Diffusion Weighted MRI (DW-MRI) allows a non-invasive observation of molecular displacement in fluids and in soft matter. In the last decade, DW-MRI became a key tool in clinical diagnosis and in the study of brain pathologies, one of which is brain and spinal cord trauma. Following trauma, brain tissue may suffer secondary degeneration that amplifies the initial insult, while on the other hand, unlike many other tissues, the tissue hardly regenerates. In spinal cord trauma, these events lead to propagation of the damage to segments that are beyond the primary site of lesion, exacerbating the functional deficit. This work describes the ex-vivo imaging of experimental spinal cord injury, of the results of secondary degeneration and of induced regeneration, by the use of DW-MRI. The basic physical principals underlying DW-MRI and the practical application of the technique will be introduced. The findings of the DW-MRI and their correlation with immuno-modulatory treatments will be presented. As times allows, current challenges in the application of DW-MRI will be presented.

December 1, 2006.