Universidade do Algarve ■ Promontoria Monográfica 16

JIA 2011

IV Jornadas de Jovens em Investigação Arqueológica

11 a 13 Maio

Campus de Gambelas
Universidade do Algarve

Volume I

actas das IV Jornadas
de Jovens em Investigação Arqueológica

Promontoria Monográfica 16

Actas das IV Jornadas de Jovens em Investigação Arqueológica - JIA 2011
Vol. I

(Faro, 11 a 14 de Maio de 2011)

Editores Científicos:
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Núcleo de Arqueologia e Paleoecologia
Departamento de Artes e Humanidades
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Universidade do Algarve
FACULDADE DE CIÊNCIAS HUMANAS E SOCIAIS
Departamento de Artes e Humanidades
Núcleo de Arqueologia e Paleoecologia

Promontoria Monográfica 16

Editor:
Núcleo de Arqueologia e Paleoecologia e
Departamento de Artes e Humanidades
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Universidade do Algarve
Campus de Gambelas
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Coordenação Editorial:
Nuno Ferreira Bicho
António Faustino Carvalho

IMPRESSÃO:
Tipografia Tavirense, Lda.

TIRAGEM:
280 exemplares

ISBN: 978-989-97666-2-4

Depósito Legal: 342265/l2

APOIOS:

The value of dental morphology in the archaeological context: example of a Portuguese population from the late 19th and early 20th centuries

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ABSTRACT

The observation of dental non-metric characters used in the Arizona State University Dental Anthropology System (among others) is of major interest in the study of past populations. Dental morphological traits are genetically determined, and dependent of a small and stable part of the genome; their development seems unaffected by the uterine environment and their evolution is slow, probably independent of natural selection. The relative frequency of dental traits is a testimony to the biological distances between populations. The study of the inferior dentition in a late XIXth/early XXth century sample deceased in Oporto, Portugal, is the example of a statistically simple approach to the biological comparison between populations, using the ASUDAS (Turner *et al.* 1991), mainly, but also a trait proposed by Weets (2009). The comparisons with international samples denoted biological relatedness with European and, to a lesser extent, North African populations. The Iberian samples also suggest a close relationship with those populations. The use of the ASUDAS to the study of teeth from archaeological contexts is important. A greater collection of data will be used in the determination of the population history of the Iberian Peninsula. Important questions, relative to cultural influence/colonization may then be closer to resolution.

KEYWORDS

Dental morphology; ASUDAS; Biological distances

INTRODUCTION

Dental Anthropology is a research area within Biological Anthropology. Dental Morphology is the study of the morphological variation on teeth (Scott & Turner 1997). This variation manifests itself through several non-metric traits, which are small details in the shape of a tooth crown, in the shape or number of roots, and even on the number of present teeth (Scott & Turner 1997).

Teeth, and particularly the phenotypic traits found on teeth, are the best source of information on biological relationships between populations or subgroups (Tyrrell 2000; Scott 2008). Their formation is independent of uterine influence, their evolution is slow and probably independent from natural selection, the development of anatomic traits of teeth is seemingly uncorrelated and presents low sexual dimorphism, and it also relies on a small and stable portion of the genome (Tyrrell 2000). The genetic factor in the presence of non-metric dental traits is theoretically associated with the presence of alleles and chromosomal *loci* (Scott & Turner 1997, 2008). Their quantity affects the expression of the trait, as well as its presence and frequency in a population or subgroup (Scott & Turner 1997, 2008).

Odontologic material is well preserved (Hillson 2005; Irish & Nelson 2008; Scott 2008; Scott & Turner 1988; Silva 2002), is easy to observe (Scott 2008), contains a wide variety of information (shape, size and several morphological traits; Irish & Nelson 2008; Scott 2008; Scott & Turner 1988, 1997, 2008; Silva 2002) and exhibits strong genetic influence in tooth development and expression (Irish & Nelson 2008; Scott 2008; Scott & Turner 1988, 2008; Silva 2002). Since teeth are present in humans all around the world and have been studied accordingly, very wide comparisons are possible (Scott 2008).

