possibilities by Bradley et al. [1] shows susceptibility weighted images with an in plane resolution of 0.5x0.5mm^2 in combination with 1 mm thick slices. Although not aimed at imaging the hippocampus, Zwanenburg et al. [2] recently published T2* weighted images with 0.5x0.5x0.5 mm3 isotropic resolution which clearly show the hippocampus. The latter study combines a multi-shot EPI readout with parallel imaging to keep scantime acceptable at around 6 minutes. Here we propose a different approach that allows for acquiring T2* weighted images of the hippocampal formation at even higher resolution (0.3x0.5x0.3mm^3), by combining spatially selective excitation with a reduced field of view readout. Complementary to the increased resolution, this approach is less sensitive to motion artifacts caused by the nearby brainstem and eye-movements which could lead to fold back artifacts.

METHODS All experiments were conducted on a 7T system (Philips) using a two channel transmit coil in combination with a 16 channel receive coil (Nova Medical). The two ports of the transmit coil were driven independently and both featured fully flexible amplitude, phase and waveform control. Images of the hippocampal formation were obtained in two volunteers, by using only one of the two transmit channels to ensure adequate SAR-monitoring. RF waveforms were designed as described in [3] and aimed at excitation of an oval cylinder in the feet-head direction (figure 1) around the left hippocampus. The calculated RF waveform (length~10ms) was used in a multi shot 3D GRE sequence with a reduced FOV around the excitation volume. Scan parameters were: TR/TE: 76/25ms, FA~15°, FOV: 220x91x58mm^3 (FHxAPxRL), resolution: 0.3x0.5x0.3mm^3, EPI factor: 9, scantime: 6m16s. Images were reformatted in the plane perpendicular to the AP axis of the hippocampus. In addition, a minimum intensity projection in the sagittal plane was made to depict the venous structure of the hippocampal formation.

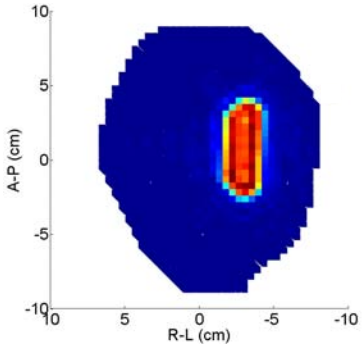

Figure 1: Excitation volume.

RESULTS & DISCUSSION Figure 2 shows a section through the body of the hippocampus of two volunteers. Several substructures can be clearly seen. Figure 3 shows the structure of the veins in the hippocampal area in a sagittal view. These images show that spatially selective excitation in combination with reduced FOV imaging can provide an alternative to slab excitation in combination with a full FOV readout. In the latter case parallel imaging techniques are often used to reduce scantime while here the excitation field is simply limited to the area of interest. As an additional advantage, moving areas like the brainstem and the eyes are not excited and possible artifacts from these areas are avoided.

CONCLUSION The results presented here show the feasibility of using reduced FOV imaging with spatially selective excitation for T2* weighted imaging of the hippocampal formation. This method is intrinsically less sensitive to motion artifacts.

REFERENCES [1] Bradley et al. JMRI 28, 2008 [2] Zwanenburg et al. NI 56, 2011, [3] Mooiweer R et al. ESMRMB 2012

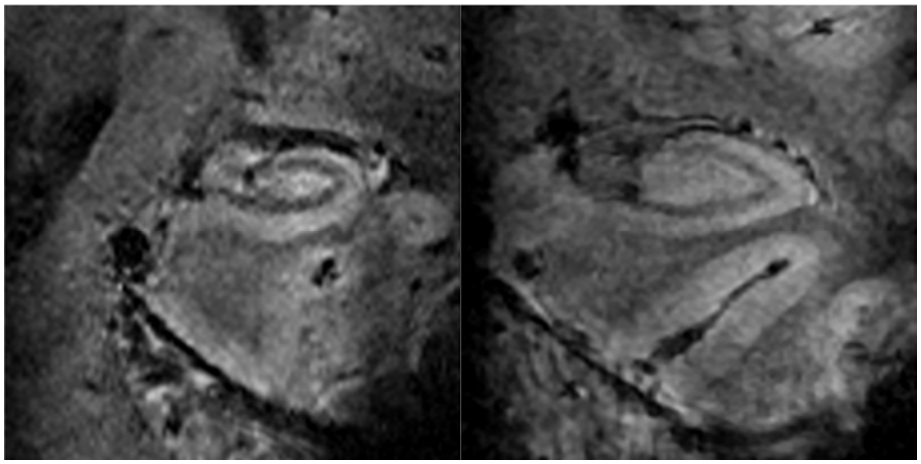

Figure 2: T2* weighted images of the body of the hippocampus in two volunteers.

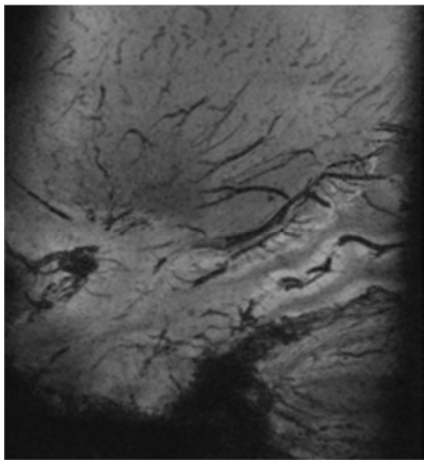

Figure 3:Venous structure hippocampus.