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ANTHROPOLOGY

NON-METRIC TRAITS OF HUMAN UPPER FIRST AND SECOND MOLARS IN A SKELETAL SAMPLE FROM THE MAUSOLEUM CRYPT OF THE FIRST WORLD WAR HEROES IN IAȘI, ROMANIA

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Nonmetric traits are often studied in palaeoanthropology to quantity genetic affinity, or biodistance within or between human populations. The present study aims at analyzing the morphology and expression pattern of the upper (maxillary) first and second molars from a sample of human remains found in the Mausoleum Crypt of the First World War Heroes in Iași, Romania. The aim is to identify similarities indicating that individuals belonged to the same population. This research provides data on dental traits of local human populations. Metacone and hypocone had a constant occurrence in the analyzed material, revealing fluctuations in their development. The Carabelli trait, metaconule and enamel extension traits were identified on a small number of molars, the highest frequency being of 23.08% metaconule in the upper first molars. The parastyle was not identified in the studied dental material.

INTRODUCTION

Teeth offer an excellent material for multidisciplinary research regarding the past human populations, in both archaeological and forensic contexts [1–3]. Due to their resistance to the taphonomic process, they have been the subject of many interconnected areas, such as physical anthropology, dentistry, biology, palaeontology, and palaeopathology [1, 4–8].

Several studies used teeth dimensions and shape as phylogenetic indicators to evaluate the intra- and inter-population variability of past human populations, and to acquire insights of migratory patterns [9–13]. Dental morphology is influenced by genetic, environmental, and epigenetic factors, the crown and root of teeth phenotype being up to 80% heritable [14–17]; therefore, teeth are used as biomarkers in biological distance (also known as biodistance) analyses [18–20]. The study of dental morphology is usually based on the assessment of the phenotypic variation of teeth, being known as *discrete traits* or *non-metric traits* [21–23]. The dental non-metric traits are represented by deviations in root numbers and features at crown level, such as ridges, tubercles, styles, and accessory cusps [9,21,24]. The dental morphological variations have been progressively studied from the beginning of the 20th century, contributing to enriching the knowledge about migration movements, origins, affinities, and variation of different human groups from different geographic regions [9,21,25–27]. Moreover, the dental discrete traits have been used to explore family groups in necropolises [28, 29].

Although numerous studies have addressed teeth morphological variation using dental non-metric traits, the knowledge of teeth phenotypic expressions in archaeological human populations is still limited, and it is almost missing in Romania. To date, only one research paper regarding non-metric characters of the mandibular second molars from a 17th century population of Iaşi city (Romania) have been published by Popovici *et al*. in 2021 [9].

The present study aims at determining similarities in terms of morphological dental traits, indicating that the analyzed subjects belonged to the same human group.

During the archaeological excavation developed for the rehabilitation of the Mausoleum Crypt of the First World War Heroes in Iași, several human bones without anatomical connection were revealed. The Mausoleum of Heroes was built between 1929 and 1930 at the initiative of the Society of the Cult of Heroes from Iași, to honour the fallen heroes of the First World War [30,31]. The edifice is situated at approximative 1.7 km from the centre of Iași city, on the North-Eastern part of Galata hill (Fig. 1A, B). The osteological material discovered in the Mausoleum Crypt was poorly preserved, of which only 50 skulls were aleatorily sampled, prepared and anthropologically studied.

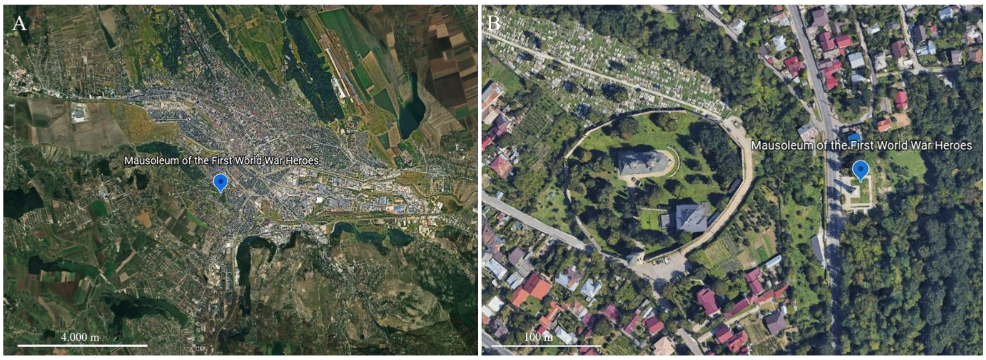

Figure 1. A – Location of the Mausoleum of the First World War Heroes in Iași;
B – Detail of location (map Source: Google Earth).

