Spine Management Report

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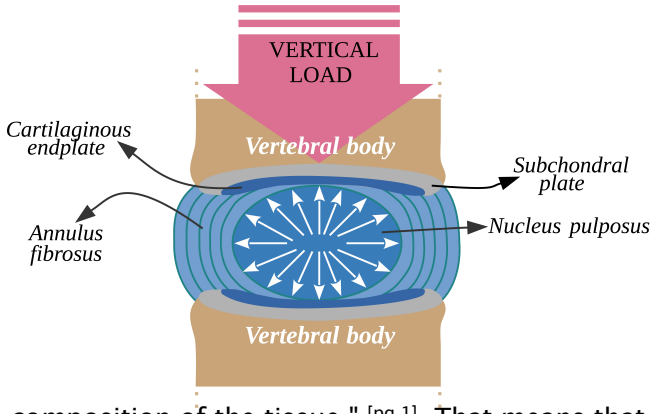
Intervertebral Disc Injury Thresholds



From an engineering perspective, tissue in the human body is no different than any other non-organic material. It has tolerances, responds to forces, can wear out and also be permanently altered as a result of traumatic forces.

In a very recent study funded by the National Institutes of Health, Wilson at al [2021] stated, "The in vivo *[taking place in a living organism]* biomechanical response of biological tissues to mechanical stimuli are often indicative of health and normative function, and yet remain largely undocumented in stiff tissues of the musculoskeletal system. Tissue stiffness is contingent on the physical and chemical composition of the tissue." [pg 1]. That means that not all tissues are created equal and present in injury victims in varying degrees of strength and health. The authors stated, "The intervertebral disc (IVD) is a load bearing tissue of the musculoskeletal system that connects adjacent vertebrae in the spinal column. The IVD consists of two primary structural compartments: a compliant nucleus pulposus (NP) containing hydrophilic glycosaminoglycans (GAGs), and a stiff annulus fibrosus (AF) comprised largely of type I collagen. The IVD enables the flexibility of the spinal column within a safe range of motion while transmitting load and reducing stress from body weight and natural muscle activity within the body." [pg 2] However, when traumatic forces exceed the threshold of this tissue, it creates damage resulting in functional deficits.

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They continue by reporting, "Upon trauma or overuse, the tissue can degrade and lead to intervertebral disc degeneration (IVDD), affecting approximately 25% of the global adult population. IVDD can result in instability and in extreme cases severe chronic pain. The two primary phenotypes [physical expression] for spinal pain, endplate-driven and AF-driven degeneration, can be distinguished by their physical origin as well as pain association with both eventuating into complete disc failure. On a tissue level, later stage endplate-driven degeneration can be detected via modic changes. Annulus driven degradation can be identified through tissue fissures. [pg 2] So, what that means is HOW the IVD tissue responds to physical stress is predicable because we know its properties. We can therefore tell if the injury is causally related or pre-existing by looking at the annulus fibrosis and surrounding end plates. The body will give us the answer to our questions.

In terms of specific injuries, the paper shows that "The C5/C6 IVD has been shown to be particularly susceptible to damage from aging or traumatic event." [pg 7] "The biomechanical function of the intervertebral disc (IVD) is a critical indicator of tissue health and pathology. The mechanical responses (displacements, strain) of the IVD to physiologic movement can be spatially complex and depend on tissue architecture, consisting of distinct compositional regions and integrity..." [pg1] It is then critical to work with doctors that not only understand the effects of trauma to the human spine, but those that know what to look for to determine causation and identifying the cause of persistent functional losses.

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REFERENCE:

Wilson, R. L., Bowen, L., Kim, W., Cai, L., Schneider, S. E., Nauman, E. A., & Neu, C. P. (2021). In vivo intervertebral disc deformation: intratissue strain patterns within adjacent discs during flexion-extension. Scientific reports, 11.