Medical Xpress

Clues to neuronal health found in tree-like nerve cell structures

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Using the small, round worm C. elegans, researchers have discovered how elaborate dendritic trees (tree-like nerve structures) are formed and maintained. Possible applications include treatments for neurodegenerative diseases and repair of injuries in which neurons are damaged.

A breakthrough about the formation and maintenance of tree-like nerve cell structures could have future applications in the treatment of neurodegenerative diseases and the repair of injuries in which neurons are damaged. The findings by the international team led by Prof. Benjamin Podbilewicz of the Technion-Israel Institute of Technology Faculty of Biology are published in the May 6th issue of *Science Express.*

While biologists have known for years that many neurons form complicated tree-like structures, it was not known HOW the neurons form and maintain them. To unravel this mystery, the team first studied the dynamic development of two neurons (called PVDs) required for reception of strong mechanical stimuli in the round worm Caenorhabditis elegans (*C. elegans*). [Prof. Podbilewicz cites Martin Chalfie, the Nobel laureate from Columbia University, as having previously shown that when a worm is hit on the body, it responds by moving away, demonstrating that the PVDs are necessary for *C. elegans* to sense pain.]

"The PVDs also elaborate neuronal trees comprising structural units we call 'menorahs,' because they look like multi-branched candelabra," said

Prof. Podbilewicz, adding that each of these tiny branches is just one-millionth of an inch in diameter.

Using light and electron microscopy in live and fixed *C. elegans*, the team also studied how the number, structure and function of these menorahs were maintained. In doing so, they discovered that a membrane protein called EFF-1 (which is also essential for the mediation of fusion between cells to form giant, multi-nucleate cells) has important roles in menorah formation and maintenance.

According to Prof. Podbilewicz, EFF-1 also acts in the PVDs to trim the branches of neuronal tree menorahs. When the gene encoding for EFF-1 was deleted, the *C. elegans* displayed disorganized menorahs with many more branches. And too much EFF-1 in the PVD reduced branching. By cutting, retracting and fusing branches, EFF-1 prunes excess or abnormal branches, serving as part of a quality control process that is important for sculpting and maintenance of complicated menorahs.

The scientists arrived at their findings during studies of the small (one millimeter long) *C. elegans*, which is considered to be an ideal animal for studying neuronal biology. Since humans are believed to have more than 100 billion neurons, understanding how they develop, connect and function is nearly impossible. But since *C. elegans* has just 302 neurons, the animal has been a veritable gold mine in the study of neurons, as well as many other fields of biology (including how organs form, how embryos develop, aging, and the programmed death of cells).

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