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Proposal of a Data Collection Form to Record Dento-Alveolar Features – Application to Two Roman Skeletal Samples from Italy

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A B S T R A C T

Bones and teeth are an important source of information about the lifestyle, health status and dietary habits of past populations. Modifications and lesions of the periodontal tissues also provide information about the health status and behavior of an individual or of an ancient population. In this paper a method to record some dento-alveolar features of both deciduous and permanent teeth is described. The forms that we propose make it easy to record the data in a Microsoft® Excel sheet. The form for adults has been applied to two Roman Imperial age skeletal samples from northern Italy – Casalecchio di Reno (II–V c. AD, Bologna) and Emilia Romagna, and central Italy – Quadrella (I–IV c. AD, Isernia, Molise).

Key words: *dento-alveolar features, dental data collecting form, human teeth*

Introduction

The dento-alveolar features can be analyzed to obtain information concerning many aspects (paleodemographic, paleonutritional, paleopathological, etc.) of past populations and many papers and books have pointed out the importance of their recording to fully exploit their informational potential. Several criteria to record these features and detailed proposals to codify a single or few traits have been published while few methods foresee the simultaneous recording of more traits[1–5].

The aim of this study is to propose a form to record a set of traits (wear, caries, abscesses, *ante mortem* tooth loss, calcu-

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lus, hypoplastic defects, chipping and horizontal bone loss) in the teeth of adults and subadults that allows to obtain an overall vision on several aspects (paleonutritional, paleopathological, etc.). This form makes it easy to record them in a sheet of any version of Microsoft® Excel for subsequent data analysis.

Here we also present an example of the application of the recording of this set of traits to two Roman osteoarcheological adult samples (Casalecchio di Reno, Bologna, Italy, II–V c. AD; Quadrella, I–IV c. AD, Isernia, Italy).

In the following section some definitions, etiological factors and applications in anthropological field of the features considered are briefly recalled.

Wear is a process that affects teeth after their eruption. The mechanisms of wear that alter the hard tissues (enamel and dentin) are generally called *abrasion* by German researchers. However, English-language researchers distinguish between *attrition*, due to tooth-to-tooth contact, *abrasion*, due to contact between the teeth and food or exogenous abrasive substances associated with food, and *erosion,* due to chemical dissolution related to highly acidic foods or drinks[6–8], vomit and chronic regurgitation[9,10] and acidic industrial products[7,11–13].

It is necessary to distinguish between *abrasion*, *attrition* and *erosion* for therapeutic purposes but it is difficult to identify a single etiological factor even when an individual's clinical history, nutritional habits and activity are known[10,12,14,15]. It is even more difficult to identify a precise etiology when dealing with skeletal material. Therefore according to Wallace[16], Smith and Knight[17] and Larsen[18] we use a single general expression including every combination of *abrasion*, *attrition* and *erosion*: dental *wear***,** a physiological process that removes the occlusal enamel and smoothes the primary dentin. Heavy wear causes the deposition of secondary dentin that protects the pulp chamber but when the wear is faster than the deposition the pulp chamber will be exposed. Wear can provide information about masticatory and dietary behavior because heavy wear can be associated with the consumption of hard fibrous foods or the use of processing techniques that introduce abrasive elements into the food, like powder from grinding stones[18]. The amount and rate of wear can affect the general dental conditions because there is a negative correlation between caries and the degree of wear[19,20]. In fact wear gradually smoothes the occlusal cusps, eliminating fissures and pits on the crown and reducing the presence of cariogenic substances on the tooth. At the same time, wear causes an expansion of the interproximal spaces where plaque and food residues can accumulate. Dental wear may also provide information about particular activities related to non-masticatory tooth use[21–27].

Caries is a process characterized by focal, irreversible and progressive demineralization of dental hard tissue. It is the result of fermentation of dietary carbohydrates – especially sugars – by the oral bacteria in dental plaque[2,3,18,28]. Powell[19] recognizes some main epidemiological factors involved in the etiology of caries: environmental factors (trace minerals in food and water), exogenous factors (chemical composition, texture, methods of preparation of foods or oral hygiene) and endogenous factors (morphology of the tooth, bacteria in the oral cavity, enamel integrity, saliva flow rate and chemical composition). Therefore dental caries is a complex multifactorial disease »caused by the interaction between a susceptible tooth, the presence of certain cariogenic microorganisms and a suitable oral environment«[29].

Infection of the dental pulp as a result of large caries or heavy wear can gener-

ate inflammation of the periapical tissue[2]. In skeletal remains the *abscesses* are recognizable by the presence of a perforating fistula[30] in which the internal part of the bone – the site of inflammation – communicates with the external part by a canaliform connection. However abscesses do not always perforate the bone. Hence the frequency of this feature is generally underestimated in skeletal studies unless X-ray diagnosis is routinely used. In fact, a macroscopic assessment cannot detect small cavities in the periapical region of the affected tooth[31–34].

