New technique helps researchers understand how acid damages teeth

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The University of Surrey and the School of Dentistry at the University of Birmingham have developed a new technique to improve understanding of how acid damages teeth at the microstructural level.

The researchers performed a technique called "in situ synchrotron X-ray microtomography" at Diamond Light Source, a special particle accelerator facility with which the University of Surrey has a strong working partnership. There, electrons were accelerated to near light

speed to generate bright X-rays that were used to scan dentine samples while they were being treated with acid. This enabled the team to build clear 3D images of dentine's internal structure with sub-micrometer resolution (a micrometer being one-thousandth of a millimeter). By analyzing these images over the six hours of the experiment, the researchers conducted the first-ever time-resolved 3D study (often referred to as 4D studies) of the dentine microstructural changes caused by acid.

The study, published in *Dental Materials*, highlights that acid dissolves the minerals in different structures of dentine at different rates. Dentine forms the main bulk of human teeth and supports the enamel, which covers the crown surface, helping to make teeth strong and resilient, but acids from dental plaque can cause tooth decay which affects the integrity of the dental structure. This research aims to develop knowledge that leads to new treatments that can restore the structure and function of dentine.

Dr. Tan Sui, Senior Lecturer in Materials Engineering at the University of Surrey, who is renowned for her work creating improved materials inspired by biology and who led the research group, said, "Relatively little is known about how exactly acid damages the dentine inside our teeth at a microstructural level. This new research technique changes that and opens the possibility of helping identify new ways to protect dental tissues and develop new treatments."

Nathanael Leung, a final year Ph.D. student at the University of Surrey, has been awarded a GSK Award 2021 by the Oral and Dental Research Trust. He will continue to study the mechanical response of dentine to masticatory forces in correlation with the microstructural changes that acid causes as well as in response to different treatments like fillings and crowns.

This research is part of an ongoing collaboration with Prof Gabriel Landini and Dr. Richard Shelton at the School of Dentistry, University of Birmingham.

More information: Nathanael Leung et al, 4D microstructural changes in dentinal tubules during acid demineralisation, *Dental Materials* (2021). DOI: 10.1016/j.dental.2021.09.002

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