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A step forward in regenerating and repairing damaged nerve cells

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A team of IRCM researchers, led by Dr. Frédéric Charron, recently uncovered a nerve cell's internal clock, used during embryonic development. The discovery was made in collaboration with Dr. Alyson Fournier's laboratory at the Montreal Neurological Institute. Published today in the prestigious scientific journal *Neuron*, this breakthrough could lead to the development of new tools to repair and regenerate nerve cells following injuries to the central nervous system.

Researchers in Dr. Charron's laboratory study neurons, which are the nerve cells that make up the central nervous system (brain and spinal cord). They want to better understand how neurons navigate through the developing embryo to arrive at their correct destination.

"To properly form neural circuits, developing axons (long extensions of neurons that form nerves) follow external signals to reach the right targets," says Dr. Frédéric Charron, Director of the Molecular Biology of Neural Development research unit at the IRCM. "We discovered that nerve cells also have an internal clock, which changes their response to external signals as they develop over time."

For this research project, IRCM scientists focused on the Sonic Hedgehog (Shh) protein, which gives cells important information for the embryo to develop properly and plays a critical role in the development of the central nervous system.

"It is known that axons follow the Shh signal during their development,"

explains Dr. Patricia Yam, research associate in Dr. Charron's laboratory and first author of the study. "However, axons change their behaviour once they reach this protein, and this has been a mystery for the scientific community. We found that a nerve cell's internal clock switches its response to external signals when it reaches the Shh protein, at which time it becomes repelled by the Shh signal rather than following it."

"Our findings therefore showed that more than one system is involved in directing axon pathfinding during development," adds Dr. Yam. "Not only do nerve cells respond to external signals, but they also have an internal control system. This discovery is important because it offers new possibilities for developing techniques to regenerate and repair damaged nerve cells. Along with trying to modify external factors, we can now also consider modifying elements inside a cell in order to change its behaviour."

Injuries to the central nervous system affect thousands of Canadians every year, and can lead to lifelong disabilities. Most often caused by an accident, stroke or disease, these injuries are very difficult to repair. New tools are therefore required to repair damage to the central nervous system, including techniques that could potentially regenerate nerve cells.

"The Canadian Institutes of Health Research is delighted to support research aimed at improving the lives of individuals with damage to the brain or spinal cord," says Dr. Anthony Phillips, Scientific Director of CIHR's Institute of Neurosciences, Mental Health and Addiction. "Nerve cell repair and regeneration remains an important health challenge, and we believe that Dr. Charron's research findings will contribute to the solution."

More information: *Neuron*: