MORPHOMETRIC VARIABILITY OF THE MOLAR TOOTH M2 IN THE SKELETAL SERIES DISCOVERED IN THE 17TH CENTURY NECROPOLIS FROM IASI (IASI COUNTY, ROMANIA)

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Abstract. M2 tooth is particularly important for paleoanthropological research. The molar tooth M2 is generally well preserved *in situ* compared to other molar teeth (M1 wears out early and therefore its form becomes with flattened cusps and unclear pattern, and M3 does not appear constantly). This particularly molar, M2, is used in the study of health and diet providing information on dental wear based on food. The 17th century necropolis of Iași was discovered in 2008, in the rescue archaeological excavations from the *Palas Mall* complex. 60 individual and collective burial tombs were excavated, from which 111 skeletons were recovered (80 males and 31 females). Dating skeletons was made based on the archaeological inventory. In the present study, 234 M2 teeth from 77 skeletons were analysed. For each tooth, the following dimensions were taken: cusps height, mesio-distal and bucco-lingual crown diameters. Morphometric variability was analysed depending on various factors such as: sex, age, laterality and position in the skull. The molar teeth M2 morphometrically analysed will be the subject of a further study concerning the dental microwear as a marker of the paleodiet.

Keywords: M2 molar, tooth, morphometry, necropolis, 17th century, Iasi.

Rezumat. Dintele M2 este deosebit de important pentru cercetarea paleoantropologică. Dintele molar M2 este în general bine conservat *in situ* comparativ cu alți dinți molari (molarul M1 se uzează devreme, prin urmare forma sa devine cu cuspizi aplatizați, cu un model neclar, iar molarul M3 nu apare în mod constant). Molarul M2 este utilizat pentru studiul sănătății și al dietei, oferind informații despre uzura dentară bazată pe alimentație. Necropola de secol XVII din Iași a fost descoperită în anul 2008, cu ocazia săpăturile arheologice de salvare de la complexul Palas Mall. Au fost excavate 60 de morminte individuale și colective, din care au fost recuperate 111 schelete (80 de bărbați și 31 de femei). Datarea scheletelor a fost făcută pe baza inventarului arheologic. În studiul de față, au fost analizați 234 de dinți M2 de la 77 de schelete. Pentru fiecare dinte au fost luate următoarele dimensiuni: înălțimea cuspizilor și diametrele coroanei mezio-distal și buco-lingual. Variabilitatea morfometrică a fost analizată în funcție de diferiți factori, precum: sex, vârstă, lateralitate și poziția în craniu. Dinții M2 analizați morfometric vor fi obiectul unui studiu ulterior privind micro-uzura dentară ca marker al paleodietei.

Cuvinte cheie: molar M2, dinte, morfometrie, necropolă, secol XVII, Iași.

Introduction

Teeth are a valuable and durable source of information for paleoanthropological research based on their hard tissues: the enamel, dentine and cementum (Gomez-Robles *et al*., 2007; Guatelli-Steinberg & Huffman, 2012). Traces of somatic development, life history and significant biological phenomena are preserved in teeth and can offer a wealth of information about the individuals of whom they were once a part (Grine, 2007). Dental crown size variations have been reported between different populations due to numerous factors such as: genetic, epigenetic and environmental influences (Brook *et al*., 2009).

The human molars are permanent teeth and they consist of three pairs in each jaw, located distal of the premolars (maxillary – M^1, M^2, M^3; mandibular – M_1, M_2, M_3). In the studies of dental morphometry, the M1 and M3 molars are avoided because M1 has a variable morphology, usually with flattened cusps and unclear pattern, and M3 does not appear constantly – congenitally missing (Moreno-Gómez, 2013; Scott, 2008).

Studies of morphometry and evolutionary relationships have been based on non-metric crown traits (marginal ridge complex, cingulum derivative, supernumerary coronal structure, cervical enamel line, variation in major cusps, supernumerary cusps) and root traits (root number, dictated by some combination of inter-radicular projections and fusion, and supernumerary roots) (Scott *et al.*, 2015). Techniques based on distance measurements and indexes constructed from them (crown index) are also used to describe the tooth form (Bernal, 2007). The most common measurements used today are the maximum crown diameters taken in the mesio-distal (M-D) and bucco-lingual (B-L) planes (Takahashi *et al.*, 2007; Hemphill, 2015).

This preliminary study aims to compare dental crown size of the molar tooth M2 in the skeletal series discovered in the 17th century necropolis from Iasi (Iasi County, Romania), depending on various factors such as: sex, age, laterality and position in the skull.

