

# BOLD Response in Pediatric Medulloblastoma Patients during Radiation Treatment

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## Introduction

Medulloblastoma is a common childhood brain tumor that occurs in the cerebellum. With current treatment protocols, which includes maximal surgical resection, radiation treatment (RT), and chemotherapy after RT, the survival rate for medulloblastoma reaches more than 75% in children. Craniospinal radiation with boost to the posterior fossa is crucial disease control; however, it is associated with brain vasculopathy and long-term cognitive deficits in the survivors. Since the occipital lobes are adjacent to the tumor site, they often receive higher dose radiation than other parts of the brain during conformal RT. We use BOLD response to visual stimulation in medulloblastoma patients as a probe to investigate the effect of radiation on normal brain function. We have reported that BOLD responses to visual stimulation were decreased in these patients after their 6 week course of RT<sup>1</sup>. Here, we evaluate the BOLD responses to photic stimulation during RT in the patients to further understand the effect of radiation on BOLD responses.

## Methods

**Subjects:** The study was approved by our Institutional Review Board, and all subjects gave written informed consent to participate. Total 51 patients were enrolled (age  $11 \pm 0.6$  years) and fMRI data were acquired after resection, and before RT in 9 patients (TP1); during the first week of RT in 14 patients (TP2); during the second week of RT in 11 patients (TP3); or during weeks three to six of RT in 11 patients (TP4). **MRI:** 1.5T Siemens Symphony scanner. Single shot T2\* weighted EPI (TR = 2.06 sec, TE = 50 msec, FOV = 192 mm, matrix = 64x64, slice thickness = 5 mm, bandwidth = 1954 Hz/pixel) for fMRI data acquisition. **Visual stimulation** was a reversing (8 Hz) black-white checkerboard, and the paradigm included four 30-sec blocks in which the stimulus was on for 2 sec; and three 40-sec blocks in which the stimulus was on for 16-sec. **Data Analysis:** SPM2 (<http://www.fil.ion.ucl.ac.uk/spm/>) was used. Images were realigned before voxel based statistical analysis. The thresholds for estimate activation volume were  $p = 0.001$  (uncorrected) and 5 voxels ( $p < 0.01$  corrected). The average time course of activated ROI in the primary visual cortex was obtained using MarsBar toolbox for SPM2 (<http://marsbar.sourceforge.net/>).

## Results

The number of activated voxels in the primary visual cortex (V1) was  $564 \pm 94$ ,  $300 \pm 68$ ,  $373 \pm 90$ , and  $360 \pm 81$  for TP1, TP2, TP3 and TP4, respectively. There was a significant decrease in the detected volume of activated brain after first week of radiation therapy ( $p = 0.02$ ) (figure 1). The peak BOLD response to the brief 2-sec visual stimulation did not change significantly during RT (figure 2), but the maximal response during the longer 16-sec stimulus was significantly lower at week 2 of RT (figure 3).

## Discussion and Conclusions

Based on control data from our previous study<sup>2</sup>, the BOLD response was normal in this cohort of medulloblastoma patients prior to RT. Therefore, the decrease in BOLD activation volume that we observed reflects an acute effect of RT and this effect occurs during the early stage of RT. In our previous report, we showed that both the peak BOLD signal and the volume of brain activated by visual stimulation were lower after the completion of RT<sup>1</sup>. Here we find that the BOLD signal change lags behind the change in activated volume. We plan to evaluate the BOLD responses in V1 in relation to patient specific radiation dosimetry, to other functional neuroimaging data (perfusion, diffusion tensor, morphometry, cognitive fMRI), and to neuropsychological testing results.

## References:

1. Zou, P., et al., ISMRM 441, 2005
2. Zou, P., et al., Neuroimage 24(1):61-9, 2005

