

# Scientists detect tooth decay in the 3rd dimension

September 7 2004

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A team of scientists from Glasgow today revealed a new technique that will allow dentists to detect and study the tell-tale signs of tooth decay before too much damage is done. Speaking at one of the opening sessions at the Institute of Physics conference Photon 04 in Glasgow, Simon Poland outlined a new way of making a detailed 3D picture of a diseased area of a tooth, which could be done while a patient waits.

Simon Poland, from the Institute of Photonics at the University of Strathclyde, working with colleagues at the Glasgow Dental Hospital, and the University of Dundee, has used an existing imaging technique which creates optical sections (individual images or slices through a 3D object) using structured light (a beam of light in a grid pattern). They applied this technique to human teeth for the first time and succeeded in producing a 3D image of a diseased area of a tooth.

The scientists took a tooth with an area of known decay and shone a beam of structured infra-red light (of around 880nm) using a halogen lamp. They took sets of 3 images at different spatial phases and combined them using standard image processing techniques. This produces an optically sectioned image - many image "slices" which are put together to form a whole 3D image.

Speaking at Photon 04, the UK's premier conference for photonics and optics, Simon Poland said: "We've successfully produced a 3D image of a region of tooth decay which will allow dentists to study the process of decay, caused by food and drink, in great detail and in real time, as the

disease occurs, rather than after the fact.”

He continued: “The technique is fast and simple and we could attach an endoscope to our kit to allow dentists to use the device in the surgery. They would shine the endoscope at the tooth they wanted to examine, and by using high-speed CCD camera, the image could be delivered very quickly, in around twenty minutes or so.”

“Dentists usually detect disease by scraping and looking, or by taking X-rays but these methods only catch decay once it’s already quite serious. Some of the more complex techniques currently available only give dentists data readings. The advantage of a detailed 3D image like the one we’ve created is that it can reveal decay in its earliest stages, and lets the dentist take measures to stop or repair the damage before it gets too bad. It gives them a powerful diagnostic tool, and tells them about the size and shape of the disease, and its progression.”

Tooth decay is caused by acid produced when the sugar in plaque (bits of food and drink mixed with bacteria) breaks down. Fizzy drinks are particularly bad for teeth because they contain acid which begins to cause decay straight away. This leads to the break-down of the enamel (the protective surface coating) and mineral loss occurs. At this stage, re-mineralization is possible and is helped by good dental hygiene – regular cleaning with toothpaste and fluorine mouthwash. The technique developed by Simon Poland and his colleagues could help dentists catch disease early in the process, before too much mineral loss occurs, when the possibility of re-mineralisation still exists. If mineral loss continues unchecked, cavities begin to form and grow, then fillings are needed.

The team now intend to use the technique to study teeth in different stages of tooth decay and to devise an easy to use kit for use in dental practices.

Citation: Scientists detect tooth decay in the 3rd dimension (2004, September 7) retrieved 27 April 2024 from <https://phys.org/news/2004-09-scientists-tooth-3rd-dimension.html>

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