

Reconstructing enamel of worn modern human permanent teeth.



A new statistical approach and its application to dental growth studies

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Introduction

Estimating enamel formation times and enamel extension rates requires the preservation of an unworn crown. Only in unworn teeth can the total perikymata number be counted along the whole crown height and the total thickness of cuspal enamel be measured. However, the methods described in the literature for accurately reconstructing the cuspal outline of slightly worn teeth have not so far been validated.

Our aim here is to generate a validated methodology in order to reconstruct the cuspal outline of slightly worn teeth by employing regression equations in upper and lower incisors, upper and lower canines, upper and lower premolars and upper molars.

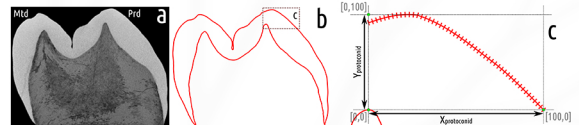
What's up with lower molars?

Modesto-Mata et al. (2017)

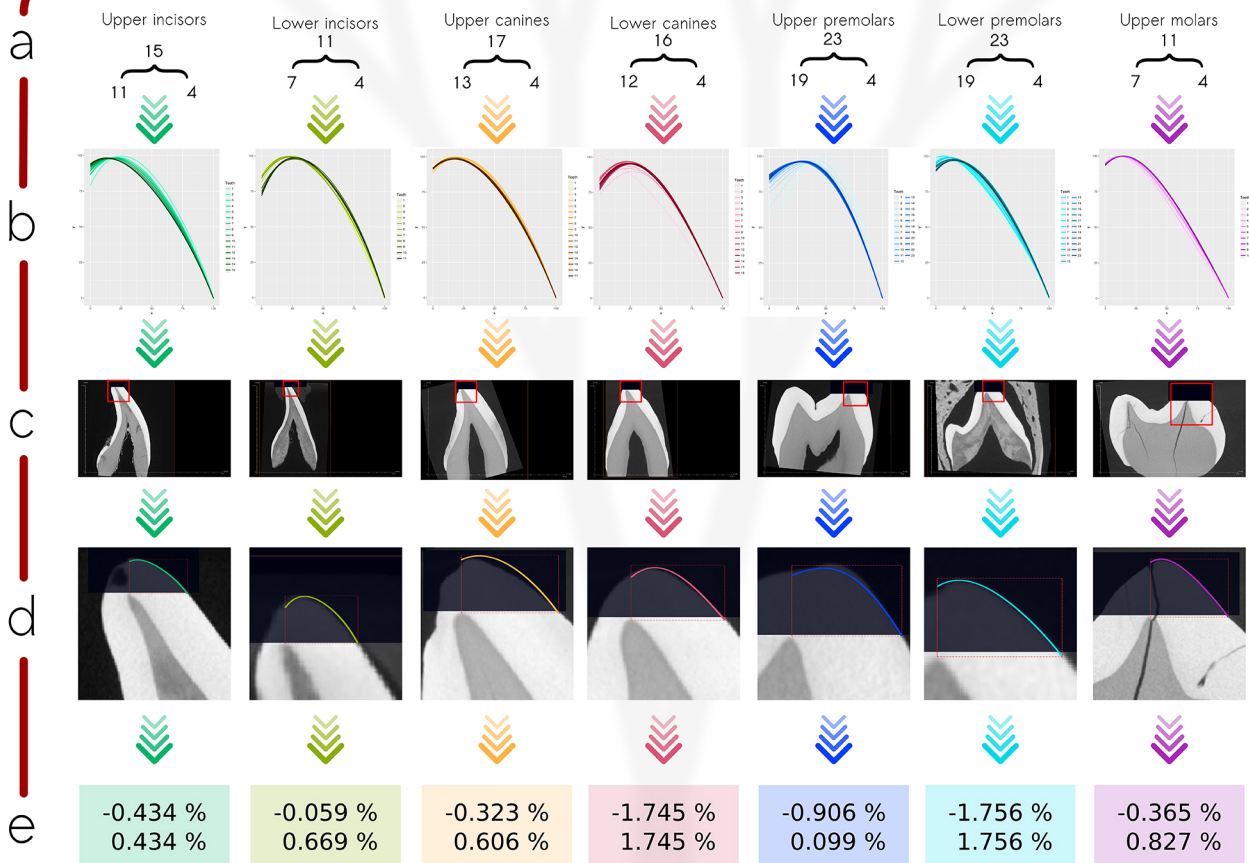


Material and Methods

Our sample comprises European and African origin (n=116). Standardized microCT slices were obtained for every unworn tooth type. Tooth-specific polynomial regressions were then generated by defining landmarks and semilandmarks superimposed on the unworn outer cuspal enamel outline. A number of tooth cusps were then virtually worn away and subsequently reconstructed by employing the data collected for each specific tooth type using predictions from the regression equations.



Results



a) Total sample size (top), sample size to calculate the regression equation (bottom left) and sample size to digitally erode and reconstruct. b) Regressions adding incrementally and randomly one tooth (from lighter to darker colors). c) Cuspal areas of one tooth as example that have been digitally darkened. d) Reconstruction of the outline of the cuspal area with each specific regression. A 20% transparency of the real outline is shown. e) Relative mean percentage errors (top) and absolute (bottom) between the real and estimated crown heights.

Discussion and Conclusions

Estimated crown heights were less than $\pm 2\%$ different with regard to their real values in all tooth types. This information allows us to estimate the number of perikymata that might have been lost in the cuspal area more precisely using existing data for density, or perikymata packing patterns.

This methodology allows the reconstruction of cuspal enamel in modern human teeth that are slightly worn enabling the accurate assessment of the original cuspal enamel thickness, crown height and the number of perikymata lost through wear. Future studies aim to increase the robusticity of this method with the inclusion of larger sample sizes. This method can be also potentially be applied to other extant or extinct human populations.

Affiliations and Acknowledgments

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