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Bmp2 gene controls bone and tooth development and controls a link between stem cells on the vascular structure and the process of terminal differentiation of osteoblasts in bone and odontoblasts and cementoblasts in and on teeth

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Our lab has been interested in the role of Bmp2 and Bmp4 in both bone and tooth postnatal function and development [Yang et al (2012). J. Dental Research, 91, 58-64 and Yang et al (2012) J. of Cell Science, Epub]. We have discovered an interesting link between terminal differentiation of Osteoblasts and Odontoblasts and control of the stem cells that produce these terminally differentiated cells that make bone matrix in bone and dentin in teeth. The stem cells are located on the vascular system and their expansion and differentiation are controlled by the Bmp2 gene. In one of our Bmp2 conditional knock-out models using the Cre-loxP system, in which the Bmp2 gene is removed in periodontium supporting the tooth, there are major defects in cementum formation as well as formation of the ligaments within the periodontium. This model also has major defects in formation of the roots of the teeth, as well as major defects in bone formation. The odontoblasts of the root region in the Bmp2-cKO^{od} and the osteoblasts of the bone do not mature properly and fail to terminally differentiate. This leads to decreased factors such as VegfA that control vascularization and formation of the stem cells on the vascular walls in both the teeth structures and surrounding periodontium, as well as in the bone. Using a new model that activates the Cre recombinase in the skeletal and dental associated stem cells, the aSMA-CreERt2 mouse model, we can now carry out lineage tracing studies to validate our hypothesis that Bmp2 is a critical regulator of 1. The vascular stem cell niche in bone periodontium and in dental pulp 2. Bmp2 expression in these stem cells is critical for egress from the vascular niche and progression to the differentiated osteoblast or odontoblast or cementoblasts.

Biography

Currently, I am professor and director of research at the U. of Texas Health Science Center at San Antonio, in the department of Periodontics. For the past 20 years I have been interested in the structure and functional analysis of bone morphogenetic protein (BMP) genes. I have focused on the role and mechanisms of BMP2 and BMP4 genes in bone and tooth biology. Our lab primarily use conditional knock-out mouse models by using the Cre-loxP system and Tamoxifen temporal control of Cre activity as well as various mouse models with fluorescent reporters. I have discovered mechanisms of how BMP2 instructs cells to new differentiated functions during development as well as during bone and teeth formation. We discovered a link between terminal differentiation and control of the niche for stem cells in bone, teeth and periodontium. Using linkage tracing procedures we are deterrming the origin of the stem cells and their capacity to differentiate into odontoblast, cementoblast and functional osteoblasts.

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