Bio-sensors for spine surgery (Class Project)

As a class project for Dr. Taylor's course, 600.446, "Advanced Computer-Integrated Surgery", graduate students Robert Webster and Babak Matinfar at the CISST ERC are developing sensors to ensure the health of spinal nerves during surgery. Surgeons correcting spinal deformities and injuries often must stretch nerves as they re-align vertebrae. Both under-stretching and over-stretching can have negative consequences for the patient in terms of recovery time, risk of infection, and motor-control of the legs. The project team and surgical collaborators theorize mechanical tension is closely correlated to nerve health and are developing a tensiometer for spinal nerve roots.

Working closely with collaborating clinician Charles Edwards of the Maryland Spine Center, they have constructed a device that can simultaneously record position and force data while applying small displacements to the nerve. This mimics and objectifies current surgical procedure of using a hand-tool to deflect the nerve a small amount to determine "how taut it feels." The tensiometer is a 1-DOF motorized micrometer stage with an attached load cell that deflects the nerve by gently pulling on a kevlar thread attached to a blunt hook under the nerve.

A prototype was constructed, and initial animal experiments were carried out in 2006 at the Minimally Invasive Surgical Training Center (MISTC). Data collected during these experiments is being used to better understand nerve properties and how they are affected by tension. Planned experiments for 2007 involve comparing electrical and mechanical measurements of nerves as tension is applied. The project team anticipates that this work will dramatically reduce complication and infection rates associated with spinal reconstruction surgery.

Figure 1: (Left) Mechanism for correcting Spondyloptosis. (Center) X-ray image showing the realignment of the vertebrae. (Right) Tensiometer for monitoring nerve health during surgery.