Ante mortem tooth loss (AMTL), recognizable by progressive resorptive destruction or healing of the alveolus, is related to many factors such as caries, abscesses, poor hygiene, periodontal disease, trauma and, to a lesser extent, physiological stress. Exposure and necrosis of the pulp followed by periapical osteitis and alveolar resorption are the fundamental steps in AMTL[18,32].

Calculus is mineralized plaque that accumulates on the tooth surface, especially near the salivary gland ducts (lingual surfaces of the anterior lower teeth and buccal surfaces of the upper molars)[1]. The vigorous movements during mastication prevent calculus deposition on the occlusal surfaces of the teeth; indeed severe calculus in this position is generally associated with masticatory or salivary gland (hypersecretion) dysfunction[35,36] or with absence of the corresponding tooth in the other arch. The consumption of high-protein foods increases alkalinity in the mouth favoring precipitation of minerals in the oral fluids. However, the beginning of mineralization is related to the amount of plaque and thus to factors that increase its accumulation, such as poor oral hygiene and the consumption of carbohydrates[2]. In addition the microorganisms in dental plaque destroy the inhibitors of mineralization[37]. A diet that facilitates plaque accumulation, i.e. rich in carbohydrates, leads to the development of both caries and calculus[2]. Calculus is difficult to estimate in skeletal remains, especially those of osteoarcheological samples, because of *post mortem* damage due to taphonomic agents and excavation/restoration activities[5,30,38].

Hypoplastic defects appear as pits and grooves on the tooth, more frequently found on the buccal surface. The Fédération Dentaire Internationale[39,40] distinguishes six types of enamel defects: 1-enamel opacities colored white or cream; 2-enamel opacities colored yellow or brown; 3-pits (enamel pitting); 4-horizontal grooves (linear enamel hypoplasia – LEH); 5-vertical grooves; 6-missing enamel. These defects occur during the development of the tooth and persist because the enamel is not remodeled after its formation; in this way the history of systemic disorders that arrest ameloblast activity is indelibly fixed in hypoplastic defects[41]. Enamel hypoplasia is a non-specific condition with three main etiological factors: hereditary anomalies (arising at birth and involving the whole crown[42]), local trauma (appearing on a single tooth or on adjacent teeth[43]) and especially metabolic stress. Hypoplasia may be the result of an interrelation between malnutrition and infectious diseases during childhood that decreases the individual's immune defenses[44].

The *chipping* is an *ante mortem* irregular crack involving the enamel or enamel and dentin; it can be on the buccal, lingual or interproximal edge or crest of the tooth. Chipping can provide information about both masticatory and non-masticatory activities[23].

The most common form of alveolar bone loss is *horizontal bone loss***,** which affects the mouth in a rather uniform pattern[45]. In skeletal samples, periodontal tissue loss and porosity of the alveolar bone are the only evident result of periodontal disease but other causes of alveo-

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Necropolis…… Grave……Sex…….Age…….Form n°……..

Date……Observer.....……..……

Maxilla

		Status	Caries	Calculus	Wear	HD	Abscesses	HBO		PAC	Chipping
R	M3										
	M2										
	M1										
	P2										
	P1										
	C										
	I2										
	I1										
L	I1										
	I2										
	C										
	P1										
	P2										
	MI										
	M2										
	M3										

Mandible

		Status	Caries	Calculus	Wear	HD	Abscesses	HBO		PAC	Chipping
R	M3										
	M2										
	M1										
	P2										
	P1										
	C										
	I2										
	I1										
L	I1										
	I2										
	C										
	P1										
	P2										
	MI										
	M2										
	M3										

Notes:

Fig. 1. Form to record dento-alveolar features of the teeth of adults.

lar bone loss have been proposed, such as diet, hormonal deficiencies and heavy chewing forces[2,46–48]. Alveolar bone loss could also be related to continuous tooth eruption (a normal aging process) in compensation for or in anticipation of dental wear[47,49–53]. Therefore it is not always easy to distinguish between normal and pathological alveolar bone loss[35,47].

Several problems concerning the criteria of recording these dento-alveolar traits can arise in osteological studies. Therefore we prepared data collection forms for teeth of adults and subadults. For each individual, the data are first recorded on a one page of the paper form (on which codes, notes and any doubts are recorded) which helps to give a general view of the specimen. This form facilitates the transfer of the data to a Microsoft® Excel sheet. In the following section we present the procedural rules to fill these forms.

