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# The Optimum TE in fMRI at 1.5T and 3.0T MRIs

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## I. INTRODUCTION

In the conventional MRI (Magnetic Resonance Imaging), the scan parameters such as TR, TE and Flip angle are variable factor to affect the tissue contrast. On the contrary, those parameters in the functional MRI(fMRI) are used not to maximize the general tissue contrast but to maximize the contrast for the changes of susceptibility and deoxyhemoglobin. In fMRI, a long TE time is used to enhance the $T2^*$ weighting effect for BOLD (blood oxygen level dependent) image contrast but this is concomitantly decreasing factor for the SNR (signal-to-noise ratio) of the obtained image. Therefore, the purpose of this study is to find the optimum TE time for enhancing $T2^*$ weighting effect and minimizing the SNR degradation and to compare the BOLD effects according to the changes of TE in 1.5T and 3.0T MRIs.

## II. MATERIALS and METHODS

Healthy human volunteers (eight males and two females with 24-38 years old) were participated in this study. Each volunteer was asked to perform a simple finger-tapping task (sequential opposition of thumb to each of the other four finger) with the right hand on a mean frequency of 2Hz as much as possible. The stimulus was initially off for 3 images (8s per image in 1.5T, 9.76s per image in 3.0T) and was then alternatively switched on and off for 2 cycles of 6 images. We used the ear plug to minimize the acoustic noise and the foam pad to minimize the head motion.

Images were acquired on the 1.5T MRI (Vision-plus, Siemens, Germany, Erlagen) and 3.0T MRI (Magnum, Medison, Seoul , Korea). The FLASH (fast low-angle shot) pulse sequence (TR : 100ms, FA : $20^\circ$, FOV : 230mm) was used with 26, 36, 46, 56, 66, 76ms of TE times in 1.5T and 16, 26, 36, 46, 56, 66ms of TE in 3.0T.

After the completion of scan, MR images were transferred into PC and processed with a home-made analysis program based on the correlation coefficient method with the threshold value of 0.45.

The T2* values of the activation and the rest state for each TE are fitted using the equation [1].

$$S = S_0 \exp(-TE / T_2^*) --- [1]$$

To search for the optimum TE value in fMRI, the difference between the activation and the rest by the susceptibility change for each TE was used in 1.5T and 3.0T respectively.

## III. RESULTS

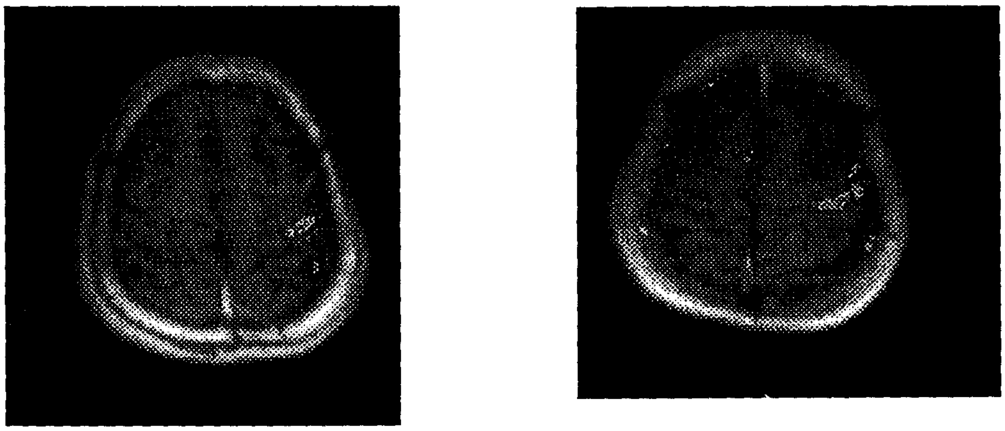
The T2* values of the activation and the rest at 1.5T and 3.0T were summarized in Table 1. The calculated optimum TE was 61.89±2.68 at 1.5T and 47.64±13.34 at 3.0T.

The maximum percentage of signal intensity change due to the susceptibility effect in activation region was 3.36% at TE 66ms in 1.5T while 10.05% at TE 46ms in 3.0T respectively. The signal change of 3.0T was about 3 times larger than that of 1.5T.

In addition, the functional T2* map was calculated to quantify susceptibility change as shown in the figure 1.

| | Activation | Rest |
|---|---|---|
| 1.5T | 60.07 (±1.875) | 64.15 (±5.966) |
| 3.0T | 47.77 (±12.78) | 47.53 (±13.95) |

**Table 1.** The T2* value of 1.5T and 3.0T in activation and rest.



(a) (b)

**Fig.** 1. The functional T2* map. (a) 1.5T. (b) 3.0T. These maps are created by obtaining the difference between activation and rest T2* map.

## IV. CONCLUSIONS

The calculated optimum TE value was consistent with TE values which results in the maximum signal change for each TE.

The 3.0T MRI was clearly more sensitive, three times in this experiment, than the 1.5T to detect the susceptibility and deoxyhemoglobin level change in the functional MR study.

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