Investigating Contact Interactions in Simulations of Simplified Non-Human Primate Spinal Cord Injury
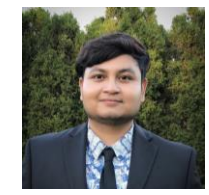
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Background

Computational models of spinal cord injury **(SCI)** are emerging as complementary tools alongside *in vivo* non-human primate **(NHP)** studies, addressing the gap between laboratory successes in rodent studies and meaningful clinical outcomes in humans [1], [2].

Methods

Sensitivity analysis investigating two contact interaction techniques in a finite element software:

- Surface-to-surface penalty contact method **(PEN)**
- Various configurations of general contact method **(GC)**

Parameters used to compare results:

- Required simulation times
- Simulated peak force outcomes
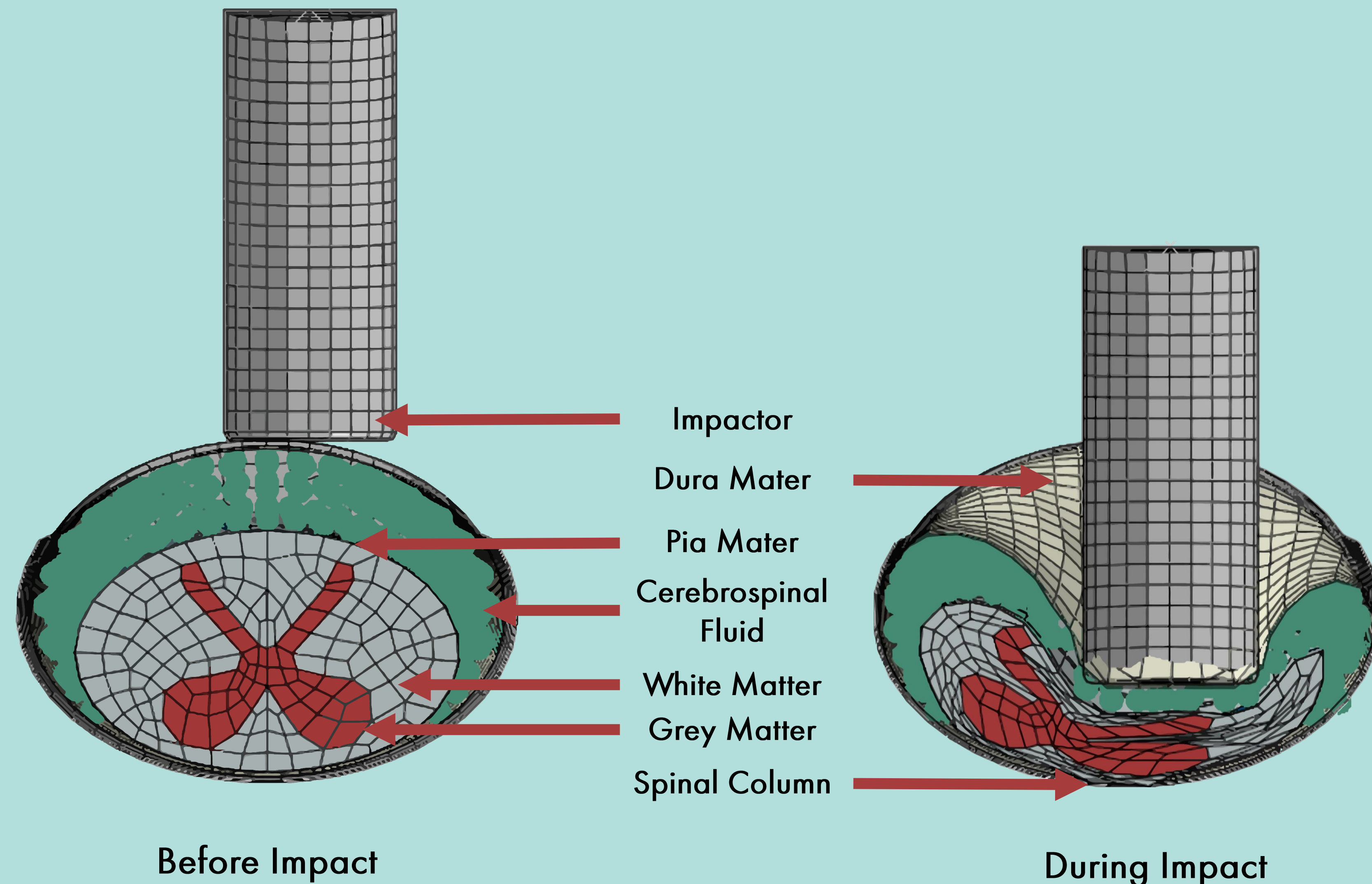- Presence of unwanted tissue penetration

