

Embedded microscopes for deep-tissue imaging could see reduction in animal use in research

April 30 2014, by Stuart Forsyth

Scientists are aiming to implant a tiny microscope into a rat that could monitor cellular changes and reduce the number of animals used in medical research over time.

The researchers will initially attempt to study spinal cells by attaching a microscope to the vertebrae of a rat to demonstrate that useful data can be gathered.

The technique could allow scientists to monitor [disease progression](#) or therapeutic effects in living organisms and reduce the number of animals sacrificed for research.

The £400,000 project is being funded by the National Centre for the Reduction, Refinement and Replacement of Animals in Research (NC3Rs) and the Engineering and Physical Sciences Research Council.

Lead investigator Professor Andy Harvey of the School of Physics and Astronomy at the University of Glasgow, said: "The use of in vivo microscopic imaging is widespread for fundamental research using animal models in biomedicine, for drug discovery and tracking disease progression.

"Deep-tissue imaging is, however, highly invasive and so termination of the animal normally occurs after each measurement.

"For experiments involving testing with multiple time points, for example in studying disease progression or cell migration, termination of an animal for each time point can require the use of a large number of animals to achieve a reliable research outcome.

"Furthermore this provides only snapshots of phenomena, hampering understanding of cell fate and function.

"If we can implant an imaging device we would be able to greatly reduce the number of animals being used and monitor the progression of a disease or the effects of treatment on the same animal."

The researchers will embed a microscope measuring just 5mm by 5mm by 10mm in size which will be cemented onto a vertebrae and attached to a power source. The aim is to provide real-time imaging.

Prof Harvey said: "This has never been done before. The technology is certainly there, but the big challenge will be in ensuring a stable image – countering the effects of movement and breathing – and finding out whether scar tissue causes any problems.

"The microscope will be sufficiently small and configured to be minimally intrusive for animal comfort. The microscope will be anchored with cement to a vertebrae and optical image guides will transmit images to detector arrays that can be remotely located within body cavities - like a pacemaker is fitted in humans with minimal or no discomfort. The [microscope](#) can be recovered at the end of the study."

The project offers several advantages in line with the NC3Rs' aims:

- the number of animals that would need to be sacrificed in typical experiments using animals could be reduced by as much as a factor of 10,

- improved accuracy since multiple experiments are conducted using a single animal,
- real-time imaging during normal animal behaviour will improve data quality and reduce animal distress.

Co-investigator Professor Sue Barnett, an expert in cellular neuroscience in the Institute of Infection, Immunity and Inflammation who studies spinal cord injury, said: "In vitro techniques – those done in Petri dishes – are always the preferred approach but they often do not mimic the complexity you find in a living organism.

"While we can study the effects of drugs aimed at repairing spinal cord injury in vitro, we are not seeing the effects that other cells in the body and the tissue environment have on the process.

"If we can establish a technique that helps us validate the methods we use in vitro it would be hugely helpful while reducing the reliance and burden on [animals](#)."

Provided by University of Glasgow

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