The necropolis of "Curtea Domnească" at Iaşi (Iaşi County, Romania) was discovered in 2008, in the rescue archaeological excavations from the *Palas Mall* complex. 60 individual and collective burial tombs were excavated, from which 111 skeletons were recovered (80 males and 31 females). Dating skeletons (17th century) was made on the archaeological inventory. Estimation of age at death and sex was done using criteria recommended by Bruzek (2002), Schmitt (2005), and White & Folkens (2000). The anthropometric and conformational study of each skeleton has been completed according to methods of Martin & Saller (1956-1966).

Material and Methods

In the present study, 234 crowns of molar tooth M2, belonging to 77 skeletons from the necropolis of "Curtea Domnească" at Iaşi, were analysed (Table 1).

Table 1. Selected teeth, belonging to 77 adult skeletons from "Curtea Domnească" necropolis.

Sex	Molar tooth M2	N
Men	Right inferior	57
	Left inferior	47
	Right superior	41
	Left superior	38
Women	Right inferior	16
	Left inferior	12
	Right superior	12
	Left superior	11

According to Hillson *et al.* (2005), the maximum crown diameters were taken with an electronic caliper: mesio-distal (the largest mesial-to-distal dimension taken parallel to the occlusal surface), and bucco-lingual (the greatest distance between the buccal and lingual

surfaces, perpendicular to the mesio-distal diameter) (Fig. 1). For each cusp, height was calculated by measuring the perpendicular distance between the maximum tip point and the cervical plane (Fiorenza *et al.*, 2011) (Fig. 2). The relationships between measurements were investigated through scatterplots, correlations, column and radar type charts. The statistical evaluation of the results was carried out by one-way ANOVA (Analysis of Variance) followed by *t* – test. Differences between groups were considered significant when p<0.05.
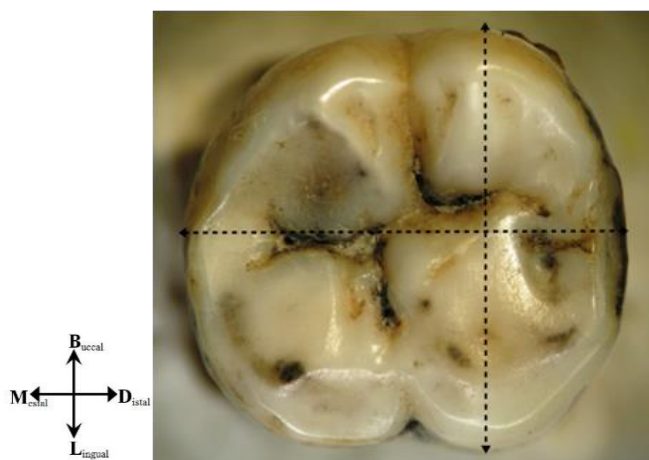
Figure 1. Occlusal view of M_2 inferior molar: mesio-distal and bucco-lingual crown diameters.

Figure 2. Lingual view of M_2 inferior molar, high cusps: 1 – paraconid; 2 – metaconid; 3 – protoconid; 4 – hypoconid.

Results and Discussion

Table 2 provides summary statistics for measurements of the M2 molars. The coefficient of variation (CV%) was used to describe variability and it has values for the M^2 and M_2 bucco-lingual crown diameter between 0.08% (in man) and 0.09% (in women), respectively 0.06% and 0.05%. The mean of the mesio-distal crown diameter of M^2 in women is smaller (mean = 9.34, n = 23) than that of men (mean = 9.42, n = 79), but bucco-lingual crown diameter is higher (mean = 11.27 in women and 11.19 in man). The highest cusp of the M^2 in man is the hypocone (H^4 maximum hight = 8.10 mm, H^4 minimum hight = 3.80 mm) and lowest is the paracone (H^1 maximum hight = 7.24 mm, H^1 minimum hight = 1.05 mm). In women, the protocone is the highest cusp (H^3 maximum hight = 7.28 mm, H^3 minimum hight = 4.15 mm) and the lowest is the paracone (H^1 maximum hight = 6.65 mm, H^1 minimum hight = 3.46 mm). The lowest cusp of the M_2 is the protoconid (in women H_3 maximum hight = 6.77 mm, in man H_3 maximum hight = 6.68 mm) and the highest is the metaconid in women (H_2 maximum high = 7.40) and hypoconid in man (H_4 maximum high = 7.51 mm).

