Morphological features of human molars of archaeological and contemporary origin

• Ana Jerat, Zrinka Jurec, Kalista Kamenečki •

University of Zagreb, School of Dental Medicine, Zagreb, Croatia – students*

Address for correspondence:
Ana Jerat
University of Zagreb, School of Dental Medicine
Gundulićeva 5
HR-10000 Zagreb, Croatia
E-mail: ane.jerat@gmail.com

*Mentor: Marin Vodanovic – University of Zagreb, School of Dental Medicine, Department of Dental Anthropology

Bull Int Assoc Paleodont. 2015;9(1):29-42.

Abstract

Dental anthropology is a branch of bioarcheology which helps in analyzing the historical questions that couldn't be explained due to lack of historical sources. Analyzing dental samples from medieval and contemporary time using the Arizona State University Dental Anthropological System shows changes in patterns of nutrition and disease over many generations of a society and also reconstructs human migration and tracks population growth or decline. Purpose: the intention of this examination was to establish the differences between archaeological and recent population in morphological features of maxillar and mandibular molars. Materials and methods: the study included 200 molars, 89 of them were of archeological origin whereas 111 were from recent population. Features analyzed on maxillary molars were: metaconus (distobuccal cusp), metaconulus (distal cusp), hypoconus (distolingual cusp) and Carabelli's trait. However, characteristics revised on mandibular molars were: anterior fovea (precuspidal fossa), groove pattern, middle trigonid crest, distal trigonid crest, deflecting wrinkle, molar cusp number, hypoconulid (cusp 5), entoconulicid (cusp 6) and metaconulid (cusp 7). Results: only hypoconus, a distopalatinal cusp of upper molars has shown difference in statistical comparison of contemporary and population of the Middle Ages. It appears more often in the recent population. Conclusion: the similarities between the two samples may be indicative of similar ancestral background of these populations.

Keywords: Tooth Morphology; ASUDAS; Paleodontology; Croatia

Introduction

Bioarcheology is a scientific study of human skeletal and dental remains from archaeological sites. It analyses burials, as well as prehistoric diets, dental anthropology, health and nutrition. Bioarcheologists look for changes in patterns of malnutrition and disease over many generations of a society; reconstruct human migration and track population growth or decline. When there is no written evidence about a specific population and other academic disciplines cannot help us in collecting data, dental anthropology has shown itself to be extremely useful source of information. Up to now, many works about exploration of Early Croatian sites were published. There are analysis of dental material from Buzet-Mejica site (1), in 1990. Ž. Mikić has analyzed samples from Mravinci near Split (2), Bedić and associates (2007.) gave a description of characteristics that belonged to population from Stranče-Gorica site (3), 2006. Šlaus has recorded results from exploring four Early Croatian cemeteries (DonjePolje near Šibenik, Glavice near Sinj, Radašinovci and Velim) (4). In 2010.IndaGauta et al. have published scientific research under the name of: “Human molar crown traits in Croatian medieval and contemporary populations” (5). Dental anthropological studies that compare the recent population with the medieval inhabitants of the territory of current-day Croatia haven’t been recorded in the professional or scientific literature. This is the reason why this study represents the first such study, and is a unique attempt at establishing the differences in tooth morphology between medieval and current-day people, to date. Since the medieval period in today’s Republic of Croatia was marked by numerous wars and other armed conflicts, there was consequential population migration. This study can provide an indirect insight into history through the morphological characteristics of teeth.

The purpose of this study is:

- To register and study the frequency and expression pattern of particular morphological characteristics of human molars from medieval Croatian population, from areas near Benkovac, and recent population
- To compare and contrast particular morphological characteristics of human molars from a medieval coastal population and recent population samples that are owned by Department of Dental Anthropology School of Dental Medicine University of Zagreb
- To identify morphological features in human molars that may serve to differentiate between archaeological and recent populations
- To establish the importance of the confirmed morphological differences with respect to the living environments of the archaeological and recent population

Materials and methods

There were 200 molars examined in this study. 89 of them were from an archeological source whereas 111 were from recent population. The molars of archeological source belong to skeletons which were found in a cemetery of village Radašinovci. It originates from the 9th century and belongs to a rural population who lived there at the beginning of the Middle Ages. On the other hand, the molars belonging to a more recent population date from the 20th and 21st century and are part of a collection of School of Dental Medicine at the University of Zagreb, Department of Dental Anthropology. The study included first and second molars of both upper and lower jaw with low stage of abrasion.

Molars were examined to define the frequency of morphological features classified according to Arizona State University Dental Anthropological System (Table 1) (5). Frequency of occurrence and expression of following morphological features were revised on maxillar molars: metaconus (distobuccal cusp), metaconulus (distal cusp), hypoconus (distolingual cusp) and Carabelli's trait. Mandibular molars were revised to define the frequency of occurrence and expression of following morphological features: anterior fovea (precuspidal fossa), groove pattern, middle trigonid crest, distal trigonid crest, deflecting wrinkle, molar cusp number, hypoconulid (cusp 5), entoconulicid (cusp 6) and metaconulid (cusp 7).

Each morphological feature was expressed by a degree after which the frequency of occurrence was observed. The difference in frequency of occurrence between archeological and recent population was compared using the chi-square test. Confidence interval was 99% with p-value of 0.01.

