Longitudinal in vivo assessment of tissue alterations and synaptic density as non-invasive biomarkers for traumatic spinal cord injury

Schrauwen C (1,2,3), Van Spilbeeck I (1,2), Van Audekerke J (1,2), Halloin N(3), Jankovski A (5,6), Staelens S (4,2), Nicaise C (3), Verhoye M (1,2), Bertoglio D (1,2)

1) Bio-Imaging Lab, University of Antwerp, Antwerp, Belgium
2) µNeuro Center for Excellence, University of Antwerp, Antwerp, Belgium
3) URPhyM–NARILIS, University of Namur, Namur, Belgium
4) Molecular Imaging Center Antwerp, University of Antwerp, Antwerp, Belgium
5) Institute of NeuroScience, NEURDivision, Universite Catholique de Louvain, Louvain, Belgium
6) Department of Neurosurgery, CHU UCL Namur, Yvoir, Belgium

Traumatic spinal cord injury (SCI) can lead to severe and lasting difficulties in movement and sensation, significantly affecting quality of life. Predicting recovery outcomes remains challenging due to the lack of reliable biological markers. My research explores how advanced imaging techniques could provide new insights into the progression of SCI and help predict recovery.

Using a rat model of cervical SCI with varying injury severities, we followed the healing process over six weeks with two types of imaging: MRI to visualize tissue damage and PET scans to assess changes in synaptic connections. MRI scans allowed us to measure the size of the injury and detect tissue alterations, while PET imaging targeted a specific protein (SV2A) involved neurotransmitter release and synaptic function. We also monitored the rats' motor skills to see how their functional recovery correlated with the imaging findings.

Our results showed that larger injuries caused more tissue damage and greater loss of synaptic connections. Although the injury size decreased over time, the extent of damage remained related to the initial severity of the injury. The combined imaging methods provided a comprehensive view of both structural and functional changes following SCI.

This study highlights the potential of MRI and PET imaging as non-invasive tools to track spinal cord injury progression. These techniques could play a key role in developing better ways to predict recovery and test new treatments for patients with SCI.