

Project Title: Post-eruptive changes of porcine tooth enamel properties

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Pig tooth enamel erupts high in protein content and porosity and softer than human enamel, yet quickly attains hardness of healthy human enamel. This process might provide a model system for new strategies to harden soft human tooth enamel.

Objectives. To characterize changes in enamel properties, specifically porosity and surface roughness of porcine tooth crowns, and their enamel microstructure during and after tooth eruption.

Methods. Mandibular deciduous first incisor of pigs 2, 4, and 16 weeks-old (N = 3 per age) were compared. Mineral density was characterized by mCT (Micro-CT 40, Scanco Medical) at 70 kV, 114 μ A, and 6 μ m resolution. Enamel microstructure was analyzed by SEM of transverse tooth sections of Epon embedded teeth that were cut at defined planes and distances before and after gingival emergence, polished, and etched (10 seconds, 0.1 M of phosphoric acid), rinsed with deionized water for 1 minute, air dried, gold coated, and imaged (Zeiss Ultra 55 FE-SEM). Porosity and surface roughness were measured by AFM on an Asylum Research Cypher using a 2.44Hz scan rate, and Olympus 10 nm AC160 silicone tip ($f = 300$ kHz, $k = 26$ N/m).

Results. Within a short time after eruption, mineralization increases, while surface roughness decreases from 13.75 nm at 2 weeks-old to 5.15 nm at 16 weeks-old at the level of gingival emergence. Enamel porosity (number of perforations per 100 μ m of crown surface on a longitudinal section) decreases from 20 pores at 2 weeks-old to 0 pore at 16 weeks-old, while a mineral layer 2 μ m thick forms.

Conclusion. Within a short time after eruption, pig enamel undergoes substantial changes to harden significantly. Additional studies are required to resolve the mechanisms for this fast hardening.

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Key words: porcine model, dental enamel, posteruptive maturation, enamel hardening