Physical exercise as a natural mechanism inducing neuroregeneration. Search for the new protein markers and therapeutic targets for Parkinson's disease.

It is well known that regular physical exercise improves overall health and fitness. But not only, they also affect our brain, e.g. by improving memory. It is also known that properly chosen physical activity and rehabilitation is beneficial for recovering the functioning of the nervous system of patients after e.g. injuries or strokes. It is also beneficial in counteracting the aging process. Recent years have brought numerous confirmations from clinical studies that exercise is also beneficial in the course of Parkinson's disease. Regular physical exercise in the form of running on a treadmill, but also Nordic Walking, dancing or even boxing, improves the possibility of free movement, gait quality, reduces the number of falls and, above all, prolongs the possibility of independent life of patients. Official recommendations for the treatment of Parkinson's disease included rehabilitation and physical training, along with pharmacotherapy, as necessary supportive therapy.

Closer experimental brain research has shown that training can have a protective effect on dopamine-producing neurons that are slowly dying as a result of Parkinson's disease. Regular physical activity slows down the disease progression and can even reduce the dose of drugs, which in the long run cause disabling side effects. At the cellular level, it is known that the disease process reduces while training itself increases the production of important protective factors in the brain, such as BDNF or GDNF, strengthens the antioxidant system, and above all causes the sprouting of terminals of various neurons, supporting signaling between brain structures. In the course of Parkinson's disease, such a growth of the terminals of remaining living dopamine neurons would be very beneficial, as it would allow functional, even if only partial, restoration of damaged connections between structures in the brain that are responsible for the possibility of free body movement.

Unlike peripheral nerves, the brain has much less regenerative potential. Although, experimental studies show that maybe this is possible. In experimental models of Parkinson's disease it has been shown that when the damage to dopamine neurons is not too extensive, the surviving neurons can compensate, including their growth and sprouting, and maintain the system functioning almost normally for some time.

Several studies have been conducted on the effects of physical exercise on the progression of dopamine neuron deaths, but none of them focused on neural terminals sprouting in the target structure of the dopaminergic neurons - striatum. Our research will analyze this aspect from the point of view of cell morphology as well as analysis of the proteins involved in this process. We will also compare the process of natural growth of endings induced by exercise to the process of compensation after partial damage of dopamine neurons and look for additional mechanisms that can intensify neuroregeneration. We will also consider the function of astrocyte cells in the brain because they are mostly responsible for supporting neurons by production of trophic factors, energetically, functionally and structurally.

We will use the DIGE method, which allows us to study the precise amount of many (> 100) proteins simultaneously. This will allow us to determine what molecular pathways are involved in the neuronal regeneration process. Currently, clinical trials are ongoing testing new drugs, aimed at enhancing the growth of nerve endings as a therapy for various neurological diseases, such as stroke or injuries. Including very spectacular research on spinal cord regeneration. On the basis of our research on proteins and already studied drugs, we want to find such proteins that may become new targets for future effective neuroregenerative therapies in Parkinson's disease.

So far there is no cure for Parkinson's disease, there is no therapy stopping or even effectively postponing its progression. Drugs used in clinic can temporarily diminish symptoms but soon they produce serious side-effects. The studies on neuroregeneration will bring hope for restoration of damaged dopaminergic system but can also be helpful in multiple other neurodegenerative diseases.