3D cell scans could help fight skin cancer

By Roger Highfield, Science Editor

Last Updated: 6:01pm GMT 05/12/2007

This is a scan of a single skin cell and marks the closest ever look at human tissue, using a new technique that could help provide new clues to stop the deadly spread of cancer.

- **Telegraph TV: 3D images of cells at work**

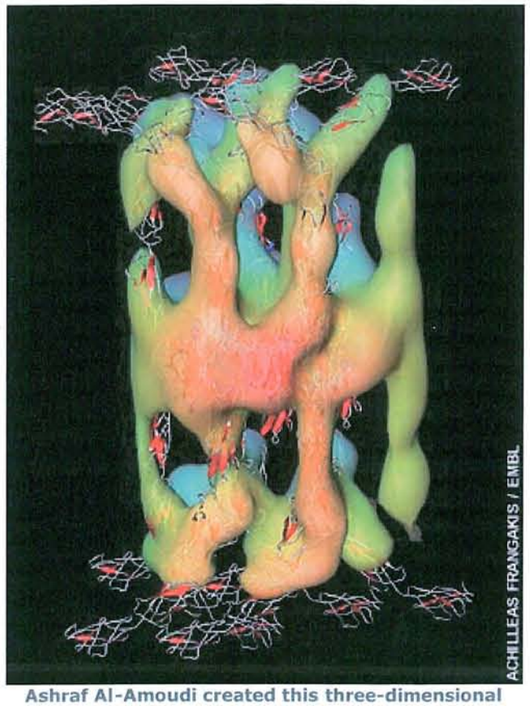
Although three dimensional scans of a body are now commonplace, the equivalent scan of a cell has been a long-standing goal of scientists. Now the feat has been achieved using a relatively new kind of microscope, revealing the molecular building blocks of a single skin cell.

The team focused on a class of proteins called cadherins, which play a key role as a kind of Velcro in enabling cells in skin and other organs to stick together, and which form a barrier for a tumour to overcome before spreading through the body, the most deadly feature of cancer, called metastasis.

Using the method of "cryo-electron tomography", researchers from the European Molecular Biology Laboratory, Heidelberg, have shown how proteins building blocks are arranged in a single cell for the first time.

In Nature they publish the first 3D image of human skin at molecular resolution. "This is a real breakthrough in two respects," says Dr Achilleas Frangakis, group leader. "Never before has it been possible to look in three dimensions at a tissue so close to its native state at such a high resolution.

"We can now see details at the scale of a few millionths of a millimetre. In this way we have gained a new view on the interactions of molecules that underlie cell adhesion in tissues - a mechanism that has been disputed over decades."



Ashraf Al-Amoudi created this three-dimensional scan of one of his own skin cells

A single cell is about 10 microns - one hundred thousandth of a metre - across and its innards are too tiny to see under a conventional light microscope.

And although the high voltage electrons in an electron microscope can easily do the job, they require a vacuum, and samples to be coated in a layer of metal, ruling out the use of this traditional method to take snapshots of a living cell.

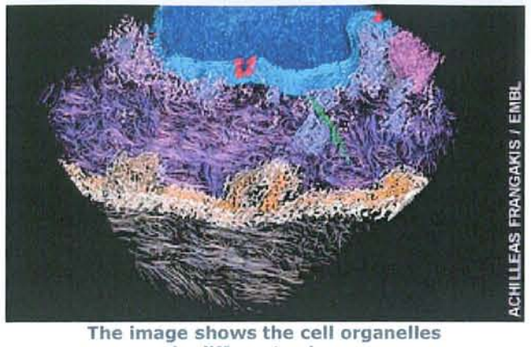
Here, Dr Frangakis and his team used a method called cryo-electron microscopy, which allows cells to be studied, after being frozen. Then using tomography, in which scans at different levels are built up to create a three dimensional picture, the team has put together this reconstruction of a human skin cell.

The image shows the "organs" - organelles - of the cell in different colours: the cadhedrins that stick cells together (sandy brown); the compartment that contains the DNA of the cell (blue), with pores (red); the cell's motorways, microtubules (green); the chemical batteries of the cell, mitochondria (purple); and a protein factory called the endoplasmic reticulum (steel blue).

The team focused on the cadherin proteins that are crucial for the integrity of tissues and organs like the skin and the heart, but also play an important role in the spread of cancers.

"We could see the interaction between two cadherins directly, and this revealed where the strength of human skin comes from," says Ashraf Al-Amoudi, who carried out the work on one of his own cells in Dr Frangakis' lab.

"The trick is that each cadherin binds twice: once to a molecule from the juxtaposed cell, and once to its next-door neighbour. The system works a bit like specialised Velcro and establishes very tight contacts between cells."



The image shows the cell organelles in different colours

Low levels of one kind of this protein, called E-cadherin, can help predict which patients with early breast cancer will need chemotherapy following surgery. It is not the original breast cancer that kills women but the tumour's spread to other sites. Low levels of E-cadherin indicate a substantially increased risk of metastasis, the spread of cancer that makes the disease difficult to treat.