Model neurons have implications for ALS and other afflictions

December 12 2013, by James Devitt

NYU biologists have created model neurons with greater precision and efficiency than have been achieved in the past. Their breakthrough, which appeared this fall in a pair of papers in the journal *Nature Neuroscience*, has potential implications for addressing a range of afflictions, including amyotrophic lateral sclerosis (ALS), or Lou Gehrig's Disease, and spinal muscular atrophy (SMA).

ALS, which affects adults, and SMA, which afflicts infants and young children, both involve malfunctioning of motor neurons and, with it, diminished muscle control.

To combat these maladies, researchers have sought to find ways to create neurons, or nerve cells, that could replace malfunctioning or inactive ones. Their focus has largely been on embryonic stem cells, which can self-replicate and can be guided to differentiate into any number of identities. Embryonic stem cells stand in contrast to adult stem cells, which take a reduced number of forms—for instance, an adult stem cell for hair can only contribute to the formation of hair, while an embryonic stem cell has the potential to replace any part of the body.

"But the issue is how do we get them to grow into the cells we want them to be," explains Esteban Mazzoni, a professor in the Department of Biology and senior author of both *Nature Neuroscience* studies.

Previous methods have relied on making the embryonic stem cells transition through a progression of differentiated steps until they reached

a fully differentiated fate. However, because not every cell makes it through all the steps, only a fraction of the starting population develops into the desired neuronal fate. Moreover, the remaining cells present a safety concern for clinical applications—because of their potential to divide and/or multiply uncontrollably, they have the potential to develop into cancer cells.

"We need to know how to guide their growth so they are an exact copy of the dysfunctional cells they are replacing—precision is vital to success," Mazzoni adds.

To avoid these pitfalls, the researchers sought to make the cells bypass all the intermediate stages and go directly to the final differentiated state; in doing so, they hypothesized that virtually every cell would become precisely the motor neuron cell types that are affected in ALS and SMA.

In their research, Mazzoni and his colleagues created, in vitro, two types of model neurons—those that malfunction and die in those afflicted with ALS and SMA, and those that function normally. These embryonic stem-cell-derived neurons are a copy of those affected in ALS and SMA and are able to find their connection targets when implanted into developing embryos.

"We now have the ability to model complex genetic diseases in vitro, which allows us to devise cells that can replace damaged ones or use the cells in vitro to find potential therapeutic targets," says Mazzoni.

Provided by New York University