MR Imaging of the Dura Mater Encephali

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INTRODUCTION

The dura mater encephali is the major pain-sensitive intracranial structure. It mediates both nociceptive and vascular responses, which are implicated in the generation of headaches [1]. MR imaging of the dura mater encephali could provide a glimpse of the neuroanatomical and physiological basis of headache [2]. On conventional MRI, the main difficulty of visualizing the supratentorial dura mater comes from the low signal to noise ratio (SNR) and from its relatively low thickness compared to the adjacent cortical gray matter. Our aim was, using high field magnet MRI, to develop methods able to distinguish the supratentorial dura mater from leptomeninges and cortical gray matter in healthy subjects.

METHODS

Three healthy subjects underwent MRI scanning on Siemens 7T and 3T (Trio and Allegra) MRI scanners (Siemens Medical Systems, Erlangen, Germany). An 8-channel phased array coil was used on 3T Trio and 7T syatem. On the 3T system, we acquired 1mm istropic 3D gradient echo (GRE) images with 25.6cmx25.6cmx16.0cm FOV, 256x256x160 matrix, with TE= 2ms, TE=6ms, and 2 averages. Non-selective excitation pulses were used with flip angles (FA) of 5, 8, 10, 12 and 15 degrees. High resolution (1 mm) MPRAGE images were also acquired (25.6x25.6x16.0cm FOV,256x256x160 matrix, TE=2ms, TR=2000ms, interecho time 4.1ms). On the 7T system, a set of MPRAGE images was acquired, with 25.6x25.6x17.1 cm FOV, 256x256x128 matrix, TE=3.37ms, TR=2530 ms. For all MPRAGES a non-selective inversion pulse was used with TI=1100 was used with an excitation pulse angle of 7 degrees.

To calculate the signal to noise ratio (SNR) of dura versus the subdural structures (cortex and leptomeninges) we manually defined for each dataset several regions of interests (ROIs) of in the dura, leptomeninges, cortical gray matter, and outside the brain (AFNI software package) [3]. The contrast to noise ratio (CNR) between the dura and subdural structures (cortex and leptomeninges) was taken as the difference of their SNRs.

RESULTS

The table below shows the mean (SD) CNR of dura versus cortex and dura versus leptomeninges for each data set on both the 3T and the 7T.

3T	Sequence	CNR Dura vs Cortex Mean (SD)	CNR Dura vs Leptomeninges Mean (SD)
	GRE Flip Angle 5	2.5 (0.8)	0.46 (0.2)**
	GRE Flip Angle 8	1.7 (1.0)	1.72 (1.0)**
	GRE Flip Angle 10	2.4 (1.0)	1.12 (0.8)**
	GRE Flip Angle 12	1.8 (0.9)	1.38 (1.2)**
	GRE Flip Angle 15	1.1 (0.8)	1.42 (1.3)**
	MPRAGE	5.5 (3.6)**	5.8 (3.3)*
7T	MPRAGE	4.5 (4.5)	14.4 (4.5)

*p<.001 from 7T by t-test
**p<.000 from 7T by t-test

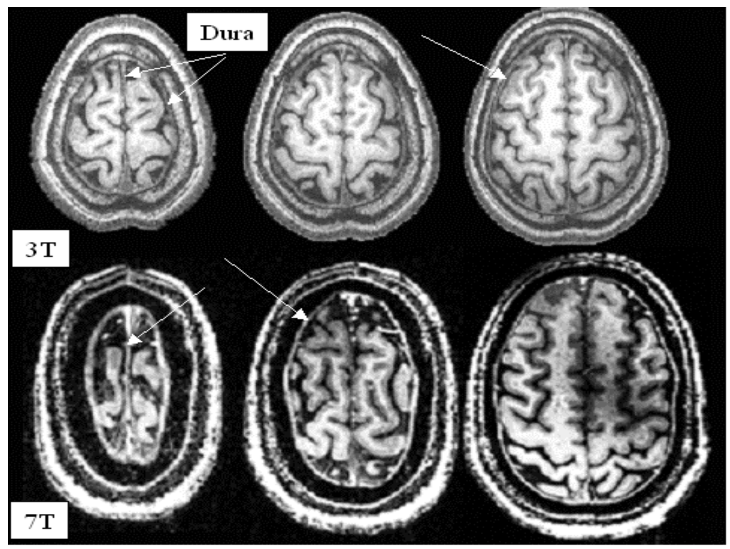
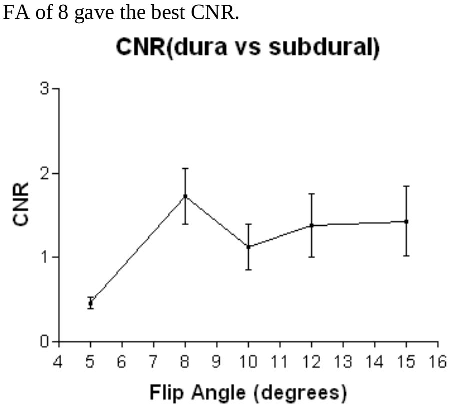


Fig.1. MPRAGE images from 3T and 7T scanners showing the dura mater encephali.

We also compared the CNR of the dura versus subdural structures (cortex and brainstem) for each GRE sequence acquired on the 3T with different FA FA of 8 gave the best CNR.



DISCUSSION

In the present work we show that, using high field MRI, the dura mater encephali can be clearly distinguished from its surrounding structures including the leptomeninges and the cortical gray matter.

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