MATERIAL AND METHODS

The material is represented by the upper (maxillary) first and second human molars (UM1, UM2) belonging to 46 skeletons from secondary depositions, found in the Mausoleum Crypt of the First World War Heroes (Iași County, Romania). The osteological material (*i.e*., skulls without mandibles) was previously studied by Groza *et al*. [31,32] in terms of age at death and sex estimations, odontopathies and anomalies. The dental material was prepared for the study, as follows: impurities were removed from the dental crown using ethanol, hydrogen peroxide, and cotton wool [4]; digital images of occlusal surfaces were recorded with a millimetre scale; all maxillary molars with an undamaged crown (without severe pathologies, highly advanced wear, and post-mortem chipping) were included. All selected teeth have fully formed crowns, free of damages or pathologies.

Six non-metric traits (*i.e*., metacone, hypocone, metaconule, Carabelli trait, parastyle, and enamel extinction) were analysed and scored using the Arizona State University Dental Anthropology System (ASUDAS) [33].

The hypocone and metacone are the most variable in size, typically being largest in first molars, reduced in second molars, and absent in the third molar.

Metacone (cusp 3) is the distobuccal cusp in upper molars. It is scored based on size from 0 to 6, with 0 indicating the absence of the cusp, and 6 the full-sized expression of the cusp. Hypocone (cusp 4), the distolingual cusp in upper molars, is also scored using the same range as for metacone. Metaconule (cusp 5) is a cusp occurring on the distal occlusal surface of the upper molars, between the metacone and the hypocone. Its size is variable, the scores including five grades of traits.

Carabelli trait is a pit or cusp in the mesiolingual cusp of the upper molars; it can be expressed as a groove or a pit, as a Y-shaped depression, or as a full cusp. Its scores range from 0 to 7, with 0 indicating the absence of expression and 7 – a full cusp.

The parastyle (paramolar tubercle) is an accessory cusp which occurs on the buccal surface of the upper molar paracone. The expression of this trait can range from a small pit or attached cusp to a very large cusp with a free-standing apex.

Enamel extensions are thin lines of enamel projecting downward from the buccal and/ or lingual cervical enamel borders towards the root bifurcations of both upper and lower molars.

Descriptive statistics was performed using XL Stat vers. 2020.4.1.

RESULTS AND DISCUSSION

Analysis of the dental material was performed for the whole dental sample and not by sex groups. Analysis by sex would have been inconclusive, considering that there are only three female specimens in the sample.

Each recorded dental trait of the investigated molars was described in terms of expression frequencies. Out of the 6 non-metric dental traits presented above, only 5 were observed in our study. Table 1 presents the prevalence of the non-metric traits in UM1 and UM2. Cusps 3 and 4 are consistently present in the analysed material, on both UM1 and UM2, while metaconule, Carabelli trait and enamel extension have a low occurrence in the sample, with frequencies of 41.26%, 12.81%, and 10.26%, respectively.

Table 1

Prevalence of non-metric dental traits by scores (%)

Traits	Molar (n specimens)	Score 0	Score 1	Score 2	Score 3	Score 4	Score 5	Score 6	Score 7
Metacone (cusp 3)	UM1 (n=39)	0.00	0.00	0.00	0.00	56.41	43.59		
	UM2 (n=44)	0.00	0.00	0.00	2.27	59.09	38.64		
Hypocone (cusp 4)	UM1 (n=39)	0.00	0.00	0.00	7.69	58.97	33.33		
	UM2 (n=44)	0.00	0.00	6.82	31.82	47.73	13.64		
Metaconule (cusp 5)	UM1 (n=39)	76.92	0.00	10.26	5.13	5.13	2.56		
	UM2 (n=44)	81.82	0.00	9.09	4.55	4.55	0.00		
Carabelli	UM1 (n=39)	0.00	0.00	2.56	0.00	0.00	2.56	7.69	0.00
	UM2 (n=44)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Parastyle	UM1 (n=39)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	UM2 (n=44)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Enamel extensions	UM1 (n=39)	0.00	10.26	0.00					
	UM2 (n=44)	0.00	0.00	0.00					