Teeth have been studied since the Classic Antiquity; the works of Hipocrates and Aristotles are some examples (Alt *et al.* 1998). Classical ideas were maintained throughout the Middle Age, in the context of naturalist philosophy (Alt *et al.* 1998). In the 18th and 19th centuries, (primarily anatomical) considerations on dental development and the histology of dental structures was initiated (Alt *et al.* 1998). Cranial and post-cranial discrete traits have been of interest for researchers since the early 19th century, and have been observed in teeth (with intention of establishing biological relationships between populations) since mid 20th century (Scott & Turner 1997, 2008). The study of discrete dental traits comes about after the origin of population genetics, which studied families and twins, given its relevance in the field (Alt *et al.* 1998). After the adoption of the “Modern synthesis” in Anthropology, Lasker’s “Genetic analysis of racial traits of the teeth” marks the change in dental morphology analysis from a classificatory stand-point to a genetic one (Scott & Turner 2008). In the last 40 years, non-metric dental traits have contributed to evaluate population dynamics and interpret the socio-cultural evolution of past populations.

The use of an ordinal scale of measure was definitely established by the Arizona State University Dental Anthropology System (the ASU), by Turner and colleagues (1991). Turner started the research to create ASU in 1970 (Scott & Turner 1997). This method is based on a collection of reference plaques, some already in use by several workers, applied in order to standardize observations by the various researchers on the field (Turner *et al.* 1991; Scott & Turner 1997, 2008). Most of the plaques exhibit several three-dimensional portrayals of grades. The researcher must compare the tooth anatomy to the portrayed (and thoroughly described) grades and choose which corresponds. This is repeated for every selected trait in every tooth.

The frequencies of dental non-metric traits (percentage of teeth with presence – or absence, in some cases, – of each trait) are comparable among populations, in order to estimate their biological relations (Scott & Turner 1997). The best way to accomplish this is through statistical procedures, but it's also possible to compare frequencies directly. Scott and Turner (1997) consider it to be possible to assign a sample to a biological group, in the wider sense, using only limited samples (low number of individuals and/or non-metric traits studied) and simple procedures (without specific statistical tests).

The identification of genetic continuities/discontinuities among populations is a way to clear questions relative to continuities of other factors (such as vulnerability to pathologies, activity patterns, diet and cultural changes, etc; Silva 2002).

As a simple example of how this can be applied to actual populations, I will present the analysis of a Portuguese sample of 104 individuals who died in Oporto in the late 19th to early 20th centuries.

MATERIALS AND METHODS

One hundred and four mandibles' dentitions were studied, including 402 teeth. These mandibles were deposited in the Museu de História Natural of the Faculdade de Ciências from the Universidade do Porto, in Portugal. Professor Mendes Correia organized a skeletal collection on the Museu Antropológico of the Faculdade de Ciências with material from the Oporto cemeteries, from the late 19th to early 20th centuries (Santos Júnior 1969). The referred mandibles are the most notorious remains of such collection.

The ASU was used. The twelve traits selected and used for comparison are shown on TABLE 1. The Mandibular Molar Pit-Tubercle (or MMPT) trait suggested by Weets (2009) was also recorded (see TABLE 1). This occurs on the distobuccal cusp and may manifest as a concavity, a groove or even a small tubercle (Weets 2009).

So as to test statistical significance between data obtained for males and females, the mandibles were sexed. This was achieved by applying the methods of: Loth and Henneberg (1996, as adapted by Balci *et al.* 2005); Buikstra *et al.* (1994); Ferembach *et al.* (1980); Giles (1984).

The Pearson *chi*-square was used to assess the difference between the sexes and the recorded sides for each trait observed. The data was pooled when allowed and a tooth count method was used, to apply all the registered information.

The tooth count method was used. This allows for the whole data to be used, by calculating the frequency of each trait on each tooth observed (Scott & Turner 1997). In small samples, the tooth count method is useful but should only be applied if symmetry is confirmed, so any existing difference between sides will not bias the results (Scott & Turner 1997). The individual count method only allows for the most expressive side, or a specific side throughout the sample, to be used (Scott & Turner 1997).

Two observations were made for each category and the intra-observer error was calculated. The precision (frequency of correct correspondence between the two observations) and the Spearman correlation tests were used.

The statistical package used was PASW Statistics 17.0 (by SPSS, Inc.).