Rules to Fill the Data Collecting Form for Teeth of Adults (Figure 1)

Status

Status provides information about the presence and the conditions of all teeth. We record:

Presence of the tooth	P
Post mortem tooth loss	X
Isolated tooth (when the alveolus is not preserved)	I
Alveolar atrophy*	A
Not recordable	9

Caries

Dental caries was assessed according to Powell[19]: »only those cavities that would admit the tip of a dental explorer were scored as actual caries, to eliminate false scoring of discolored but intact enamel«. Dental caries are classified:

1. on the basis of their *severity*:
   - Non-penetrating (involving only the enamel);
   - Penetrating (involving the enamel and dentin);
   - Destructive (if the tooth crown is destroyed and it is not possible to identify the location of the lesion);

2. on the basis of their *location* and *position:*

Location	*Position*
occlusal	buccal
coronal	lingual
cervical	interproximal mesial
radical	interproximal distal.

To record these lesions we propose the codes that take into account the absence and all the possible combinations of *severity, location* and *position* (Table 1).

The not recordable condition has to be recorded when the tooth is *post mortem* damaged, in the case of heavy wear and for any reason that makes it impossible to record the lesion.

There are some cases in which it is possible to record the lesions in some position but not in others because of *post mortem* damage. In this case it is useful to record in notes the position of the damage as an alternative to a more complicate codification of absence/presence (with all the possible combinations)/not recordable condition.

In case of multiple caries on the same tooth all the caries are recorded in the same cell of the paper form, separated by comma to better read the codifications.

* Note any differences in the atrophy (alveolus partly or completely resorpted) between the two arches and between the right and left sides of the same arch.

TABLE 1
CARIES CODIFICATIONS

Absent		0	
		Penetrating	Non penetrating
Occlusal		1	15
Coronal	Lingual	2	16
	Buccal	3	17
	Interproximal mesial	4	18
	Interproximal distal	5	19
Cervical	Lingual	6	20
	Buccal	7	21
	Interproximal mesial	8	22
	Interproximal distal	10	23
Radical	Lingual	11	24
	Buccal	12	25
	Interproximal mesial	13	26
	Interproximal distal	14	27
Destructive		28	
Not recordable		9	

For the data imputing in the Excel sheet, according to the different possible occurrences, the following instructions are proposed:

– more caries of the same severity, location and position: they are recorded as present only once;
– caries of different severity in the same location and position: only the penetrating one is recorded;
– same severity in different locations and positions and different severity in different locations and positions: all caries have to be recorded.

The same order of codification should be used and we suggest using the increasing order of the codification numbers.

When the pulp chamber is exposed as a result of caries or severe wear, it must be indicated in the caries and wear rows by a symbol (*); pulp exposure, due to either caries or wear, and *ante mortem* tooth loss are necessary to calculate the caries correction factor[54–56].

Calculus

The degree, scored according to Brothwell's scale[30], is recorded together with position in the same cell. In the first and second position the buccal and lingual sides are recorded respectively (e.g.: 03 indicate absence of calculus in buccal surface and severe deposition in lingual one; 29 moderate deposition of calculus in buccal surface and not recordability in lingual one and so on):

	Buccal surface	Lingual surface
Absent	0	0
Low deposition	1	1
Moderate deposition	2	2
Severe deposition	3	3
Not recordable	9	9

When the calculus covering entirely or almost all the surfaces of the tooth it is recorded as 4.

The not recordable condition has to be recorded when the tooth is *post mortem* damaged, in the case of heavy wear and for any reason that makes it impossible to record the trait.

Wear

The occlusal wear is scored for each tooth according to Smith's[57] eight-stage method. The not recordable condition is scored as 9.

Hypoplastic defects (HD)

We record types 3 (pits), 4 (LEH), 5 (vertical grooves) and 6 (missing enamel) of the classification by the Fédération Dentaire Internationale[39,40]:

Absent	0
Pits	3
LEH	4
Vertical grooves	5
Missing enamel	6
Not recordable	9

In the case of the contemporary presence of different forms, the corresponding numbers must be recorded in the same cell.

The not recordable condition has to be recorded when the tooth is *post mortem* damaged, in the case of heavy wear and for any reason that makes it impossible to record the trait.

Abscesses

Absent	0
Present	1
Not recordable	9

The buccal or lingual position of the defect has to be recorded in notes.

Horizontal bone loss (HBO)

The distance CEJ-AC (Cement Enamel Junction – Alveolar Crest) is measured with a digital sliding caliper. Although there are different indications in literature on how to record this features for which several measuring points are necessary for each tooth[45,55,58,59], we decided to consider only the mid-point of the CEJ perpendicular to the alveolar margin on both the *buccal* and *lingual* surfaces of the tooth. In fact the bad preservation state of many osteoarchaeological specimens often prevents the application of more detailed methods.

