The nervous system consists of two major cell types: neurons and glial cells. For a long time neurons stood in the center of interest for their important roles and special functions. In the past few years numerous researches had shown that beside the neurons, glial cells also have a significant role in the operation of the nervous system. These cells do not only fill the space between nerve cells as it was thought before but they also participate in the recyclization of the metabolites made by neurons. They regulate the synaptic process between two nerve cells and with the configuration of the blood-brain barrier they defend the whole nervous system from mechanical or molecular impacts.

However, it seems that there are still a lot of unknown functions and procedures, controlled by glial cells, even undiscovered glial subtypes may exist. For the proper investigation of these functions it is necessary to have a clear vision of the ultrastructure of those cells. Therefore we put the electronmicroscopical examination of single-labelled glial cells in the focus of our research. For model organism we used fruit-flies (Drosophila melanogaster) instead of rat or other mammals. The advantages of the fly strains are they can be kept in small place, the development of the animals are fast and last but not least their nervous system and genomic sequences are very similar to mammals in numerous ways, so the results can be referred even to human brain researches.

In this experiment with crossing of Drosophila strains we created a transgenic line where some glial cells are single-labelled in the nervous system. Those cells expresses a membrane-specific protein, the horseradish-peroxidase enzyme. The brain of those animals were dissected, fixed and the marked cells were developed with DAB-reaction. After the reaction, the whole cell membrane with its projections became visible and could be easily recognised. The samples were embedded in Durcupan epoxy resin and were cut into ultra-thin sections. After that, the complete sections were studied under electronmicroscope. To our first knowledge this is the first genetic method to label glial cells directly for electron microscopic examination.

The proper investigation of single cells in the level of the electronmicroscope is required to have precise knowledge about neurodegenerative diseases and basic functional processes in the central nervous system, therefore our method hopefully could provide help for all the scientists working in this field.

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Fig. 1: Single labeled glial cell visualized in Drosophila brain tissue. Light microscope image of the projections of a single glial cell. Arrowheads indicate the borders of the cell marked by horseradish-peroxidase. Scale: 10μm.

Fig. 2: Electron microscopy images of the ultrastructure of the nervous tissue. The HRP labels the membrane of the specific glial cell (white arrows), allowing observation of structures of the cytoplasm. Asterix: mitochondria, L: lipid droplet, N: nucleus. Black arrowheads mark the endoplasmic reticulum.

Fig. 3: Fluorescent images of a surface glial cell forming part of the blood-brain-barrier in Drosophila. Red Fluorescent Protein (RFP) was bound to the HRP enzyme, all cell nuclei are labeled with HisGFP. Scale: 50μm.