

# Evaluation of the Potential of Odontometry for Sex Estimation on Burned Human Skeletal Remains

Márcia Gouveia<sup>1</sup>; Inês Santos<sup>1</sup>; Ana Luísa Santos<sup>1,2</sup>; David Gonçalves<sup>2-4</sup>

<sup>1</sup>Department of Life Sciences, University of Coimbra, Portugal.

<sup>2</sup>CIAS (Research Centre for Anthropology and Health) University of Coimbra, Portugal.

<sup>3</sup>Laboratório de Arqueociências, Direcção Geral do Património Cultural and LARC/CIBIO/InBIO, Lisboa, Portugal

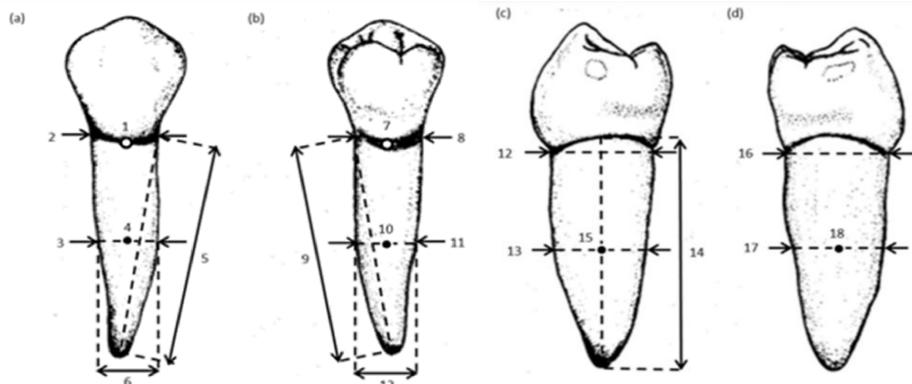
<sup>4</sup>Laboratory of Forensic Anthropology, Department of Life Sciences, University of Coimbra, Portugal.

Corresponding author: marciagou\_20@hotmail.com



## Introduction

In fire contexts where teeth are frequently the most resistant skeleton components, the understanding of thermic-induced changes is vital when trying to achieve the biological profile of burned individuals. Unfortunately, teeth enamel is rarely preserved in such scenarios. Thus, this study is focused on alternative measurements such as dimensions at enamel-dentin border (CEJ) and roots. They will, hopefully, allow the study of teeth sexual dimorphism and their potential for sex estimation.



**Figure 1.** Proposed measures by the present study in a lower second pre-molar in (a) buccal, (b) lingual, (c) mesial and (d) distal views. 1, 7, 12, 16: Buccolingual diameter at CEJ. 2, 8: Mesiodistal at CEJ level. 3, 11, 15, 18: Mesiodistal diameter at the middle of the root. 4, 10, 13, 17: Buccolingual diameter at the middle of the root. 5, 9, 14: Maximum height of the root (measured on the mesial side). 6, 12: Perimeter at the middle of the root. 12, 16: CEJ perimeter (adapted from Fuller *et al.*, 2001: 132).

## Material and Methods

Forty (20 from males and 20 from females) recently extracted lower second pre-molars (of individuals of known age and sex) were collected (with informed consent) in. The sample was cleaned, weighted, measured (Fig. 1) and burned in an electric muffle Barracha K-3 three-phase 14A at 900°C for 4 hours with increments of 4°C/min). The sample-specific cut-off point technique based on Albanese and colleagues (2005) and Cardoso (2008) was applied, i.e., by calculating cut-off points on the sample that is being subject to sex estimation. Both used to isolated and combined measurements.

## Results

1. All measurements show significant sexual dimorphism before and after burning,
2. Due to a larger heat-induced shrinkage in female teeth dimensions, sexual dimorphism in the sample artificially increased after burning,
3. The cut-off point technique (after burn) provided correct classification percentages above 80% for both sexes in two dimensions: CEJ Perimeter (male = 81,82% and female = 91, 82%); sum: buccolingual diameter of CEJ + mesiodistal diameter (male = 88,89% and female = 83,33%),
4. The sum of dimensions **provided** correct sex classification percentages usually higher to those assigned separately,
5. The logistic regression technique **provided** sex classifications above 80%.

## Discussion

**Limitations:** (a) to use the values obtained on this sample as cut-off points for sex estimation of unknown individuals, the tooth must be burned up to 900°C; (b) to calculate sample-specific cut-off points for sex estimation, samples must follow the assumptions recommended by Albanese *et al.* (2005) – be composed of more than 40 teeth of the same type and have a sex ratio of at least 1:1.5. Also, teeth must have been burned at similar temperatures. Although heat-induced dimensional change may vary between teeth burned at similar temperatures, this apparently did not interfere dramatically with sex estimation based on some standard measurements.

**Application:** Results suggest that sample-specific sex estimation (Albanese *et al.*, 2008; Cardoso, 2005) can be carried out based on some standard measurements.

**Advantages:** (a) samples of burned remains, roots measurements, especially those at the level of the CEJ, may provide an alternative to crown measurements; (b) root measurements are not affected by attrition, as frequently happens with the crown; (c) the proposed measures are also applicable to teeth found outside of the alveoli in archaeological contexts; (d) metric approaches is also more objective and require less experience than morphologic methods; (e) if these approaches are applied to other kind of teeth, for example incisors, they will allow sex estimation of even younger non adults since their time of eruption occurs earlier than the one of lower second pre-molars, as shown by Cardoso (2008).

## Conclusion

This research proposes alternative approaches to sex estimation in burned human teeth. Even though additional investigation is necessary to gather the real potential of human dentition, the observations based on lower pre molars are encouraging and the analysis of other teeth, such as the more sexually dimorphic canines, may supply even better results.

## References:

- Albanese, J., Cardoso, H.F.V., Saunders, S.R., 2005. Universal methodology for developing univariate sample-specific sex determination methods: an example using the epicondylar breadth of the humerus. *Journal of Archaeological Science*. 32, 143-152.  
Cardoso, H., 2008. Sample-specific (universal) metric approaches for determining the sex of immature human skeletal remains using permanent tooth dimensions. *Journal of Archaeological Science*. 35, 158-168.  
Fuller, J. L., Denehy, G. E., Schulien, T. M., 2001. Concise dental anatomy and morphology, fourth ed. University of Iowa College of Dentistry, pp. 39-117.  
Gouveia, M., [On going]. Evaluation of the potential of odontometry for sex estimation on burned human skeletal remains. Master thesis. Department of Life Sciences, University of Coimbra.

**Note:** The poster will be available in HOTA's website after the Meeting (<http://hotresearch.wix.com/main>).