Intervertebral Disc

Degenerative Disc Disease (DDD)

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The intervertebral disc is a cartilaginous structure that resembles articular cartilage biochemically, but structurally it is quite different. The disc functions as a shock absorber and semi-flexible link between vertebrae. The intervertebral discs take considerable biomechanical stress from actions such as bending, twisting or jumping up and down. These stresses have a cumulative effect throughout life and consequently the disc undergoes degenerative changes earlier than any other connective tissue in the body. The normal aging process affects connective tissues of the disc as well, resulting in mild to moderate degeneration of the intervertebral discs in the aged population.

Intervertebral disc degeneration is strongly correlated with the development of low back pain. Degenerative disc disease (DDD) is extremely common, estimated to occur in 50% of individuals over 40 years of age and 80% of individuals over 70. DDD becomes increasing common as we get older. It occurs in part secondary to wear and tear similar to osteoarthrosis. It occurs most commonly in the lumbar spine, due to level of physical stress.

A healthy intervertebral disc has a great deal of water in the nucleus pulposus (the center portion of the disc). The center of the disc (nucleus pulposis) is composed of some large molecules called proteoglycans which attract water to a capacity approximately 250% of their weight. Until the third decade of life, the gel-like nucleus pulposus is composed of approximately 90% water. The water content gradually decreases over the subsequent 4-5 decades to approximately 65%. The water content gives the nucleus a spongy absorbing quality and allows it to dynamically adapt to loads placed on it. Excessive pressure on the disc can cause disruption of annular fibers (the outer ring of tough fibrous tissue) that holds the vertebrae together. The inner annulus is usually the first portion of the disc to become compromised. Small tears develop within annular fibers. These small tears can come together and become larger regions of compromise. Annular tears heal by scar tissue, which is not as strong as normal tissue. The annulus becomes weakened over time as circumferential tears enlarge and scar tissue forms.

The adult disc does not have a blood supply and is therefore dependent on blood vessels along their margins and within adjacent bone to supply nutrients and remove metabolic products. Damage of the endplate which comprises the surfaces of the vertebral bodies can lead to disc degeneration by limiting chemical (metabolite) transport from the vertebral body into the center of the disc (nucleus), or by causing an inflammatory or autoimmune type reaction within the disc or the vertebral body.

The delivery of adequate nutrition to the inner fibers of the disc (annulus fibrosis) and to the center portion of the disc (nucleus pulposus) depends on the diffusion of water and small molecular substances across the vertebral endplates. The outer third of the disc (annular fibers) receives nutrients via diffusion via a blood supply around the disc.

One of the primary causes of disc degeneration is felt to be the result of a loss of efficient nutrient supply to cells within the disc. Like all other cell types, the cells of the intervertebral disc require nutrients such as glucose and oxygen to remain alive and active. The cells actively influence the chemical and structural environment around them. There are very few cells with the discs when

compared to other tissues. This is why even subtle changes in the delivery of nutrients can adversely affect the cells and the structure of the disc. Reduced nutrient availability within the disc causes the disc to become more acidic, a state that interferes with the cells ability to function properly for the disc leading to disc degeneration.

As a disc undergoes degenerative changes, it tends to lose volume. This is characterized on X-rays as well as MRI by a loss of vertical height. The approximation of vertebral bodies contributes to approximation of the facet joint surfaces. This process can lead to increased risk for nerve impingement, inflammation, as well as joint pain. The pain associated with degenerative disc disease is often mechanical in nature, characterized by increased pain intensity with movement such as extension, flexion, rotation and/or lifting.

The diagnosis of degenerative disease is generally made by diagnostic imaging studies. Spinal X-rays are the most common diagnostic imaging procedure for diagnosis of degenerative disc disease. MRI evaluation can be used to confirm the diagnosis. MRI provides imaging of soft tissue detail and therefore reveals the loss of water content in the disc.

Degenerative disc disease typically does not require surgical intervention. The approach for a symptomatic DDD is typically conservative involving the use of clinical nutrition, spinal manipulation, physical therapy, oral anti-inflammatory medication, exercise, intervention, and less often, epidural steroid injections. Many patients have reported favorable response to chiropractic care, which incorporates most of the non-pharmaceutical and surgical options. When symptoms are unremitting and compromising quality of life and has not responded to conservative care, surgery may be a reasonable option. Fusion tends to be the standard surgical approach for the treatment of mechanical lower back pain and/or mechanically induced nerve damage with pain. Fusion of a spinal segment reduces the risk for progressive approximation of vertebral bodies due to the loss of disc volume.

Unfortunately, when one or more disc levels or vertebral levels are surgically fused, the adjacent unfused segments are placed under additional physical stress and strain in order to compensate the loss of mobility of the fused site. This can lead to a domino-like effect with complications arising at these adjacent segments. The artificial disc will become more readily available to restore some movement and to restore disc height thus increasing the openings of the neuroforamen and unloading the facet joints. The use of an artificial disc will help improve spine segment stability and function rather than acting as a fusion of the segment.