Table 2. Summary statistics for measurements of M2 molars. Abbreviations: B-L D. – bucco-lingual maximum crown diameter; M-D D. – mesio-distal maximum crown diameter; H^1/H_1 – paracone/paraconid hight; H^2/H_2 – metacone/metaconid hight; H^3/H_3 – protocone/protoconid hight; H^4/H_4 – hypocone/hypoconid hight; N – number of examined molars; Min. – Minimum; Max. – Maximum; SD – standard deviation; CV – coefficient of variation (%); CL – confidence level.

| Anatomical element	Variable	Sex	N	Mean (mm)	Min. (mm)	Max. (mm)	SD	CL (95%)	CV (%)
M²	B-L D.	Man	79	11.19	7.18	13.45	0.94	0.21	0.08
		Women	23	11.27	9.32	13.13	1.04	0.44	0.09
	M-D D.	Man	79	9.42	5.93	12.52	0.89	0.20	0.09
		Women	23	9.34	7.76	10.72	0.83	0.36	0.08
	H^1	Man	79	4.51	1.05	7.24	1.26	0.28	0.27
		Women	23	4.93	3.46	6.65	0.85	0.37	0.17
	H^2	Man	79	4.71	1.73	7.24	1.22	0.27	0.25
		Women	23	5.19	3.80	7.03	0.87	0.37	0.16
	H^3	Man	79	5.73	3.67	7.61	0.95	0.21	0.16
		Women	23	5.90	4.15	7.28	0.77	0.33	0.13
	H^4	Man	79	5.82	3.80	8.10	0.91	0.20	0.15
		Women	23	5.83	3.46	7.10	0.84	0.36	0.14
M₂	B-L D.	Man	104	10.09	8.96	12.04	0.64	0.12	0.06
		Women	28	9.83	8.95	11.35	0.57	0.22	0.05
	M-D D.	Man	104	10.63	8.87	12.97	0.77	0.15	0.07
		Women	28	10.68	9.34	12.67	0.71	0.27	0.06
	H_1	Man	104	4.99	1.57	7.01	1.00	0.19	0.20
		Women	28	5.27	2.84	6.95	0.88	0.34	0.16
	H_2	Man	104	5.15	2.44	7.38	0.95	0.18	0.18
		Women	28	5.53	4.06	7.40	0.81	0.30	0.14
	H_3	Man	104	4.81	1.25	6.68	1.10	0.21	0.22
		Women	28	5.33	3.27	6.77	0.96	0.37	0.18
	H_4	Man	104	4.82	2.35	7.51	1.06	0.20	0.21
		Women	28	5.38	3.69	6.88	0.85	0.33	0.15

The correlations of the dimensional variability (bucco-lingual and mesio-distal diameters) of the M_2 inferior (Fig. 3) and M^2 superior (Fig. 4) tooth are positive in men, showing a weak ($r = 0.22$) and moderate ($r = 0.6$) sample correlation coefficients. A scattered moderate correlation ($r = 0,62$) (Fig. 7) and no correlation ($r = -0,6$) (Fig. 8) were recorded in the dimensional variability (bucco-lingual and mesio-distal diameters) of the M_2 inferior tooth, respectively M^2 superior tooth, in women.
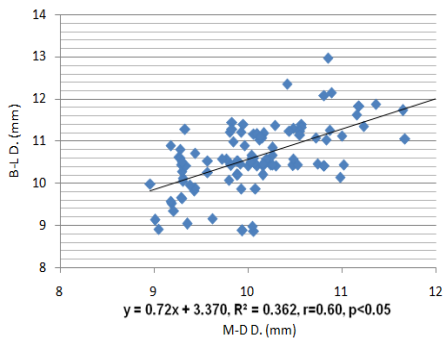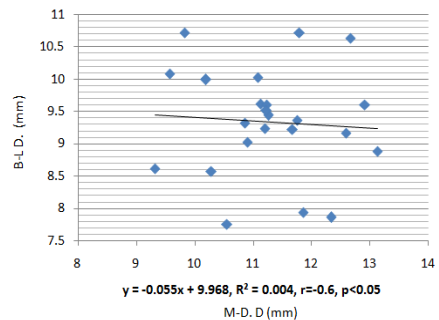
Figure 3. Dimensional variability of the M_2 inferior tooth, in men.
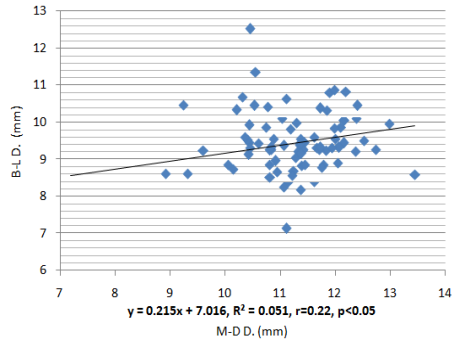
Figure 4. Dimensional variability of the M^2 superior tooth, in men.
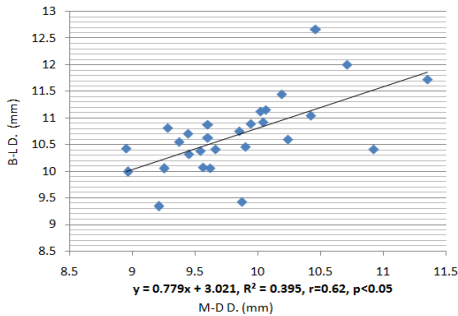

Figure 5. Dimensional variability of the M_2 inferior tooth, in women


Figure 6. Dimensional variability of the M^2 superior tooth, in women.

