

High Speed Radiography Can Be Used to Measure Dynamic Spinal Cord Deformation in an *in vivo* Rodent Model

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Spinal cord injuries are commonly studied by causing injury to *in vivo* rodent spinal cords and analyzing histological and behavioral results post injury. However, very few researchers have investigated the dynamic behavior of the *in vivo* spinal cord during impact. This information would help to define relationships between impact parameters, internal structure deformation (such as grey and white matter), and biological and functional outcomes. Many applications of this technique in the fields of SCI treatment and prevention are conceivable. The objective of this study was to develop a method of tracking the real-time internal and surface deformations of an *in vivo* rat spinal cord during injury.

Radio-opaque markers were injected into the spinal cord of twelve *in vivo* anesthetized Sprague Dawley rats. Two Tantalum beads were then injected into the cord (one dorsal, one ventral bead) through a C5 laminectomy using a custom needle. Four additional beads were glued onto the surface of the cord. The spinal cord was impacted on the dorsal surface at the C5 level using a hydraulic actuator at approximately 130mm/s to a depth of 1mm. The spine was imaged laterally at 3,000 fps using a custom high speed x-ray system (approximately 0.1 mm resolution) and the bead motion was tracked in the x-ray video.

A method was successfully developed to track internal and surface spinal cord deformation of an *in vivo* rodent. Initial analysis of ten animals showed the internal dorsal beads had a larger AP displacement than the internal ventral beads ($1.05\text{mm} \pm 0.12\text{mm}$ and $0.50\text{mm} \pm 0.12\text{mm}$ (ave \pm SD) respectively). The internal ventral beads had a larger AP displacement than the caudal and cranial surface ventral bead displacements of $0.16\text{mm} \pm 0.08\text{mm}$ and $0.14\text{mm} \pm 0.09\text{mm}$ respectively. While these results are preliminary, they appear to indicate that the *in vivo* spinal cord undergoes complex internal and surface deformations during impact. More detailed analysis will be completed within the next month.

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