Vertical retraction[2,45] as well as other non-uniform defects usually occurring in a single tooth have to be recorded in notes.

Porosity of the cortex of alveolar crest (PAC)

We record porosity as *absent* (0) when the alveolar crest is smooth and forms convex to flat surfaces faciolingually and the nutrient canals are small; it is recorded as *present* (1) when the alveolar crest appears resorbed and the surface is roughened with enlarged nutrient canals that expose the cancellous bone[45].

Absent	0
Present	1
Not recordable	9

Chipping

We use the standard of Bonfiglioli[27,60] that classifies chipping according to a three-degree scale based on the simultaneous evaluation of size and depth:

1 – slight crack or fracture (0.5 mm), or larger but superficial enamel flake loss (Figure 2a);
2 – square irregular lesion (1 mm) with the enamel more deeply involved (Figure 2b);
3 – crack (>1 mm) involving enamel and dentine or large fracture – very irregular in shape – that could destroy the tooth (Figure 2c).

The chipping is recorded in relation to the *position* – buccal (B), lingual (L), interproximal mesial (M), interproximal distal (D) and *grade*:

1B	2B	3B
1L	2L	3L
1M	2M	3M
1D	2D	3D

Absent	0
Not recordable	9

The not recordable condition has to be recorded when the tooth is *post mortem* damaged, in the case of heavy wear and

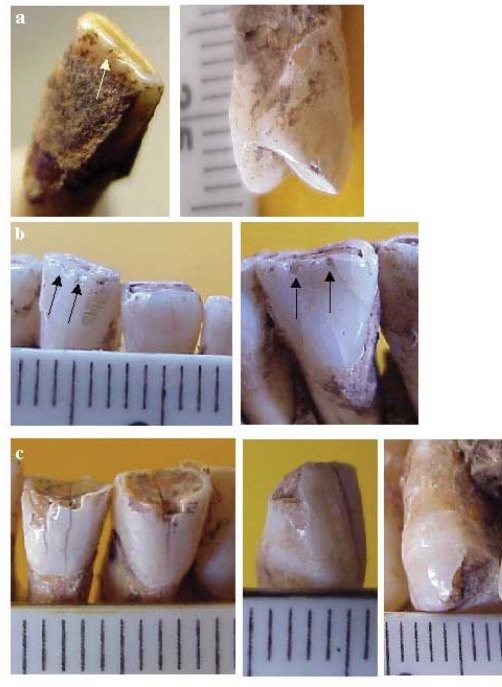

Fig. 2. Chipping scale. a) grade 1; b) grade 2; c) grade 3 (from Bonfiglioli et al. »Masticatory and non-masticatory dental modifications in the Epipaleolithic necropolis of Taforalt (Morocco)« Int. J. Osteoarchaeol., in press).

for any reason that makes it impossible to record the trait.

There are some cases in which it is possible to record the lesions in some positions but not in others because of *post mortem* damage or heavy wear. In this case it is advisable to record in the notes the position of the damage as an alternative to a more complicate codification of absence/presence (with all the possible combinations)/not recordable condition.

In case of multiple chipping on the same tooth we recorded all them in the same cell of the paper form. For the data imputing in the Excel sheet, we propose to follow these instructions:

– more chippings of the same degree in the same position: they are recorded as present only once;
– chipping of different degrees in the same position: only the highest grade is recorded;
– same degree in different positions and different grades in different positions: all conditions are recorded.

The same order of codification should be used without inserting a space, comma or other symbol: we suggest that the degree (3/2/1) precedes the position (e.g.: 3B2ML, 3L1D or 2L1B1D, etc.).

Rules to Fill the Data Collecting Form for Teeth of Subadults (Figure 3)

In the same form two different tables are provided for the recording of the features of the deciduous and permanent teeth both for maxilla and mandible.

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Necropolis…….. Grave…….Sex…….Age…….Form n°……..
Date……Observer.....……

	Maxilla with deciduous teeth							**Mandible with deciduous teeth**						
	Status	**Caries**	**Calculus**	**Wear**	**HD**	**Abscesses**	**Chipping**	**Status**	**Caries**	**Calculus**	**Wear**	**HD**	**Abscesses**	**Chipping**
R M2														
M1														
C														
I2														
I1														
L I1														
I2														
C														
MI														
M2														

Notes:

	Maxilla with permanent teeth							**Mandible with permanent teeth**						
	Status	**Caries**	**Calculus**	**Wear**	**HD**	**Abscesses**	**Chipping**	**Status**	**Caries**	**Calculus**	**Wear**	**HD**	**Abscesses**	**Chipping**
R M3														
M2														
M1														
P2														
P1														
C														
I2														
I1														
L I1														
I2														
C														
P1														
P2														
MI														
M2														
M3														

Notes:

Fig. 3. Form to record dento-alveolar features of the teeth of the subadults.

