WNT10A REGULATES DENTIN SIALOPHOSPHOPROTEIN MRNA EXPRESSION AND POSSIBLY LINKS ODONTOBLAST DIFFERENTIATION AND TOOTH MORPHOGENESIS

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Abstract: We have explored the role of Wnt signaling in dentinogenesis of mouse molar teeth. We found that Wnt10a was specifically associated with the differentiation of odontoblasts and that it showed striking colocalization with dentin sialophosphoprotein (Dspp) expression in secretory odontoblasts. Dspp is a tooth specific non-collagenous matrix protein and regulates dentin mineralization. Transient overexpression of Wnt10a in C3H10T1/2, a pluripotent fibroblast cell line induced Dspp mRNA. Interestingly, this induction occurred only when transfected cells were cultured on Matrigel basement membrane extracts. These findings indicated that Wnt10a is an upstream regulatory molecule for Dspp expression, and that cell−matrix interaction is essential for induction of Dspp expression. Furthermore, Wnt10a was specifically expressed in the epithelial signaling centers regulating tooth development, the primary and secondary enamel knots. The spatial and temporal distribution of Wnt10a mRNA demonstrated that the expression shifts from the secondary enamel knots, to the underlying preodontoblasts in the tips of future cusps. The expression patterns and overexpression studies together indicate that Wnt10a is a key molecule for dentinogenesis and that it is associated with the cell−matrix interactions regulating odontoblast differentiation. We conclude that Wnt10a may link the differentiation of odontoblasts and cusp morphogenesis.

Fig. 1: Odontoblasts (od) are columnar cells lining the pulpal surface of dentin (de), and preodontoblasts (pod) are the odontoblast precursors in the apical end of the root. At the apical end of the growing root, Wnt10a transcripts were present in the preodontoblasts (pod). (D) The expression was continuous and maintained in differentiating and secretory odontoblasts (od).

Fig. 2 (A) C310T1/2 cells were transiently transfected with pCMV-Wnt10a and cultured on Matrigel (Wnt10a+Mg (+)), and positive control (tooth germ). (B) Forced-expression of Wnt10a induced Dspp expression when the transfected cells were cultured on Matrigel dishes (Wnt10a+Mg (+), 40 cycles). Wnt10a transfected cells cultured on normal culture dishes (Wnt10a+Mg (−), 40 cycles) and Mock transfected cells cultured on Matrigel dishes (Mock+Mg (+) or normal culture dishes (Mock+Mg (−)) did not show Dspp expression. Positive control (Tooth germ) showed intense Dspp expression. (C) PCR products were subjected to melting peak analyses to determine the specificity of the products.

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