* Gray area – no classification

Metacone. Its reduction or absence is uncharacteristic – the first and second molars (UM1, UM2), but can occur on the third molars [33]. In this sample, metacone was recorded on all molars, showing fluctuations in its size. According to ASUDAS classification, in this sample, metacone has a score of 3 to 5. In UM1, score 4 was most frequently expressed, representing 56.41% of the UM1, followed by a large metacone, equal in size with hypocone (score 5, 43.59%). A large metacone was recorded in UM2, with score 4 (59.09%) and 5 (43.59%), a reduction being recorded in only 2.27% of UM2 teeth (Fig. 2A).

Hypocone. It is the most variable element of upper molar cusps, possibly ranging from a large, fully developed cusp, most often seen on the UM1, to a reduced or absent cusp on the UM2 and UM3 [34, 35]. A large cusp (score 4) was recorded on both UM1 and UM2, with frequencies of 58.97% and 47.76%, respectively. Cusp with score 5 (very large) had a high frequency in both molars (UM1, UM2), with frequencies of 43.59% in UM1, and 38.64% in UM2. A small cusp (score 3) was more present in UM2 (31.82%) than in UM1 (7.69%). A reduction of hypocone as a faint ridging (score 2) was observed in 6.82% of UM2 teeth (Fig 2B).

The constant occurrence of the hypocone in the analysed material was observed, compared to the frequencies indicated for other archaeological populations (*e.g.*, 2.8% for the Molí de Can Fonoll Medieval population [36] or 33.3% on UM2 in a modern sample of 20 century from Georgia [37]).

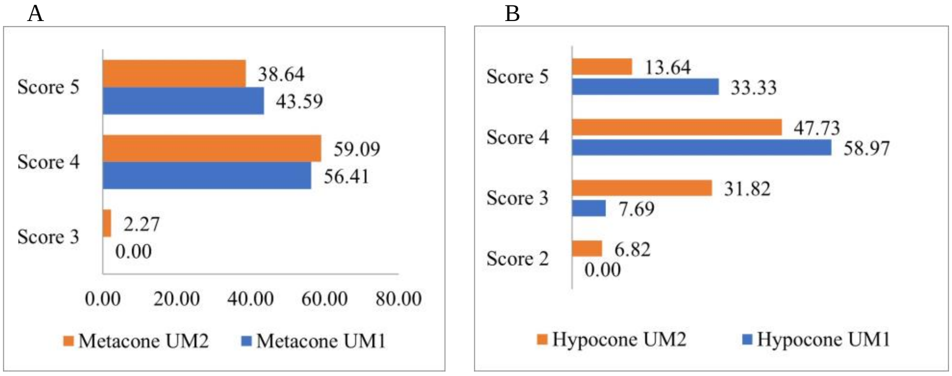

Figure 2. Frequencies (in %) of dental traits in the analysed sample: A – metacone; B – hypocone.

Carabelli trait. It is a supernumerary cusp, which occurs on the mesiolingual surface of the protocone on the upper molars (Fig. 3). Its most common occurrence is recorded on the UM1 [35]. Also, in our dental material, this trait was identified only on UM1 teeth. Carabelli trait occurred under different expressions (scores). With a frequency of 7.69%, it appeared as a cuspid with an attached apex contacting de medial lingual groove (score 6, according ASUDAS); in the form of a pit (score 2), but also as a small cusp without free apex (score 5), it was present in the sample with a frequency of 2.56% (Fig. 4).

Carabelli trait is considered to be a Caucasoid trait [37]. Hanihara [38] observed low frequencies of this trait in Japanese, and higher in American population, finding that this trait distinguishes Caucasoid populations of Asia and also that, in the latter ones, the groove and pit forms are dominant. Also, Turner [39] found significant patterns in sinodont people (South American indigenous and North Eastern Europeans).

Figure 3. Carabelli cusp on UM1; border highlighting the cusp; M – mesial, B – buccal.

