SUPPLEMENTARY INFORMATION

Supplementary Figures

Figure S1

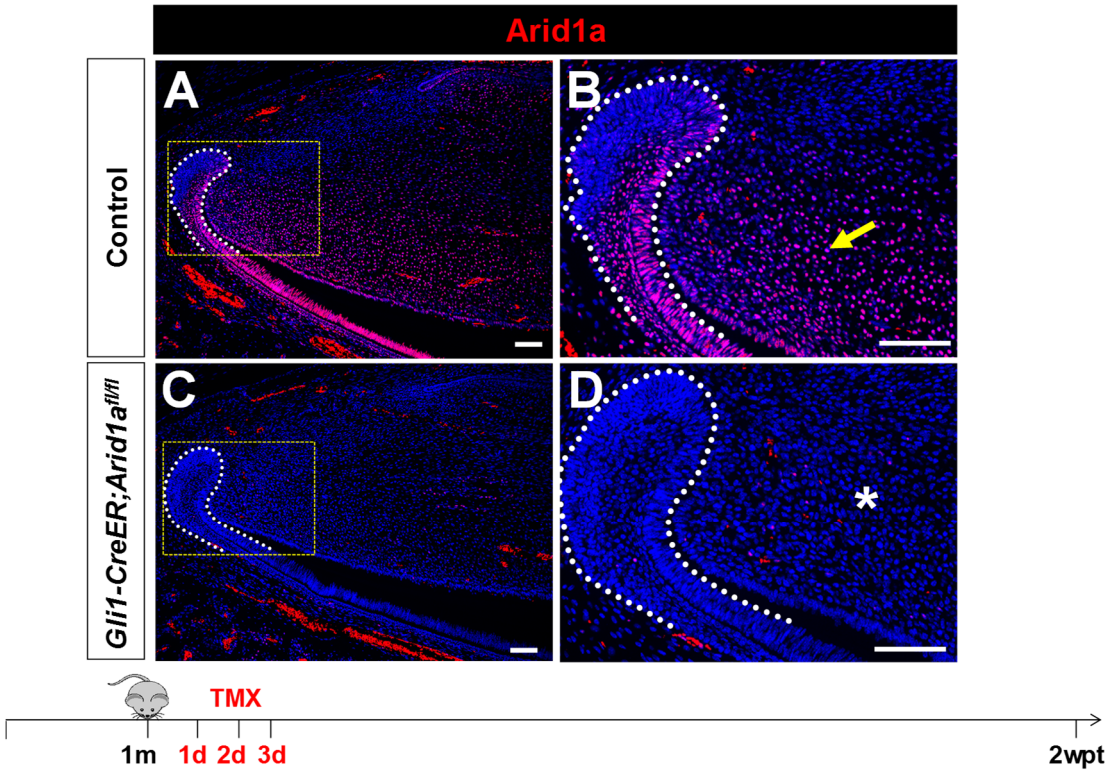

Figure S1. Arid1a is knocked out efficiently in *Gli1-CreER;Arid1a*$^{fl/fl}$ mouse incisor 2 weeks after induction.

(A-D) Arid1a immunofluorescence of incisors from control (A-B) and *Gli1-CreER;Arid1a*$^{fl/fl}$ (C-D) mice 2 weeks after induction. Boxes in A and C are shown enlarged in B and D. White dotted line outlines the cervical loop. Yellow arrow in B indicates positive signal in control mice; asterisk in D indicates absence of signal in *Gli1-CreER;Arid1a*$^{fl/fl}$ mice. Schematic at the bottom indicates induction protocol. N=3. Scale bars: 100 μm.

