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3D-Printed Collagen/Chitosan Scaffolds Loaded with Exosomes Derived from Neural Stem Cells Pretreated with Insulin Growth Factor-1 for Neural Regeneration after Traumatic Brain Injury

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Abstract : Traumatic brain injury (TBI), as a kind of nerve trauma caused by an external force, affects people all over the world and is a global public health problem. Although there are various clinical treatments for brain injury, including surgery, drug therapy, and rehabilitation therapy, the therapeutic effect is very limited. To improve the therapeutic effect of TBI, scaffolds combined with exosomes are a promising but challenging method for TBI repair. In this study, we examined whether a novel 3D-printed collagen/chitosan scaffold/exosomes derived from neural stem cells (NSCs) pretreated with insulin growth factor-1 (IGF-I) scaffolds (3D-CC-INExos) could be used to improve TBI repair and functional recovery after TBI. Our results showed that composite scaffolds of collagen-, chitosan- and exosomes derived from NSCs pretreated with IGF-I (INExos) could continuously release the exosomes for two weeks. In the rat TBI model, 3D-CC-INExos scaffold transplantation significantly improved motor and cognitive function after TBI, as assessed by the Morris water maze test and modified neurological severity scores. In addition, immunofluorescence staining and transmission electron microscopy showed that the recovery of damaged nerve tissue in the injured area was significantly improved by 3D-CC-INExos implantation. In conclusion, our data suggest that 3D-CC-INExos might provide a potential strategy for the treatment of TBI and lay a solid foundation for clinical translation.

Keywords : traumatic brain injury, exosomes, insulin growth factor-1, neural stem cells, collagen, chitosan, 3D printing, neural regeneration, angiogenesis, functional recovery
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