Reduction of Susceptibility Artifacts Using Volume Selected Z-shim and Intra-oral Shim

Y. P. Du[1]

[1]Psychiatry and Radiology, University of Colorado Health Sciences Center, Denver, CO, United States

Introduction:

Gradient-echo EPI fMRI is prone to considerable signal loss and local image distortion in several regions, including the orbito-prefrontal cortex (OFC), due to the local field gradient caused by the magnetic susceptibility effect. A z-shim compensation technique was developed to reduce this signal loss by acquiring multiple images with different compensation gradients in the z-direction [1, 2]. We have presented a volume selective z-shim technique in which the z-shim compensation is applied only to the regions that are severely affected by the susceptibility effect [3]. This technique considerably improves temporal resolution, making it more practical for whole brain fMRI studies. On the other hand, an intra-oral shim approach was recently proposed to reduce the susceptibility artifacts at the OFC [4]. In this abstract, we compare the effectiveness of the volume selective z-shim and intra-oral shim in reducing susceptibility artifacts at 3 Tesla.

Methods:

A volume selective z-shim EPI pulse sequence was implemented on a GE 3T scanner. Two additional z-shim compensated images were acquired at 6 out of 24 slice locations (see Fig. 1). Other imaging parameters were: TE/TR=30ms/2,200ms, 4 mm slice thickness, matrix=64x64, and FOV=22cm. The intra-oral shim consisted of a piece of continuously nucleated pyrolytic graphite (36x23x12 mm^3) carved into a shape that smoothly fit in the mouth. The z-shimmed EPI images were acquired with and without the intra-oral shim.

Results:

The multiple images acquired *without* intra-oral shim at a slice that covers the OFC are shown in the left column of Figure 2. The images acquired *with* intra-oral shim at the same location are shown in the right column of Figure 2. The base images acquired without z-shim and the images acquired with two different z-shim compensations are shown in the second, third, and fourth row, respectively. The composite images are shown in the top row.

Discussion:

The intra-oral shim greatly reduced signal loss and local image distortion occurred at the OFC. The image acquired with z-shim demonstrated effective reduction of signal loss at the OFC, even when the intra-oral shim was used. Substantial image distortion was observed at the OFC region in images acquired without intra-oral shim (see the location marked with a dashed line in Fig. 2). This local image distortion at the OFC further dilutes the signal intensity in that region. A combination of the z-shim technique and the intra-oral shim provides the most effective reduction of signal loss and local image distortion caused by the susceptibility effect at the OFC.

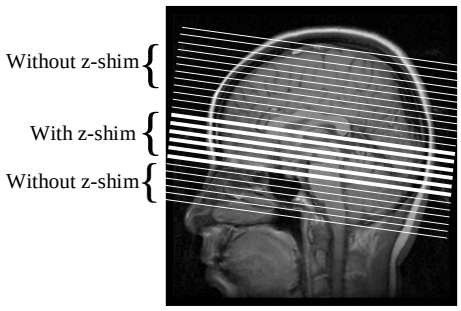

Figure 1. A scheme shows 6 out of 24 locations are acquired with z-shim compensations in one TR.

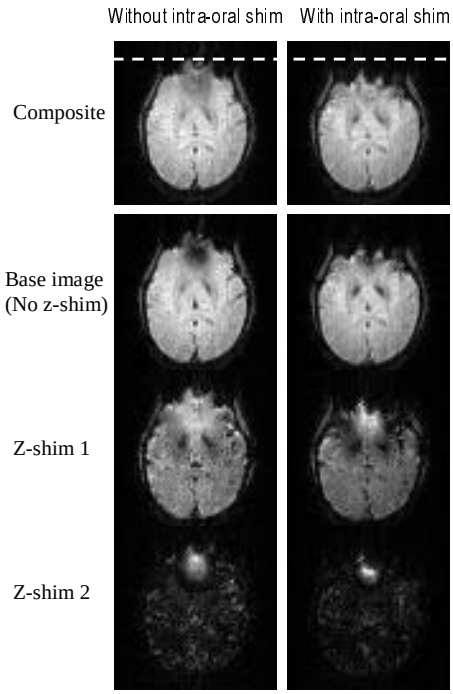

Figure 2. Comparison between z-shim and intra-oral shim.

References:

1. Frahm J. et al. MRM 6:474-480, 1988.
2. Constable RT, et al. JMRI, 5:746-752, 1995.
3. Du YP. Proc. of the 11th Meeting of ISMRM, p.1231, 2001.
4. Wilson JL, et al. MRM 50:1089-1094, 2003