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Investigation of the Effect of IL-1Œ≤, RANTES, and MMP-1 Injection into Nucleus Pulposus (NP) of Intervertebral Disc (IVD)

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INTRODUCTION: Back pain can originate from Intervertebral Disc (IVD) degeneration (IVDD). Inflammatory stimulation and degradative enzyme activity contribute to this disease. IVDD often develops through changes in nucleus pulposus (NP) structure, compromising the function of the IVD. However, the metabolic effects of injury and localized inflammation, and degradative enzyme activity on the NP is poorly understood. This study was designed to determine the effects of NP stimulation with IL-1β, RANTES, and MMP-1. It was hypothesized that localized IVD stimulation would result in significant increases in the proinflammatory and degradative metabolism and decreases in physical properties.

METHODS: With ACUC approval, rat tail IVD explants were created, and assigned to MMP-1 (Injury+injection), IL-1β (Injury+injection), RANTES (Injury+injection), PBS (Injury+injection), injury only, or uninjured control groups. A 25g needle was used to create an injury and inject 10ul of solution based on group. Explants were cultured for 6 days, media was collected for biomarker analysis, and IVDs were tested biomechanically. RESULTS: The IL-1β and injury only groups had a higher inflammatory and degradative metabolism compared to other injection groups. The biomechanical properties of the IL-1 β, RANTES, and MMP-1 groups were significantly lower than the uninjured control.

CONCLUSION: IL-1β was the most inflammatory treatment applied to the IVD and produced significantly higher biomarker levels compared to other injection groups. Injury alone was more inflammatory than injury+injection, as the PBS, RANTES, and MMP-1 groups produced significantly lower inflammatory biomarkers compared to the injury only control. The IL-1β, RANTES, and MMP-1 resulted in physical changes to the IVD based on decreased creep modulus and higher histology scores. In conclusion, IL-1β elicited an inflammatory metabolic response, contributing to pain and inflammation in IVD degeneration and physical changes within the IVD, while RANTES and MMP-1 elicit physical changes in IVD degeneration but not a metabolic inflammatory response.