Fast mapping of absolute water content in the human brain using TAPIR
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Introduction
Water content in the human brain is highly regulated and influenced by various diseases such as brain tumours, stroke and hepatic encephalopathy [1-4]. We present a new method for fast and accurate high resolution mapping of in vivo water content in the human brain. The method is based on the TAPIR sequence [6-9] for M0 mapping and QUTE[10] to correct for T2* relaxation effects. The proposed method employs the M0 value of cerebral spinal fluid (CSF) as a reference to calibrate the watermaps. Thus, no additional reference probes are required.

Methods
All experiments were performed on a 3 Tesla Siemens Tim-Trio System (Siemens Medical, Erlangen, Germany). Water content mapping was performed on 9 healthy volunteers. A modified version of the known TAPIR sequence [11], with an adiabatic inversion pulse to reach better inversion efficiency and more accurate fitting results is used. Additionally, the inversion efficiency was measured with TAPIRie and passed to the fitting routine together with the TAPIR data to obtain M0 data. These M0 maps are influenced by T2* weighting due to the finite TE of the sequence and by receiver coil sensitivities. These effects are corrected using quantitative T2* values calculated by means of QUTE and a unified segmentation algorithm to estimate the bias field which is implemented in SPM8[12,13]. The corrected M0 map is calibrated to the H2O value of CSF using the CSF peak of the histogram.

Sequence parameters:
TAPIR: TR=12ms;TE=5.6ms;EPI=5;TI=20ms;TAU=2400ms;20 timepoints; BW=720Hz/Px; resolution=(1x1x2)mm; 8 slices; acquisition time (TA): 2.50 min; TAPIRie: same as TAPIR but resolution=(2x2x2)mm; TA=0.40min; QUTE: TR=479ms; 1.TE=4.6ms; last TE=55ms; BW=260Hz/Px; resolution=(1x1x2)mm; 8 slices; 3 averages; TA=4.48min

Results
Figure 1 depicts a representative slice of a water content map and a histogram. Averaged results of 9 healthy volunteers (male only, age 26±1) show water contents of (67±2)% and (83±2)% for white and grey matter respectively which is in good agreement to literature values [14-16].

Discussion
It has been demonstrated that water mapping of the human brain without external reference probes and a resolution of 1x1x2mm is feasible in total acquisition times of 6-18min. Using parallel imaging techniques, it should be possible to further reduce the total acquisition time. The use of combined EPI and PI techniques for water mapping is under investigation.

Table 1: H2O values of a single subject measured with different receiver coils

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<th>GM</th>
<th>WM</th>
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<tr>
<td>CP</td>
<td>80±10</td>
<td>66±4</td>
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<td>32ch</td>
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References