Figure S2

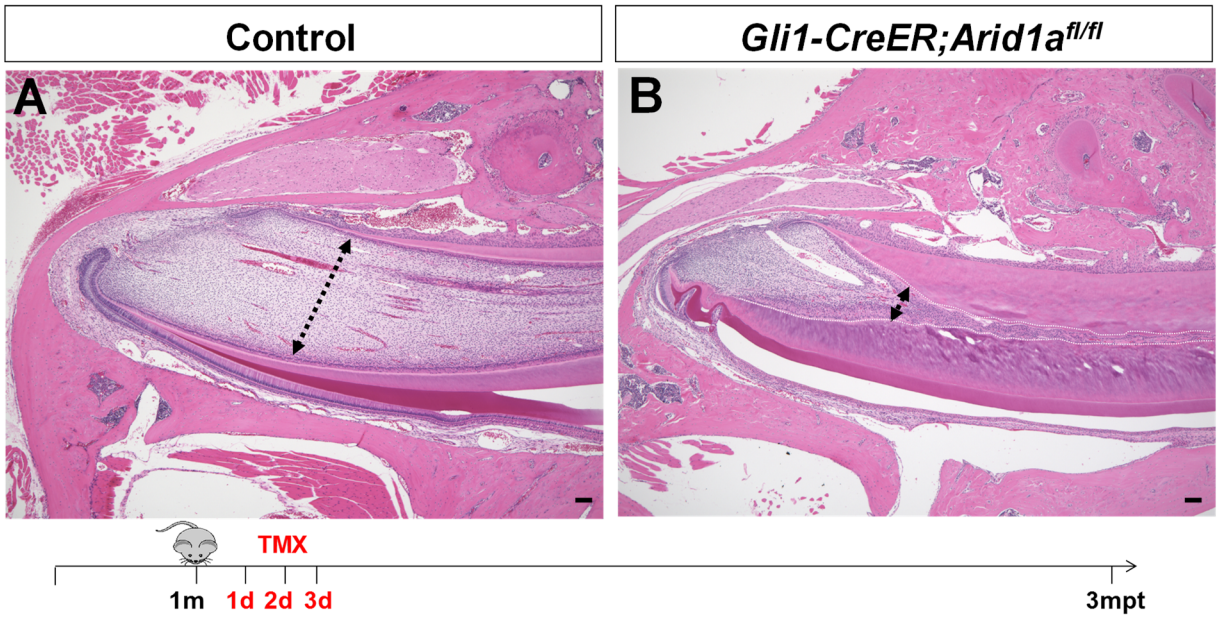

Figure S2. Loss of *Arid1a* results in severe stacked dentin in dental pulp cavity of *Gli1-CreER;Arid1a*$^{fl/fl}$ mouse incisor 3 months post-induction.

H&E staining of incisors from control and *Gli1-CreER;Arid1a*$^{fl/fl}$ mice 3 months after induction. White dashed lines in (B) outline the stacked dentin in the dental pulp cavity. Black dotted two-way arrow shows the width of the dental pulp cavity in control (A) and *Gli1-CreER;Arid1a*$^{fl/fl}$ mice (B). Schematic at the bottom indicates induction protocol. N=3. Scale bars: 100 μm.

