Improving Spinal Fusions: Redesigned Pedicle Probe to Prevent Vertebral Breaches

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Pedicle probes are medical devices used during spinal fusion surgeries for patients with scoliosis or spinal fractures. The probe creates pilot holes to guide placement of pedicle screws in vertebrae, which are then connected with metal rods to stabilize the spine. 29% of patients who undergo spinal fusions suffer from vertebral breaches – accidental damage to the spinal cord – which cause infection, motor defects, and paralysis. This project aimed to make spinal fusions safer by redesigning the pedicle probe to provide instantaneous feedback on the probe's location using a similar procedure to what exists today, all the while increasing accuracy of pedicle screw placement. The novel pedicle probe developed exploits the density difference between the inner cancellous (spongy) bone and the outer cortical (compact) bone found in vertebrae. Cortical bone is avoided by monitoring the cannulation force – the force required to insert the probe. When the probe contacts denser cortical tissue, it warns the user by providing tactile and visual feedback. This enables the surgeon to redirect the probe and advance down the optimum path, avoiding a possible breach. The redesigned probe is accurate within 0.2 Newtons and has an average standard deviation of +/-0.005 Newtons. Consequently, it was able to prevent all breaches in trials with lamb vertebrae, a proxy for human vertebrae. Enhancing a surgeon's ability to determine an appropriate path for pedicle screws through a sensor-enabled probe has the potential to significantly reduce the incidence of vertebral breaches during spinal fusion surgery.

Awards Won:

Third Award of $1,000

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