Status of deciduous and permanent teeth

P – crown completely erupted;
PP – crown partially erupted;
PA – tooth included in the alveolus;
I – tooth isolated and complete (when the alveolus is not preserved);
IO – tooth isolated and not completely developed (when the alveolus is not preserved);
X – *post mortem* tooth loss;
9 – non recordable (tooth or alveolus damaged).

For P and I the other features (wear, caries, abscesses, calculus, hypoplastic defects and chipping) are codified as described for teeth of the adults. For PP, PA and IO they should be recorded only if they are clearly observable and have not to be counted together with the features of P and I.

In the data analysis we calculate the absolute and relative frequencies in relation to both individuals (number of affected individuals/number of total individuals) and teeth (number of affected teeth/number of total teeth), taking into account sex, age, jaw, side and tooth. For the per individual frequencies, subjects are eliminated from the analysis if it is not possible to observe at least one quadrant of their dentition. The subjects are considered with/without hypoplastic defects only if it is possible to observe at least four teeth (including central maxillary incisors and mandibular canines), according to Goodman and Rose[61].

Applications

Materials and methods

The above-mentioned dento-alveolar traits were recorded in skeletal samples from two Roman necropoleis: Casalecchio di Reno (II–V c. AD, Bologna, Italy) (CSL) and Quadrella (I–IV c. AD, Molise, Italy) (QDR). The area of Casalecchio di Reno, excavated (1986–2001) by the Soprintendenza Archeologica dell'Emilia-Romagna, is very important because the archaeological record ranges from Neo-Eneolithic structures to late ancient Roman/Early Middle Ages cemeteries, although the most important discoveries refer to the Iron Age (IV–III c. BC) and Roman periods. In the »zona A«[62], about 250 graves of the Roman Imperial age (II–IV c. AD) were discovered. Incinerations and inhumations are both present, the latter representing 76% of the total. A few graves, mainly containing incinerations, were associated with poor funerary goods[63]. The Roman Imperial age necropolis of »zona A« can be subdivided into two groups: a larger »necropolis A« (second half of II–V c. AD) in the western area of the cemetery and a smaller »necropolis B« (II–III c. AD) in the eastern area[62,63]. On the basis of their size and funerary goods, these necropoles were probably associated with a *pagus* or *vicus*, small towns of farmers and traders situated next to the city of *Bononia*[64].

More than 200 inhumations ranging from the II c. AD to the V c. AD have been found, even though most of the graves refer to the II–III c. AD. A complete study of the skeletons is in progress, although some analyses concerning the peopling of the area and the lifestyle have been completed[65–70].

For the sample of teeth, we referred to the skeletons of »necropolis A« representing 129 individuals: about 63% adults and 30% subadults (data not published). It was not possible to estimate the age of the remaining skeletons. Age and sex were estimated according to the common anthropological methods[5,71]. In total 1,400 teeth belonging to the adult sample of »necropolis A« (62 adults: 36 males, 22 females, 4 sex not identified) were examined.

The necropolis of *Quadrella*, excavated in 1980 by the Soprintendenza Archeologica per i Beni Ambientali Architettonici Artistici e Storici del Molise, includes more than 100 graves[72]. The necropolis was an extra-urban area of *Aesernia*[73]. It is characterized by enclosures and small walls, where both inhumations and cremations are found**.** The few grave goods are rather uniform and repetitive, indicating »a rather undifferentiated social extraction of the occupants«[72]. The graves of males have fewer objects than those of females, in which ewers, oil lamps and coins are predominant. Inscriptions on *stelae* refer to *liberti* (freed slaves)[73]. There are 99 skeletons (72% adults and 28% subadults) with a mean age at death of 30–35 years[74,75]. The state of preservation of the material allowed us to analyze about 2,000 teeth of 67 adults (26 males, 28 females and 13 sex not identified)[76].

The data for the CSL and QDR samples (AMTL, wear, caries, abscess, calculus, LEH) were recorded on a Microsoft® Excel 2000 sheet. In the univariate analysis we calculated the absolute and relative frequencies in relation to both the individuals and the teeth. The Principal Coordinate Analysis (PCOORDA) was performed with NTSYSpc vers. 2.02h, ©1986–1998, Applied Biostatistics Inc., which can import Microsoft® Excel files. Before importing the file into this software, we had to transform some data. In particular all the traits were considered as absence/presence. Only heavy degrees of wear were considered (5–8 on Smith's scale). In this way we recorded 192 variables taking into account each tooth of the maxilla and mandible for each individual. The complete database consisted of 129 individuals (CSL and QDR). For the PCOORDA, the data for each variable (row) were first standardized using the stand (in particular simqual) procedure. The distance matrix was double-centered and then factored and plotted to show the objects in a 2-dimensional space.