Results

According to analysis (Table 2), there were 58 molars from Maxilla and 53 from Mandible that were examined from recent population. This means that the amount of examined sample was almost equal (52.2% upper molars, 47.8% lower molars). However, there was a slight difference between the amount of upper and lower molars of the archaeological population, 57 maxillary and 32 mandible molars were revised (64.0% maxillary and 36.0 % mandibular molars).

The results of the chi-square test failed to confirm any statistically significant differences between the archeological and contemporary populations regarding the frequency of occurrence of the metaconus. The degree of expression of the metaconus in both populations and both types of teeth was most commonly found to be degree 3.5 of expression (27.3% - 48.0%), Figure 1.

The chi- square test was used to establish statistically significant differences between the archeological and contemporary populations with respect to the frequency of occurrence of the hypoconus on the first molar ($p<0.01$; $\chi=6.74$). The hypoconus was indentified on the 72.8% of the upper first molars from the contemporary population and 96.3% of those from archeological. The most common degree of frequency for the hypoconus on the upper first molar in both archeological and

contemporary population is 4 but the in the contemporary population degree 0 was equally represented as degree 4 (Figure 2).

The chi-square test was also used to determine statistically significant differences between the archaeological and contemporary population regarding the frequency of occurrence of the metaconulus on upper molars. The test has shown no statistically significant differences between the two populations. The frequency of occurrence of the metaconulus in the upper molars in both populations is 0 (51.5% - 59.3%). Figure 3.

There were no statistically significant differences between the archeological and recent samples concerning the Carabelli trait. The frequency of occurrence of the Carrabelli trait varied from 0% (recent population- upper second molar) to 33.4% (archeological population- upper first molar). The degree of expression of the Carabelli trait, where found, was mostly 1 or 5, figure 4.

In course of this research, not a single tooth in either population displayed a parastyle. With that taken into consideration, no statistical analysis was performed.

The chi-square test wasn't able to confirm any statistically significant differences between archeological and recent population in regard to the frequency of occurrence of the anterior fovea on first lower molars. The most common degree of expression of this trait was 0 in first molars and 2 in second molars, Figure 5.

There were no statistically significant differences regarding the frequency of occurrence of the middle trigonoid crest. The middle trigonoid crest was found more frequently on the lower molars of the contemporary population (59,0% - 61,0%) than on the molars of archeological population (40,0% - 52,0%). Figure 6.

No statistically significant differences have been confirmed between the archeological and recent population regarding the degree of expression of the groove pattern. The X groove pattern dominates within the recent population (51.9% - 61.5%) as same as in the archeological population (40.0% - 47.1%), Figure 7.

The chi-square test did not determine any statistically significant differences between the frequency of occurrence of the distal trigonoid crest within the contemporary and archeological population. Distal trigonoid crest was mostly found among the second lower molars of archeological population (52.9%) whereas it was found less often on the first lower molars of the archeological population (26.7%) and on the lower molars of the recent population (22.2% – 37.0%), Figure 8.

No statistically significant differences were found between the archeological and recent populations concerning the expression of entoconulid. Most teeth in both populations did not possess the expression of entoconulid (46.7% - 76.5%). The ones who did display entoconulid had mostly number 2, 3 or 4 degree of expression, Figure 9.

In course of this research, not a single tooth in either population displayed a protostylid, therefore no statistical analysis was performed.

No statistically significant differences were found between recent and archeological populations concerning the number of cusps on molars. First molar with 5 cusps prevail in both populations, while in archeological population on the first lower molar five cusps are found more often then 4 or 6 cusps (60.0%) in opposed to the second lower molar where 4 cusps prevail (76.5%), Figure 10.

The chi-square test did not determine any statistically significant differences between frequency of occurrence of the deflecting wrinkle within the archaeological and recent populations.

The deflecting wrinkle was found most frequently among the lower first molars from the archeological population (60.0%), where the largest degree of expression was 3, Figure 11.

The chi-square test failed to confirm any statistically significant differences between the archeological and recent populations concerning the frequency of occurrence of hypoconulid. Hypoconulid frequency varies between degrees 1 to 4 in first lower molars of both populations while on the second molar of the recent population there are only degrees 1 and 2 present. On second molar of the archeological population degrees 1, 2 and 3 are present, Figure 12.

The chi-square test failed to establish statistically significant differences between the archeological and contemporary populations with respect to the frequency of occurrence of the metaconulid. Metaconulid was most frequently found on the first lower molar of the archeological population (40.0%). The most common expression of metaconulid was 1A degree, Figure 13.

Discussion

The analyzing of teeth is a subfield of bioarcheology. Teeth showed extraordinary source of information on the condition of life of our ancestors because they are durable in time and remain unchanged for a long time. The teeth of human remains can help estimate how old the remains are, the diet that that person ate, they represent personal, family and population characteristics and even possibly tell about the human's cultural rituals. Furthermore, teeth are useful in the assessment of evolutionary and population origin because they can be studied directly both in recent and in archaeological populations.

This study has established statistically significant differences in the frequency of occurrence of the hypoconus on upper first molars. The hypoconus was identified on the 72.72% of the upper first molars from the contemporary population and 96.67% of those from archeological. The most common degree of frequency for the hypoconus on the upper first molar in both archeological and contemporary population is 4 but the in the contemporary population degree 0 was equally represented as degree 4.