Figure S3

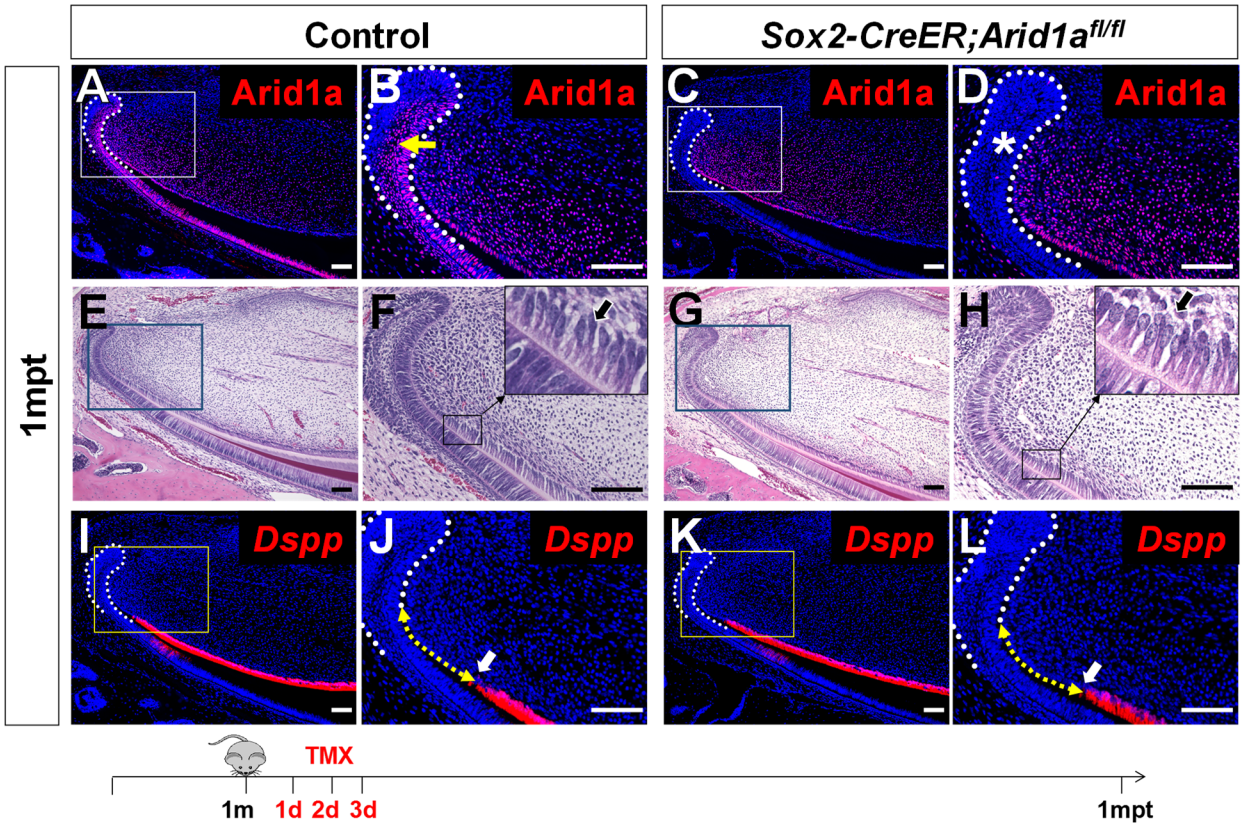

Figure S3. Loss of *Arid1a* in the dental epithelium leads to no apparent odontoblast defects 1 month after induction.

(A-D) Arid1a immunofluorescence of incisors from control (A-B) and *Sox2-CreER;Arid1a*$^{fl/fl}$ (C-D) mice 1 month after induction. Boxes in A and C are shown enlarged in B and D. White dotted line outlines the cervical loop. Yellow arrow in B indicates positive signal in control mice; asterisk in D indicates absence of signal in *Sox2-CreER;Arid1a*$^{fl/fl}$ mice. N=3. (E-H) H&E staining of incisor from control (E, F) and *Sox2-CreER;Arid1a*$^{fl/fl}$ (G, H) mice 1 month after induction. Boxes in E and G are shown enlarged in F and H. Black arrows indicate the initiation of odontoblast polarization. N=3. *In situ* hybridization of *Dspp* (red) in incisors of control (I, J) and *Sox2-*

CreER;Arid1a$^{fl/fl}$ (K, L) mice 1 month after induction. Boxes in I and K are shown enlarged in J and L. White dotted line outlines the cervical loop. White arrows indicate the initiation of odontoblast differentiation. Yellow dotted two-way arrow shows the distance between the bending point of the cervical loop and the initiation of odontoblast differentiation. N=3. Schematic at the bottom indicates induction protocol. Scale bars: 100 μm.

