Papers on Anthropology XXIII/2, 2014, pp. 47–66

A DENTAL NON-METRIC ANALYSIS OF THE CLASSICAL/LATE ANTIQUITY PERIOD (1ST CENTURY BC–3RD CENTURY AD) POPULATION FROM ARMENIAN PLATEAU

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ABSTRACT

The aim of the study is to assess of the biological distance between the populations from the Armenian Plateau and Georgia, with samples from Eastern Europe, and Central Asia on the basis of the frequency of dental non-metric traits. It is well known that these traits are characterised by high inter-population differentiation, low sexual dimorphism, and their recording is loaded by relatively small intra and inter observer error. The dental non-metric traits are successfully used in the description and explanation of the ethnogenetic processes. The comparative analysis was carried out on the basis of 19 populations. The frequency of the dental non-metric traits among all the populations was analysed using the multiple correspondence analysis and the cluster analysis. Analysis results do not allow to concretize the sources of components of the odontological structure of the Classical/Late Antiquity period populations of the Armenian Highland reducing them to the direct influence of representatives of any cultures or communities. Future dental morphology investigation in Armenia should focus on characterizing, with the aid of an identified skeletal collection, the frequencies of traits on an Armenia large sample. This would be only a gateway to a wider (geographically and, more important, chronologically) dental morphology characterization of Armenian peoples.

Keywords: *classical period, transcaucasian, nonmetric dental traits*

http://dx.doi.org/10.12697/poa.2014.23.2.04

INTRODUCTION

Dental anthropology is the study of the morphological variation on teeth [36, 45, 47]. Dental traits have been a mainstay of physical anthropological studies for over a century (Swindler, 2002). This variation manifests itself through several nonmetric 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 [36]. Teeth, and particularly the phenotypic traits found on teeth, are the best source of information on biological relationships between populations or subgroups [23, 34]. 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 [41]. The genetic factor in the presence of non-metric dental traits is theoretically associated with the presence of alleles and chromosomal loci [36]. Their quantity affects the expression of the trait, as well as its presence and frequency in a population or subgroup [36]. Odontological traits are used successfully in the description and explanation of both evolutionary and microevolutionary processes.

The term non-metric implies structural variations of individual crown and root forms that are visually scored in two ways: “presence-absence” characters such as furrow patterns, accessory ridges, supernumerary cusps and roots, or, as differences in form such as curvature and angles [12, 45, 47, 36]. Numerous studies have demonstrated that morphological dental forms respond to the microevolutionary forces of admixture [21, 30, 32, 42], mutation, genetic drift [19, 22, 37, 38, 35, 42, 43], and selection [7], thus evincing their high degree of genetic control.

Historical and archaeological sources enable the rough reconstruction of the population history in the Armenian Plateau and Caucasus. Changes in the population size may be estimated with the use of archaeological survey data and some migrations and/or ethnic changes were attested by written documents [13, 39]. However, the picture obtained from these sources is quite superficial, as the real impact of migrations on local population may be only loosely correlated with the change of language or self-identification, not even mentioning the material culture [26]. For that reason, bioarchaeological methods of phenetic affinity reconstruction are the reliable alternative, especially the research on dental non-metric traits, which are less subject to environmental stress and postmortem alterations than skeletal non-metric traits or metric measurements [36]. In spite of often poor preservation and relatively high degree of dental wear, the dental sample is sufficient for rough estimation of phenetic affinities between populations inhabiting the Transcaucasian Area in Classical/Late Antiquity.

HISTORICAL AND ARCHAEOLOGICAL BACKGROUND

The Armenian Plateau (also known as the Armenian upland, the Armenian highland, or simply as Armenia) is the central and highest of three land-locked plateaus that together form the northern sector of the Middle East [14]. The Armenian Plateau was in early history a crossroad linking the worlds of East and West [28]. Those who dominated the Armenian Plateau were in a position to control these lucrative trade routes, to exploit the fertile valleys that extended beyond them to the east and west, and to dominate the lowlands to the south. Accordingly, the Armenian Plateau has been an area of frequent military conflict, and its history was largely determined by external forces [4, 8, 33].

