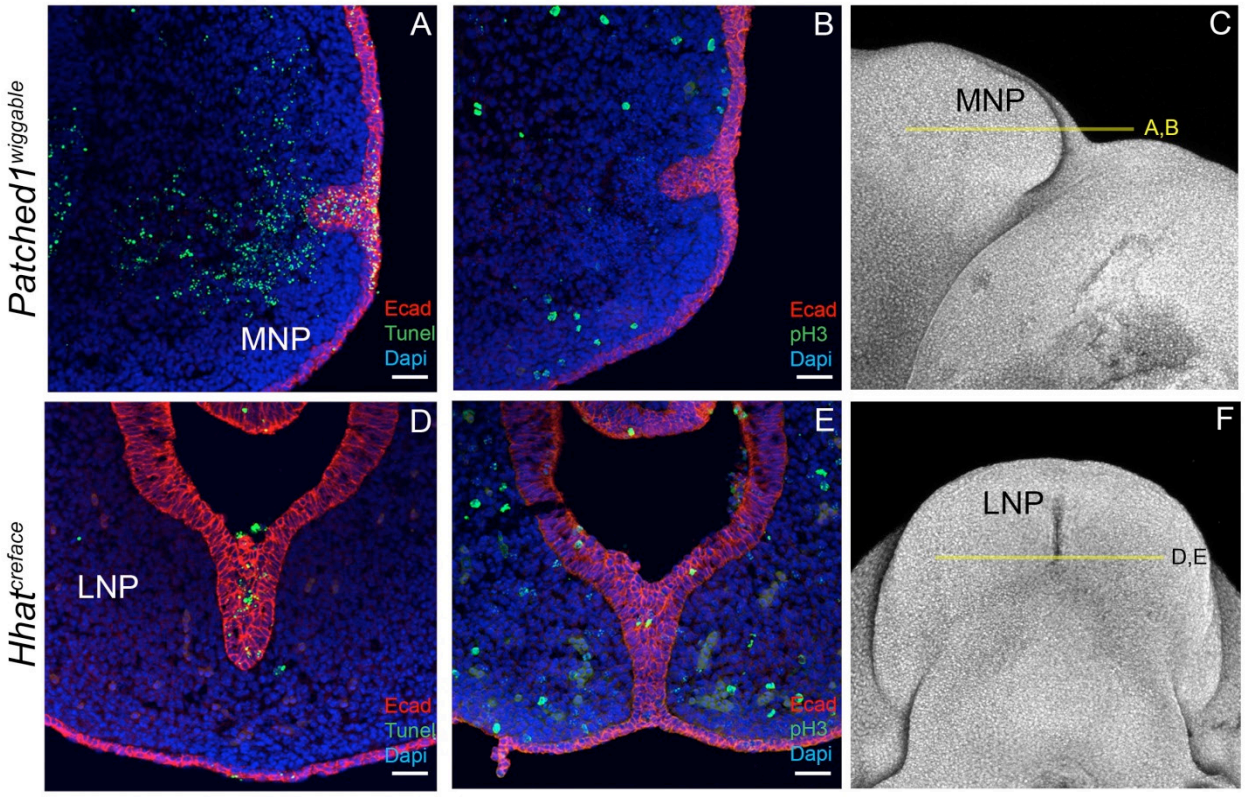


**Figure S1** Cell proliferation and death during frontonasal development of *Patched1*$^{wiggable}$ and *Hhat*$^{creface}$ embryos. TUNEL staining or Phospho-Histone H3 (green) and E-CADHERIN immunohistochemistry (red) of *Patched1*$^{wiggable}$ (A,B) and *Hhat*$^{creface}$ embyros (D,E). Yellow lines in C and F show the planes of section (C,F). LNP, lateral nasal process; MNP, medial nasal process. Scale bars: 50μm.

