Investigating microstructural and histological alterations in a graded contusion rat model of spinal cord injury

Laermans Z (1,2), Schrauwen C (1,2,3), Van Spilbeeck I (1,2), Van Audekerke J (1,2), Halloin N (3), Nicaise C (3), Verhoye M (1,2), Bertoglio D (1,2)

(1) Bio-Imaging Lab, University of Antwerp.
(2) µNeuro Center for Excellence, University of Antwerp.
(3) URPhyM-NARILIS, University of Namur.

Traumatic spinal cord injury (SCI) is referred to as damage to the spinal cord caused by an external impact resulting in temporary or permanent functional changes and occurs most often at the cervical level of the spinal cord. It can cause paralysis, sensory disturbance, loss of independence, and other clinical manifestations and thus have an enormous impact on the quality of life. Despite the large amount of research that has already been conducted regarding SCI, no treatment options exist to fully restore the injured spinal cord. SCI has a complex pathophysiology where many factors are involved. However, the large heterogeneity in patients with traumatic SCI poses challenges. Experimental animal models can help to study SCI under controlled conditions. The objective of this research aims to microstructurally and histologically characterize graded severity contusion by using a cervical C5 contusion model in rats. The rats were divided into four experimental groups: sham surgery (laminectomy), mild SCI (100 kdyne), moderate SCI (250 kdyne), and severe SCI (400 kdyne) and their spinal cords were collected six weeks after the contusion surgery (chronic phase). Ex vivo diffusion MRI (7T Pharmascan) is used for microstructural characterization, including diffusion tensor imaging (DTI), diffusion kurtosis imaging (DKI), and fixel-based analysis (FBA). For the histological characterization, we are focusing on luxol fast blue (LFB), glial fibrillary acid protein (GFAP), ionized calcium-binding adaptor molecule 1 (Iba1), neurofilament-light (Nf-L) and synaptic vesicle glycoprotein 2A (SV2A). Region-specific analyses within each spinal cord (epicenter, rostral, and caudal of the lesion) will be performed, and outcome will be compared between experimental groups.