Figure S4

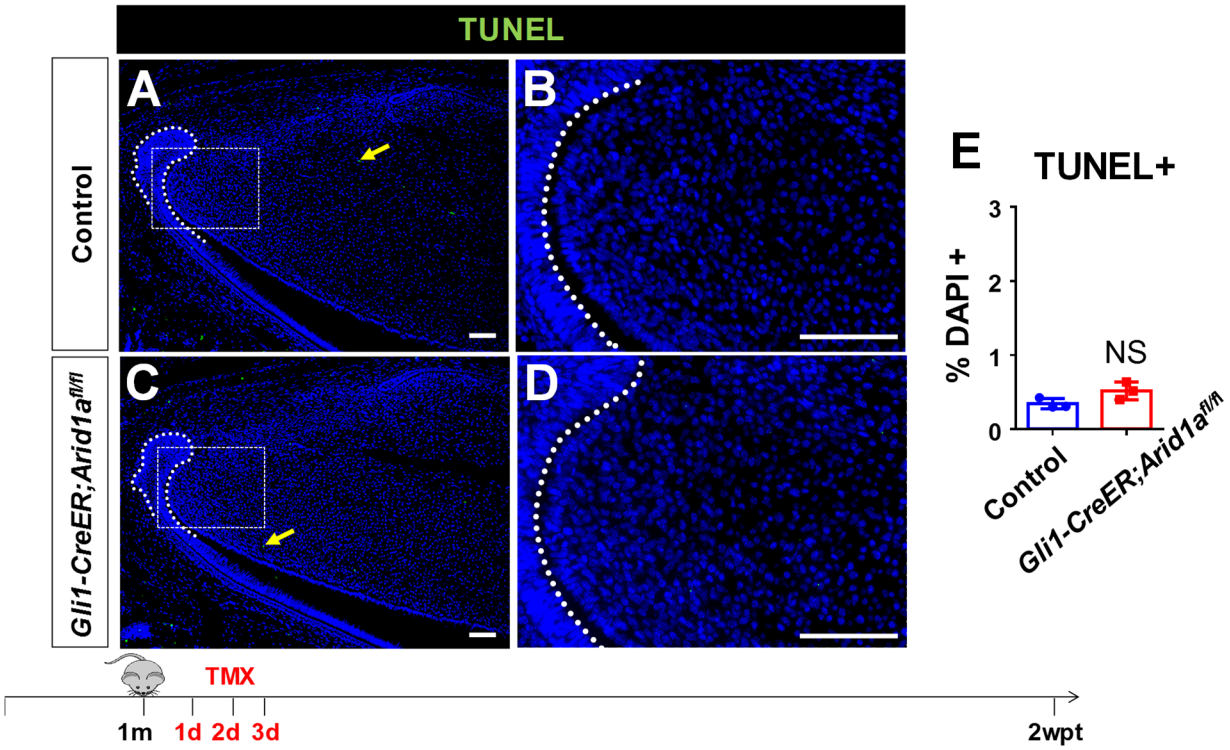

Figure S4. Loss of *Arid1a* leads to no apparent change of cell apoptosis 2 weeks after induction.

(A-D) Terminal deoxynucleotidyl transferase dUTP nick end labeling (TUNEL) staining of incisors from control and *Gli1-CreER;Arid1a*$^{fl/fl}$ mice 2 weeks after induction. White dotted line outlines the cervical loop. Boxes in A and C are enlarged on the right. Arrows in A and C indicate positive signals. (E) Quantification of TUNEL+ cells in dental mesenchyme in control and *Gli1-CreER;Arid1a*$^{fl/fl}$ mice 2 weeks after induction. N=3, unpaired, two-tailed Student's t-test, $p > 0.05$, NS, no significant difference. Schematic at the bottom indicates induction protocol. Scale bars: 100 μm.