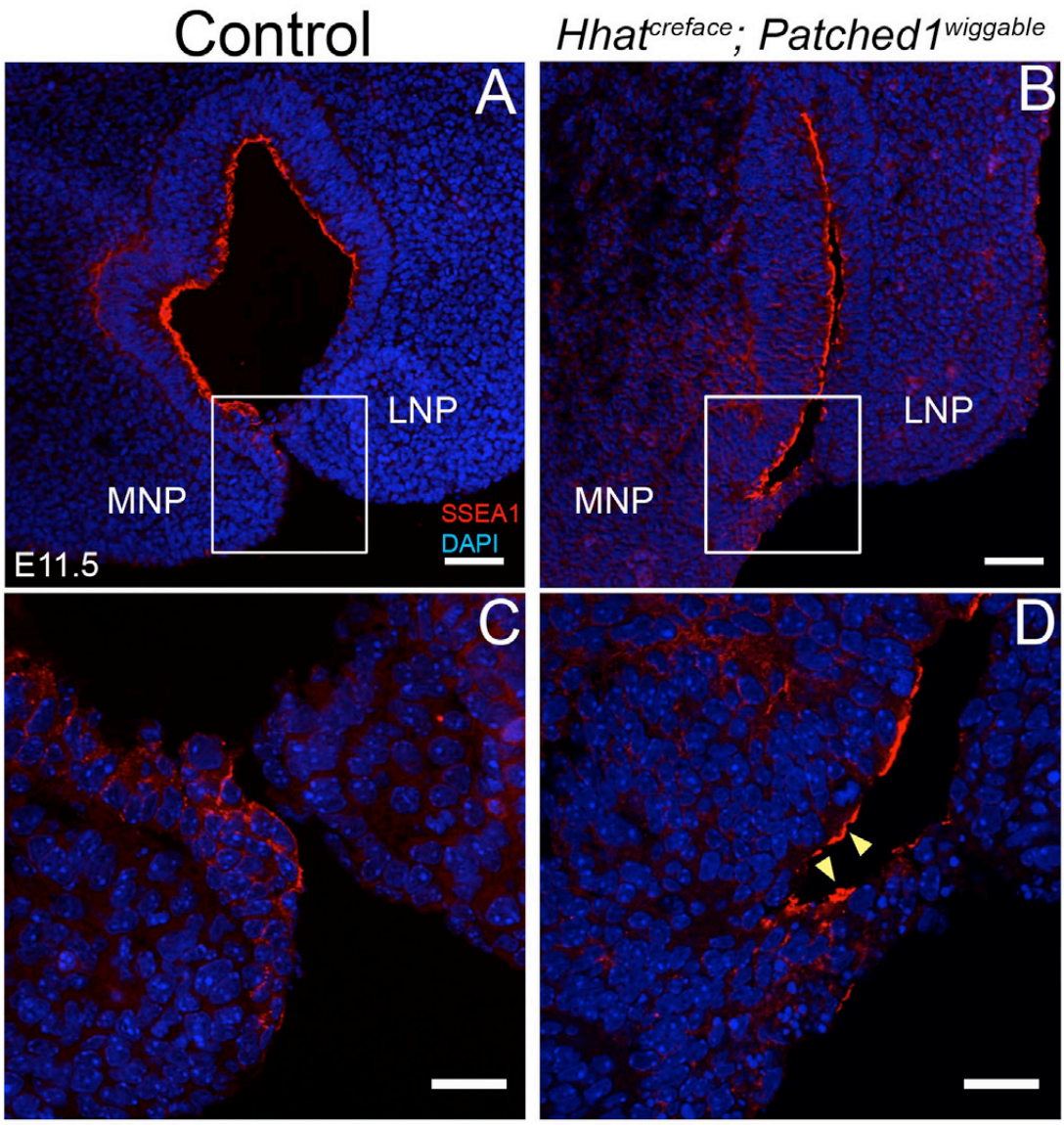


**Figure S2** Periderm cells detected by immunohistochemistry of SSEA1 in frontonasal processes. SSEA1 immunoreaction (red) shown in control (A) and *Hhat*$^{creface}$*; Patched1*$^{wiggable}$ embryos (B). Higher magnification of epithelial seam cells showed stronger *SSEA1* expression in *Hhat*$^{creface}$*; Patched1*$^{wiggable}$ embryos (D, yellow arrowhead) than control embryos (C). Scale bars: 50μm (A-B); 20μm (C-D). LNP, lateral nasal process; MNP, medial nasal process.

