

## Mitochondrial Recycling in Neurons is linked to Genes Mutated in Parkinson's disease

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### Introduction

New research led by Gladstone Institutes experts has shed light on the involvement of genes like PINK1 and Parkin, which have been linked to Parkinson's disease, in the recycling of energy-generating mitochondria in brain cells. The findings of the published trials, supported up by further research, could hint to new therapeutic pathways, according to the researchers.

"This research provides us with unique insight into the life cycle of mitochondria and how they are recycled by crucial proteins that, when altered, cause Parkinson's disease," said Nakamura. "It shows that mitochondrial recycling is important for maintaining healthy mitochondria, and that disrupting this mechanism can lead to neurodegeneration. Future research will look into how these pathways contribute to disease and how they might be therapeutically targeted."

Living cells have long been recognized to be expert recyclers, continuously breaking down old pieces and reassembling them into new molecular machinery. Damaged mitochondria are degraded in most cells through a process called mitophagy, which is triggered by two proteins called PINK1 and Parkin. Hereditary types of Parkinson's disease are also caused by mutations in these proteins. While the involvement of PINK1 and Parkin in mitophagy has been extensively researched in a variety of cell types, it is unknown if these proteins act in the same way in neurons, which are the cells that die in Parkinson's disease. "Altered mitochondrial quality control and dynamics may contribute to neurodegenerative illnesses, such as Parkinson's disease," the researchers said, "but we know very little about these mechanisms in neurons." Indeed, neurons have disproportionately high energy demands, and their mitochondria are far more resistant to Parkin breakdown than those of other cell types.

Nakamura's team studied mitochondria inside real neurons to see how PINK1 and Parkin altered their fate in their latest study. Mitochondria are small and move about inside cells, fusing or dividing in half regularly, making them difficult to track. "We needed to come up with a new approach to track individual mitochondria over long periods of time, practically a day," says the researcher.

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The researchers also utilised a technique that allowed them to create mitochondria that were larger than typical, making them easier to view under a microscope. "We used a combination of time-lapse microscopy, correlative light and electron microscopy, and time-lapse microscopy to track individual mitochondria in neurons lacking the fission-promoting protein dynamin-related protein 1 (Drp1) and delineate the kinetics of PINK1-dependent mitochondrial quality control pathways," they explained. The method's high resolution should aid researchers in learning more about how Parkin and PINK1 affect mitochondrial breakdown in Parkinson's disease. The scientists discovered that Parkin proteins ringed injured mitochondria and targeted them for disintegration in the recently published investigations, suggesting that mitophagy begins in neurons in the same way it happens in other cell types. "Parkin is recruited to the outer mitochondrial membrane by depolarized mitochondria, inducing autophagosome formation, fast lysosomal fusion, and Parkin redistribution, according to the study."

The scientists could, however, see the process develop in amazing detail thanks to the new technology. They revealed the crucial first steps in the formation of mitolysosomes, which degrade mitochondria by fusing damaged, Parkin-coated mitochondria with other components inside the cell. The researchers said, "We were able to depict these steps at a level that hasn't been done before in any cell type".

The researchers then looked at what happens to mitochondria in mitolysosomes during the later stages of mitophagy. "No one has known what occurs next to these mitolysosomes until

now,” Nakamura added. Scientists had previously supposed that they quickly degrade into compounds that the cell can utilise to regenerate new mitochondria. However, Nakamura and his colleagues discovered that mitolysosomes could persist for hours inside cells.

Some mitolysosomes were surprisingly and unexpectedly swallowed by healthy mitochondria, while others ruptured, releasing their contents into the inside of the cell, including some proteins that were still functional. “We discovered that after mitophagosomes and lysosomes fuse, the resulting acidic mitolysosomes interact with other healthy mitochondria for several hours and are occasionally absorbed by functional mitochondria,” the researchers wrote. Furthermore, a subset of them finally normalize their pH, rupture, and discharge their contents into the cytosol,” are according to the researchers.

Importantly, the study demonstrates that the scientists' proposed recycling route necessitates the presence of PINK1 and Parkin, implying that mitochondrial recycling may be important in preventing neuro-degeneration in Parkinson's disease. “Mutations in PINK1 and Parkin are particularly vulnerable to dopamine neurons that die in Parkinson's disease,” said Nakamura. “Our research adds to our knowledge of how these two important Parkinson's disease proteins breakdown and recycle mitochondria.”

The new findings, according to the scientists, raise "important questions." Scientists need to know how and why mitolysosomes

merge with mitochondria and are consumed by them, as well as how much mitochondrial material is recycled as a result of these activities. “It will also be critical to further characterize how mitolysosomes burst and if this helps recycling of degraded mitochondrial contents and degradation of nonrecyclable components,” they wrote, as well as to understand how and when these activities are essential for neuronal health and survival. “More study is needed to see if the processes of mitochondrial quality control we've described here, such as the release of mitochondrial contents into the cytosol, might trigger immunological and other signalling cascades and contribute to neurons' selective sensitivity to PINK1 and Parkin mutations.”

## References

1. Genetic Engineering and Biotechnology News. (2021). Genes Mutated in Parkinson's Disease Linked to Mitochondrial Recycling in Neurons.
2. Nakamura, K (2021). Researchers uncover new mitochondrial recycling pathway that may be linked to Parkinson's disease. News Medical life Sciences.
3. Li H, Doric Z, Berthet A, Jorgens DM, Nguyen, MK, et al. (2021). Longitudinal tracking of neuronal mitochondria delineates PINK1/Parkin-dependent mechanisms of mitochondrial recycling and degradation. Science Advances.
4. Ray F (2020) Impaired Mitochondrial Recycling Drives Neuron Death in Parkinson's, Study Indicates. Parkinson's News Today.