Figure S5

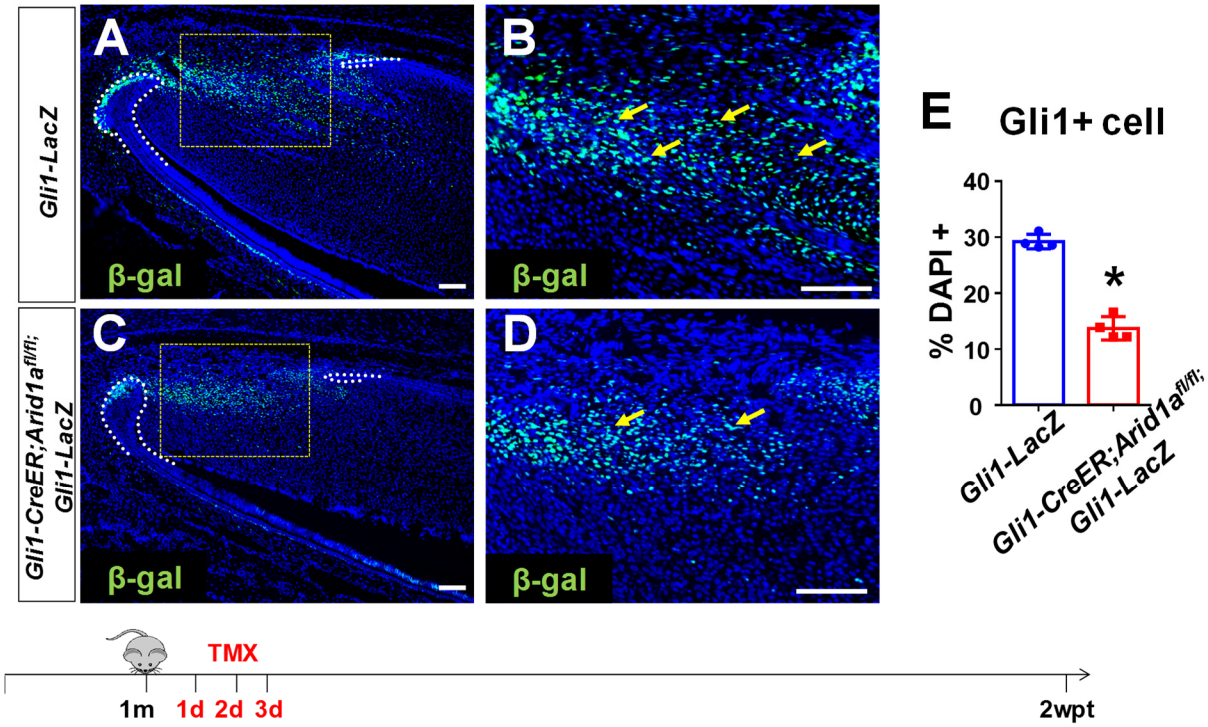

Figure S5. Loss of *Arid1a* leads to reduction of Gli1+ MSCs 2 weeks after induction.

(A-D) Immunofluorescence of β-gal (green) of incisor from *Gli1-LacZ* (A-B) and *Gli1-CreER;Arid1a$^{fl/fl}$;Gli1-LacZ* (C-D) mice 2 weeks after induction. White dotted line outlines the cervical loop. Boxes in A and C are shown enlarged in B and D. Arrows in B and D indicate positive signal. Quantification of Gli1+ cells in the dental mesenchyme of *Gli1-LacZ* and *Gli1-CreER;Arid1a$^{fl/fl}$;Gli1-LacZ* mice 2 weeks after induction. N=4, unpaired, two-tailed Student's t-test, *$p < 0.05$. Schematic at the bottom indicates induction protocol. Scale bars: 100 μm.

