Genetic defects in tooth enamel conducive to development of caries

7 February 2017

Credit:

Bacteria are not the sole cause of caries; tooth resistance also plays an instrumental role. Researchers from the University of Zurich demonstrate that mutated genes lead to defects in the tooth enamel and can therefore encourage the development of caries.

Why do some people develop caries even though they always brush their teeth carefully while others are less stringent regarding dental hygiene yet do not have any holes? Ultimately, both have bacteria on the surface of their teeth which can attack the enamel. Enamel forms via the mineralization of specific enamel proteins. If the outer layer of the teeth is defective, tooth decay can strike.

Researchers from the University of Zurich have now pinpointed a gene complex for the first time that is responsible for the formation of tooth enamel. Two teams from the Centre of Dental Medicine and the Institute of Molecular Life Sciences used mice with varying mutations of the enamel proteins involved in the so-called Wnt signaling pathway. Thanks to this transmission route, human and animal cells respond to external signals and specifically activate selected genes in the cell nucleus. The signaling pathway is essential for embryonal development and also plays a pivotal role in the development of cancer or physical malformations.

Mutations in proteins trigger defective tooth enamel

"All mice with mutations in these proteins exhibit teeth with enamel defects," explains Pierfrancesco Pagella, one of the study's two first authors. "Therefore, we demonstrated that there is a direct link between mutations in the genetic blueprints for these proteins and the development of tooth enamel defects." This genetic discovery goes a long way towards improving our understanding of the production of tooth enamel.

The team of researchers was the first in the world to use modern genetic, molecular and biochemical methods to study tooth enamel defects in detail. "We discovered that three particular proteins involved in the Wnt signaling pathway aren't just involved in the development of severe illnesses, but also in the qualitative refinement of highly developed tissue," says co-first author Claudio Cantù from the molecular biologist research group lead by Prof. Konrad Basler. "If the signal transmission isn't working properly, the structure of the tooth enamel can change."

Increased risk of caries with defective tooth enamel

The hardness and composition of the tooth enamel can affect the progression of caries. "We revealed that tooth decay isn't just linked to bacteria, but also the tooth's resistance," says Thimios Mitsiadis, Professor of Oral Biology at the Center of Dental Medicine. Bacteria and their toxic products can easily penetrate enamel with a less stable structure, which leads to carious lesions, even if oral hygiene is maintained.

Understanding the molecular-biological connections of tooth enamel development and the impact of mutations that lead to enamel defects opens up new possibilities for the prevention of caries. "New products that hinder the progress of tooth caries in the event of defective tooth enamel will enable us to improve the dental health of patients considerably," adds Mitsiadis.

More information: C. Cantù, P. Pagella, T. D. Shajiei, D. Zimmerli, T. Valenta, G. Hausmann, K. Basler and T. A. Mitsiadis. A cytoplasmic role of Wnt-?-catenin transcriptional cofactors in tooth enamel formation. *Science Signaling*. February 7, 2017. DOI: 10.1126/scisignal.aah4598

Provided by University of Zurich