

The contribution of traumatic spinal cord injury and surgical laminectomy on intraspinal pressure elevation – findings from a comprehensive porcine study series.

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Background:

Intraspinal pressure (ISP) and traumatic spinal cord injury (TSCI) is suggested to be correlated as intracranial pressure and traumatic brain injury serving as a driver for secondary damage. To rigorously test ISP and TSCI correlation, we conducted a comprehensive series of five experimental studies in a porcine model.

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Methods:

TSCI was induced by a 75 g rod dropped 75 mm onto the thoracic cord, with continuous ISP monitoring.

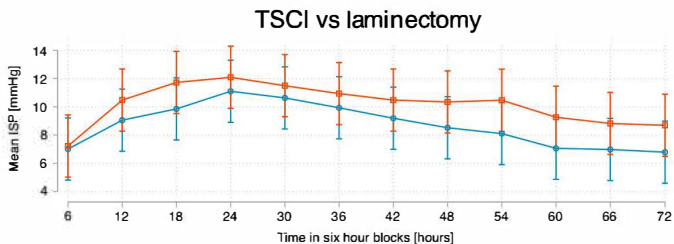
1. 72-h laminectomy-controlled study (TSCI n=5, sham n=5) assessed whether TSCI itself increases ISP.
2. Two contusion regimes (n=4+4) tested whether injury severity or duration altered ISP.
3. Compartmental monitoring (n=5) compared epidural, subdural, and intraparenchymal pressures.
4. CSF drainage study (n=3) tested whether eliminating CSF pressure reduced ISP.
5. Open-wound study (TSCI n=3, sham n=3) tested whether removing external pressure reduced ISP.

Results:

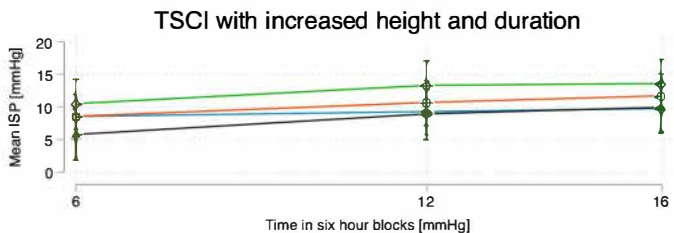
ISP rose significantly in both TSCI and laminectomy alone animals, but without a significant group–time interaction. Injury severity and duration likewise did not produce a significant effect. Compartmental pressures followed similar trajectories. CSF drainage did not lower ISP, whereas leaving surgical wounds open significantly reduced it.

Conclusions:

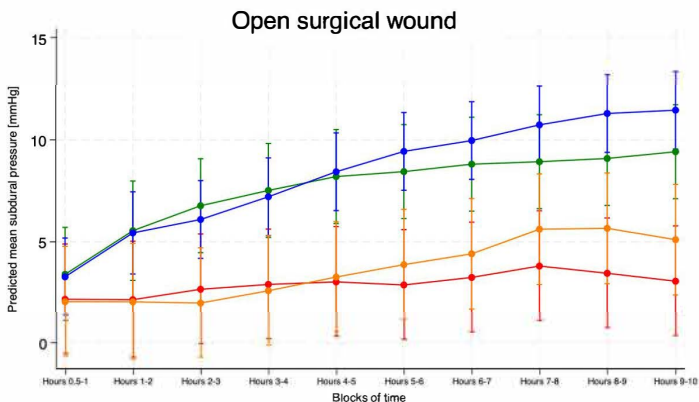
Across five complementary sub-studies, we were not able to find a significant ISP elevation caused by TSCI. However, we did find ISP to marginally higher following TSCI as compared to laminectomy alone. Additional studies revealed laminectomy and surgical trauma on the surrounding tissue, contributed significantly to the ISP elevation. Whether high ISP is detrimental to outcome needs further investigation.



ORANGE: TSCI 75 mm 5 min
CYAN: Laminectomy alone



ORANGE: TSCI 75 mm 5 min
GREEN: TSCI 125 mm 5 min
BLACK: 75 mm 240 min
CYAN: Laminectomy alone



ORANGE: TSCI CLOSED
GREEN: TSCI OPEN
Orange: Laminectomy alone CLOSED
RED: Laminectomy alone OPEN

Mixed effects models showing the estimated ISP at various time point for three of the sub-studies. The top panel shows how ISP is non-significantly higher in TSCI as compared to laminectomy.

The middle panel shows how higher falling height and longer compression does no increase ISP more. The lower panel shows how ISP decreases significantly by leaving the surgical wound open.