RESULTS AND DISCUSSION

TABLE 2 shows all morphological dental characters' frequencies that were searched for (except shoveling of the incisors, which were not used for comparison), and some frequencies for Europeans collected by Irish (1998). The mentioned statistical methods and intra-observer error were applied and calculated. There were no significant differences between sides, which allows for the tooth count method to be used. The data were also aggregated among sexes (63.8% of the individuals are male, 24.5% are female and 11.7% are "undetermined"), with two exceptions: distal trigonid crest of the third molar and the protostylid of the second molar, the only significantly different traits. The full results of these tests aren't discriminated here so as to not remove focus from the main objective: to show the usefulness of dental morphology in distinguishing between human populations or understanding their biological origins. For the full report and interpretation, see Marado (2010).

Odontomes are not present on premolars. Multiple lingual cusps occur in 23.1% of the first premolar and 52.4% on the second. 4.2% of first molars have four cusps, 95.7% have a C5 and 2.1% have a C6. The C7 is present in 7.5% of these teeth. The first molars do not present distal trigonid crests or MMPTs.

As reported by Weets (2009), the MMPT is rare on the first molar, as well as on the second (6.0%). In the third molar this trait is more common (31.4%).

On the worldwide samples used for comparison, the similarity with European samples is almost transversal to the characters studied (as seen on TABLE 2). The populations from North Africa are also rather similar, according to samples cited by Marado (2010). This deems the Museu de História Natural collection biologically near the European population, according to the inferior dental traits observed.

Only the protostylid doesn't present close frequencies to those found on European samples. This may be result from a difficulty in defining grade 1 (equivalent to the *foramen caecum molare*). This grade is generally considered as present, but its correct identification may be reduced because of its location and external characteristics. Aguirre *et al.* (2006) consider the *foramen caecum* a grade 1 protostylid, common in American populations. In the enamel-dentin junction the protostylid presents as a crest along the mesiobuccal cusp, or involves both buccal cusps (Skinner *et al.* 2009). Skinner *et al.* (2009) established, at least for *A. africanus* and *P. robustus*, that the protostylid is not a cusp, as it does not form a dentin cone on the enamel-dentin junction.

As expected, the sample from the Museu de História Natural is well framed within the frequencies used for comparison from the Iberian Peninsula (see Marado 2010). The fact that there are only small samples from recent Portuguese populations and the dental morphological traits weren't prioritized on the research projects do not allow for better comparisons, but the general tendency indicates this sample is biologically well placed among the Portuguese (Marado 2010).

CONCLUSIONS

This work characterizes the morphological pattern found on the mandibular teeth of a Portuguese sample of individuals buried in Oporto in the early Contemporary period.

The frequencies found integrate the sample among the European dental complex. The fact that the sample is biologically Portuguese wasn't empirically proven, since the data available for comparison was chronologically distant and had few dental non-metric traits. Nonetheless this sample was similar and in all likelihood confirmed to be Portuguese.

The frequency of protostylid should be underlined (34.4% on the first molar, 17.3% on the second), since it is superior to the frequencies found on other samples. The world variation of MMPT should be investigated. This will contribute to the biological characterization of populations worldwide and dilute confusion between this trait and protostylid. Parallel statistical analysis suggested the importance of selecting the correct presence/absence dichotomy on cusp 7, since the incorrect dichotomy may facilitate statistical differences between sexes.

Future dental morphology investigation in Portugal should focus on characterizing, with the aid of an identified skeletal collection, the frequencies of traits on a Portuguese large sample. This would be only a gateway to a wider (geographically and, more important, chronologically) dental morphology characterization of Portuguese peoples. That would be an important achievement in the search for the genetic influences behind the several culturally diversified groups who passed through and stayed in the current Portuguese territory, coloring our history books and defining our present identity.

The objective consideration of dental attrition when evaluating dental non-metric traits is essential to posterior result interpretation. This will diminish subjectivity and the subsequent risk of incorrectly measuring biological distances.

Future works should prioritize X-ray analysis, since it allows the detection of dental agenesis and contributes to the differential diagnosis of morphological or pathological changes on mandibles (or maxillas).

ACKNOWLEDGEMENTS

Vanessa Campanacho was very important to this JIA session's existence and the author's presence and small contribution to JIA 2011.

The Museu de História Natural of the Faculdade de Ciências from the Universidade do Porto and particularly its curator, Doctor Maria José Cunha, granted the author access to the material and logistic conditions to develop the research.