The Classical and Late Antiquity period of the Armenian people covers nine centuries from the 6th century BC to the 3rd century AD. In the first half of the 6th century BC the Armenians fell under the domination of the powerful state of Media. The fall of the Median state brought no freedom to Armenia as it changed hands and came under the Persian Achaemenid rulers. Taking advantage of the Gaumata uprising, the Armenians sought to achieve their independence, but Darius I, who had ascended the throne of Iran, crushed the rebellion of the Armenians and wiped out the Armenian state. As a result Armenia was split into two satrapies in the political system of the Achaemenid Empire until its collapse under the blows of Alexander the Great. With the decline of the Achaemenid Empire, local state formations emerged in Armenia; these formally recognized the supremacy of the Seleucid kings until the close of the third century BC when they fell completely under Seleucid sovereignty. But in 189 BC, the kingdom of Great Armenia came into existence bearing the name of its founder Artashes I. This kingdom grew into a powerful and prosperous state under Tigranes the Great (95–96 BC) [4, 8, 17].

Suffering defeat by Rome, Tigranes lost the lands he had conquered, but preserved its natural boundaries, and the social, economic and political life of the country continued to progress under Tigranes and his son and successor, Artavazdes II (55–34 BC). As early as the third century the capitals of the Yervandids, Armavir and Yervandashat, the capital of Sophene-Arsamosata, and the city of Arkatiakert were notable centres of economy and culture. Urban construction gained substantial impetus under the Artashesid dynasty, and a number of cities sprang up, along Hellenistic lines. Renowned among them were the capital city of Artashat, founded by Artashes I, and Tigranakert, the city of Tigranes the Great, inhabited, according to the exaggerated figures of Greek authors [39], 300 thousand inhabitants. The Artashesid kingdom collapsed early in the 1st century AD as Rome, seeking to turn Armenia into a province of the Empire but facing resistance, contented itself with the nomination of puppets to the Armenian throne. Allied with the Parthians, the Armenians strove to resist the expansionist actions of Rome, but in the autumn of 58 the Roman troops conquered Armenia and captured its capital Artashat, But the allied forces of Armenia and Parthia, eventually defeated the Roman invasion and Nero acknowledged Tiridates, the brother of the Parthian king Vologes, as king of Armenia. Thus the kingdom of Armenian Arsacids came to power in Armenia; they fought a life and death battle to preserve the independence of the country and since Rome still clung to the idea of overrunning Armenia, and the Sassanian kings, who had mounted Iran's throne following the breakup of the Parthian kingdom in 226, also fought hard to conquer Armenia [17].

Armenia has been rich and independent at times, particularly under the dynasties of the Ervandids, the Artashesians, the Arshakunis, and the Bagratunis. At other times, when surrounded by powerful empires or invaded by militant peoples, Armenia found itself only autonomous, semi-autonomous, or completely under foreign dominion. Numberless nomad tribes and peoples pouring in from different parts of Eurasia brought considerable changes in the ethnic composition of the Armenian Plateau population, which was reflected in further cultural and ethnic processes in this area. Reference to the morphological features of the ancient population of the Armenian Plateau was made in some previous works [18, 22], which showed the participation of the population from the Eastern Europe and Central Asia in the formation of the anthropological ended of the populations the Armenian Plateau and Caucasus. The artificial modification of skulls (such as bregmatic, ring deformations of a head was known in the ancient population of the Beniamin, Shirakavan and Karmrakar, Vardbakh) and teeth in Classical/Late Antiquity period on the Armenian Plateau may be related to emerging social complexity and the need to differentiate among people, creating a niche for such a highly visual bodily markers [20].

