A clear view of the nervous system

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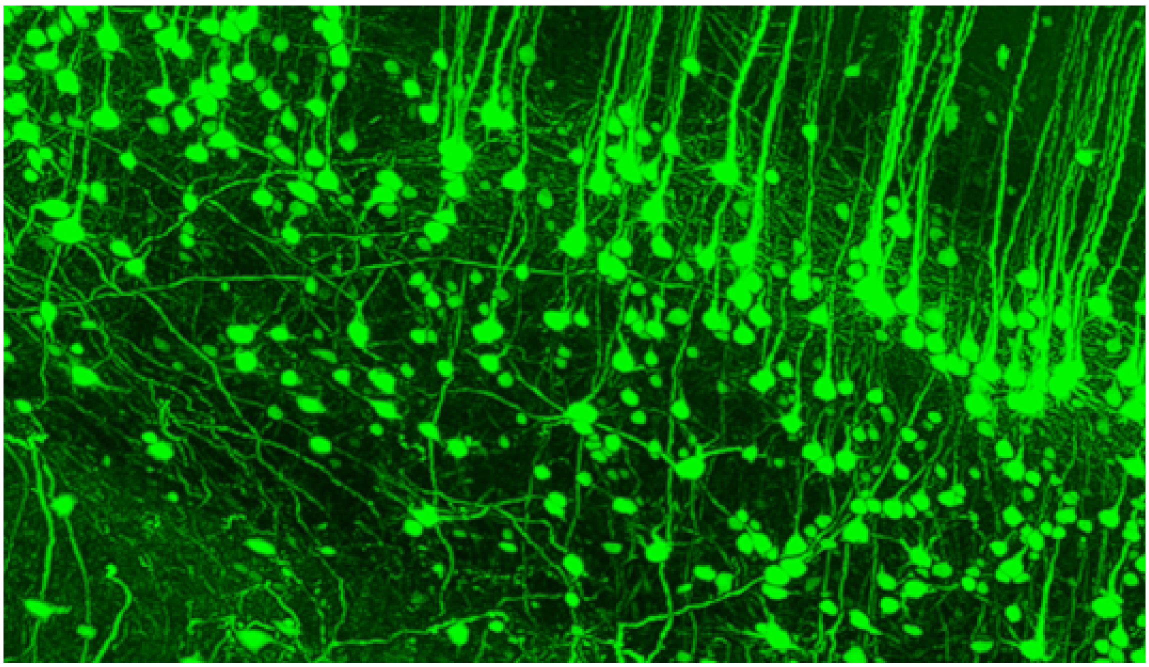

Neuronal structures at subcellular resolution in the cortex. Credit: Ludwig Maximilian University of Munich

A new and versatile imaging technique enables researchers to trace the trajectories of whole nerve cells and provides extensive insights into the structure of neuronal networks.

Lesions caused by traumatic brain damage, stroke and functional decline due to aging processes can disrupt the complex cellular network that constitutes the central nervous system, and lead to chronic pathologies, such as dementia, epilepsy and deleterious metabolic perturbations.

"How exactly this happens is completely unknown," says Dr. Ali Ertürk, who heads a research group at the Institute for Stroke and Dementia Research at the LMU Medical Center. Ertürk and his team previously developed and have now refined a novel imaging technique that allows them to visualize and monitor these structural alterations in neuronal networks. The new findings appear in the journal *Nature Methods*.

Nerve cells transmit electrical impulses over long distances along fibrous connections called axons, which extend from the cell body where the nucleus resides. Indeed, many neurons in the brainstem possess axons that project as far as the base of the spinal column. Thus damage to these axons can affect the function of parts of the central nervous system that are remote from the actual site of injury. The new imaging method is based on a clearing-and-shrinkage procedure that can render whole organs and organisms transparent, making—for instance—the full length of the rodent spinal cord accessible to optical imaging. Moreover, the technique is applicable down to the level of individual cells, which are labeled with fluorescent protein tags and can be visualized under the microscope by irradiating them with visible light. This enables researchers to map complex neuronal networks in rodents in 3D, a significant step in revealing the enigma behind the human brain.

Because essentially all cell types—including immune cells and tumor cells—can be specifically labeled with the aid of appropriate fluorescent markers or antibodies, the new method can be employed in a broad range of biomedical settings. "Since it allows individual cells to be localized, the method could be used to detect and characterize metastatic tumors at an earlier stage than is now feasible, or to monitor how stem cells behave in the body following a bone-marrow transplant," says Ertürk. Furthermore, the images obtained can be archived in a database and made available to other researchers, which should help reduce unnecessary duplication of studies. Ertürk and his colleagues are already planning to assemble such an online archive.

More information: *Nature Methods*, nature.com/articles/doi:10.1038/nmeth.3964

Provided by Ludwig Maximilian University of Munich