Induced pluripotent stem cells for neural tissue engineering.

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Public Summary:

Scientific Abstract:
Induced pluripotent stem cells (iPSCs) hold great promise for cell therapies and tissue engineering. Neural crest stem cells (NCSCs) are multipotent and represent a valuable system to investigate iPSC differentiation and therapeutic potential. Here we derived NCSCs from human iPSCs and embryonic stem cells (ESCs), and investigated the potential of NCSCs for neural tissue engineering. The differentiation of iPSCs and the expansion of derived NCSCs varied in different cell lines, but all NCSC lines were capable of differentiating into mesodermal and ectodermal lineages, including neural cells. Tissue-engineered nerve conduits were fabricated by seeding NCSCs into nanofibrous tubular scaffolds, and used as a bridge for transected sciatic nerves in a rat model. Electrophysiological analysis showed that only NCSC-engrafted nerve conduits resulted in an accelerated regeneration of sciatic nerves at 1 month. Histological analysis demonstrated that NCSC transplantation promoted axonal myelination. Furthermore, NCSCs differentiated into Schwann cells and were integrated into the myelin sheath around axons. No teratoma formation was observed for up to 1 year after NCSC transplantation in vivo. This study demonstrates that iPSC-derived multipotent NCSCs can be directly used for tissue engineering and that the approach that combines stem cells and scaffolds has tremendous potential for regenerative medicine applications.

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