**Proteoglycan profile** and Level-Specific Biomarker of Lumbar Disc Displacement

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**Background**

Displacement and Disc degeneration - Disc displacement is defined as herniation, bulge or extrusion of disc material beyond intervertebral disc space (Fig 1)[1] which can result in spinal nerve root compression and classic symptoms of low back pain and sciatica with lifetime prevalence of 13-40% and 67-84% respectively [2]. Controversy exists whether disc displacement is associated with disc degeneration. [3] Disc degeneration is characterized by a loss of proteoglycan content in disc histologically. However, there is no precise method to measure in vivo proteoglycan concentrations in the disc which can detect the severity of disc degeneration in patients. [4] Therefore, a more precise and quantitative assessment is required to further establish the linkage between two disc pathological entities. [5]

**Objective**

This is the first study globally aiming to a generate “proteoglycan profile” for lumbar discs (i.e. a quantitative and precise measurement for the degree of disc degeneration) and b) level specific threshold value as a predictive biomarker for disc displacement via T1 rho MRI, to address the precise correlation of disc integrity in displacement and degeneration.

**Method**

**i) Study design and Study population**

This is a cross-sectional radiological study comprising of 76 Southern Chinese volunteers (mean age: 50.6 years, 51.6% males) from Hong Kong Degenerative Disc Disease Cohort.[7] Questionnaires based on epidemiology and clinical questions related to low back pain and sciatica was carried out under supervision of research staff in Queen Mary Hospital Orthopaedics and Traumatology outpatient clinic.

**ii) MR Image Acquisition & T2 weighted imaging**

All volunteers underwent T2-weighted (T2W) and T1 rho MRI of the lumbar spine from L1-S1 via a clinical 3T MRI scanner in Department of Diagnostic Radiology of University of Hong Kong. T2-weighted MRI imaging was analyzed using a clinical degenerative score [5], along with other imaging pathological phenotypes (e.g. disc displacement, Schmorl’s node, high intensity zone, spondylolisthesis, modic changes) (Fig 3 - Left).

**iii) T1 rho MRI processing & Data analysis**

T1 rho values were calculated on a pixel-by-pixel basis by a linear regression of intensity data to an exponential decay function. Values were used to create 3-dimensional spatial maps of T1 rho (Fig 3 - Right). Interpretaion : lower T1 rho value indicates loss of proteoglycan in disc (i.e. Green or Blue in Fig 3), which corresponds to disc degeneration that specific level, and hence risk of displacement ROC curve analyses were performed in order to determine a) area under the curve (AUC) (Fig 4) and b) optimal threshold levels for T1 rho values associated with disc displacement. (Fig 5, Table 2)

**Conclusion**

This is the first study globally to address the correlation between “proteoglycan profile” and disc displacement. Result from this study has revealed that “Proteoglycan profile” as constructed by T1 rho MRI on intervertebral discs can be a sensitive imaging biomarker to predict disc displacement. Level-specific biomarker from statistical analyses can provide clinicians and researchers with a more precise and quantitative tool to predict early disc degeneration and its association with disc displacement.

*With the “Proteoglycan profile” and level-specific biomarker, further development on the etiology, classification and management strategies of disc degeneration and displacement can be initiated to benefit the great population suffering from the above two common spinal disease entities.*

**Reference**