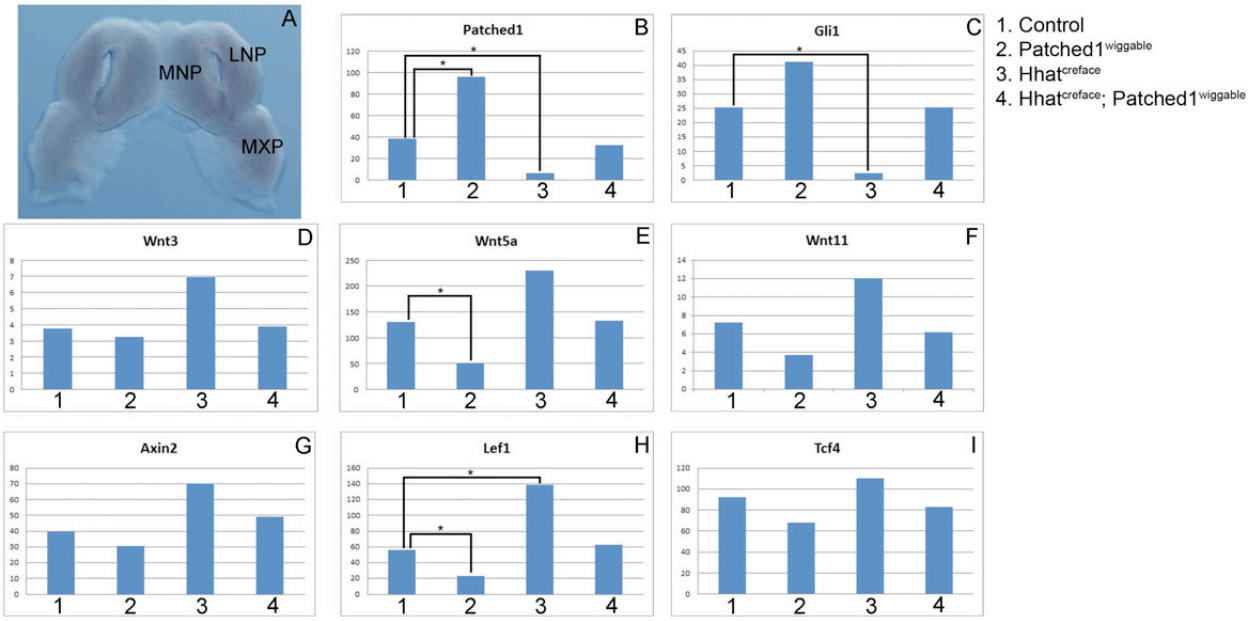


**Figure S3** Representative gene expression analysis using RNAseq. Dissected E11.5 maxillary complex were used for RNA-seq (A). Representative gene expression data for each genotype genotype indicated (B-I). We compared the level of gene expression in each mutant embryo (*Hhat*$^{creface}$,*Patched1*$^{wiggable}$ and *Hhat*$^{creface}$*; Patched1*$^{wiggable}$) against control embryos. Asterisks indicate statistically significant differences. $^{*}$P<0.05, R package DESeq. LNP, lateral nasal process; MNP, medial nasal process; MXP, maxillary process.