The results of the chi-square test failed to confirm any statistically significant differences between the archeological and contemporary populations regarding the frequency of occurrence of the metaconus, the middle trigonoid crest, frequency of occurrence of hypoconulid or of the metaconulid.

The test has shown there is no statistically significant differences between the two populations regarding the frequency of occurrence of the metaconulus in the upper molars or regard to the frequency of occurrence of the anterior fovea on first lower molars.

There were also no statistically significant differences between the archeological and recent samples concerning the Carabelli trait (26%). In course of this research, not a single tooth in either population displayed a parastyle. With that taken into consideration, no statistical analysis was performed.

The x groove pattern dominates within the recent population (51.85 %- 61.54%) as same as in archeological population. A very probable cause of that is the relatively small sample size, since the complexity of the fissure system on the occlusal surfaces is related to the incidence of caries, and it is well-known that the prevalence of caries is greater in today's human population than it was in archaeological populations, which depends on the diet.

This research confirmed what was proved in the previous studies on similar topic. It has shown that, from an evolutionary perspective, twelve centuries separating the samples needn't affect the changes in the morphological characteristics of the tooth crowns analyzed, since they originate from a homogenous population tracked though various historical periods . Possible explanations should be sought out within the context of the fact that the recent population sampled for this research may belong to this geographical area or to this same archaeological population.

Conclusion

Analysis and comparison of the morphological features of the human molars from medieval (9th century) and current (20th/21. century) Croatian population has shown statistically significant differences in the frequency of occurrence of the hypoconus. This morphological trait appears more often in the recent population. Although most of the sample teeth displayed low-level or no abrasion, some teeth were affected more than others and therefore their traits could not be defined. Eating habits of both populations should be also taken into consideration as we cannot be certain how much effect they had on morphological traits and occurrence of dental caries. The similarities between the two samples may be indicative of similar ancestral background of these populations.

References

1. Dolinar Z. and Vidovič M. Študija z obovja iz grobišča Buzet – Mejica, Glasnik Antropološkog društva Jugoslavije. 1974.

2. Mikić Ž. Ausgrabungen des archäologischenVereins “Bihać” in Mravinice, Veröffentlicht. 1990.

3. Bedić Ž. Forenzično–antropološka analiza ljudskih kostiju iz groba 1 s nalazišta Guran – Na križu u Istri – Davno počinjeno ubojstvo i primjer kako postmortalna oštećenja kostiju mogu oponašati ubojstvo, Zaštitna arheologija na magistralnom plinovodu Pula–Karlovac, Denona, Zagreb. 2007.

4. Šlaus M. Analiza trauma u srednjovjekovnim uzorcima iz Kliškovca i Crkvara, prilozi Instituta za arheologiju u Zagrebu, 2006.

5. Gauta I, Vazdar MA, Vodanović M. Human molar crown traits in Croatian medieval and contemporary populations. Acta Stomatol Croat. 2010;44(1):3-16.

UPPER MOLARS	
METACONUS 0-Metacone is absent 1- An attached ridge is present on the metacone side 2- Faint cuspule with a free apex 3- Small cusp 3,5- Moderate-sized cusp 4- Large cusp 5- very large cusp	**HYPOCONUS** 0- Hypocone is absent 1- Faint ridging 2- Faint cuspule 3- small cusp 3,5- Moderate-sized cusp 4- Large cusp 5- Very large cusp
CARABELLI'S TRAIT 0- The mesiolingual aspect of cusp 1 is smooth 1- Groove 2- Pit 3- Small Y-shaped depression 4- Large Y-Shaped depression 5- Small cusp without a free apex 6- Medium sized cusp with an attached apex 7- Large free cusp	**METACONULUS** 0- Site of distal cusp is smooth 1- Faint cuspule 2-Trace cuspule 3- Small cuspule 4- Small cusp 5- Medium-sized cusp
LOWER MOLARS	
GROOVE PATTERN Y groove pattern + groove pattern X groove pattern	**MOLAR CUSP NUMBER** 4- cusp 1-4 5- cusp 5 is also present 6- cusp 6 is also present
ANTERIOR FOVEA 0- None 1- A weak ridge connects the mesial aspects of cusps 1 and 2 producing a faint groove 2- The connecting ridge is larger and resulting groove depper than in grade 1 3- Groove is longer than in grade 2 4- Groove is very long and mesial ridge robust	**HYPOCONULID** 0- None 1- Very small cusp 2- Small cusp 3- Medium sized cusp 4- Large cusp 5- Very large cusp
MIDDLE TRIGONID CREST 0- Middle trigonid crest is absent 1A- A crest is present- sharp connection 1B- A crest Is present- blunt and wide connection	**DISTAL TRIGONID CREST** 0- Absent 1- Present
ENTOCONULID 0- None 1- Cusp much smaller than cusp 5 2- Cusp smaller than cusp 5 3- Cusp equal in size than cusp 5 4- Cusp larger than cusp 5 5- Cusp much larger than cusp 5	**METACONULID** 0 - None 1- Faint cusp 1A- Faint tipples cusp 2- Small cusp 3- Medium-sized cusp 4- Large cusp
DEFLECTING WRINKLE 0- None 1- Straight with constriction 2-Deflected (no contact with cusp 4) 3- Deflected (contact with cusp 4)	

