**Cube Cx2: Free 3D T2w dataset along with 3D T2FLAIR acquisition**

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**Introduction**

3D Fast Spin Echo sequence with variable flip angles [1,2] has been widely used in clinical scans. For brain scans, T2 and T2 FLAIR are two popular prescribed sequences. In current clinical settings, each Cube T2 or Cube T2 FLAIR sequence will take about 5-7 minutes. In this abstract, a new method is proposed to acquire the Cube T2 and Cube T2 FLAIR contrast simultaneously, all within the same scan time as the original Cube T2 FLAIR sequence.

**Methods**

As shown in Figure 1(a), current Cube T2 FLAIR starts with an inversion pulse, follows by a long wait time (TI) and then by a data acquisition echo train. By using a T2Prep sequence in front of the inversion pulse, as shown in Figure 1(b), the spins experience a T2-decay first before they decay with T1. This will effectively improve the gray/white contrast and the SNR of the Cube T2 FLAIR images. We could make T2 Prep sequence another Cube T2 acquisition, as shown in Figure 1(c). This will generate another T2-weighted 3D dataset, in addition to the original T2 FLAIR 3D dataset. We call this new technique Cube Cx2 (Contrast times 2).

The inversion time will be different from regular Cube T2 FLAIR, and it could be calculated from simulation. The T2Prep time $t_0$ was determined by $etl$ (echo train length) and $esp$ (echo spacing): $t_0 = etl*esp$. $TI$ is then determined by $TR$ and $t_0$: $TI = T1*log((1+exp(-t_0/T2))/(1+exp(-TR/T1+ t_0/T1- t_0/T2)))$.

In vivo images are acquired on a GE 3T HDx system with an eight-channel brain coil. Regular CUBE T2 FLAIR was acquired with default protocol: $Xres = 224$, $Yres = 224$, $Slice Thickness = 1.2mm$, $TR = 6000ms$, $TE = 118ms$, $BW = 31.2kHz$, $FOV = 24cm$. Total scan time is 5:45. Another dataset is acquired with T2Prep Cube T2 FLAIR with the same parameters, and the scan time is still 5:45. In the third scan, in the same 5:45 scan time, in addition to the original Cube T2 FLAIR dataset; another T2 weighted 3D image dataset with same resolution and $FOV$ was generated.

**Results**

Volunteer scan images were shown in Figure 2. As predicted by the simulation, T2Prep FLAIR (Figure2b) provides better Gray/White contrast and SNR over the traditional Cube T2 FLAIR product (Figure 2a). By applying Cube Cx2 technique, in the same scan time, additional T2 weighted dataset (Figure 2d) was acquired, along with the Cube T2 FLAIR weighted dataset (Figure 2c).

**Discussions**

Cube Cx2 greatly saved scan time while still provides 3D datasets with two important contrasts. This could be very meaningful in clinical settings. With another fast T1 and DWI scan, a basic brain scan protocol could be scanned in 10mins.

**References**