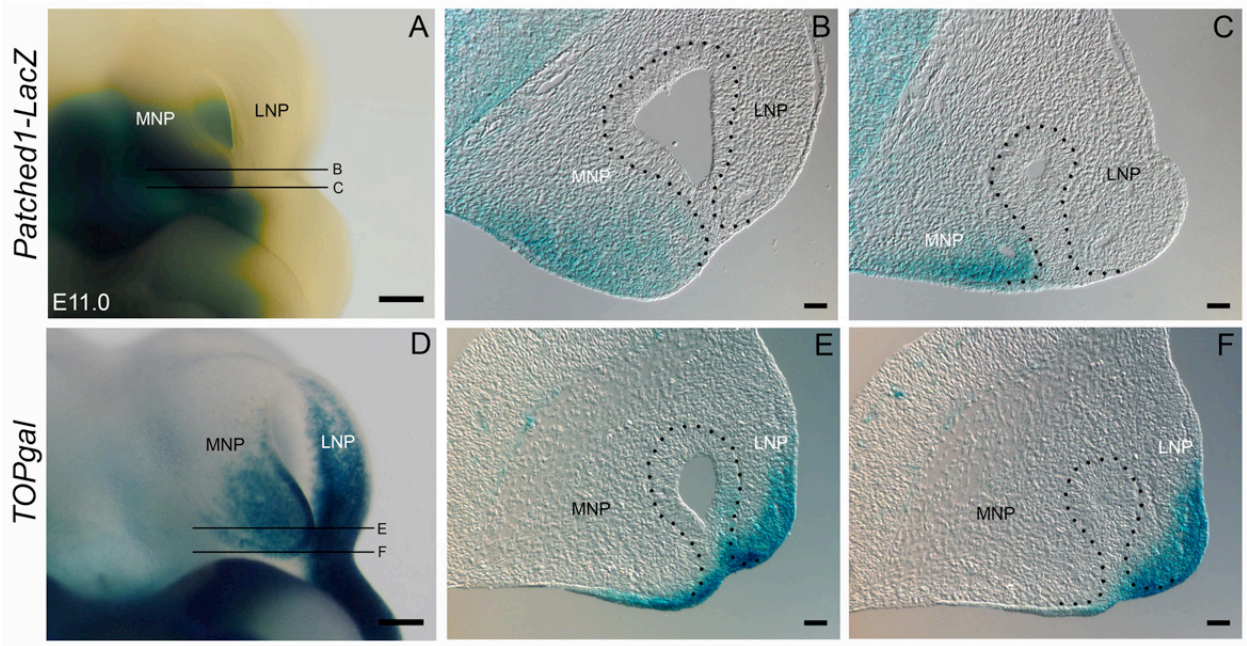


**Figure S4** *Patched1-LacZ* and *TOPgal* embryos showed complementary *LacZ* expression during frontonasal processes development. (A) Ventral view of *Patched1-LacZ* embryos frontonasal processes. Each line represents which plane was used for the sectioned image. (B,C) Section of *Patched1-LacZ* embryos showed strong signal mainly in MNP. (D) Ventral view of *TOPgal* embryos frontonasal processes. (E,F) Sections of *TOPgal* embryos showed strong *LacZ* activity mainly at LNP. Scale bars: 200μm (A,D); 50μm (B,C,E and F).