Figure S6

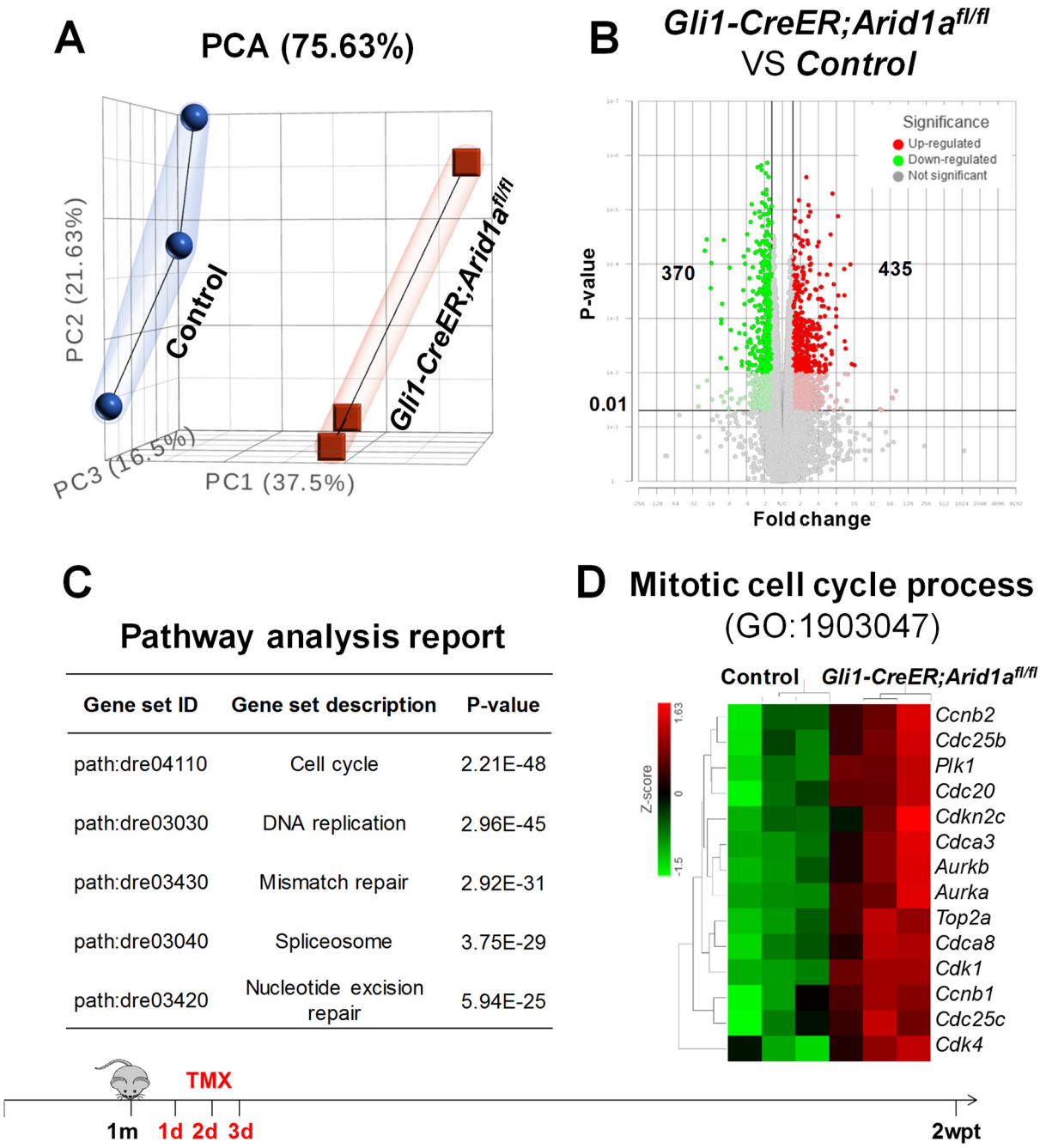

Figure S6. RNA sequencing of control and *Gli1-CreER;Arid1a*$^{fl/fl}$ mouse incisor mesenchyme. (A) Principal component analysis showing two distinct clusters belonging to control and *Gli1-CreER;Arid1a*$^{fl/fl}$ mouse incisor mesenchyme 2 weeks after induction.

(B) Volcano plot showing that 370 genes were downregulated and 435 genes were upregulated (>1.5-fold, $p < 0.01$) in *Gli1-CreER;Arid1a*$^{fl/fl}$ mice compared to control samples. (C) Pathway analysis report showing the top 5 differentially expressed gene sets between control and *Gli1-CreER;Arid1a*$^{fl/fl}$ mice. (D) Heat map showing differential expression of a set of mitosis-associated genes between control and *Gli1-CreER;Arid1a*$^{fl/fl}$ mice. N=3. Schematic at the bottom indicates induction protocol.

Figure S7

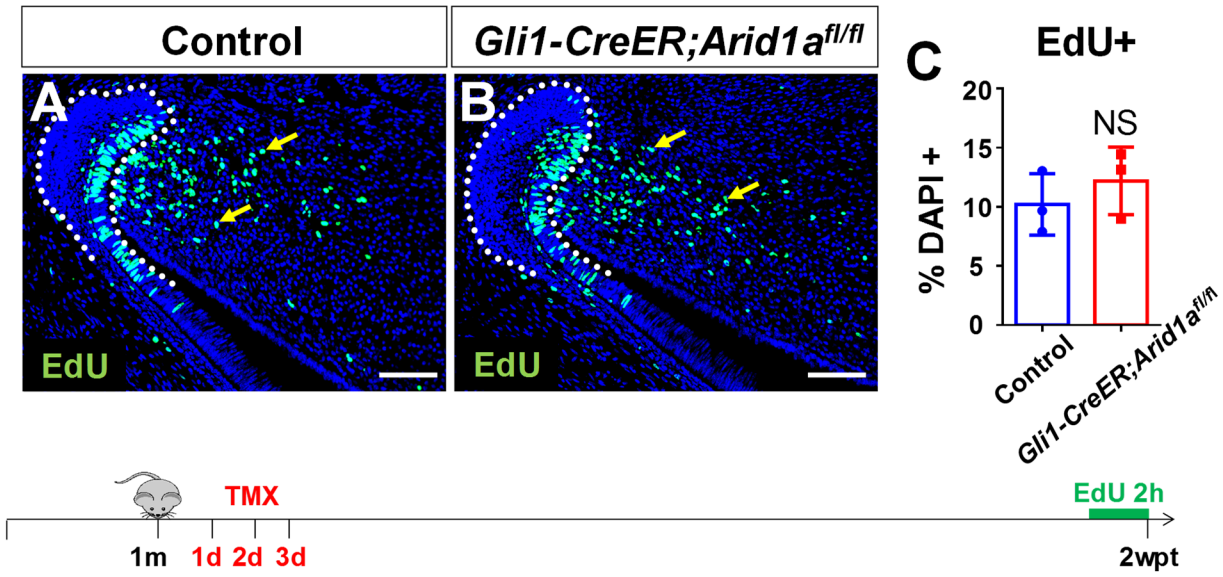

Figure S7. Loss of *Arid1a* leads to no apparent change in the number of cells in the DNA synthesis phase labeled by EdU 2 weeks after induction.