During the Classical/Late Antiquity period in the Armenian Plateau and in the Caucasus various ethno-cultural groups – Iranic nomads (Scythians, Sarmatians, Sauromatians, Saka) and locals are interacted. Their presence in this region perhaps goes back to the 8^{th} century BC [33]. The archaeologists believe that their presence can be attested through the occurrence of their distinctive weapons, their horse harness and objects decorated in the Scythian animal style

[9, 31, 44]. It is generally accepted that in the 7th century BC the Scythians mounted their incursions into the Ancient Near East through the Caucasus. The Scythians first appear in Assyrian annals as Ishkuzai, who are reported as pouring in from the north some time around 700 BC, settling in Ascania and modern Azerbaijan as far as to the southeast of Lake Urmia.

This is clearly set forth in classical writers (Herodotus in book IV) [13]. They broke through the barrier of the Caucasus in 632 BC and swept down like a swarm of locusts upon Media and Assyria, turning the fruitful fields into a desert; pushing across Mesopotamia, they ravaged Syria and were about to invade Egypt when Psammitichus I, who was besieging Ashdod, bought them off by rich gifts, but they remained in Western Asia for 28 years, according to Herodotus. Their domain reached from north of the Danube and east of the Carpathians across the fertile plains of eastern central Europe and southern Russia to the River Don. Although the Don formed their eastern boundary, beyond it lived other groups of nomadic peoples culturally similar to the Scythians. These included the Sarmatians [13], their immediate neighbors to the east. Beyond the Sarmatians lived the Massagetae, and beyond them the Saka. The Saka were Asian Scythians and were known as Sai to the Chinese. The word Saka, however, was used by the Persians as a general term to include all of the nomadic peoples to the north of the Iranian plateau, in the two Turkestans. A complete description of Scythia has been recorded by Greek authors of the 5th and 4th centuries BC and foremost by Herodotus.

Unfortunately odontological data have not been collected of the Scythian population. The detailed analysis of the craniological materials from Armenia allowed to explain not only the complicated anthropological compound of population but also to discover the reason of anthropological and ethnic non-homogeneity in populations of Classical/Late Antiquity period. Intragroup analysis revealed two groups within population [18]. It is necessary to state that carriers of two groups remind one of Scythians from the territory of Moldova, Steppes of Black Sea Coast, Ukraine, Sarmatians from the Volga region and Saka from the territory of Turkmenistan [22]. These conclusions are consistent with those reported by other biodistance studies that examined nonmetric cranial for Armenia samples [29]. This scenario is consistent with other archaeological and historical studies of the area [8, 27, 33, 39] which show the long-standing presence of Scythians in the Caucasus [9, 31, 44].

The purpose of this paper is to compare odontological variation among the ancient inhabitants of Transcaucasus (Armenia and Georgia) with samples from Eastern Europe, and Central Asia in order help clarify the origins and interactions between the inhabitants of the Armenian Plateau and neighboring Eurasia.

MATERIALS AND METHODS

In total, the intergroup analysis included 19 series (Tables 1 and 2) from the territory of the Transcaucasus (1–8), Eastern Europe (9–11, 14–19), Central Asia (12–13) [5, 10, 16, 19] (Figure. 1).

The Classical and Late Antiquity period (1st century BC – 3rd century AD) samples from the Armenian Plateau, examined in this study, include remains from Beniamin, Vardbakh, Black Fortress I, and Karmracar [19]. The combination of remains from these 4 sites is justified for three reasons. First, the small sample sizes for sites (Vardbakh, Black Fortress I, Karmracar) were inadequate (from 12–23 individuals) for subsequent biodistance analysis. Second, the Beniamin, Vardbakh, Black Fortress I, and Karmracar sites they represent a cemetery from Shirak Plain. Indeed, the geographic distance among sites is small. Finally, the analysis of all nonmetric traits examined by this study revealed that no significant differences exist among remains from the 4 sites, so data from these sites were combined for subsequent statistical analyses [24]. To avoid inter-observer error, all the data were recorded by one observer (Anahit Khudaverdyan).

