# Cell Replacement Therapy and Electrophysiological Assessment in Rat Model of Spinal Cord Injury

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Spinal cord injury (SCI) currently affects 400,000 people in the United States and ranks second after mental retardation among neurological disorders in terms of cost to society.
SCI is characterized by the rapid development of necrosis in the damaged tissues, followed by a delayed secondary degeneration of surrounding neural tissue, which leads to paralysis.
Although the regenerative capacity of the adult central nervous system (CNS) is limited, stem cell therapies provide tremendous prospects for cellular replacement strategies. Stem cells have the ability to provide seemingly unlimited cell numbers *in vitro*. They are amenable to genetic engineering and have broad plasticity toward neural cell-types. To determine the utility of these cells for SCI, it will be essential to understand their pattern of integration, migration into damaged tissues, their survivability, and whether they can reestablish a neural architecture with therapeutic effect.
In our study, we have used a contusion injury model of SCI in rats with the NYU impactor for controlling and measuring the extent of injury.
Oligodendrocyte progenitors cells (OPC's) were generated from two different sources, Human Embryonic stem cells (hESC) and Induce Pluripotent stem cell (iPSC). These cells were transplanted into the spinal cord at and around the epicenter of injury to study and compare their parenchyma integration, survival and migration. I*n vitro* immunofluorescence revealed that most OPCs expressed oligodendrocyte markers, including CNPase, A2B5, O4, and Olig1. Migration and survivability was measured postmortem.
Together these results show the integration of both hESC- and iPSC- derived OPC's into the spinal cord with or without contusion injury and importantly without disruption of the parenchyma.
However, along with the benefits, the generation of OPCs from hESC and iPSC has its own limitations. The use of hESC has been considered unethical, although it is easy to obtain and culture *in vitro*. The advantage of iPSC in our experiments has opened up to explore new avenues overcoming the use of hESC ethical but the long time for reprogramming of somatic cells to pluripotency and possible tumorigenicity has limited its application. These limitations are challenges in the stem cell application therapies, which have to be explored to benefit human application.
The extent of injury and recovery after cell transplant were measured using (i) Basso-Beatie-Bresnahan motor behavioral scores (BBB), (ii) diffusion tensor MRI (DT-MRI) for imaging anatomical changes to detect the progress of injury and recovery, (iii) bioluminescent imaging (BLI) for *in vivo* cell tracking of the transplanted and (iv) Somatosensory Evoked Potential (SEP) monitoring, which has been associated with a combination of improved sensory conduction (increase in amplitude and decrease in latency in comparison to post-injury SEP signals as well as improvement in the motor evoked potentials signals.