Diffusion Tensor Imaging Studies in Limb-Girdle Muscular Distrophies

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Introduction: Limb-girdle muscular dystrophies (LGMD) are a group of autosomal dominantly or recessively inherited muscular dystrophies that also present with primary proximal (limb-girdle) muscle weakness. This type of dystrophy involves the shoulder and pelvic girdles, distinct phenotypic or clinical characteristics are recognized. LGMD dystrophies affect posterior thigh muscle compartment, predominantly gracilis and sartorius muscles. In the thigh, muscles at the back are affected, with a tendency to preserve the tibialis anterior and gastrocnemius[1].

Material and method: Eleven patients and eight healthy volunteers were examined as follows: all subjects were scanned while in the supine position with thighs relaxed and parallel to the magnet magnetic field direction(Figure 1). Images were acquired on a 1.5T imager (GE Medical Systems, WI, USA), using a combination of two eight-channel coil array. Diffusion Tensor Imaging (DTI) data were acquired using a SE-EPI sequence with the following parameters: TR/TE = 3000/71 ms, FOV=42x42 cm², matrix = 128x128, slices number= 17 and NEX = 10. Diffusion weighted gradients were applied along 30 non-collinear directions with a b-value=550 s/mm². High-resolution images were acquired using Fast Spin-Echo with the following parameters: TR/TE=600/23ms, slice thickness 8mm, matrix=256x256 and NEX=2.

Tractography: Two regions of Interest (ROI) were hand-drawn containing all seventeen slices of the Gracilis and Sartorius muscles for each subject and fiber tracking of the primary and secondary eigenvectors was performed with TrackVis software [2], using the interpolated streamline algorithm with 0.5 mm step size [3-5]. (Figure 2.)

Results: The statistics for fractional anisotropy obtained from DTI data by averaging over each VOI for both the sartorius and gracilis muscles of healthy controls and patients. The tractography and net calculations were repeated 5 times and their means computed for each subject. All measurements were normalized to the VOI size. The connective tissue content does not appear to have a significant effect on the directionality of the diffusion, as assessed by fractional anisotropy. The sartorius muscle and gracilis fibers have a lower tract number, secondary to fatty infiltration and replacement of connective tissue and muscle mass loss characteristic of the underlying pathology.

Conclusions. Our results demonstrated the utility of non-invasive MRI techniques to characterize the muscle pathology, through quantitative and qualitative methods such as the FA values and tractography. Correlation coefficients were negative between Number of tracts/Volumen and FA values for Sartorius and Gracilis muscles in patients.

References:
1. Wattjes et al. EurRadiol (20), 2010
4. Quan D. Rheum Dis Clin NA (37), 2011;