Functional T2 weighted MRI for investigation of muscle fatigue in the lower back muscles

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Introduction

The aim of the presented study was to test a T2 weighted MRI sequence that assess the muscle fatigue in lower back muscles, like in the *M. multifidus* (MF) and *M. erector spinae* (ES), by measuring T2 relaxation times. Deeper insights into muscle fatigue due to performed muscle contraction during isometric load, as described by Sørensen (Biering-Sørensen 1984), remain information about the state of health of the observed muscular system in, e.g., patients with nonspecific chronic low back pain (Panjabi 2003).

Methods

The presented study was performed on a 3T whole-body MR scanner (MAGENTOM Tim Trio, Siemens Medical Solutions) while measuring transverse slices at the height of the intervertebral disk L3-L4. Initial measurements were done in two healthy volunteers prior and after loading (data acquisition 4min after end of exercise), which was done until total exhaustion of the subject. For quantitative T2 mapping we obtained T2 weighted images by using a ME-TSE sequence (NEX=1; FOV=280×201mm²; 1.1×1.1mm²; d=3mm; TR=2s; TE1/TE2/TE3=15/38/69ms; TA=1.5min). After data acquisition, T2 maps were calculated in a custom-built MATLAB routine by pixelwise fitting of a mono-exponential function for signal decay over three different echo times. The ROIs of the MF and ES were drawn in the T2 weighted images.

Results

We found in both subjects increased T2 values due to muscular activation, whereas main deviations occur in the inner low back muscle (MF). Determined T2 values (in ms) pre/post exercise: 40.8/50.6 (right ES), 40.7/43.0 (left ES), 42.8/51.3 (right MF), 45.3/53.7 (left MF); subject 2: 41.8/45.9 (right ES), 41.6/42.5 (left ES), 39.5/46.3 (right MF), 37.2/42.9 (left MF).

Conclusion

In this first initial study we demonstrated the capability to characterize muscle fatigue by employing T2 weighted MRI. Hereby, we showed increasing T2 values in the lower back muscles of two examined subjects. However, further reproducibility studies and long term measurements are necessary to enhance the diagnostic value in muscle fatigue analyses.