Professor Ana Maria Silva, the author's advisor, patiently taught and instructed the research and the resulting dissertation, with utmost support and dedication.

Professor Sofia Wasterlain provided the author with valuable knowledge in the field of statistics and helpful criticism. The author's colleagues, friends and family were very supportive and essential to the conclusion of his dissertation. The whole teaching staff at the Department of Life Sciences in the University of Coimbra creates a wonderful learning environment and is very supportive of their students.

REFERENCES

AGUIRRE, L., D. CASTILLO, D. SOLARTE & F. MORENO
2006. Frequency and Variability of Five Non-Metric Dental Crown Traits in the Primary and Permanent Dentitions of a Racially Mixed Population from Cali, Colombia. *Dental Anthropology* 19(2): 39-47.

ALT, K.W., C.L. BRACE & J.C. TURP
1998. The History of Dental Anthropology, in K.W. Alt, F.W. Rösing & M. Teschler-Nicola (ed.) *Dental anthropology: fundamentals, limits, and prospects*: 15-39. Wien: Springer.

BALCI, Y., M.F. YAVUZ & S. CAGDIR
2005. Predictive accuracy of sexing the mandible by ramus flexure. *HOMO – Journal of Comparative Human Biology* 55: 229-237.

BUIKSTRA, J.E. (ed.); D.H. UBELAKER (ed.) & D. AFTANDILIAN. (assist. ed.)
1994. Standards for data collection from human skeletal remains, in *Proceedings of a Seminar at The Field Museum of Natural History* (Organized by Jonhathan Haas). Fayetteville: Arkansas Archeological Survey Research Series no.44.

FEREMBACH, D., I. SCHWIDETZKY & M. STLOUKAL
1980. Recommendations for age and sex diagnoses of skeletons. *Journal of Human Evolution* 9(7): 517-550.

GILES, E.
1964. Sex determination by discriminant function analysis of the mandible. *American Journal of Physical Anthropology* 22: 129-136.

HILLSON, S.
2005. *Teeth*. Cambridge: Cambridge University Press.

IRISH, J.D.
1998. Ancestral dental traits in recent Sub-Saharan Africans and the origins of modern humans. *Journal of Human Evolution* 34: 81-98.

IRISH, J.D. & G.C. NELSON
2008. Introduction, in J. D. Irish & G. C. Nelson (ed.) *Technique and application in Dental Anthropology*: 3-9. Cambridge: Cambridge University Press.

LOTH, S.R. & M. HENNEBERG
1996. Mandibular ramus flexure: A new morphological indicator of sexual dimorphism in the human skeleton. *American Journal of Physical Anthropology* 99: 473-485.

MARADO, L.M.
2010. Análise dos caracteres discretos da dentição inferior e do osso mandibular numa série do Museu de História Natural (FCUP). Unpublished Master's degree thesis, Universidade de Coimbra.

SCOTT, G.R.
2008. Dental morphology, in M.A. Katzenberg & S.R. Saunders (ed.) *Biological anthropology of the human skeleton*: 265-298. Hoboken, New Jersey: Wiley-Liss.

SCOTT, G.R. & C.G. TURNER. II.
2008. History of dental anthropology, in J. D. Irish & G. C. Nelson (ed.) *Technique and application in Dental Anthropology*: 10-34. Cambridge: Cambridge University Press.
1997. *The anthropology of modern human teeth. Dental morphology and its variation in recent human populations*. Cambridge studies in Biological Anthropology. Cambridge: Cambridge University Press.
1988. Dental anthropology. *Annual Review of Anthropology* 17: 99-126.

SILVA, A.M.
2002. Antropologia funerária e paleobiologia das populações portuguesas (litorais) do Neolítico final-Calcolítico. Unpublished doctorate thesis, Universidade de Coimbra.

SKINNER, M.M., B.A. WOOD & J.-J. HUBLIN
2009. Protostylid expression at the enamel-dentine junction and enamel surface of mandibular molars of *Paranthropus robustus* and *Australopithecus africanus*. *Journal of Human Evolution* 56: 76-85.

TURNER, C.G. II., C.R. NICHOL & G.R. SCOTT
1991. Scoring procedures for key morphological traits of the permanent dentition: The Arizona State University Dental Anthropology System, in M.A. Kelley & C.S. Larsen (ed.) *Advances in Dental Anthropology*: 13-31. New York: Wiley-Liss.