Table 1 Arizona State University Dental Anthropological System ASUDAS

ARHAEOLOGICAL POPULATION			
	MAXILLA(%)	MANDIBLE (%)	total (%)
M1	30 (73.3 %)	15 (33%)	45 (100.0%)
M2	27 (61.3%)	17 (38.6%)	44 (100.0%)
total	57 (64.0%)	32 (36.0%)	89 (100.0%)
RECENT POPULATION			
	MAXILLA(%)	MANDIBLE (%)	total (%)
M1	33 (56.0%)	26 (44.0%)	59 (100.0%)
M2	25 (48.1%)	27 (51.9%)	52 (100.0%)
total	58 (52.2%)	53 (47.8%)	111 (100.0%)
ARHAEOLOGICAL + RECENT POPULATION			
	MAXILLA(%)	MANDIBLE (%)	total (%)
M1	63 (60.5%)	41 (39.5%)	104 (100.0%)
M2	52 (54.2%)	44 (45.8%)	96 (100.0%)
total	115 (57.5%)	85 (42.5%)	200 (100.0%)

Table 2 Distribution of samples.

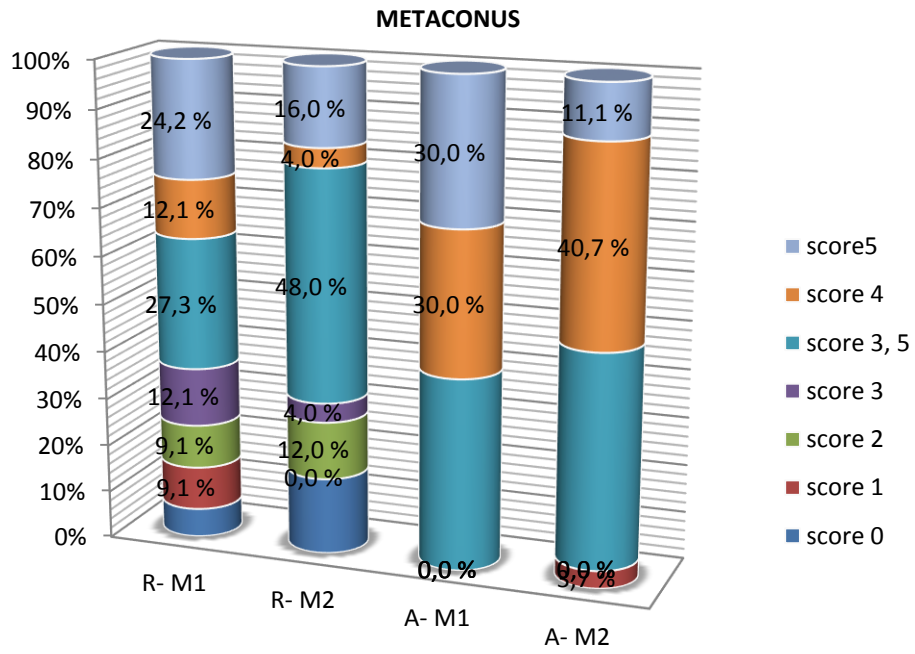

Figure 1 The degree of expression of the metaconus.

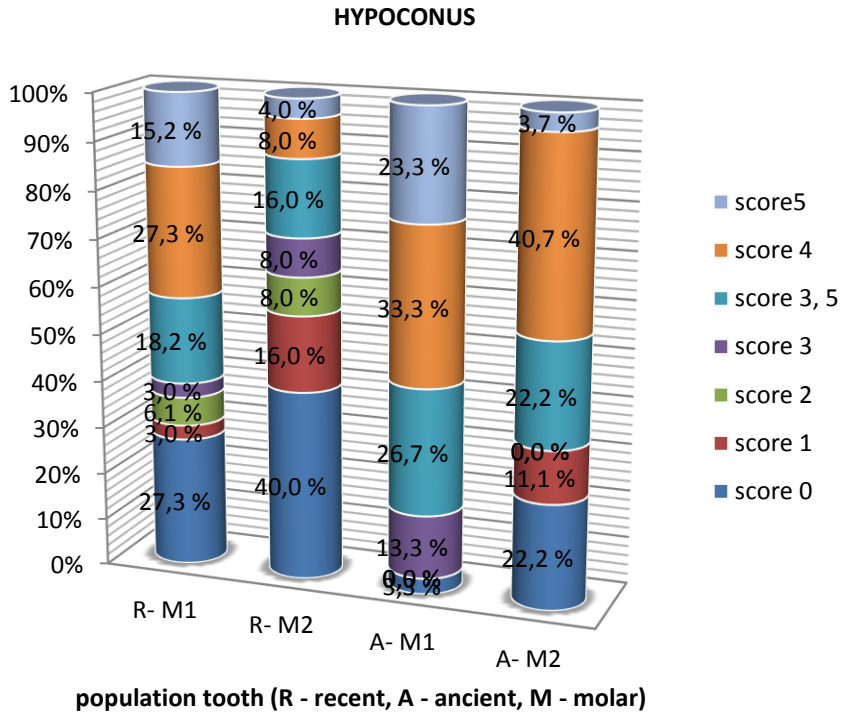

Figure 2 The degree of expression of the hypoconus.

