Magnetization transfer effects in human median nerve at 3 T

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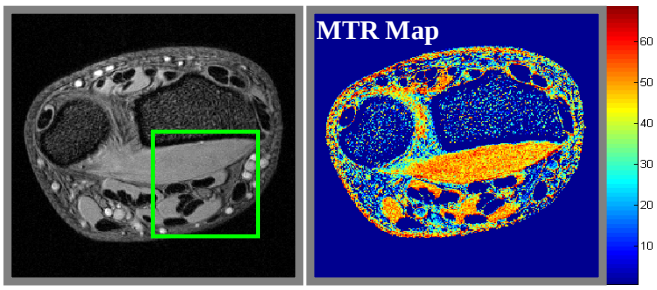
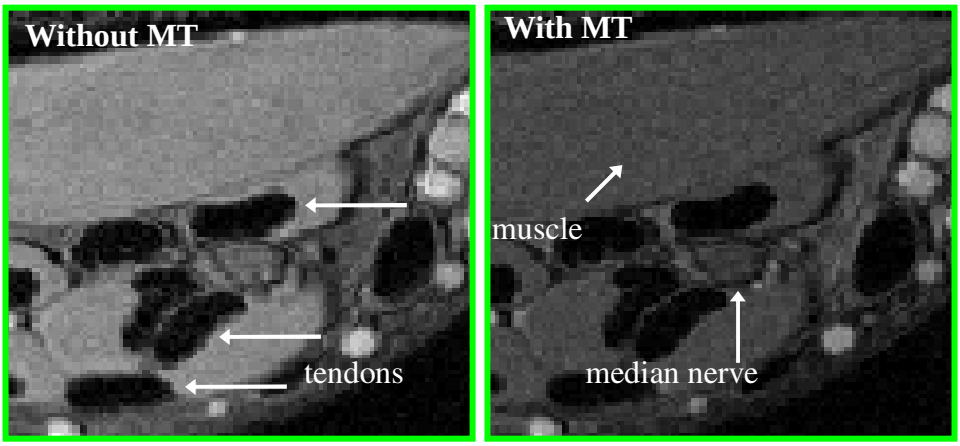
Introduction. Demyelination processes are common in a number of pathologies of the central and peripheral nervous system (CNS and PNS, respectively). Magnetization transfer (MT) contrast is sensitive to demyelineation and it has proven useful in investigations of CNS pathologies. Despite the potential of MT contrast to assess demyelination, which is one of the common features of a number of PNS pathologies [1], no measurements of MTR have been performed to date on human PNS. The purpose of this study was to determine the MT ratio (MTR) in human median nerve to provide baseline values of MTR for the PNS in healthy volunteers.

Methods. All MRI experiments were performed on a clinical 3 T Tim Trio Siemens scanner, using a dedicated Tx/Rx CP wrist coil, on healthy male volunteers. High resolution 3D gradient echo images (TR/TE = 33/6 ms, $\alpha = 10°$, in-plane resolution 260 µm x 260 µm) were acquired with and without a saturation pulse (Gaussian shape, duration of 8 ms, an effective flip angle of 500, frequency offset of 1.5 kHz), at the level of the wrist, in the low forearm region (n = 4). Pixel-by-pixel MTR maps were calculated according to the standard equation MTR = 100*(Mo – Ms)/Mo, where Mo and Ms is the magnetization without and with off-resonance saturation pulse, respectively, within a manually segmented ROIs in muscle and nerve.



Results

With the spatial resolution achieved in the current study, the manually segmented ROI in nerve included typically more than 40 pixels. An anatomical image and an MTR map is shown on the left. The zoom in the median nerve region is shown below, where arrows point to the cross section of tendons (low signal elliptical-shaped regions), the median nerve (elliptical-shaped region next to tendons) and forearm muscle. Due to the very short T_2, no MT was observed in tendons. The MT ratio observed in median nerve was lower than that of muscle (36% ± 5% in nerve vs 47% ± 4% in muscle, n = 4).



Discussion

For most clinical relevant tissues, the MTR values -though dependent on sequence paramenters and MT schemes- are well established, with muscle, cartilage and white matter having high MTR values and gray matter and liver, for instance, being characterized by lower values of MTR [2]. The MT ratio observed in muscle in the current study is in good agreement with that (50% ± 2%) measured in another study [2], where similar sequence and MT pulse were used. The MT ratio observed here in the median nerve can be ascribed to water interaction with macromolecules within myelin and connective tissue sheats present in the median nerve.

Conclusions

In this study, MTR was measured in the human PNS for the first time. To date, MRI assessment of peripheral nerve pathology relies on T_2-weighted imaging. MT measurements could be an attractive alternative to T_2-weighted imaging for detecting diseases of PNS in humans, in particular to investigate degenerative processes within peripheral nerves.

References. [1] Dailey AT et al., Lancet. 1997;350:1221-1222. [2] Boss A et al., J Magn Reson Imaging. 2006;24:1183-1187. --- Supported by Centre d'Imagerie BioMédicale (CIBM) of the UNIL, UNIGE, HUG, CHUV, EPFL and the Leenaards and Jeantet Foundations.