TYRRELL, A.
2000. Skeletal non-metric traits and the assessment of inter- and intra- population diversity: past problems and future potential, in M. Cox & S. Mays (ed.) *Human osteology in archaeology and forensic science*: 289-306. London: Greenwich Medical Media.

WEETS, J.D.
2009. A promising mandibular molar trait in ancient populations of Ireland. *Dental Anthropology* 22(3): 65-72.

TABLE 1. Selected non-metric traits of the dentition.

Source	Trait	Observed teeth	Dichotomy
ASUDAS (Turner *et al.* 1991)	Distal accessory crest	Canine	+ = ASU 1-5
	Odontome	1st and 2nd premolars	+ = ASU 1
	Lingual cusp variation	1st and 2nd premolars	+ = ASU 2-9
	Anterior *fovea*	1st molar	+ = ASU 1-4
	Deflecting wrinkle	1st molar	+ = ASU 1-3
	Cusp pattern	1st, 2nd and 3rd molars	1st molar: + = ASU X 2nd and 3rd molars: + = ASU Y
	Distal trigonid crest	1st, 2nd and 3rd molars	+ = ASU 1
	Protostylid	1st, 2nd and 3rd molars	+ = ASU 1-7
	Cusp number	1st, 2nd and 3rd molars	1st molar: + = ASU 4 2nd and 3rd molars: + = ASU 5+
	Cusp 5	1st, 2nd and 3rd molars	+ = ASU 1-5
	Cusp 6	1st, 2nd and 3rd molars	+ = ASU 1-5
	Cusp 7	1st, 2nd and 3rd molars	+ = ASU 1-4
Weets (2009)	(MMPT) Mandibular molar pit-tubercle	1st, 2nd and 3rd molars	+ = Weets (2009) 1-3

TABLE 2. Discrete dental traits frequencies of the observed sample and of Europeans.

Dental traits		MHN	Europe
Distal accessory crest (C) + = ASU 1-5	% *n*	40 2/5	51.7 89
Odontome (PM1) + = ASU 1	% *n*	0 0/38	1.2 171
Odontome (PM2) + = ASU 1	% *n*	0 0/22	
Lingual cusp number (PM1) + = ASU 2-9	% *n*	23.1 9/39	-
Lingual cusp number (PM2) + = ASU 2-9	% *n*	52.4 11/21	62.9 529
Deflecting wrinkle (M1) + = ASU 1-3	% *n*	20.7 12/58	30.9 149
Anterior *fovea* (M1) + = ASU 1-4	% *n*	65.2 43/66	-
Cusp pattern (M1) + = ASU X and +	% *n*	10.2 10/98	-
Cusp pattern (M2) + = ASU Y	% *n*	22 22/100	22.9 214
Distal trigonid crest (M1) + = ASU 1	% *n*	0 0/58	8.6 185
Distal trigonid crest (M2) + = ASU 1	% *n*	3.2 3/93	-
Protostylid (M1) + = ASU 1-7	% *n*	34.4 32/93	20 200

Dental traits		MHN	Europe
Protostylid (M2) + = ASU 1-7	% *n*	M: 12.1 F: 36.8 U: 15.4 98	-
MMPT (M1) + = Weets (2009) 1-3	% *n*	0 0/85	-
MMPT (M2) + = Weets (2009) 1-3	% *n*	6 6/100	-
MMPT (M3) + = Weets (2009) 1-3	% *n*	31.4 27/86	-
Cusp number (M1) + = ASU 4	% *n*	4.2 4/96	-
Cusp number (M2) + = ASU 5+	% *n*	3.8 4/104	34.9 189
C5 (M1) + = ASU 1-5	% *n*	95.7 90/94	-
C5 (M2) + = ASU 1-5	% *n*	3.8 4/104	-
C6 (M1) + = ASU 1-5	% *n*	2.1 2/96	7.9 178
C6 (M2) + = ASU 1-5	% *n*	0 0/104	-
C7 (M1) + = ASU 1-4	% *n*	7.4 7/94	5.8 223
C7 (M2) + = ASU 1-4	% *n*	1.9 2/104	-

MHN – Museu de História Natural FC-UP; Europe: Irish (1998); M: Male; F: Female; U: Undetermined.