We performed separate analyses: the *first* on caries, abscesses, calculus and AMTL, the *second* on wear and the *third* on LEH. In this way, we tried to identify differences related to dietary habits (caries, abscesses, calculus, AMTL) and health status (LEH). We decided to perform a separate analysis on wear because besides being related to type of diet it is strongly related to age.

The first analysis was performed on a data set of 128 variables × 49 individuals (21 CSL: 11 males, 10 females, 28 QDR: 13 males, 14 females and 1 sex not identified) (22% of missing data). The age breakdown was: 20 young (Y: 20–34 years), 17 middle (M: 35–50 years), 10 old (O: >50 years) adults and 2 adults (Ad) (age not estimated). The second analysis (wear) involved a data set of 32 variables × 58 individuals (28 CSL: 16 males, 11 females, 1 sex not identified, 30 QDR: 15 males, 13 females and 2 sex not identified) (21% of missing data). The age breakdown was 23 Y, 18 M, 13 O and 3 Ad. The third analysis (linear hypoplasia) used a data set of 32 variables × 41 individuals (23 CSL: 12 males, 11 females, 18 QDR: 10 males, 8 females) (18% of missing data) with an age breakdown of 19 Y, 15 M, 5 O and 2 Ad.

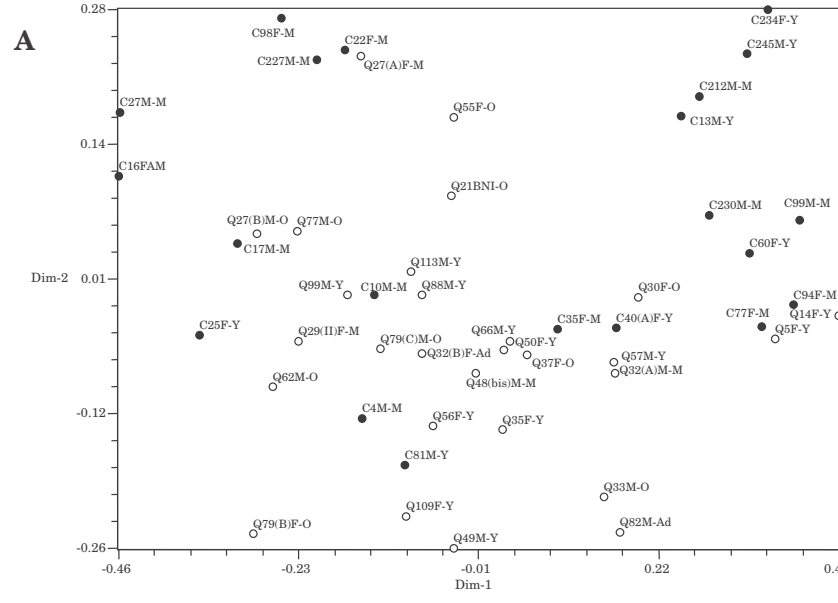
Results and discussion

The univariate analysis revealed differences between QDR and CSL in per tooth and per individual frequencies. For the calculus the per tooth (35% CSL vs. 51% QDR; $p<0.001$) and per individual (76% CSL vs. 84% QDR) frequencies are higher in QDR, indicating a possible greater consumption of high-protein foods by this population. Nevertheless these differences could depend on many etiological factors, including also oral hygiene and the state of preservation of the calculus. No significant differences of carbohydrate consumption between the popula-

tions are revealed by the frequencies of caries (per tooth: 17% CSL vs. 15% QDR; per individual: 88% CSL vs. 72% QDR) and AMTL (per tooth: 14% CSL vs. 12% QDR; per individual: 58% CSL vs. 60% QDR). For the abscesses the differences are significant per tooth (3% CSL vs. 1% QDR; $p<0.05$) but not per individual (28% CSL vs. 20% QDR). In the PCOORDA on caries, abscesses, calculus and AMTL (Figure 4a) (first and second components: 26% and 9% of the variability) the QDR individuals mostly plot together whereas the CSL ones appear more scattered, even though a male group is relatively isolated in the upper right corner. Thus the QDR population seems more homogenous.