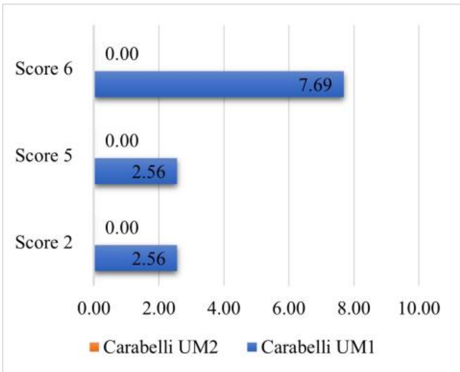

Figure 4. Frequency (in %) by scores of Carabelli trait in the analysed sample.

Metaconule. The presence of cusp 5 (metaconule) on the upper molars occurs with frequencies of 23.08% in UM1, and 18.19% in UM2 (Fig. 5). It appears under different expressions (scores), the highest frequency having the metaconule assigned to score 2 (trace cuspule present, according to ASUDAS definition) – 9.09% in UM2 molars, and 10.26% in UM1 molars.

Better outlined metaconules were also recorded. In the form of a small cusp (score 3), it has been identified with frequencies 5.13% in UM1 and 4.55% in UM2, while larger cusps (scores 4 and 5) were found especially in UM1. Only two UM1 recorded metaconule with a score 4 (5.13%), and only one UM1 had metaconule with score 5 (2.56%).

We notice a low frequency for this trait in the analysed dental sample, compared to the frequencies reported for other populations. For example, a frequency of about 80% is recorded in Aboriginal populations [40], were various degrees of expression of the metaconule are observed on maxillary molars.

Figure 5. Metaconule cusp on UM2; border highlighting the cusp; M – mesial, B – buccal.

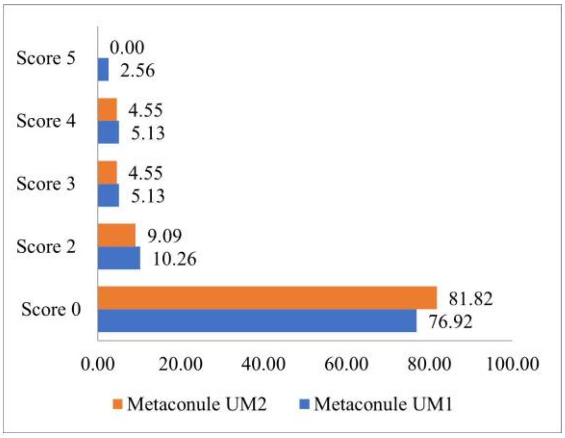

Figure 6. Frequency (in %) by scores of metaconule cusp in the analysed sample.

Enamel extensions. These are thin lines of enamel which project downward from the buccal and/ or lingual cervical enamel borders towards the root bifurcations of molars. The scores range from 0 to 3, with 0 indicating no extension and 3 meaning an extension more than 4 mm. This non-metric trait was identified on only four molars of the UM1 sample; its score was in type 2, measured by a moderate extension. In terms of distribution, enamel extensions occur with low frequencies (0–10%) among Western Eurasians. The trait appears most often (40–60%) in American and East and North Asian populations [41].

Parastyle. Parastyle is rare in the present human populations, and very little information is available regarding its occurrence, owing to its low incidence [42].

Expression of this trait can range from a small pit or attached cusp to a very large cusp with a free-standing apex. It appears mostly on the upper third molars, although it is sometimes observed on the first and second molars, as well [35]. However, some studies report a higher occurrence in Indians, compared to other populations [43,44].

This trait was not identified in the analysed dental sample.

CONCLUSIONS

This study aimed at examining the dental morphology of upper first and second molars (UM1 and UM2) in a sample of human remains recovered from the Mausoleum Crypt of the First World War Heroes in Iași. The results obtained highlighted a morphological variability of non-metric characters, but also similarities, indicating that individuals belonged to a same group.

The similarities refer to the constant incidence of metacone and hypocone in all analysed individuals; particularly, the predominance of scores 4 and 5 for these two cusps could be an evidence supporting our conclusion.

Carabelli trait, metaconule and enamel extensions were identified on a small number of molars. The parastyle was not identified in the studied dental material. Despite the small sample size, this research provides important data on dental traits in a human group. These will allow us to understand the human biological diversity of this region, in association with historical events.

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