Several scoring protocols for dental non-metric traits are available, including Zubov's [45, 46] odontoglyphics and the system used by Alt and Vach [2, 3] for kinship studies. The method, developed by A.A. Zubova is the most widely employed system in the Russian school of anthropology which is the recommended standard for scoring dental non-metric traits. The following 10 odontological traits were used in the comparative analysis: 1) diastema of I^1-I^1, 2) crowding of I^1; 3) reduction hypocone (forms 3+ and 3) of the upper second molar; 4) carabelli's cusp on M^1; 5) four-cusped forms on M_1; 6) six-cusped forms on M_1; 7) four-cusped forms on M_2; 8) deflecting wrinkle of the metaconid of M_1; 9) the variant 2med II position of the second furrow of the metaconid on M_1; 10) distal crest of trigonid on M_1. The above-mentioned traits were selected based on the following criteria: 1) the traits should not reveal inter-correlations as for the frequency of occurrence; 2) they should reveal high inter-group variability; c) their degree or variant of formation can not change with an individual's age; 3) it should be easy to find comparative data for different populations.

Table 1. Transcaucasian, Eastern Europe, Central Asia odontological samples

	Country	Region	Sample name	Age	Date	Researchers
1	Armenia	Transcaucasian	Beniamin, Vardbakh, Black Fortress I, Karmracar	Classical/Late Antiquity period	c. 1 BC – AD 3	Khudaverdyan 2009
2	Georgia	Transcaucasian	Chiaturia	Classical/Late Antiquity period	c. 1 BC – AD 3	Kashibadze 2006
3	Georgia	Transcaucasian	Mckheti I	Classical/Late Antiquity period	c. 1 BC – AD 3	Kashibadze 2006
4	Georgia	Transcaucasian	Mckheti (total group)	Classical/Late Antiquity period	c. 1 BC – AD 3	Kashibadze 2006
5	Georgia	Transcaucasian	Dzinvali	Early Feudal period	c. 600 – 1000 AD	Kashibadze 2006
6	Georgia	Transcaucasian	Samtavro	Early Feudal period	c. 600 – 1000 AD	Kashibadze 2006
7	Georgia	Transcaucasian	Mckheti I	Early Feudal period	c. 600 – 1000 AD	Kashibadze 2006
8	Georgia	Transcaucasian	Mckheti (total group)	Early Feudal period	c. 600 – 1000 AD	Kashibadze 2006
9	Russia	Eastern Europe (Volga region)	Bol'shaya Tarkhanskaya	Classical/Late Antiquity period	c. 1 BC – AD 3	Gravere 1999
10	Russia	Eastern Europe (Don region)	Dmitrovskaya	Classical/Late Antiquity period	c. 1 BC – AD 3	Gravere 1999
11	Russia	Eastern Europe (Don region)	Mayackaya	Classical/Late Antiquity period	c. 1 BC – AD 3	Gravere 1999
12	Russia	Central Asia	Kazibaba I /Sauromatians/	Iron Age	c. 500 BC	Bagdasarova 2000
13	Russia	Central Asia	Kazibaba II /Late Sarmatians/	Iron Age	c. 500 BC	Bagdasarova 2000
14	Ukraina	Eastern Europe (Dnepr region)	(Chernyakhov culture: total group)	Late Antiquity period	c. 300 – 400 AD	Gravere 1999
15	Latvia	Eastern Europe	(Kurgan Culture: total group)	Late Antiquity period	c. 1600 – 1200 BC	Gravere 1999
16	Latvia	Eastern Europe	Latgali	Feudal period	c. 800 – 1300 AD	Gravere 1999
17	Latvia	Eastern Europe	Livi	Feudal period	c. 1000 – 1300 AD	Gravere 1999
18	Latvia	Eastern Europe	Zemgali	Feudal period	c. 600 – 1300 AD	Gravere 1999
19	Lithuania	Eastern Europe	Dzemaiti	Feudal period	c. 300 – 500 AD	Gravere 1999