Heavy wear is more frequent in the teeth of CSL (23% vs. 16% QDR; $p<0.001$) especially in the males in the anterior teeth (46% CSL vs. 24% QDR; $p<0.001$). This suggests a higher consumption of hard fibrous foods requiring vigorous mastication in the CSL population, although a non-masticatory function, especially of the anterior teeth in the CSL males, could also be inferred. The PCOORDA on wear revealed no apparent distribution in relation to provenance (Figure 4b). The first component (46% variability; second component: 16%) distributes the individuals mainly by age (as expected) but also by sex: young adults (independently on the sex) and females are concentrated on the right side of the plot. It is important to recall that the samples were balanced for age (Y: 10 CSL vs. 11 QDR; M+O: 17 CSL vs. 17 QDR).

Strong metabolic stress during childhood, e.g. in a critical period like weaning, is indicated by the high frequency of LEH in both samples. The per tooth frequency is higher in QDR than CSL (59% QDR vs. 49% CSL; $p<0.001$) but not per individual one (95% QDR vs. 93% CSL). The females of CSL show quite higher per tooth frequencies than males (58% females vs. 42% males; $p<0.001$) but not per individual (95% females vs. 100% males). In the QDR sample no significant differences have been observed but the females show higher per tooth and per indi-



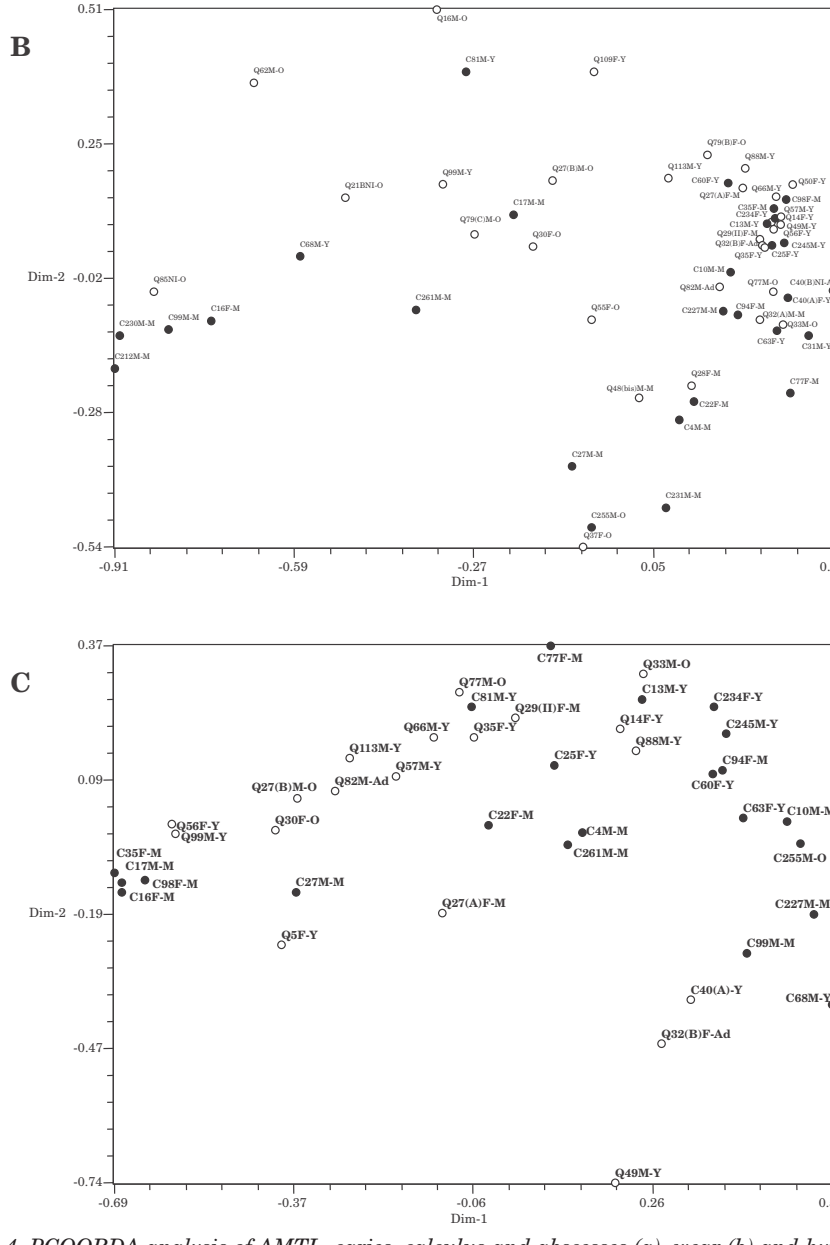


Fig. 4. PCOORDA analysis of AMTL, caries, calculus and abscesses (a), wear (b) and hypoplasia (c). The solid and empty circles refer to the Casalecchio di Reno and Quadrella samples respectively. The labels of the subsamples consist of: first the provenance (C/Q for Casalecchio di Reno and Quadrella), second the number and other codes of the grave, third the sex (M/F), and finally the age (Y/M/O/Ad).

vidual frequencies than males (62% females vs. 56% males; per individual: 100% females vs. 92% males), suggesting a more stressful condition than in males. In the PCOORDA on LEH (Figure 4c) the first component (38% variability; second component: 14%) seems to separate the QDR and CSL individuals: the former tend to cluster in the upper part while the latter (more scattered) plot mainly on the right.

