

Mini human 'brains' grown in lab for first time

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We rely on mouse brains to help us understand [our most complex organ](#) when you can grow a model of a human one? Tiny "brains" that include parts of the cortex, hippocampus and even retinas, have been made for the first time using stem cells. The 3D tissue structures will let researchers study the early stages of human brain development in unprecedented detail.

Because human brains are so different from those of most animals, looking at how animal brains develop only gives us a crude understanding of the process in humans. "Mouse models don't cut it," says [Juergen Knoblich](#) at the Institute of Molecular Biology (IMB) in Vienna, Austria.

To grow their miniature brains, Knoblich and colleagues took induced pluripotent stem (iPS) cells – adult cells reprogrammed to behave like embryonic stem cells – and gave them a mix of nutrients thought to be essential for brain development. The stem cells first differentiated into neuroectoderm tissue, the layer of cells that would eventually become an embryo's nervous system. The tissue was suspended in a gel scaffold to help it develop a 3D structure.

Right food, right structure

In less than a month, the stem cells grew into brain-like "organoids" 3 to 4 millimetres across and containing structures that corresponded to most of the regions of the brain. For example, all the organoids they made appeared to contain parts of the cortex, about 70 per cent contained a choroid plexus – which produces spinal fluid – and about 10 per cent contained retinal tissue.

"If you provide the right nutrients, they have amazing capacity to self-organise," says team member Madeline Lancaster, also at the IMB.

However, one brain region that wasn't present was the cerebellum, the part of the brain that handles motor skills and language, among other functions. This isn't surprising, says Lancaster, since this region develops later than the others.

Using imaging techniques, the researchers were even able to detect neural activity (see video, above), although this doesn't mean the brain is conscious in anyway.

Too few stem cells

The model has already provided new insights into the sorts of things that can go wrong during development. For example, to understand why a fetal brain sometimes doesn't reach full size, a condition called microcephaly, the researchers grew organoids using iPS cells derived from a person with the condition.

During the initial stages of typical brain development, stem cells go through a period in which they divide to make more stem cells, increasing their numbers. After a certain period, some of these stem cells switch to producing neurons, a stage known as asymmetric division.

By studying the model of the microcephalic brain, the team found that the period of stem cell multiplication was shorter than usual. This means there are not enough stem cells available to turn into neurons, leading to a smaller brain overall.

The researchers found that the reduced number of neurons in the microcephalic models was linked to a lack of a protein called CDK5RAP2. When they added this protein to the microcephalic organoids, the number of neurons increased.

Not conscious

Currently, the organoids are roughly equivalent in size to a human brain during early fetal development. To grow larger brains, the stem cells would also have to differentiate into blood vessels to supply nutrients to the growing organoid. This is more difficult than growing brain tissue alone.

However, if the team could amend their technique to incorporate this, it would allow them to model later stages of brain development, which could lead to insights into conditions such as autism and schizophrenia.

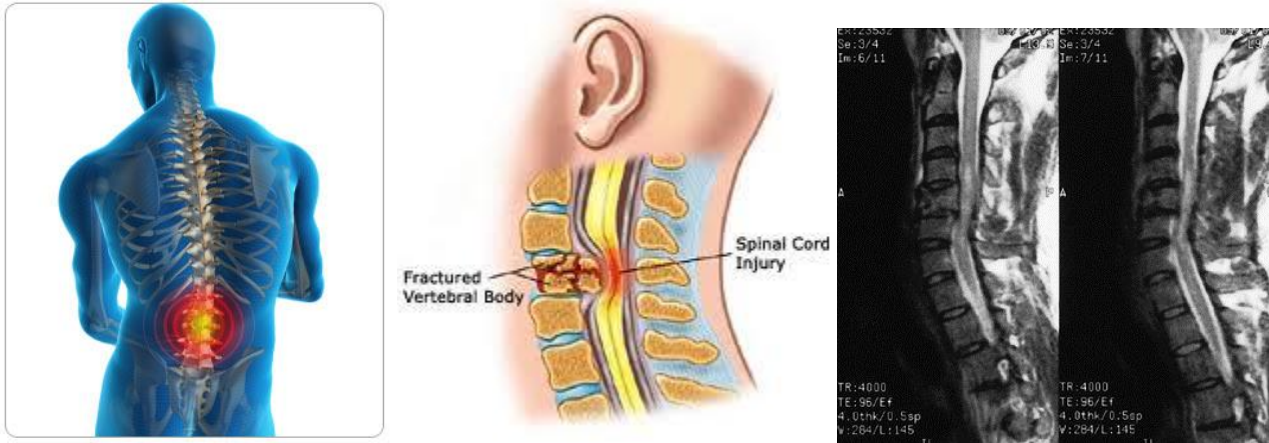
One thing the brains won't be able to do though is become conscious. Knoblich says that although they provide a good structural model, the complex activities necessary for higher brain function cannot be reproduced.

[Martin Coath](#) of the Cognition Institute at Plymouth University, UK agrees: "Anything that might reasonably be called a real brain is going to have to pass more tests than simply being made of brain cells and looking a bit like a brain under a microscope."

He adds: "Any technique that gives us 'something like a brain' that we can modify, work on, and watch as it develops, has to be exciting. But just how exciting will depend on the results it produces."

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Treatment - Spinal Cord Injury



A spinal cord injury usually begins with a sudden, traumatic blow to the spine that fractures or dislocates vertebrae. The damage begins at the moment of injury when displaced bone fragments, disc material or ligaments bruise or tear into spinal cord tissue. Spinal cord injuries cause myelopathy or damage to nerve roots or myelinated fiber tracts that carry signals to and from the brain.

Stem cell derived from human umbilical cord or bone marrow improves mobility with spinal cord injuries providing the first physical evidence that the therapeutic use of these cells can help restore motor skills lost from acute spinal cord tissue damage. Patients are treated by injecting the stem cells directly into damaged area or in the cerebrospinal fluid which flows within the spinal canal. This procedure is called intrathecal injection or lumbar puncture. After the treatments, improvements were reported by patients with both incomplete and complete injuries. The Stem Cell Spinal cord injury treatment is unique because it focuses on repairing damaged tissue and restoring function to improve each patient's quality of life. The entire treatment consists of three steps: bone marrow collection, laboratory processing and stem cell implantation of stem cell .