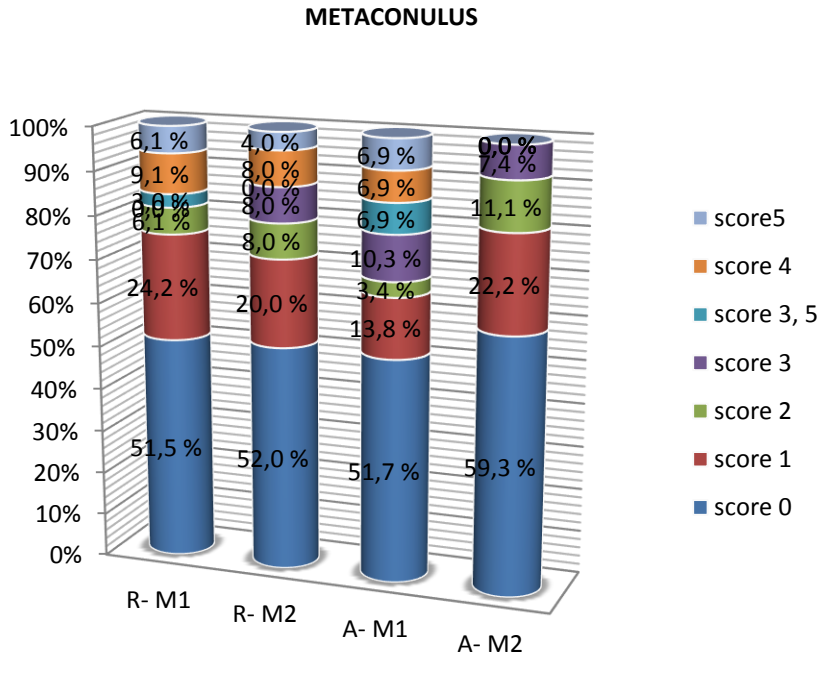

Figure 3 The degree of expression of the metaconulus.

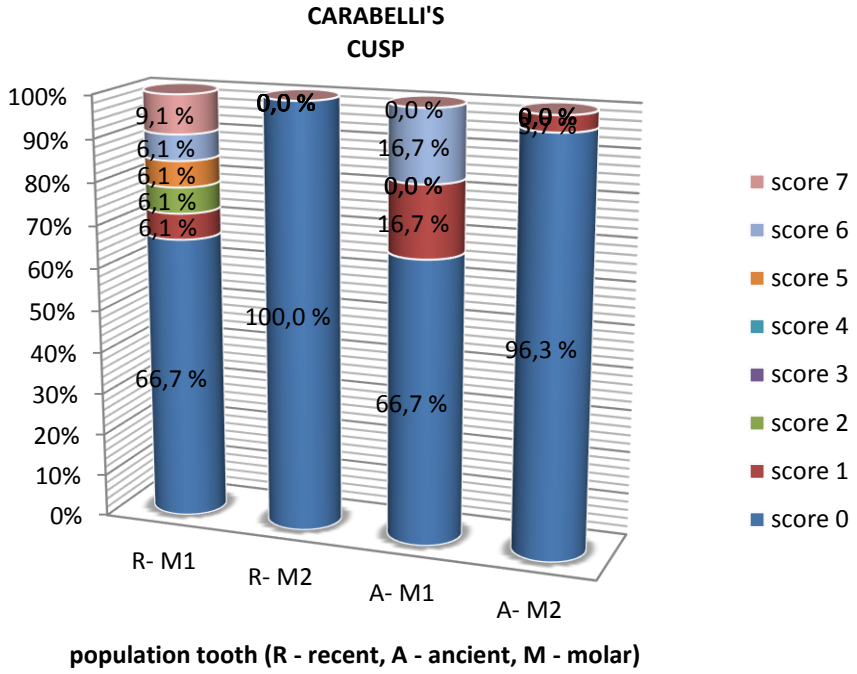

Figure 4 The degree of expression of the Carabelli`s trait.

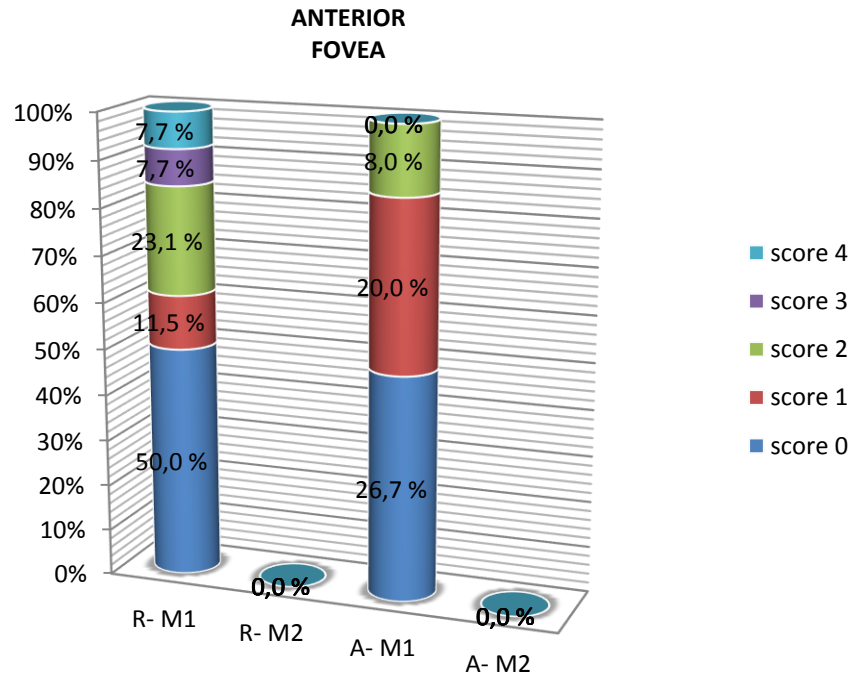

Figure 5 The degree of expression of the anterior fovea.

