



## Application of Neural Stem Cells in Hearing Regeneration

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### DESCRIPTION

Neural stem cell transplantation has drawn a lot of attention recently as a novel therapeutic approach for replacing certain cells depleted by illness, such as those caused by neurodegenerative illnesses. Numerous studies have demonstrated the significant therapeutic impact that neural stem cell transplantation in various organs has on cell activation and regeneration as well as the repair of damaged neurons. This article elaborates on the relevant signal pathways of stem cells in the inner ear, the techniques for inducing the differentiation of endogenous and exogenous stem cells, the implantation procedure and regulation of exogenous stem cells after implanted into the inner ear, as well as the clinical use of various new materials. Although stem cell therapy still has some limits today, it is well known that it can be used to treat illnesses of the hearing. Stem cell therapy will become more prevalent in the treatment of inner ear ailments as associated research advances.

The Non-neuroectoderm (NNE) at the junction of the neural tube and the ectoderm thickens to become the Pre-Placodal Ectoderm (PPE) during the embryonic development of mammals when the expression of BMP alters (PPE). The auditory placode is formed at the front of the embryo by pre-placodal ectoderm. The auditory placode is squeezed from the surface of the ectoderm to form an auditory vesicle when FGF (fibroblast growth factors) and Wnt released from the mesenchyme and neural tubes are activated. The cochlear-vestibular ganglion is created when the SOX2-positive cell fraction in the auditory vesicle upregulates the pre-neural transcription factor bHLH and creates neuron precursor cells. Through cell proliferation, modification, and death, the cells in the auditory vesicle create the sensory and non-sensory components of the inner ear. The cochlear precursor cells in the organ of Corti have the ability to develop into neurospheres after birth. These cells can proliferate and then differentiate into

hair cells and supporting cells under the positive regulation of EGF (Epidermal Growth Factor), IGF (Insulin-Like Growth Factor-1), bFGF (Basic Fibroblast Growth Factor), Wnt, and Shh, and the negative regulation of p27Kip1. These cells include Lgr5, Lgr6, Abcg2, EPCAM, and CD271 positive cells. Precursor cells differentiate into hair cells under the regulation of the Atoh1, Shh, and Notch pathways. EGF, IGF, bFGF, LIF (Leukaemia Inhibitory Factor), and other pathways regulate the proliferation and differentiation of nestin and Sox2-positive neural stem cells generated from spiral ganglia into neurons and astrocytes. An essential regulatory function is played in this process by BDNF, GDNF (Glial Cell Derived Neurotrophic Factor), NT-3 (Neurotrophic Factor-3), RA (valproic acid), FA (Ferulic Acid), and other substances.

Many researchers have investigated the use of neural stem cell therapy in the inner ear in recent years, and they have seen some very encouraging outcomes. The main goal is to stimulate spiral ganglion and auditory hair cell regeneration in an effort to replace damaged cells and treat SNHL. Auditory neurons, hair cells, and supporting cells can all develop from neural stem cells found in the inner ear.

### CONCLUSION

Neural stem cells can thereby replace the injured cells after noise-induced inner ear injury while lowering spiral ganglion cell death. According to Iguchi et al., residual spiral ganglion cells are necessary for Cochlear Implantation (CI) to be effective, and following CI, neural stem cells can develop into glial cells and neuronal cells. Spiral ganglion cells can be fed by GDNF and BDNF to improve hearing after CI. Two basic components of stem cell treatment are used in the inner ear: exogenous stem cells are implanted, and indigenous stem cells are encouraged to proliferate and differentiate.

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