Estimating interproximal wear in upper first molars

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1. Research Question

Introduction
- Fossil hominin dental remains play an important role in determining taxonomic affinity and investigating differences among known species (e.g. Leakey et al., 1964; Villmoare et al., 2015).
- Crown and/or cusp areas are frequently the object of study; however, these measurements are affected by interproximal wear (see Box 1).
- It is not always clear how researchers account for interproximal wear, and how accurate their reconstructions are when they do compensate for it (Wolpoff, 1971).
- One method for estimating crown area relies upon recreating the worn sections of the original crown from occlusal photographs. In this method the original mesial and distal borders are estimated based on the buccolingual extent of the wear facet and preserved tooth shape.

Hypotheses
- We hypothesized that estimated crown areas using this method accurately reflect actual crown areas, but that accuracy may be influenced by an individual’s experience/familiarity with tooth morphology.

2. Materials & Methods

Workflow

1. Mesial
2. Unworn
3. Lingual
4. Artificially worn

(1-2) S.B. used unworn teeth and created artificial interproximal wear

(3-4) J.E. used unworn teeth and created artificial interproximal wear

(5-6) J.E. processed the reconstructions in Photoshop and ImageJ before measuring the reconstructed crown area in ImageJ

Experience levels of the reconstructors
All reconstructors are PhD students who were enrolled in S.B.’s Dental Anthropology course. J.E. (Rec 1.1 & Rec 1.2) was then a 5th year, and studies postcranial functional morphology; P.C. (Rec 2) was then a 4th year studying dental anthropology; and E.K. (Rec 3) was then a 2nd year studying dental anthropology.

3. Results

- The areas of the reconstructed crowns in Rec 1.1 and Rec 1.2 (N=29) each did not differ significantly from the areas of the unworn crowns when compared using Student’s t-test (p=0.69 & p=0.91, respectively).
- The means of Rec 1.1 and Rec 2 (N=29) did not differ significantly from each other and the mean of the actual areas in one-way ANOVA (p=0.96) (see Fig. 1).
- The means for Rec 1.1 and Rec 1.2 were both slightly higher (0.93mm² & 0.25mm², respectively) than the actual mean.

<table>
<thead>
<tr>
<th>N=10</th>
<th>Actual area</th>
<th>Rec 1.1 (J.E.)</th>
<th>Rec 1.2 (J.E.)</th>
<th>Rec 2 (P.C.)</th>
<th>Rec 3 (E.K.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual area</td>
<td>0.61</td>
<td>0.25</td>
<td>0.36</td>
<td>0.048</td>
<td></td>
</tr>
<tr>
<td>Rec 1.1 (J.E.)</td>
<td>0.30</td>
<td>0.36</td>
<td>0.55</td>
<td>0.60</td>
<td></td>
</tr>
<tr>
<td>Rec 2 (P.C.)</td>
<td>0.30</td>
<td>0.91</td>
<td>0.55</td>
<td>0.60</td>
<td></td>
</tr>
</tbody>
</table>

Box 2: PB9, the problem tooth

The reconstructions of PB9 were the most inaccurate across reconstructions due to barely noticeable differences between the unworn tooth and the artificially worn version (left). All reconstructors significantly overestimated the worn area.

4. Conclusions

- This method of reconstructing crown areas from worn UM1s is a justifiable way of accounting for interproximal wear when the investigator is experienced, but caution should be used in interpretations that rely upon reconstructed crowns.

Acknowledgements & Citations