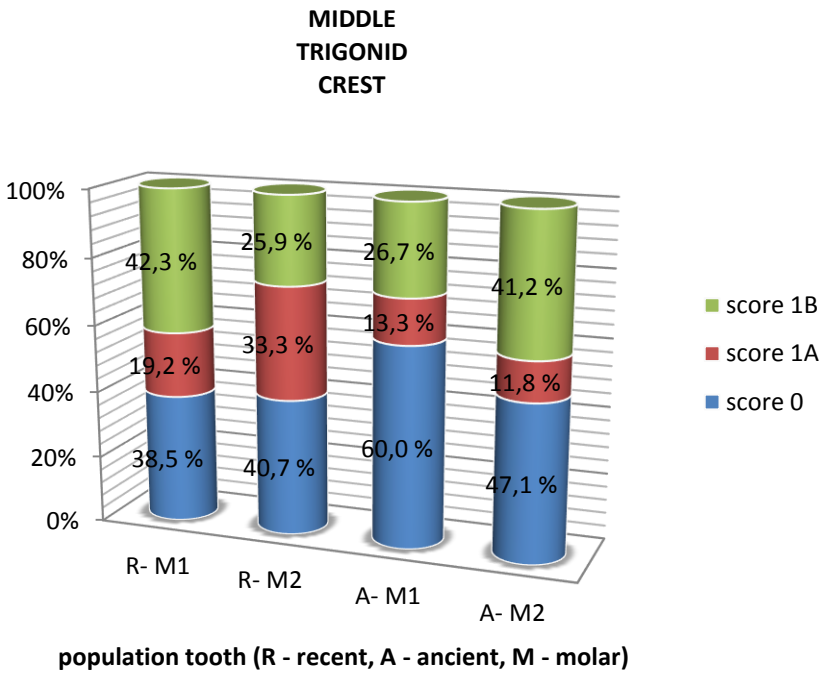

Figure 6 The degree of expression of middle trigonoid crest.

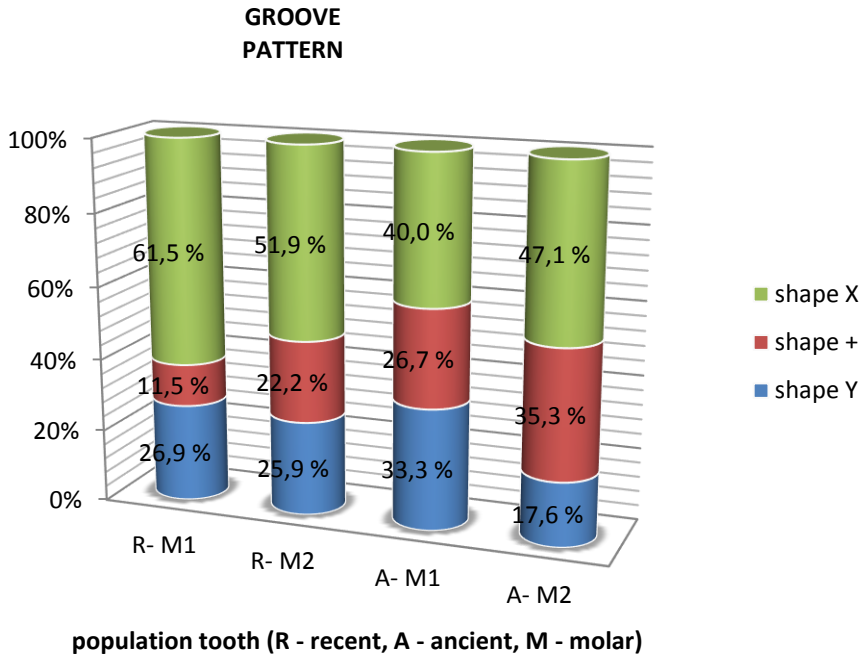

Figure 7 Expression of the groove pattern.

