# Ultra-High Resolution 7.0T MRI of Medial Temporal Lobe Epilepsy

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## Introduction

The diagnosis and treatment of medial temporal lobe (MTL) epilepsy presents an ongoing challenge to neuroradiology. Traditional imaging diagnosis of medial temporal sclerosis relies on atrophy, increased T2 signal, and altered architecture of the hippocampus, sometimes supplemented by PET or SPECT (1,2). If the imaging is concordant with ictal EEG and certain other clinical features, then patients can proceed to surgery with high success rates. However, if there is discordance or normal imaging results, patients require implantation of depth electrodes to define the responsible seizure focus. High field MRI offers the prospect of higher image resolution than currently obtainable at 1.5 or 3.0T, which could resolve abnormalities too subtle for traditional techniques. We propose the use of ultra-high resolution 7.0T MRI in medial temporal lobe epilepsy to define more precisely the structural correlates of epileptogenesis.

## Methods

Six patients with clinical evidence of medial temporal epilepsy participated in this study. Informed consent was obtained with approval of the Stanford IRB. All patients had recent 1.5T or 3.0T MRI imaging and EEGs suggesting unilateral medial temporal lobe epilepsy. Imaging sequences included oblique coronal 2D gradient echo images, oblique coronal 3D gradient echo images, and sagittal and oblique coronal 2D fast spin echo images. One patient withdrew from the study because of nausea and vertigo while in the scanner. All other patients tolerated the examination.

## Results

Two patients with MRI evidence of MTL sclerosis at lower field strength demonstrated cortical thinning in the CA1 field and a decreased size of the hippocampal head, more clearly delineated at ultra-high resolution (Fig 1). One patient had seizure related edema on 1.5T MRI; on subsequent 7.0T MRI, mild atrophy of the hippocampal head followed the pattern of the other MTL sclerosis patients, suggestive of incipient MTL sclerosis. One patient with normal 1.5 and 3.0T MRIs suggested questionable abnormalities at 7.0T, and subsequently implanted depth electrodes measured epileptiform discharges from both sides, right greater than left. Images from one patient with a known MTL low grade tumor illustrated excellent demarcation of the tumor involving the amygdala extending to the anterior hippocampus, and GRE images highlighted with great detail the tumor mineralization extending into the hippocampal head (Fig 2).

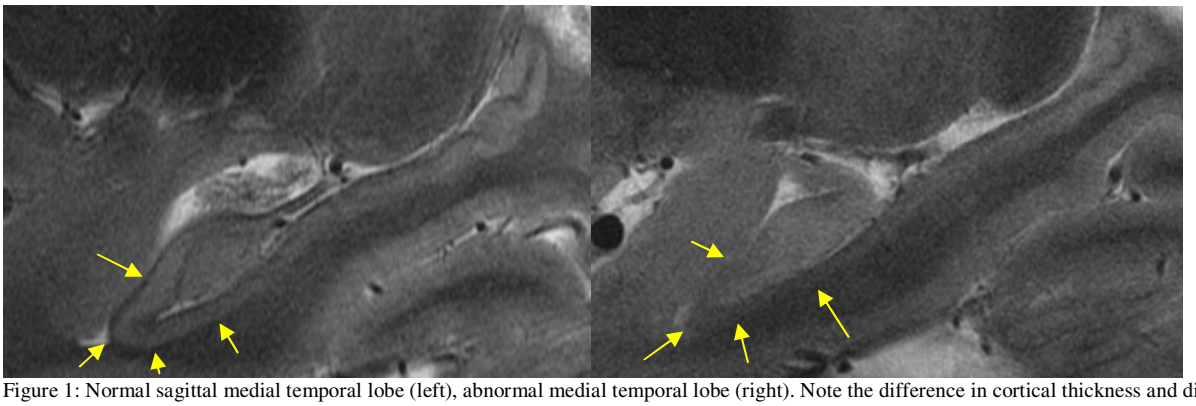

Figure 1: Normal sagittal medial temporal lobe (left), abnormal medial temporal lobe (right). Note the difference in cortical thickness and distinctness.

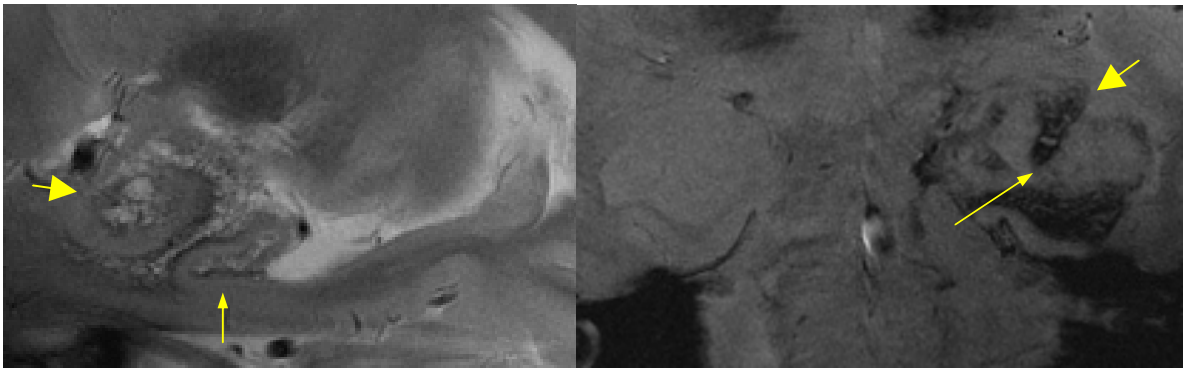

Figure 2: Sagittal FSE and coronal GRE. Note the tumor in the amygdala (big arrowhead) infiltrating the hippocampal head (small arrowhead) with low GRE signal suggestive of mineralization.

## Conclusion

Ultra-high resolution 7.0T MRI holds great promise to visualize with greater precision foci of epileptogenesis and sometimes underlying etiologies in the medial temporal lobes. This study confirms the safety and tolerability of 7.0 Tesla imaging on patients with epilepsy.

## References

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