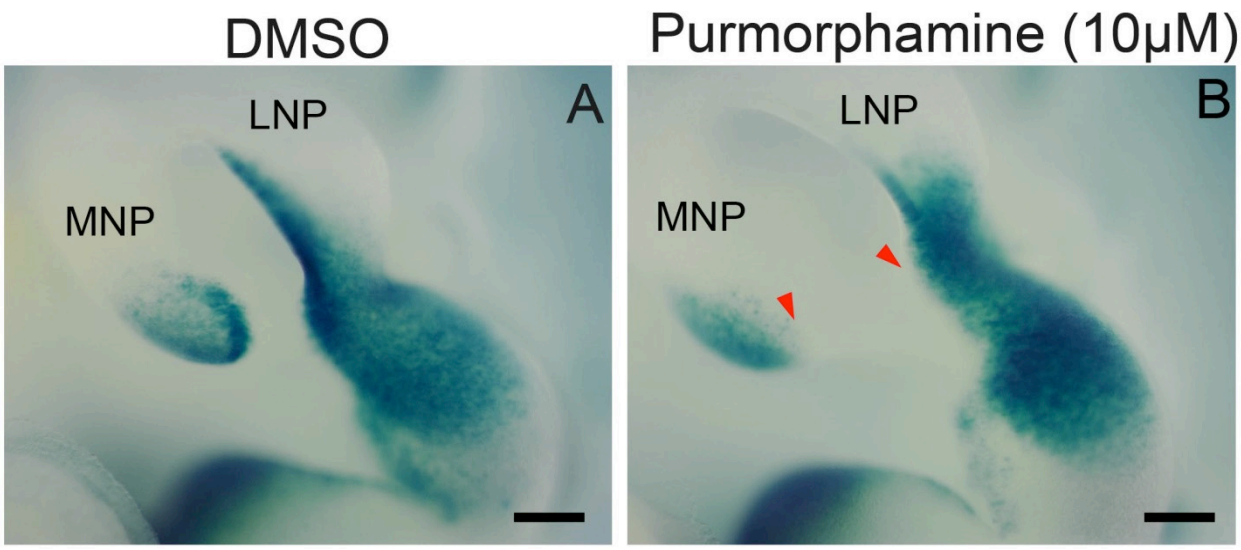


**Figure S5** *Shh* signaling activation during whole embryo culture caused reduced *TOPgal* expression. Purmorphamine (*Shh* signaling agonist) treatment results in reduced *TOPgal* activity in the lambdoidal region (B, red arrowhead) compared to DMSO treated embryo (A). LNP, lateral nasal process; MNP, medial nasal process. Scale bars: 200μm

