Mechanism regulating tooth shape formulation found

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One of the remaining challenges for evolutionary developmental studies of mammals, whose evolution is best known from their teeth, is how their tooth shape is altered during development.

Researchers of the University of Helsinki together with their Japanese colleagues from the University of Kioto now propose a 'balance of induction' mechanism directing the placement of tooth shape features called cusps. Position and shape of cusps determine whether a tooth shape belongs to human or mouse, for example. Whereas developmental initiation of cusp formation is known to involve several developmental genes at the places of future cusps, it has remained unknown how cusps form at the right places.

Computer simulations on tooth development have suggested that there should be a gene inhibiting induction of cusps. The research team has now identified this inhibitor to be a recently identified gene called ectodin. It turned out that ectodin is the first gene that is expressed as a mirror image of the future cusps.

The team generated a mouse that has no functional ectodin. Whereas the mice appear fairly normal, the areas forming cusps were much broader resulting in cheek teeth whose shape resembles more rhinoceros teeth than mouse teeth. Furthermore, these mice have extra teeth and sometimes adjacent teeth are fused. These results indicate that there is a delicate balance of induction and inhibition in determining tooth cusps and that ectodin is a key gene in this developmental control.

The team confirmed the importasnce of ectodin to development of teeth by culturing teeth that produce ectodin and teeth that lack ectodin with excess amounts of cusp inducing protein (bone morphogenetic protein or BMP). Whereas teeth producing ectodin develop quite normally with excess BMP, teeth without ectodin had a markedly accelerated induction of cusps. Indeed the researchers were able to induce cusps and mineralization of teeth much faster than happens in normal mouse teeth, suggesting that tinkering with the balance of cusp induction may hold potential for future tissue engineering of hard tissues.

Source: University of Helsinki