Table 2. Frequency of dental morphological traits in comparative populations

	Traits	Transcau-casian	Transcau-casian	Transcau-casian	Transcau-casian	Transcau-casian	Transcau-casian	Transcau-casian	Transcau-casian	Eastern Europe
		1	2	3	4	5	6	7	8	9
1	I^1-I^1 diastema	10.5	14.3	15.4	11.4	7.7	6.4	0.0	3.2	0.0
2	Double shoveling	45.1	0.0	8.3	7.1	0.0	0.0	25.0	7.7	35.3
3	Hypocone reduction on M^2	30.5	31.2	27.3	23.8	18.8	32.5	14.8	25.7	22.2
4	Carabelli cusp on M^1	46.7	37.5	46.2	43.8	28.6	37.5	16.6	28.6	28.3
5	Four-cusped M_1	17.8	0.0	6.9	10.8	0.0	10.3	16.7	11.8	7.9
6	Six-cusped M_1	5.8	0.0	6.9	5.4	16.7	0.0	0.0	0.0	2.6
7	Four-cusped M_2	71.3	76.5	97.1	93.0	100.0	83.0	85.7	83.6	94.1
8	Deflecting wrinkle of meta-conid	38.1	33.3	33.3	28.5	33.3	0.0	50.0	8.3	28.0
9	2 med II on M_1	53.4	50.0	40.0	33.3	33.3	20.0	0.0	12.5	20.8
10	Distal ridge of trigonid	50.9	0.0	0.0	0.0	33.3	0.0	0.0	0.0	24.3

	Traits	Eastern Europe	Eastern Europe	Central Asia	Central Asia	Eastern Europe	Eastern Europe	Eastern Europe	Eastern Europe	Eastern Europe	Eastern Europe i
		10	11	12	13	14	15	16	17	18	19
1	I^1-I^1 diastema	18.8	7.7	30.3	0.0	10.0	0.0	6.8	15.0	19.4	10.6
2	Double shoveling	21.7	28.0	33.3	27.8	0.0	40.0	0.0	11.5	3.6	0.0
3	Hypocone reduction on M^2	17.9	21.8	20.0	22.4	16.7	22.7	9.8	26.2	28.3	18.8
4	Carabelli cusp on M^1	43.7	52.6	21.7	12.9	25.0	46.2	20.4	25.5	16.7	50.0
5	Four-cusped M_1	8.8	12.0	15.2	17.5	11.1	15.8	9.1	10.6	17.5	2.6
6	Six-cusped M_1	1.7	2.0	3.4	0.0	0.0	0.0	2.3	10.6	0.0	2.6
7	Four-cusped M_2	90.8	79.2	85.0	86.5	92.7	81.5	88.3	84.5	90.2	100.0
8	Deflecting wrinkle of meta-conid	13.3	28.0	15.8	16.7	0.0	0.0	0.0	15.1	9.5	4.2
9	2 med II on M_1	18.2	22.2	29.5	23.1	72.2	13.3	–	–	45.0	17.9
10	Distal ridge of trigonid	10.4	10.8	3.2	20.0	0.0	7.1	2.3	1.5	0.0	0.0

