

Abstract #1018.docx

Cervical Intervertebral disc degeneration: assessment by quantitative magnetic resonance imaging and histology

Introduction/Aim

Understanding Intervertebral Disc (IVD) degeneration is fundamental to the development of new therapies and technologies aimed at treating spinal pathology. Magnetic resonance (MR) imaging can non-invasively assess IVD changes, but current clinical MR-based classification systems for IVD degeneration are qualitative and susceptible to observer variability. This study introduces an MR-based method for the quantification of intervertebral disc degeneration, exploiting textural and morphological image information. The authors hypothesize that texture and morphology can capture the biochemical and structural alterations described in IVD degeneration. The aim here is to provide a quantitative tool for non-invasive assessment of IVD degeneration severity. The proposed method is validated against a published and standard histological grading of disc samples.

Methods

This study comprised data on 84 patient datasets. All patients had preoperative MRI scans followed by cervical spine discectomy at Salford Royal NHS Foundation Trust (SRFT). The excised IVD samples form part of the Human Intervertebral Disc Tissue Bank of the SRFT held by the University of Manchester. The tissue samples were graded histologically according to established criteria developed at the University of Manchester.

The MR quantification method included the segmentation of the IVD region from T2-weighted images of the cervical spine, followed by the extraction of textural and morphological features from the disc region (histogram features, grey-level-co-occurrence-matrix features and region property descriptors).

Results

Linear discriminant analysis identified two quantitative features extracted from MR images, the disc “extent” and the “information-measure-of-correlation”, as the most descriptive features of IVD degeneration. Non-parametric correlation analysis (Spearman) indicated significant association between these quantitative IVD parameters values and the histological grading of disc degeneration ($p < 0.01$). The Mann-Whitney-U test showed significant differentiation in IVD texture and shape between disc samples with histologically defined early vs advanced degeneration ($p < 0.01$).

Conclusion

Due to their ability to capture small changes in MR images, IVD texture and morphology provide novel biomarkers for quantitative non-invasive characterisation of IVD degeneration, as defined by histological grading. The proposed quantitative tool could potentially support targeting patients with appropriate types of therapy; conservative versus surgical treatment, or evaluating the effectiveness of new treatment methods such as biological or cell therapy.