

Thematic Session: NanoBioscience

Keywords (max. 4-5): Multiphotonic, atomic force microscopy (AFM), nano-bio-mechanic, spinal cord injury (SCI).

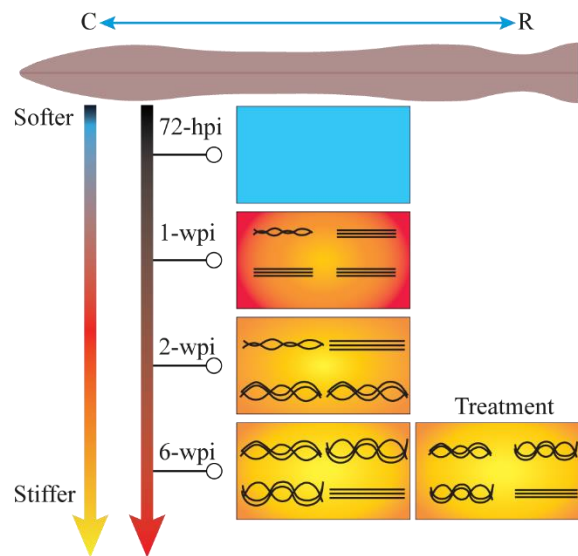
Disciplinary fields involved: Physics, biology and medicine.

Organization of collagen I fibers and tissue hardening: markers of fibrotic scarring after spinal cord injury in mice revealed by multiphoton-atomic force microscopy imaging

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Spinal cord injury (SCI) is a dramatic disease leading to severe motor, sensitive and autonomic impairments. After the injury, the axonal regeneration is partly inhibited by the glial scar, acting as a physical and chemical barrier[1]. The scarring process involves microglia, astrocytes, and extracellular matrix components, such as collagen, composing the fibrotic part of the scar[2]. To investigate the role of collagen and microglia, we used a multimodal label-free imaging approach combining multiphoton and atomic force microscopies. The second harmonic generation signal exhibited by fibrillar collagen-I enables specifically monitoring it as a biomarker of the lesion. An increase in collagen density and the formation of more curved fibers over time after SCI are observed. Whereas 2-photon excitation microscopy (2PEF) showed the appearance and activation of microglia over millimeters in length near the injured area. Nano-mechanical investigations revealed a noticeable hardening of the injured area, correlated with collagen fibers' development. Additionally, we observed that inhibition of microglial proliferation by oral administration of GW2580 decreased the collagen density at the injured area. These observations indicate the concomitance of relevant structural and mechanical modifications during the fibrotic scar evolution.



References:

- [1] J. C. Perez, Y. N. Gerber, and F. E. Perrin, "Dynamic Diversity of Glial Response Among Species in Spinal Cord Injury," *Frontiers in Aging Neuroscience*, vol. 13. Frontiers Media S.A., Nov. 26, 2021. doi: 10.3389/fnagi.2021.769548.
- [2] Z. Li et al., "Fibrotic Scar After Spinal Cord Injury: Crosstalk With Other Cells, Cellular Origin, Function, and Mechanism," *Frontiers in Cellular Neuroscience*, vol. 15. Frontiers Media S.A., Aug. 26, 2021. doi: 10.3389/fncel.2021.720938.

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