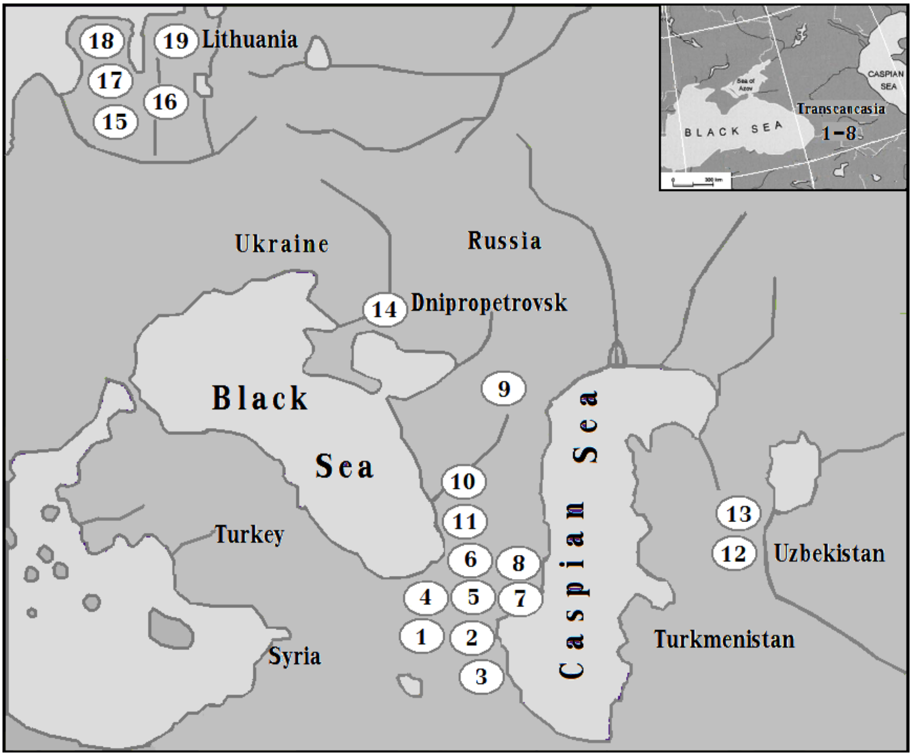

Figure 1. Localization groups from Transcaucasian, Eastern Europe, Central Asia.

These data were then subjected to the multiple correspondence analysis (MCA) and agglomerative clustering techniques (UPGMA). The multiple correspondence analysis (MCA) has several features that distinguish it from other techniques of data analysis. An important feature of the correspondence analysis is the multivariate treatment of the data through simultaneous consideration of multiple categorical variables. The multivariate nature of the correspondence analysis can reveal relationships that would not be detected in a series of pair-wise comparisons of variable. The first axis is the most important dimension, the second axis the second most important, and so on, in terms of the amount of variance accounted for. Useful treatments of the correspondence analysis have been given by J.-P. Benzécri [6], M.J. Greenacre [11] and J.D. Jobson [15]. UPGMA employs a sequential clustering algorithm, in which local morphological relationships are identified in order of similarity, and the phylogenetic tree is built in a stepwise manner. Agglomerative clustering techniques the unweighted pair-group method/arithmetic average algorithm, which measures similarity as the average distance between all the cases in one cluster to all the cases in another. Here, the average distance between all the cases in the resulting cluster is as small as possible and the distance between two clusters is taken as the average between all the possible pairs of cases in the cluster.

We compute two analyses (1 and 2), as many nonmetric dental traits are absent in the groups. Each trait was scored as a binary variable (absence, presence). We calculate the frequencies of the presence of each trait in each group and use these data for computation. Statistical software packages of Kozintseva and Kozintseva (Museum of Anthropology and Ethnography name after Peter the Great, St. Petersburg), and Stat Soft STATISTICA 6.0 were used for this analysis.

RESULTS AND DISCUSSION

Global processes led to cultural and genetic transformations within Transcaucasia. In the present study, we investigate the potential effects of gene flow among the population samples of Transcaucasia. According to the results of the odontological analysis, these effects provide a typical picture of infiltration, from the 8th century BC up to the 3rd century AD, of groups alien to the ethnic groups of the Transcaucasia.

Analysis No. 1. The value for the first three coordinates given in Table 4. The analysis included the groups of the Armenian Plateau, Eastern Europe, Central Asia (Table 1: No 1–13, 15, 18–19) in which the researchers fixed nonmetric traits.

The first two coordinate values are also presented in Table 3 with the placement of the 16 sample coordinate axis determined by the first dimension value of 32.6% of inertia and dimension 2 with 25.5%. The positive weight (dimension 1) given for maximum the hypocone reduction on M^2 (0.824), the Carabelli cusp on M^1 (0.700) and the 2 med (II) (0.699). The negative weight is attributed to the four-cusp lower second molars (–0.637). The positive weight (on dimension 2) given for maximum the four-cusp lower second molars (0.672) and the I^1–I^1 diastema (0.646). The highest negative loading is the four-cusp lower first molars (–0.731). The third dimension accounts for the 16.0% of the intergroup. The positive weight gives the deflecting wrinkle of metaconid (0.945).