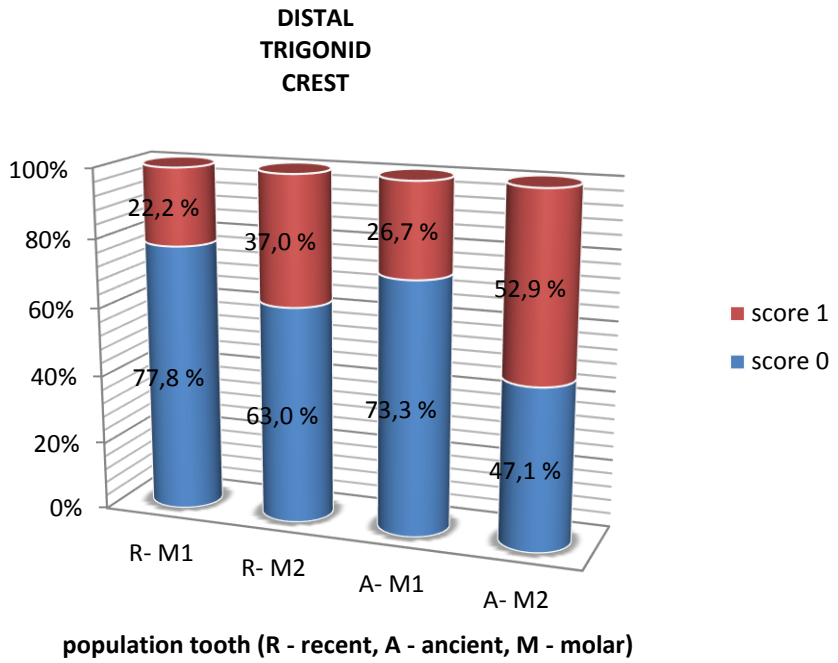

Figure 8 Expression of the distal trigonid crest.

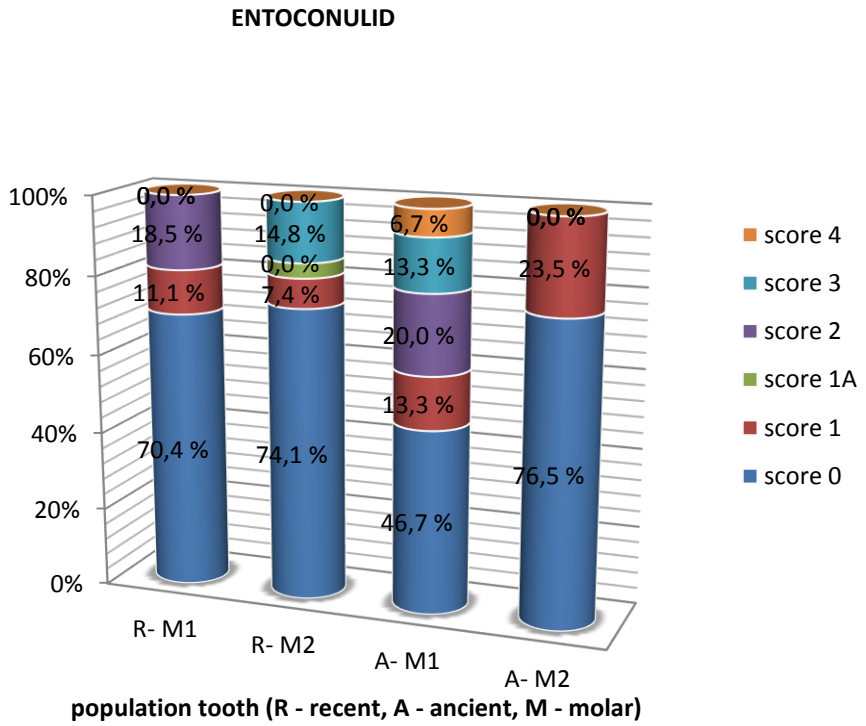

Figure 9 Expression of the entoconulid.

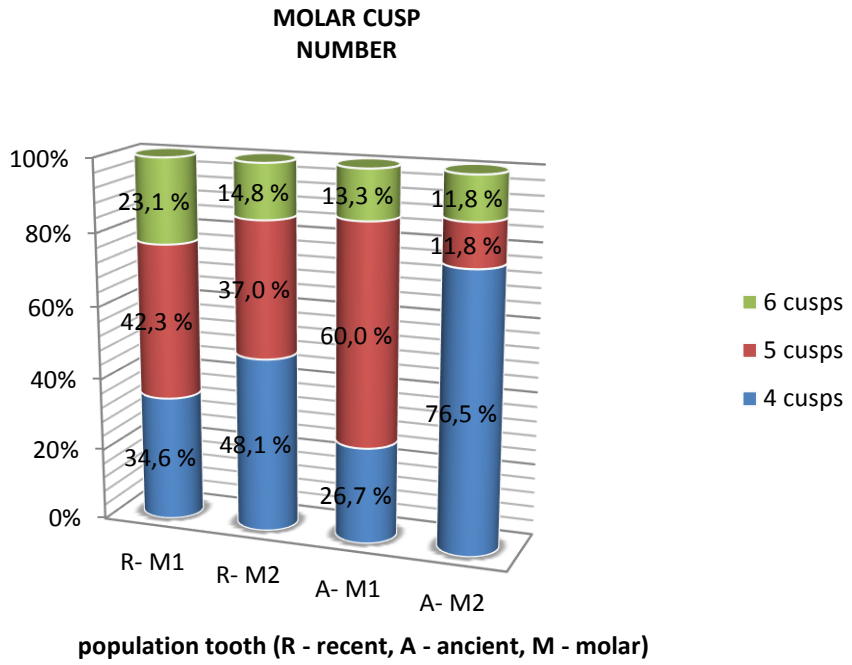

Figure 10 Molar cusp number.

