# A Measurement Tool to Visually Analyze Exfoliated Primary Teeth: A Study of the Children of Mothers Pregnant Surrounding the Time of the 2013 Boston Bombing

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## Background

The analysis of deciduous teeth has the potential to serve as a non-invasive window into critical developmental periods. Variations in their morphology can provide insight into early childhood experiences, pathology, stress exposure, and oral health.

Odontological collections that identify teeth and catalog features are relevant for research in disciplines including dentistry, biological anthropology, archaeology, and epidemiology. There are no measurement tools available that have systematically characterized oral health related indicators from exfoliated teeth.

The Dunn Lab with Mass General Hospital collected nearly 1000 primary teeth from ~150 children whose mothers were pregnant during or one year prior to the 2013 Boston Marathon bombings. The Strong Study aims to understand how adverse perinatal experiences affect tooth development.

## Objectives

- Develop a measurement tool of "oral health indicators" and assess its strengths and challenges.
- Recruit interdisciplinary cohort to utilize measurement tool.
- Evaluate the extent to which there is inter-rater consistency among researchers of different backgrounds.

## Methods

Developed tool to analyze collected primary teeth.

A set of 30 maxillary central incisors were rated across 12 "oral health indicators" by 9 raters.

9 Raters: (2) post-doctoral biological anthropologists, (3) dental students, (1) pediatric dental resident, (1) veteran pediatric dentist and (2) post-graduate/undergraduate research assistants.

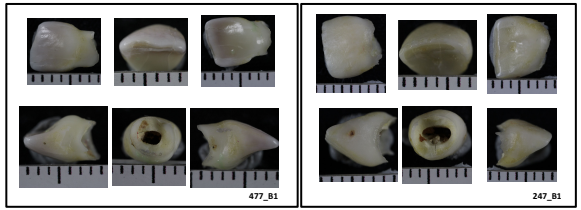


Figure 1: Example of 2 tooth samples - each tooth from 6 angles.

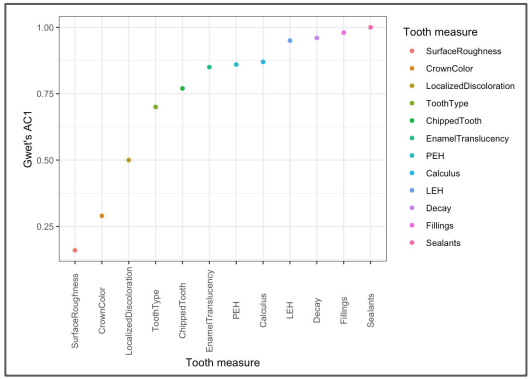


Figure 2: Plot of Gwet's AC1 statistic of inter-rater reliability of "tooth measures"

## Results

| variable | pa | kappa_light | kappa_fleiss | gwet_ac1 |
|---|---|---|---|---|
| ToothType | 0.74 | 0.58 | 0.53 | 0.70 |
| CrownColor | 0.33 | 0.12 | 0.10 | 0.29 |
| LocalizedDiscoloration | 0.59 | 0.31 | 0.25 | 0.50 |
| SurfaceRoughness | 0.56 | 0.14 | 0.10 | 0.16 |
| ChippedTooth | 0.82 | 0.11 | 0.11 | 0.77 |
| EnamelTranslucency | 0.86 | NaN | 0.01 | 0.85 |
| LEH | 0.96 | NaN | -0.02 | 0.95 |
| PEH | 0.87 | NaN | 0.01 | 0.86 |
| Calculus | 0.88 | NaN | -0.03 | 0.87 |
| Decay | 0.96 | 0.40 | 0.39 | 0.96 |
| Fillings | 0.98 | NaN | -0.01 | 0.98 |
| Sealants | 1.00 | NA | NaN | 1.00 |

Figure 3: Percentage Agreement, Fleiss' and Light's Kappa, and Gwet's AC1 Statistics

Conclusions:

- Consistency amongst raters in assessment of tooth type, chipping, translucency, hypoplasia, decay, fillings, and sealants.
- Inconsistent identification of crown color, surface roughness, and localized discoloration.

Challenges/Limitations:

- No recorded metric for origin of discoloration (e.g. Intrinsic vs extrinsic) or surface roughness (e.g. plaque vs dysplasia).
- Subjectivity in assessment of color, roughness, and discoloration.
- Lack of heterogeneity in sample set of 30 maxillary central incisors.

## Future Directions

- Modify existing measurement tool and repeat assessment with larger sample size with greater variability in features/tooth type.
- Analyze developmental/stress lines of a subset of teeth with microCT, light microscopy, scanning electron microscopy.
- Investigate relationship between perinatal/maternal health, Boston Marathon bombing exposure data, and tooth structure.

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