Results

Contact Type	Peak Force [N]	Simulation Time [h]	Tissue Penetration
PEN	11.6	34	Yes
GC	12.9-38.6	27-51	No[1]

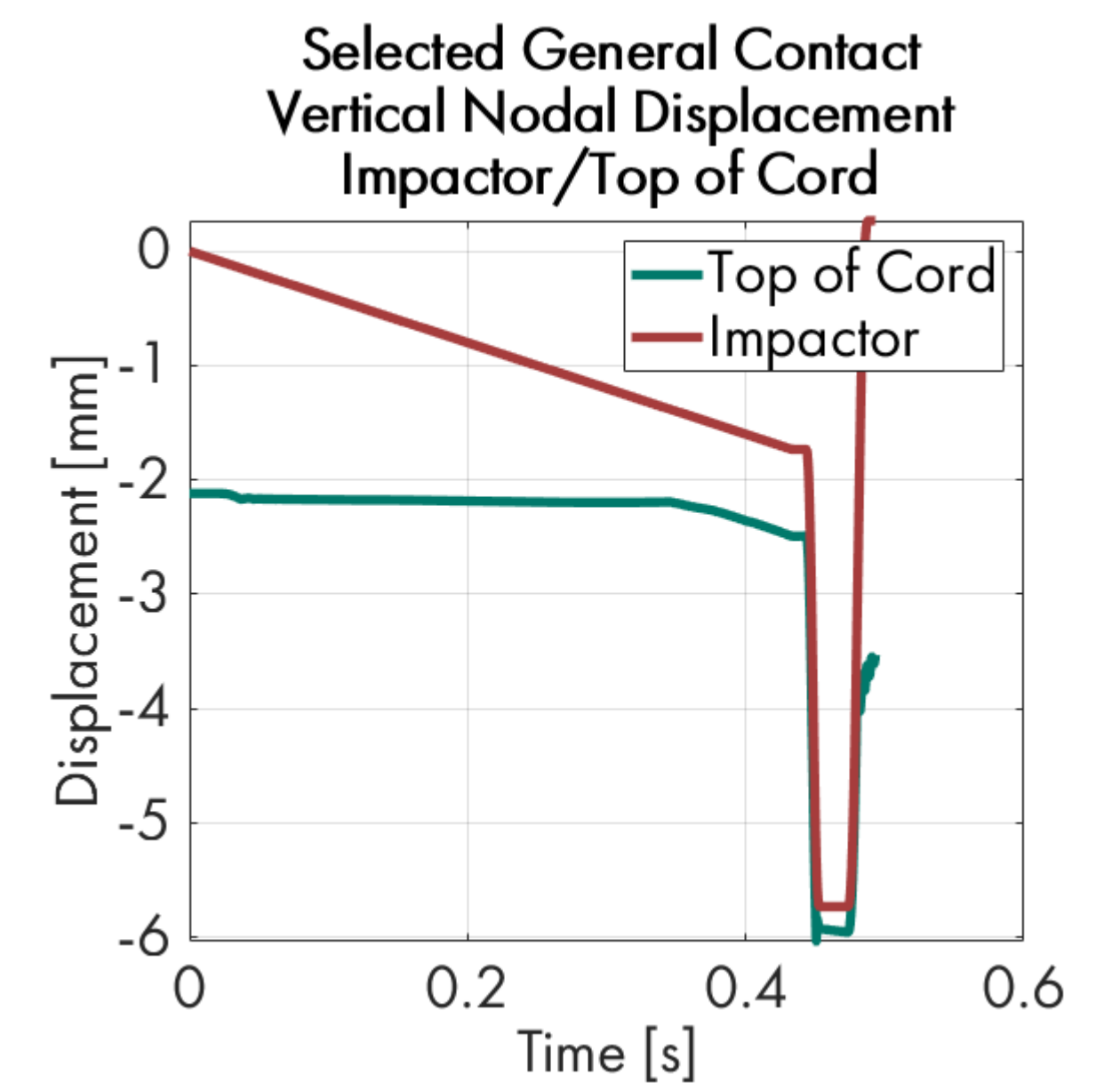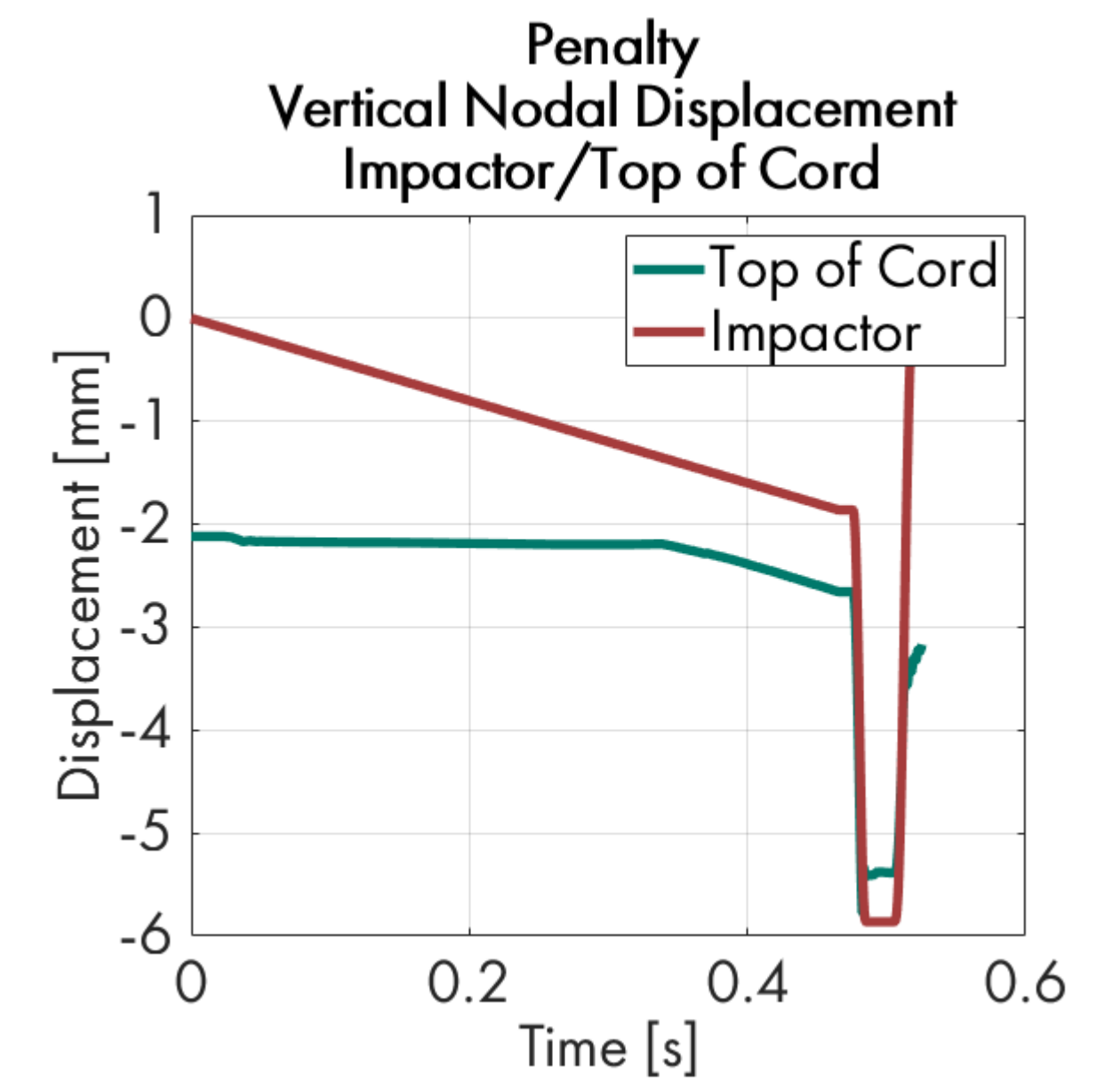[1] Vast majority had no tissue penetration

Discussion

- Specific configurations of general contact can achieve similar *in vivo* experimental peak forces (10.54-23.19N) [3] with no cord/impactor penetration

- Highlights the importance of contact interactions in computational SCI models and need to document them

Contact interactions **significantly affect** simulated biomechanical outcomes – documenting and reporting them will **improve computational model implementation** amongst researchers.

Impactor
Dura Mater
Pia Mater
Cerebrospinal Fluid
White Matter
Grey Matter
Spinal Column

Before Impact

During Impact

Current SCI Computational Model Iteration

Penalty
Vertical Nodal Displacement
Impactor/Top of Cord

Selected General Contact
Vertical Nodal Displacement
Impactor/Top of Cord

References

[1] Sparrey, C., et al., J. Neurotrauma, 2016.
[2] Jannesar, S., et al., J. Neurotrauma, 2021.
[3] Salegio, E., et al., J. Neurotrauma, 2016.