Clinical Applications of FFC MRI

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Field-cycling NMR allows the detection of ^{14}N quadrupolar cross-relaxation effect in biological tissues [1]. This allows detecting variations in protein contents, with applications in various fields of medicine. This presentation will focus on three projects established in collaboration with clinicians and medical research groups at the University of Aberdeen that aimed to use quadrupolar detection by FFC MRI for the detection of variations of protein contents.

A preliminary validation was conducted using FFC-NMR relaxometry on the fibrinogen/fibrin (blood clotting) system *in vitro*. We have measured the amplitude of the quadrupolar peaks at different fibrin concentrations and have shown that the peak amplitude increases linearly with fibrin concentration, as expected. It was also shown that soluble and thus mobile fibrinogen did not exhibit a quadrupolar signal.

FFC-MRI experiments have been conducted using a modified PRESS sequence [2] on two groups of volunteers to detect the quadrupolar relaxation *in vivo* following two types of exercises aimed to create oedema or Delayed Onset Muscle Soreness (DOMS). The results show differences in the evolution of the quadrupolar peaks between the two groups, suggesting the possibility to detect muscle damage independently from the formation of oedema.

FFC NMR experiments on osteoarthritic cartilages have also revealed large diminutions of the quadrupolar peaks amplitude between healthy and diseased samples, which correlate with the values of GA G protein contents taken from the literature. This may be a quantitative measurement of GA G content, which could lead to early and quantitative detection of OA.

[1] Lurie, D.J et al, *Comptes Rendus Physique* **11**(2), *2010*, 136-148
[2] Pine, K.J.; Davies, G.R.; Lurie, D.J., *Magnetic Resonance in Medicine* **63** (6), *2010*, 1698–1702