Optimizing the Infill Pattern in Spinal Discs to Resolve Long-term Back Pain within Patients

Friedman, Dor

Artificial disc replacement (ADR) is a relatively new spinal surgical procedure in the United States that has had only a small amount of time—less than a decade—to be conclusively criticized based on its long-term durability. In recent years, Charité and ProDisc, the only FDA-approved artificial spinal discs thus far, have been reported to cause critical issues that have only led to more surgical procedures. A team at Cornell University has attempted to resolve such issues by 3D-printing spinal disc models. Yet, the pattern inside the disc is not entirely optimized to be anatomically correct. Thus, I have designed an experiment that focuses on internal infill pattern and tests the vertically compressive durability of a 3D-printed spinal disc with a pattern—one I am calling “ring-concentric”—similar to that of a natural spinal disc against 3D-printed spinal discs with other patterns. These compression tests should determine whether the ring-concentric is the most durable pattern to use within ADR surgical procedures. Data collection and analysis showed that ring-concentric was not the most compressively durable of all the patterns tested, but due to specific errors with fill density that may be easily resolved in the near future. In addition, for future work, I would like to eventually combine my internal design with an anatomically correct external design and 3D-print with stem cells in order to create a commercially viable product that may be used in ADR procedures to resolve back pain within patients.