Motor recovery and synaptic preservation after ventral root avulsion and repair with a fibrin sealant derived from snake venom.

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Abstract:

BACKGROUND: Ventral root avulsion is an experimental model of proximal axonal injury at the central/peripheral nervous system interface that results in paralysis and poor clinical outcome after restorative surgery. Root reimplantation may decrease neuronal degeneration in such cases. We describe the use of a snake venom-derived fibrin sealant during surgical reconnection of avulsed roots at the spinal cord surface. The present work investigates the effects of this fibrin sealant on functional recovery, neuronal survival, synaptic plasticity, and glial reaction in the spinal motoneuron microenvironment after ventral root reimplantation.

METHODOLOGY/PRINCIPAL FINDINGS: Female Lewis rats (7 weeks old) were subjected to VRA and root replantation. The animals were divided into two groups: 1) avulsion only and 2) replanted roots with fibrin sealant derived from snake venom. Post-surgical motor performance was evaluated using the CatWalk system twice a week for 12 weeks. The rats were sacrificed 12 weeks after surgery, and their lumbar intumescences were processed for motoneuron counting and immunohistochemistry (GFAP, Iba-1 and synaptophysin antisera). Array based qRT-PCR was used to evaluate gene regulation of several neurotrophic factors and receptors as well as inflammatory related molecules. The results indicated that the root reimplantation with fibrin sealant enhanced motor recovery, preserved the synaptic covering of the motoneurons and improved neuronal survival. The replanted group did not show significant changes in microglial response compared to VRA-only. However, the astroglial reaction was significantly reduced in this group.

CONCLUSIONS/SIGNIFICANCE: In conclusion, the present data suggest that the repair of avulsed roots with snake venom fibrin glue at the exact point of detachment results in neuroprotection and preservation of the synaptic network at the microenvironment of the lesioned motoneurons. Also such procedure reduced the astroglial reaction and increased mRNA levels to neurotrophins and anti-inflammatory cytokines that may in turn, contribute to improving recovery of motor function.