

Systematic review of techniques for intramedullary transplantation for traumatic spinal cord injury in large animal models

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Background: A systematic review to assess the safety and efficiency of the techniques, volumes and number of stem cells transplanted in large animal studies for spinal cord injury.

Method: A search on Pubmed, Embase and Scopus where made, and the results extracted to Covidence. Review followed the PRISMA guidelines. SYRCLE's tool was made to assess risk of bias, and GRADE guidelines were used to assess certainty.

Results: After reviewing 827 articles, 27 were included. We identified 3 techniques: hand-held (n=15), percutaneous (n=8) and stereotaxic (n=4). The mesenchymal stem cell was the most studied cell type, followed by the neural stem cell. The embryonic stem cell and induced pluripotent stem cell have only been reported once each. There is a large span between volume (range 5-1000µL) and stem cells (range 1-10 x 10⁶) per intramedullary transplantation. All hand-held techniques used a 30 Gauge needle. Percutaneous transplantation used 20 to 26 Gauge and the stereotaxic transplantation used glass pipettes. Transplantation was divided in 1, 3 or 5 injections, ranging from 20 to 1000 µL per injection. We identified 25 unique motor outcome assessment tools. Improvement of motor function after transplantation of stem cells were seen in 26 studies. The only study not finding an effect transplanted neural stem cells using a percutaneous technique in a chronic canine model.

Conclusion: Stem cell transplantation seems to be safe and may improve motor function when done in an intramedullary technique. Yet, there is a vast heterogeneity between large animal studies and a need for more coherence between future protocols. In future research, we suggest using a stereotaxic technique, with multiple injections of smaller volumes.