The Longitudinal Impact of Intervertebral Disc Distraction on Disc Health – A Preliminary, in VIVO Study Using Magnetic Resonance Imaging in a Rabbit Model

Tan KA[1], Lam WMR[2], Zhuo WH[2], Hey HWD[1], Wong HK[1]

[1] Department of Orthopaedic Surgery, National University Health System

[2] Department of Orthopaedic Surgery, Yong Loo Lin School of Medicine, National University of Singapore

Introduction / Objectives: Intervertebral disc (IVD) degeneration, along with its sequelae, is one of the commonest causes of low back pain and chronic disability. Presently, pharmaceutical and physical treatment modalities provide only symptomatic relief, while surgical options often predispose to accelerated IVD degeneration at the index or adjacent levels. Potentially therapeutic effects of IVD distraction have yet to be demonstrated over a prolonged period. The objective of this study was to establish an *in vivo,* MRI-compatible rabbit IVD distraction model, to investigate whether this treatment strategy promotes IVD health.

Materials and Methods: Seven adult male rabbits were divided into control (n=2), short- (n=2) and long-term (n=3) distraction treatment groups. Six weeks following IVD degeneration induced by stabbing, treatment group rabbits were implanted with titanium-PEEK IVD distraction devices. IVD hydration, height and nutrient diffusion were evaluated by MRI at 7- and 15-weeks post-distraction treatment. Following the last MRI scan, the animals were euthanized, and the treated and adjacent spine segments were assessed via high-resolution microCT and histology. Control group rabbits underwent the same protocol without IVD distraction treatment.

Results / Discussion: The distraction device was MRI-compatible and generated negligible artefacts. T2-STIR imaging showed that IVD hydration declined faster in the control group than in the distraction treatment groups. All stabbed IVDs sustained loss of height, which did not improve despite short- or long-term distraction treatment. Nutrient diffusion was improved in the long-term distraction group as compared to the control group. Porosity data on microCT showed that IVD distraction increased its vascularity. Histological examination showed that nucleus pulposus (NP) integrity was maintained in both short- and long-term treatment groups.

Conclusions: The novel MRI-compatible IVD distractor enabled the longitudinal study of IVD health *in vivo* over a 15-week period. IVD distraction can attenuate IVD dehydration, improve nutrient diffusion and vascularity, as well as maintain NP integrity in degenerated IVD. IVD distraction therapy may have a significant role to play in improving the IVD microenvironment to make it conducive for regeneration.