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Morphological and structural comparison of tooth and jaw development in wild type and PACAP-deficient mice

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Pituitary adenylate cyclase activating polypeptide (PACAP) is a multifunctional neuropeptide and it plays important role in the development of the nervous system. Tooth development shows similarities with the development of the nervous system, because teeth arise from the oral ectoderm and mesenchyme derived from the neural crest. PACAP-immunoreactive fibers are found in the tooth pulp odontoblastic and subodontobalstic layers, but there is no data about the exact effect of endogenous PACAP on tooth development.

In the first part of the study our aim was the morphological and immunohistochemical examination of tooth development in 7-day-old wild type and PACAP-deficient mice. On native histological sections, we measured the thickness of the forming dentin and enamel layers on first, second upper and lower molar teeth. We examined the structural differences between the teeth with Thermo Scientific DXR Raman microscope. We also labeled the localization of PAC1 receptors with immunohistochemistry. In the second part of the experiment we investigated the structure of the teeth and facial bones from adult wild type and PACAP-deficient mice with morphological measurement (FT-IR IMPACT 400 spectrometer, mass spectrometry and Skyscan Micro-CT).

Our results demonstrated that in PACAP-deficient mice the developing dentin layer is significantly thinner compared to wild-type mice and wild-type animals showed significantly higher PAC1 receptor expression in the odontoblastic and subodontoblastic layer compared to PACAP-deficient mice. We found significantly smaller teeth in adult PACAP-deficient mice with morphological examinations and FT-IR spectra of facial bones showed significantly higher amid band in PACAP KO animals compared to wild-type mice. These observations suggest that PACAP plays a role in tooth development in the dentin formation as well as in the mineralization of alveolar bones, but further examinations are necessary to describe the exact molecular background of these effects. Supported by OTKA (K72592, 73044, CNK78480), TAMOP (4.2.1.B-10/2/KONV-2010-002, 4.2.2.B-10/1-2010-0029), Bolyai Scholarship, Richter Foundation, PTE-MTA "Lendulet" Program.