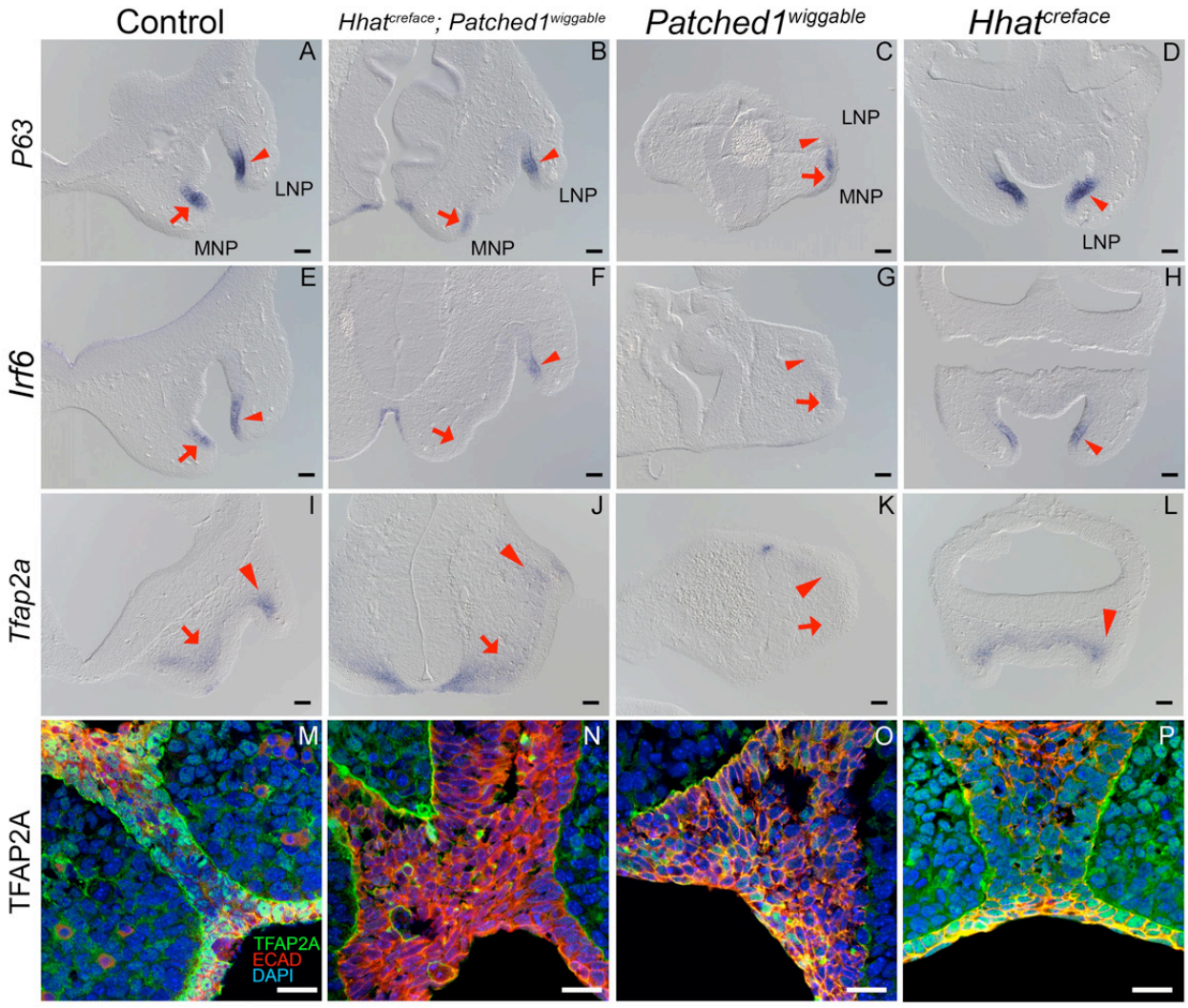


**Figure S6** Expression of *P63*, *Irf6* and *Tfap2a*. (A-D) *P63* expression in E11.0 embryos. *P63* is strongly expressed in both the MNP (A, red arrow) and LNP (A, red arrowhead) epithelium. *Hhat*$^{creface}$*; Patched1*$^{wiggable}$ embryos showed reduced *P63* expression (B), while *Patched1*$^{wiggable}$ embryos showed even lower expression levels (C). In contrast *Hhat*$^{creface}$ embryos retained *P63* expression in the LNP (D, red arrowhead). *Irf6* is expressed in a similar domain to *P63* (E-H). Also similar to *P63*, *Hhat*$^{creface}$*; Patched1*$^{wiggable}$ (F) as well as *Patched1*$^{wiggable}$ (G) embryos showed down-regulation of *Irf6* in the nasal processes epithelium while *Hhat*$^{creface}$ embryos retained its expression (H). *Tfap2a* is expressed predominantly in the mesenchymal region of nasal processes in control embryos (I). *Hhat*$^{creface}$*; Patched1*$^{wiggable}$ (J) and *Patched1*$^{wiggable}$ embryos (K) both showed reduced expression of *Tfap2a* while *Hhat*$^{creface}$ embryos retained its expression (L). (M-P) Immunohistochemistry of TFAP2A (green) and E-CADHERIN (red) in E11.5 embryos. LNP, lateral nasal process; MNP, medial nasal process. Scale bars: 50μm (A-L); 20 μm (M-P).