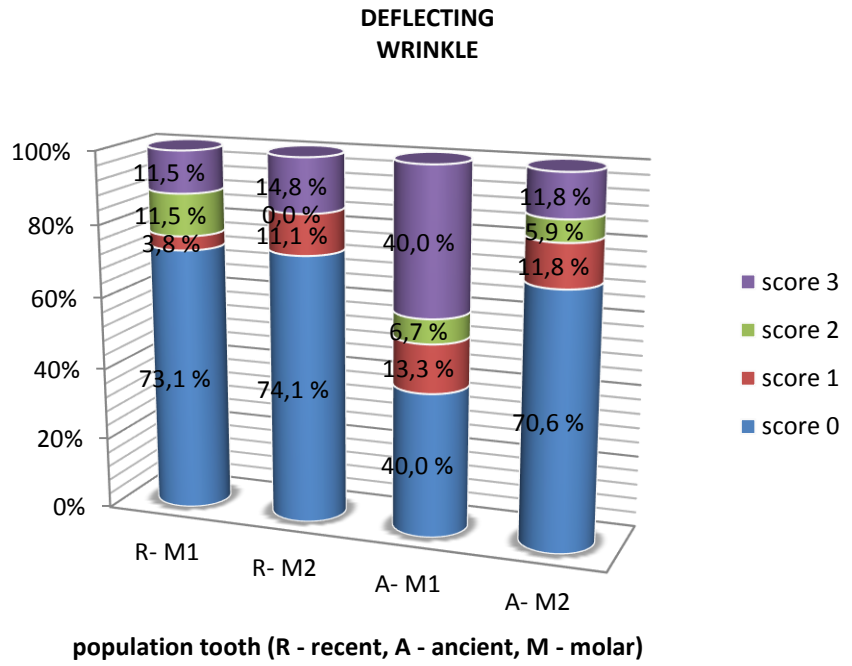

Figure 11 Expression of the deflecting wrinkle.

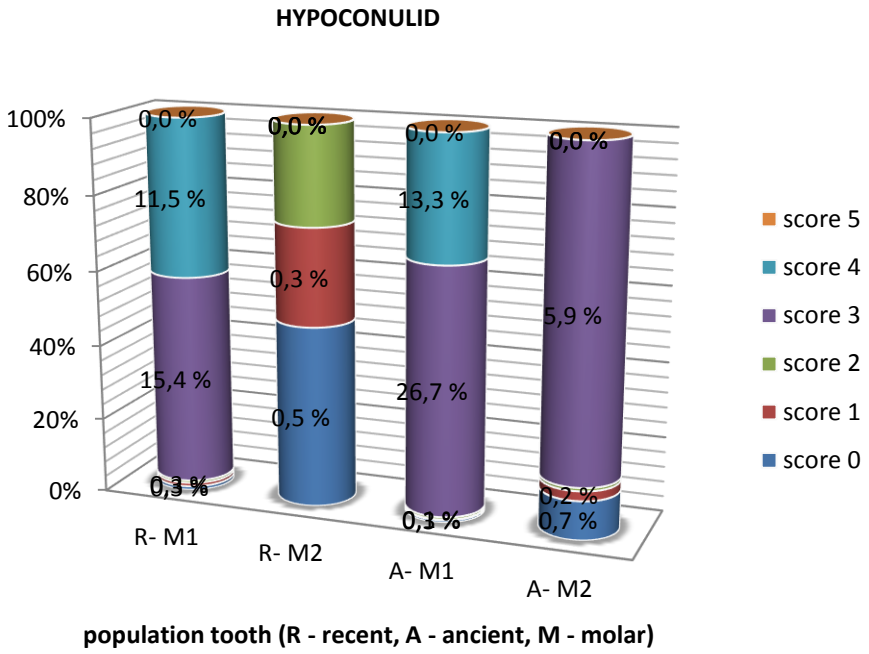

Figure 12 Expression of the hypoconulid.

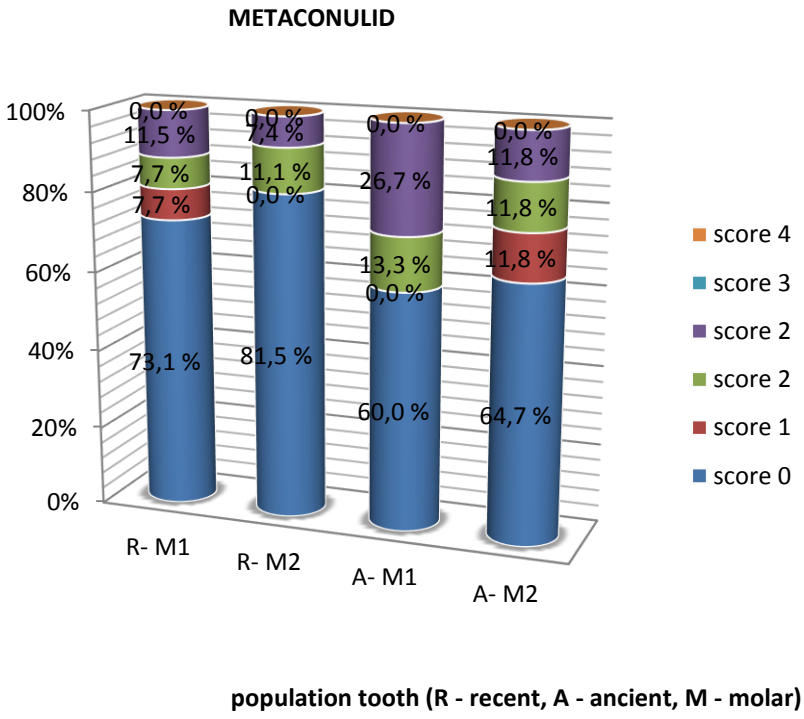

Figure 13 Expression of the metaconulid.