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Design of a Near-Constant Force Spring for Orthopedic Implants

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ABSTRACT

The design and testing of a spring assembly for the attachment of an orthopedic implant is presented. The assembly is intended to supply a constant compressive force of approximately 800 lb. at the bone-implant interface, while exhibiting insensitivity to changes in the displacement of the clamping device. This near-constant force will aid in-growth of bone tissue at the implant surface. This constant compressive force was ultimately not attained due to the packaging dimensions and materials available. However, significant improvement was made upon the current design in use by lowering the spring constant around 800 lb.

The final assembly fits in a unique packaging envelope and is composed of a number of springs in compression used to apply tensile load to an anchor plug inserted into the patient's bone, thereby accomplishing the design goal of clamping the bone to the implant surface. The materials used in the assembly are limited to those that are recognized by the Food and Drug Administration (FDA) as biocompatible for long-term implantation.

The design was modeled using an analytical computer program, solid-modeling software, and finite element analysis (FEA) software. The design was validated by the construction of a prototype and correlated physical testing.