Medical Xpress

Triangles guide the way for live neural circuits in a dish

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Korean scientists have used tiny stars, squares and triangles as a toolkit to create live neural circuits in a dish.

They hope the shapes can be used to create a reproducible neural circuit model that could be used for learning and memory studies as well as drug screening applications; the shapes could also be integrated into the latest neural tissue scaffolds to aid the regeneration of neurons at injured sites in the body, such as the spinal cord.

Published today in the Journal of Neural Engineering, the study, by researchers at the Korea Advanced Institute of Science and Technology (KAIST), found that triangles were the most effective shape for helping to facilitate the growth of axons and guide them onto specific paths to form a complete circuit.

Co-author of the study, Professor Yoonkey Nam, said: "Eventually, we want to know if we can design a neural tissue model that biologically mimics some neural circuits in our brain."

A neuron is an electrically excitable cell that processes and transmits information around the body. The neuron is composed of three main parts: a cell body, or soma, dendrites and an axon, which extends from the soma and links to other cells, creating a network.

When axons grow they are usually guided by proteins. Many researchers have been trying to re-create this key process in a dish by manipulating nerve cells from rat brains.

As nerve cells are usually just a few tens of micrometres in size, the challenge associated with creating a live neural network is firstly positioning cells in desired locations and, secondly, making connections between these cells by guiding the axons in designated directions.

The researchers investigated whether two star shapes, five regular shapes (square, circle, triangle, pentagon and hexagon) and three different sizes of isosceles triangles could guide axons in designated directions. Each shape was the size of a single cell and was replicated to form an array which was printed onto a glass surface.

Each of the arrays had an overall size of 1cm-by-1cm with a gap of 10 micrometres between each shape. Hippocampal neurons were taken from rats and plated onto the patterned surfaces. The neurons were fluorescently labelled with dyes so that images could be taken of their growth.

The researchers found that triangles were the most efficient shape to encourage the growth and guidance of an axon. The key to this was the angles at the points where two of the triangle's lines meet, also known as the vertices. It was shown that the smaller the vertices, the higher chance the triangle had of inducing growth.

"Based on our results, we are suggesting a new design principle for guiding axons in a dish. We can control the axonal growth in a certain direction by putting a sharp triangle pointing to a certain direction. Then, a neuron that adhered to the triangle will have an axon in the sharp vertex direction.

"Overall, we integrated microtechnology with neurobiology to find a new engineering solution" continued Professor Nam.

More information: "Geometric effect of cell adhesive polygonal micropatterns on neuritogenesis and axon guidance" Jang M J and Nam Y 2012 *J. Neural Eng.* 9 046019 iopscience.iop.org/1741-2552/9/4/046019

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