The graph of the first two dimensions is shown in Figure 2, it demonstrates how geographic and ethnic trends are vizualised. The groups from Georgia (Classical/Late Antiquity period: (2) Chiaturia, (3) Mckheti I, (4) Mckheti I – total group) are close to each other. The group from Georgia (Classical period: (4) Mckheti I – total group), is closely related to the samples from Central Asia (Sauromatians: (12) Kazibaba I), and Latvia ((18) Zemgali). The first axis shows the populations of Georgia (Early Feudal period: (6) Samtavro) and the Don region ((11) Mayackaya) on the positive-coordinate axis, which are close to each other. The Classical samples from Georgia ((2) Chiaturia, (3) Mckheti I, (4) Mckheti I – total group) are clearly different from Early Feudal samples (Georgia: (7) Mckheti I, (5) Dzinvali, (8) Mckheti – total group), and the samples from Lithuania ((19)Dzemaiti), Latvia ((15) Kurgan Culture) and Central Asia (Late Sarmatians (13) Kazibaba II). The sample from the Armenian Plateau ((1) Beniamin, Vardbakh, Black Fortress I, Karmrakar) is not similar to any other sample.

Table 3. The MCA singular values of 7 non-metric dental traits in three dimensions for 16 samples from Tables 1 and 2 (No 1–13, 15, 18–19)

Non-metric dental trait	Dimension 1	Dimension 2	Dimension 3
I^1-I^1 diastema	0.348	0.646	–0.138
Hypocone reduction on M^2	0.824	0.093	–0.295
Carabelli cusp on M^1	0.700	–0.107	0.340
Four-cusped M_1	0.303	–0.731	–0.083
Four-cusped M_2	–0.637	0.672	–0.001
Deflecting wrinkle of metaconid	0.089	0.105	0.945
2med (II)	0.699	0.593	–0.010
Inertia	32.643	25.524	16.024

Table 4. The MCA singular values of 8 non-metric dental traits in three dimensions for 16 samples from Tables 1 and 2 (No 1, 3, 4, 5, 7, 9–19)

Non-metric dental trait	Dimension 1	Dimension 2	Dimension 3
Double shoveling	0.872	0.269	0.024
Hypocone reduction on M^2	0.401	0.591	0.279
Carabelli cusp on M^1	–0.076	0.478	0.816
Four-cusped M_1	0.899	–0.354	–0.004
Six-cusped M_1	–0.439	0.748	–0.163
Four-cusped M_2	–0.905	0.134	–0.025
Deflecting wrinkle of metaconid	0.291	0.621	–0.262
Distal trigonid crest	0.216	0.705	–0.389
Inertia	35.989	27.942	12.386

