Study population of young adults using T1rho as a marker to detect early changes in intervertebral disc degeneration

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Background: among chronic pain disorders, pain arising from various structures of the spine constitutes the majority of the problems. Recent studies have proposed that magnetic resonance (MR) T1rho relaxation time is associated with loss of macromolecules. Conventional MRI cannot detect the depletion of macromolecules in the matrix of the intervertebral disc that occurs during early degeneration.

Purpose: to test the feasibility of quantifying T1rho relaxation time intervertebral discs of healthy volunteers using in vivo MR imaging at 1.5 T.

Materials and Methods: written informed consent was obtained from all the participants. T1rho measurement were performed at 1.5 T MR imaging in 63 young asymptomatic volunteers (32 male; 31 female; mean age 23,4 +/-1,9; range 18 to 27). T1rho maps were performed using software developed with MATLAB. Moreover the stage of degeneration was graded using conventional T2 images according to Pfirmann et al. scale; linear regression analyses were performed to examine the correlation with clinical features like BMI, and lifestyle (sport activity, smoke) .

Results: the median T1rho-value of the nucleus and of the anulus were significant different for each level and gender (r=0,887 and p<0.0001, Spearman's test). The T1rho-value mean decreased linearly with increasing degeneration (R^2=0.93) (Fig. 1). Significant difference between male and female was found in the lower discs's T1rho-value (± standard deviation) (Male L5-S1= 86,15 (± 24,32); Female L4-L5 = 80,78 (± 20,23) (Fig. 2A, 2B).

Conclusion: the result of this study suggest that T1rho can potentially use as a clinical tool in identifying early degenerative change in the intervertebral disc, and it can use to create a quantitative scale based on T1rho-value monitoring concentration of proteoglycan in the disc in patients under therapies.
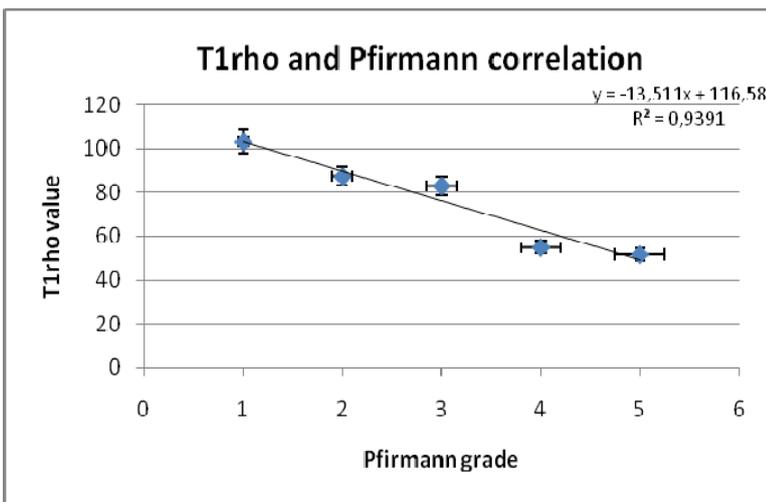

Fig. 1 The T1rho-value mean decreased linearly with increasing degeneration (R^2=0.93)

	T2	T1 rho	T1 rho value		T2	T1 rho	T1 rho value
L1-L2			153,24 ms				104,38 ms
L2-L3			128,61 ms				145,33 ms
L3-L4			94,8 ms				106,05 ms
L4-L5			81,95 ms				47,73 ms
L5-S1			51,49 ms				81,17 ms

Fig. 2A) T2-weighted (left) and T1rho-weighted (right) images of the spine of a23 years old young male with corresponding T1rho values. The degenerative grade according with Pfirmann scale was 1 for the disc between L1-L2, L2-L3, L3-L4; 2 for the disc L4-L5; and 3 for the disc L5-S1.

Fig. 2B) T2-weighted (left) and T1rho-weighted (right) images of the spine of a 21 years old young female with the corresponding T1rho values. The degenerative grade according with Pfirmann scale was 2 for the disc between L1-L2, 1 for the discs L2-L3, L3-L4; 4 for the disc L4-L5; and 2 for the disc L5-S1.