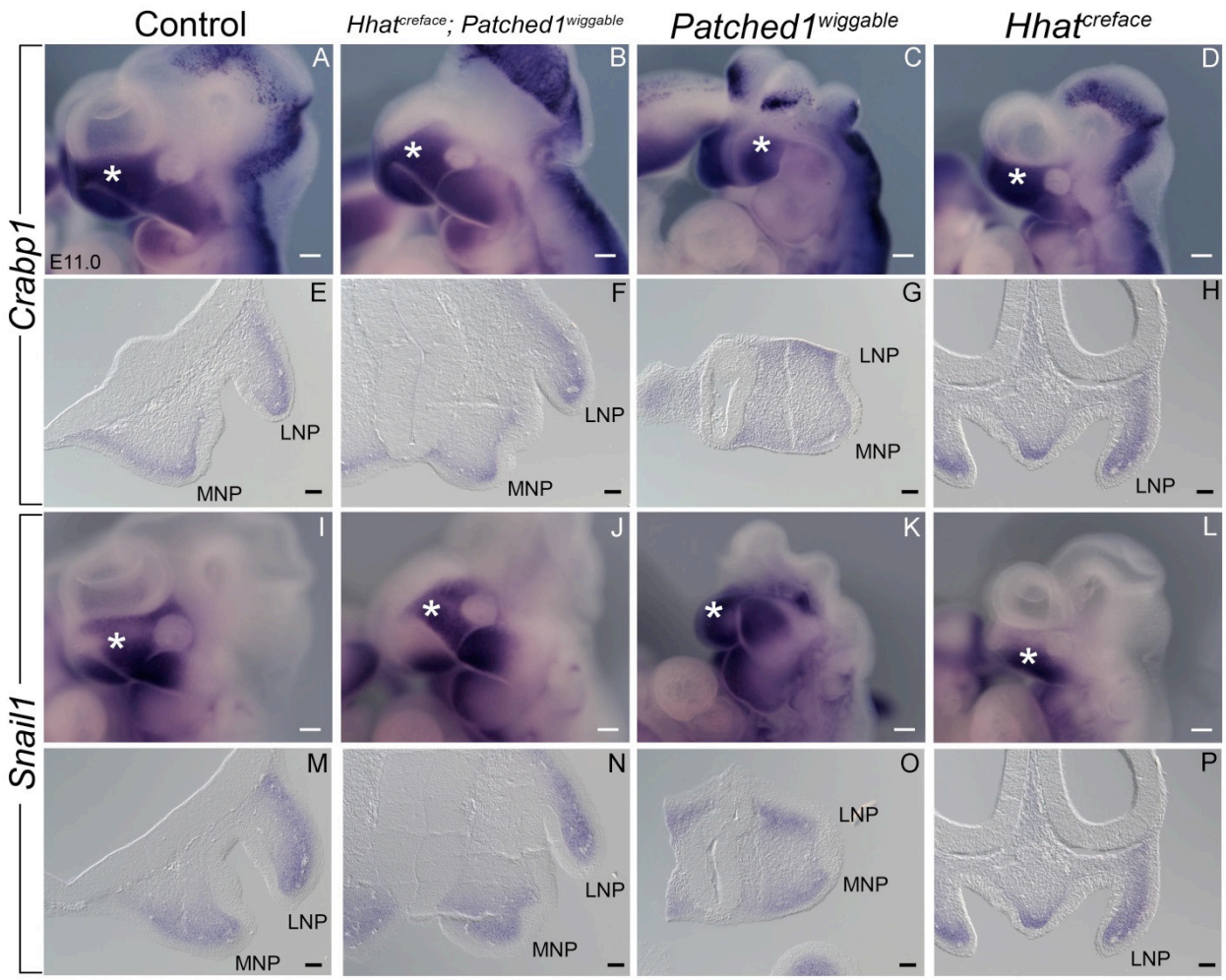


**Figure S7** *In situ* hybridization of *Crabp1* and *Snail1* in E11.0 embryos with their genptypes indicated at the top of the figure. Neither of *Crabp1* (A-D, asterisk) or *Snail1* (I-L, asterisk) showed noticeable difference of expression at frontonasal processes by whole mount *in situ* hybridization. Sectioned embryos also showed similar distribution of *Crabp1* (E-H) and *Snail1* (M-P) in each embryos. LNP, lateral nasal process; MNP, medial nasal process. Scale bars: 200μm (A-D, I-L); 50μm (E-H, M-P).