Diffusion Tensor Imaging of Extraocular Muscle Using 2D-Single-Shot Interleaved Multiple Inner Volume Imaging Diffusion-Weighted EPI at 3T

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Purpose: To evaluate the feasibility of DTI for the extraocular muscle (EOM) evaluation, to investigate the normal DTI parameters of EOM, and to compare to other skeletal muscle.

Methods: Seven multiple sclerosis patients and 5 normal subjects (M:F=5:7, mean age=31.6±9.2) without EOM disorder were included. The orbital DTIs using 2D Single-shot DWEPI using interleaved multiple inner volume imaging (2D-ss-IMVI-DWEPI) were scanned with b=500 s/mm^2 and 12 directions. The mean diffusivity (MD) and FA of medial and lateral rectus EOMs in both orbits, and temporalis muscles were measured in ROIs on two consecutive axial slices. Student t-test was performed to compare the mean ADC and FA values between medial and lateral rectus EOMs, and between EOMs and temporalis muscles.

Results: The MDs in medial (0.578±0.180x10^{-3}mm^2/s) and lateral rectus EOMs (0.706±0.179x10^{-3}mm^2/s) were significantly lower than temporalis muscle (0.837±0.144x10^{-3}mm^2/s) ($p<0.001$, respectively). The MD in medial rectus EOM was significantly lower than lateral rectus EOM ($p=0.001$). The FAs in medial (0.40±0.05) and lateral rectus EOMs (0.40±0.05) were significantly higher than temporalis muscle (0.25±0.05) ($p<0.001$, respectively). There was no significant difference between the FAs in medial and lateral rectus EOMs ($p>0.05$).

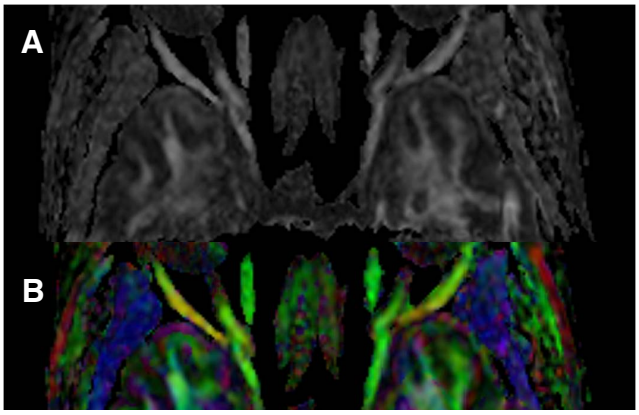

Fig. 1. On the gray-scale FA map (A), lateral and medial rectus EOMs in both orbits are much hyperintense compared to both temporalis muscles in extraorbital spaces. The color-coded FA map (B) presents the well organized anteroposterior direction of EOMs as bright green color. The green, blue and red colors represent anteroposterior, superoinferior and right-left directions, respectively.

Discussion: Recently developed 2D-ss-IMVI-DWEPI supplied high-resolution DTI in small orbital structure with reduced geometric distortion and blurring. The different values of EOM on DTI from other skeletal muscle is well correlated the unique histological features of EOM. The smaller myofiber and the lower radial diffusivity of EOM could depict well the higher FA value, and high cellularity might give an explanation of lower MD.

Conclusion: The MDs of EOMs were lower and the FAs were higher than those of skeletal muscle. These are well correlated to the unique characteristics of EOMs.

References

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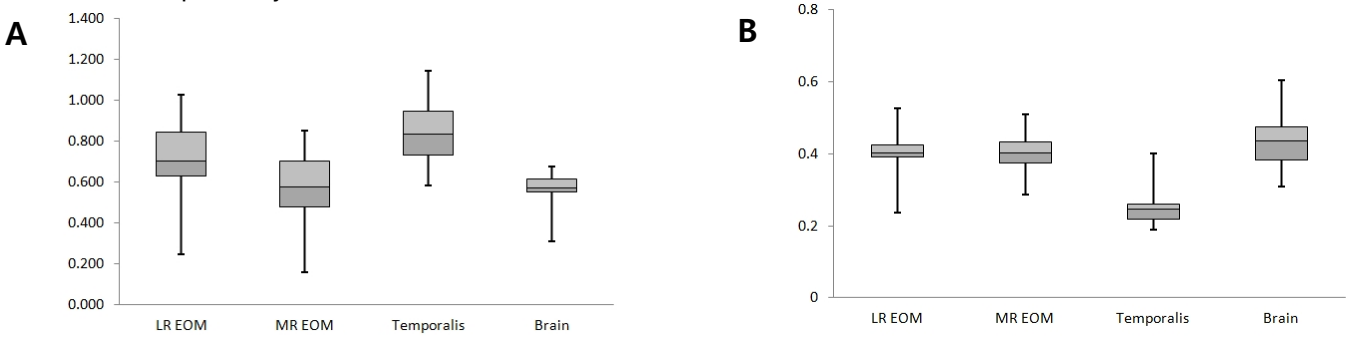

Fig. 2. Box plots of (A) mean diffusivity and (B) FA values in lateral rectus EOM (LR EOM), medial rectus EOM (MR EOM), temporalis muscle (Temporalis) and temporal lobe subcortical white matter (Brain).