Developmental origins of tooth classes in vertebrates

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Pogona vitticeps, central bearded dragon lizard. Credit: University of Helsinki

The researchers from the HiLIFE Institute of Biotechnology, University of Helsinki compared two central bearded dragon lizards (Pogona vitticeps): a normal one and a mutant with no body scales. They identified striking differences in the development of teeth. The teeth of the mutant lizard exhibited a large size and an unusual attachment type in specific locations along the jaw.

"This is the first example of vertebrate mutation leading to an apparent positional transformation in tooth identity," says Doctoral Researcher Lotta Salomies from the Institute of Biotechnology.

The gene affected by the lizard mutation was previously identified as being ectodysplasin-A (EDA). In humans, mice, and fish, mutations of the EDA gene are already known to generate defects in the development of teeth, hair, scales and glands.

The effect of the change in the expression of a single gene further confirms that fine-tuning the gene network in tooth development is very important.

"Furthermore, such a simple mechanism likely produced the large variability of dentitions observed across non-mammalian lineages. Our results can be used to predict the dental formula and associated developmental mechanisms characterizing extant and fossil vertebrate species beyond mammals. This also gives perspectives on vertebrate tooth patterning that is relevant to multiple research areas—ranging from phylogeny, taxonomy and ecology to organogenesis and regenerative medicine," says Associate Professor Nicolas Di-Poï from the Institute of Biotechnology.

The mouse is not an all-purpose model for vertebrate research

The general mechanisms of tooth development have been extensively studied using a classic research model—the mouse. However, the mouse has dental features that differ from other mammalian and non-mammalian vertebrates, so it is not a perfect model for all vertebrates.

"For example, mouse teeth are not replaced during the animal's lifetime, but most other vertebrates have two or multiple sets of teeth. Mammal teeth sit in sockets in the jaw, while most non-mammalian vertebrates have their teeth partially or completely fused to the jaw bone itself. As a result, the developmental origins of many dental features such as tooth implantation, tooth identity, and dental replacement capacity remain relatively unknown in vertebrates," says Nicolas Di-Poï.

However, as shown above, studying lizards and snakes can shed more light on the tooth development process, especially those exclusively represented in non-mammalian lineages. They show a large array of dental phenotypes that directly reflect their ecological specialization.

More information: Lotta Salomies et al, The developmental origins of heterodonty and acrodonty as revealed by reptile dentitions, *Science Advances* (2021). DOI: 10.1126/sciadv.abj7912

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