Stenosis in the cervical spinal canal causes spinal cord compression during motion that otherwise would not cause spinal cord compression

J. Boak [1], P. Gédet[2], M. F.S. Dvorak[3], Stephen Ferguson[2], Peter A. Cripton[1]

[1] Department of Mechanical Engineering, University of British Columbia, Canada;
[2] Dipl. Ing. ARTORG Center, University of Bern, Switzerland. Stauffacherstrasse;
[3] Department of Orthopaedic Surgery, University of British Columbia, Canada

ABSTRACT

The rate of spinal cord injuries among people over the age of 65 is increasing and it often occurs among patients who have spondylotic pathologies of the cervical spine. These injuries are typically due to low energy impacts, such as a fall from standing height. A common feature of a spondylotic cervical spine is a stenotic spinal canal, which can cause myelopathy when the spine is flexed or extended. We hypothesize that traumatic flexion or extension (i.e. beyond the point of voluntary motion) causes an osteophyte to impinge the cord during the low energy impact.

Six cadaveric whole cervical porcine spines were used to study this injury mechanism. The following techniques were combined to directly observe spinal cord compression in a stenotic spine during physiologic and greater than physiologic motion:

- *A radio-opaque surrogate cord was placed in the spinal canal.*
- *Sagittal plane fluoroscopy was used to image the surrogate cord during testing.*
- *Varying amounts of canal stenosis were simulated using an M8 machine screw that entered the canal from the anterior through the C5 vertebral body.*
- *Pure moment loading was used to replicate physiologic and traumatic motion.*

A stenotic occlusion that removes all extra space in the canal in the neutral posture, without compressing the cord, caused spinal cord compression within physiologic ranges of flexion and extension. The spinal cord could also be compressed during traumatic flexion and extension with 25% canal occlusion.

These results suggest that cervical spinal canal stenosis can increase the risk of spinal cord injury because spinal cord compression was observed during motions and loads that would not cause spinal cord compression in a non-stenotic spine. These results are limited due to the use of a porcine spine. This new stenosis model and experimental technique will be applied to in vitro human spine experiments in future work.