The shape of the occlusal surface can be characterized by a crown shape index B-L diameter x 100/M-D diameter. The crown shape index of the M_2 inferior tooth shows a low variability in both women and men (Fig. 7); instead, the M^2 superior tooth crown shape has a greater variability, especially in women compared to men (Fig. 8).
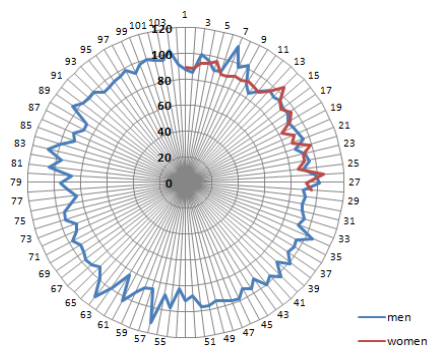

Figure 7. Variability of the crown shape index of the M_2 inferior tooth, by sex.
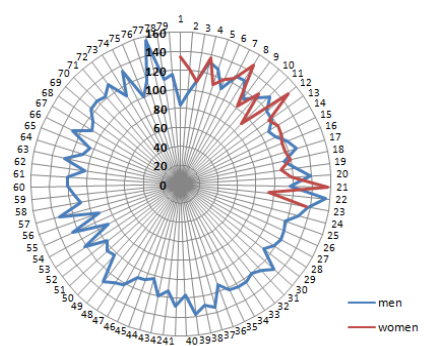

Figure 8. Variability of the crown shape index of the M^2 superior tooth, by sex.

Considering the height of the dental crown of the M2 molar, it decreases with age due to dental wear, with different rhythm depending on sex and dental position. The decrease rhythm is greater in men compared to women, especially in the case of the M^2 superior (Figs. 10-11).
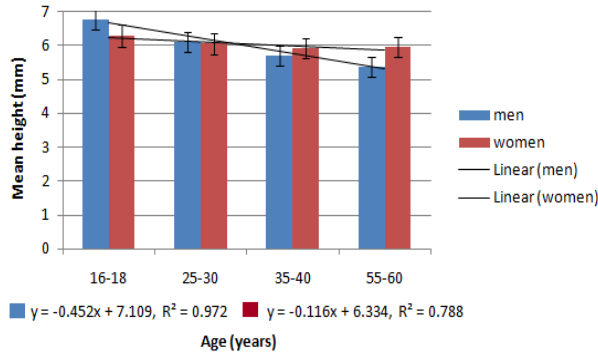
Figure 9. Variability of the mean height,
dental crow of the M^2 superior molar, depending on sex.
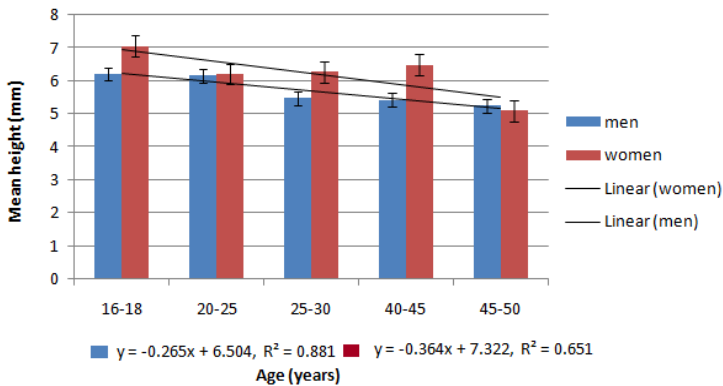
Figure 10. Variability of the mean height,
dental crow of the M_2 inferior molar, depending on sex.

Conclusions

The morphometry of the molar tooth M2, analysed in the skeletal series discovered in the 17th century necropolis from Iasi, shows a variability depending on the tooth position, sex and age. According to the data obtained in our study, the most stable shape of the dental crown appears in the case of the inferior M_2 tooth in men, and the most variable form at the upper M^2 tooth in women. The height of the dental crown decreases with age due to dental wear, but with a different rhythm depending on the position of the tooth and the sex.

The molar tooth M2 is the subject of the study concerning the dental macro- and micro-wear as a marker of the paleodiet. Thus, such research is started, based on electron microscopy techniques, image analysis and geometric morphometrics (Mahoney, 2006).

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