(A-B) EdU staining of incisors from control and *Gli1-CreER;Arid1a*$^{fl/fl}$ mice 2 weeks after induction. White dotted line outlines the cervical loop. Arrows in A and B indicate positive signals. N=3. (C) Quantification of EdU+ cells in dental mesenchyme in control and *Gli1-CreER;Arid1a*$^{fl/fl}$ mice 2 weeks after induction. N=3. unpaired, two-tailed Student's t-test, $p > 0.05$, NS, no significant difference. Schematic at the bottom indicates induction and EdU incorporation protocol. Scale bars: 100 μm.

Figure S8

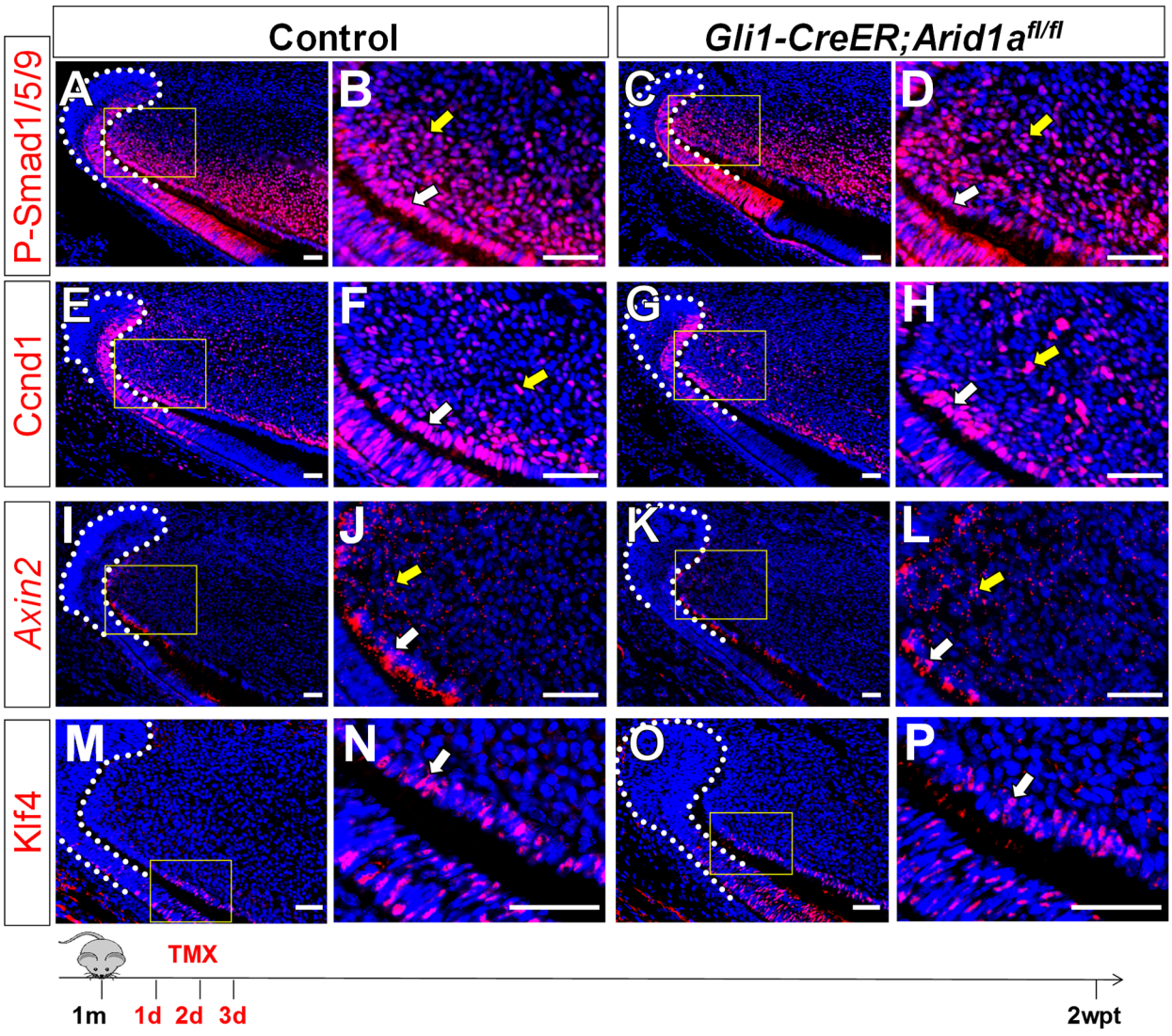

Figure S8. Loss of *Arid1a* leads to no apparent change in the expression levels of p-Smad1/5/9, Ccnd1, *Axin2* and Klf4 2 weeks after induction.

