ALK3-Mediated BMP Signaling in the Tongue Mesenchyme is Essential for the Proper Development of Tongue and Taste Papillae.

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The development of tongue and taste papillae requires mesenchymal-epithelial interactions via multiple molecular pathways, including bone morphogenetic protein (BMP) signaling in which type I receptors (ALK2, ALK3, ALK6) are the main determinant of downstream signaling specificity. Our studies have demonstrated that BMP signaling mediated by ALK2 in the tongue mesenchyme plays an important role in regulating the tongue shape and size. Here we report that BMP signaling mediated by ALK3 (ALK3-BMP signaling hereafter) in the tongue mesenchyme exerts distinct roles in the development of tongue and taste papillae. The RNA-Seq analysis demonstrated that Alk3 is highly expressed in both tongue epithelium and mesenchyme in embryonic and newborn mice. We used transgenic mouse models to constitutively activate (ca) and conditionally knock out (cKO) Alk3 in a mesenchyme-specific manner using Wnt1-Cre. At E12.5, Wnt1-Cre/Alk3 cKO mutants had a smaller tongue with a truncated tip compared to the littermate controls. In the posterior region, tongue swellings were not fused. At E12.5 when Shh+ taste papilla placodes normally emerge, taste papilla placodes were absent in the Wnt1-Cre/Alk3 cKO tongue. In contrast to Wnt1-Cre/Alk3 cKO, Wnt1-Cre/caAlk3 mutants did not depict obvious changes of tongue shape, size and papilla pattern. Our data indicate that a proper level of ALK3-BMP signaling is needed for the formation of tongue and taste papillae. Absence of taste papillae in the Wnt1-Cre/Alk3 cKO mutants suggests that ALK3-BMP signaling in the tongue mesenchyme is critical for the mesenchymal-epithelial interactions in taste papilla formation. Further studies are ongoing to explore the role and mechanism of ALK3-BMP signaling in tongue and taste papillae formation.

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