Some conclusions can be drawn from the results despite the relatively low percentage of variability explained by the multivariate analyses (related to the missing data that always characterize the osteoarcheological samples). Moreover it should be pointed out that these are preliminary analyses within a larger study concerning all the Roman samples of Casalecchio di Reno.

Firstly there appear to be *inter*-population differences between CSL and QDR. Given the geographic positions of these samples – in northern (CSL) and in central Italy (QDR) – different local environments and resource availability may have affected the quality and quantity of food. Social structure and conditions could also have affected the diet but both Roman cemeteries represent populations with a relatively low social level. The signs of relatively high carbohydrate consumption suggest general malnutrition in both populations. The CSL population may have consumed less high-protein food, although different oral hygiene practices and other factors could have caused the difference in calculus deposition. Age seems to affect the heavy wear in both samples but sex also seems to play a role independently of the provenance of the individuals, suggesting a different use (masticatory and non-masticatory) of the teeth by males and females. Differences in the heavy wear frequencies and particular wear patterns must be investigated further to discriminate the masticatory and non-masticatory functions. Finally the CSL sample seems to show more *intra*-population differences than the QDR one, especially in relation to sex.

Poor living conditions in these two Roman populations can also be inferred from the relatively high subadult mortality (about 30% in CSL and 20% in QDR), especially in infancy. Life was difficult between the II and III c. and an economic crisis, with an abrupt reduction of the population and the abandonment of many settlements, affected Italian territory[77]. A huge demographic crisis in the III c. caused the Italian population to drop from 8 million inhabitants to about 4 million at the beginning of the IV century[78]. These changes and the deteriorating social and political contexts could have had a strong negative effect on the dietary habits, nutrition, hygienic-sanitary conditions and thus on the growth and lifestyle of some other Roman populations[79].

Conclusions

Anthropologists are well aware of the difficulties in standardizing and recording skeletal features because of their variability. This makes it difficult to interpret the data and to compare them with the findings of other researchers. The same problems apply to teeth since many variables can be recorded and different scoring criteria can be used. Therefore we propose a method to codify and record some dento-alveolar features. Even though many criteria to record them have been proposed, our form offers some advantages. First of all the dento-alveolar data are recorded together on only one page which is useful to have a general and complete view of all the features for each individual (this allows also to save paper and then time and money!). The data can then be transferred easily to a sheet of any version of Microsoft® Excel. Moreover the Excel sheet can be imported into

many other statistical packages, such as NTSYSpc vers.2.02h, © 1986–1998, Applied Biostatistics Inc.

Finally we have used the proposed form in a preliminary analysis of the Roman skeletal samples from Casalecchio di Reno (Bologna) and Quadrella (Isernia) from Italy. Despite the usual problems related to the preservation of osteoarcheological materials, we were able to draw some conclusions about *inter*-population differences in nutritional habits and behavior. We are currently conducting a complete study of the teeth of all the Casalecchio di Reno samples and a comparison with other Roman samples. In this way we hope to further clarify aspects of the lifestyle of these ancient populations.

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PRIJEDLOG OBRASCA ZA PRIKUPLJANJE PODATAKA O DENTO-ALVEOLARNIM KARAKTERISTIKAMA – PRIMJENA NA DVIJE SKUPINE SKELETNIH OSTATAKA IZ ITALIJE

S A Ž E T A K

Kosti i zubi važan su izvor podataka o stilu života, zdravstvenom statusu i prehrambenim navikama proteklih naraštaja. Promjene i lezije periodontalnog tkiva također pružaju informacije o zdravstvenom statusu i ponašanju individue ili drevne populacije. U radu je opisana metoda prikupljanja nekih dento-alveolarnih karakteristika mliječnih i trajnih zuba. Obrazac koji predlažemo olakšava unošenje podataka u Microsoft® Excel formatu. Obrazac za odrasle primijenjen je na dva skeletna uzorka iz sjeverne Italije – Casalecchio di Reno (Bologna, 2.–5. stoljeće) (neobjavljeno) i središnje Italije – Quadrella (1.–4. stoljeće, Isernia, Molise).