Immunofluorescence (red) of p-Smad1/5/9 (A-D), Ccnd1 (E-H), and Klf4 (M-P) and RNAscope *in situ* hybridization (red) of *Axin2* (I-L) on incisors from control and *Gli1-CreER;Arid1a*$^{fl/fl}$ mice 2 weeks after induction. White dotted line outlines the cervical loop. Boxes in A, C, E, G, I, K, M, and O are shown enlarged in B, D, F, H, J, L, N, and P, respectively. Yellow arrows indicate positive signal in TAC region; white arrows indicate positive signal in pre-odontoblast and odontoblast regions. N=3. Schematic at the bottom indicates induction protocol. Scale bars: 100 μm.

Figure S9

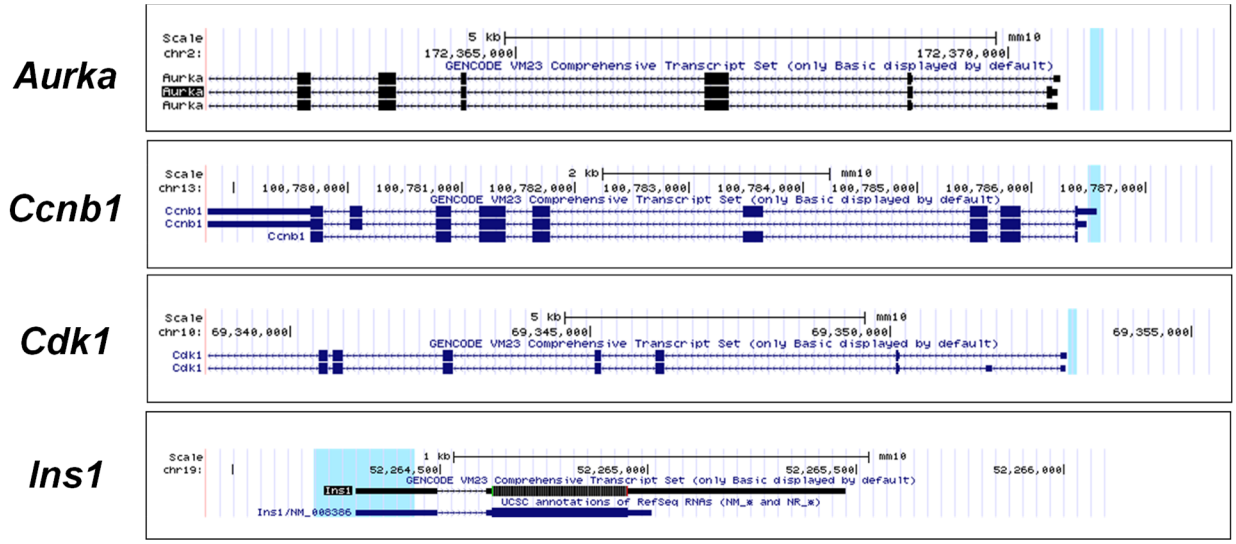

Figure S9. Genomic location of the primer sets used in chromatin immunoprecipitation (ChIP) assay.

Images representing the relative locations of the primer set amplicon (blue region) at the promoter regions of *Aurka*, *Ccnb1*, *Cdk1* and *Ins1* (negative genomic control) within the genome, as generated by the UCSC Genome Browser.

Figure S10

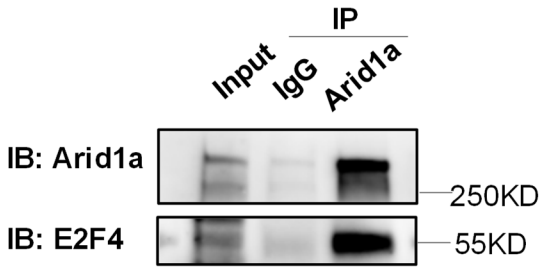

Figure S10. Arid1a and E2F4 interact in the proximal incisor mesenchyme.

Co-immunoprecipitation (co-IP) experiments using the proximal region of the incisor mesenchyme from control adult mice with Arid1a antibody (or IgG), followed by immunoblotting of Arid1a and E2F4. IP, immunoprecipitation. IB, immunoblotting.

Table S1. Key resources table.

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