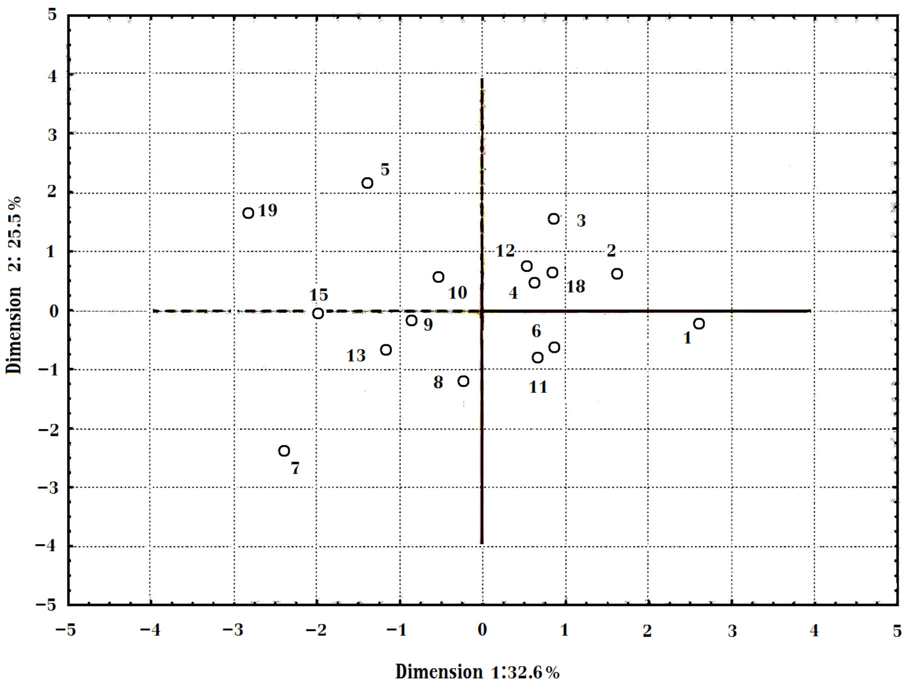

Figure 2. Multiple Correspondence Analysis; 2D plot of column coordinates: dimension 1 × 2: 16 groups from Tables 1 and 2 (No 1–13, 15, 18–19).

I noted that on the positive coordinates of the first axis, the highest loading dental traits are the hypocone reduction of the maxillary second permanent molar and the Carabelli cusp on the upper first molar (Table 3). These traits show a higher dimension in the groups from the Armenian Plateau ((1) Beniamin, Vardbakh, Black Fortress I, Karmrakar: 2.965) and Georgia ((2) Classical/Late Antiquity period: Chiaturia: 1.628), and slightly lower dimension in the Latvian ((15) Kurgan Culture: 0.065) and Central Asian (Sauromatians: (12) Kazibaba I: 0.289) samples. On the negative coordinates, on the other hand, the most significant trait is the the four-cusp lower second molars, which shows higher dimension in the Lithuanian ((19) Dzemaiti: –2.922) and Georgia (Early Feudal period: (7) Mckheti I: –2.421) samples. Slightly lower dimension in the Georgia (Early Feudal period: (8) Mckheti – total group: –0.253).

The distance between the samples was checked in the cluster tree on Figure 3, where the following affinities are noted: the sample from the Don region ((11) Mayackaya) exhibits a phenetic link with the Georgia (Classical period: (3) Mckheti I, (4) Mckheti I (total group) samples. For the deflecting wrinkle of metaconid, the four-cusp lower second molars, the hypocone reduction of maxillary second permanent molar and the Carabelli cusp on the upper first molar traits, the Classical samples from the Don region and Georgia generally have higher frequencies of expression. The Armenia sample (Classical period (1): Beniamin-Vardbakh-Black Fortress I-Karmrakar) and the sample from Georgia (Classical period: (2) Chiaturia) exhibit affinities to one another. The results of the analysis reveal certain intersample affinities among the samples from Latvia ((18) Zemgali) and Central Asia ((12) Kazibaba I (Sauro-matians), (13) Kazibaba II (Late Sarmatians)). The Armenia Classical sample ((1): Beniamin-Vardbakh-Black Fortress I-Karmrakar) and the sample from Georgia (Classical period: (2) Chiaturia) exhibit affinities to one another. The results of the analysis reveal certain intersample affinities among the samples from Latvia ((18) Zemgali) and Central Asia ((12) Kazibaba I (Sauromatians), (13) Kazibaba II (Late Sarmatians)).

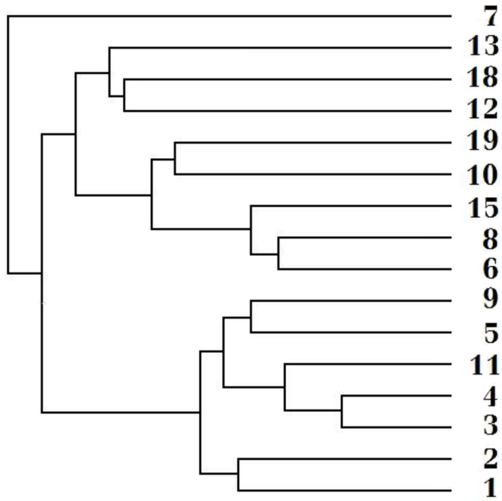

Figure 3. UPGMA tree: 16 groups from Tables 1 and (No 1–13, 15, 18–19).

The Georgia Early Feudal sample ((5) Dzinvali) and the sample from the Volga region ((9) Bol`shaya Tarkhanskaya) exhibit affinities to one another. For the deflecting wrinkle of metaconid, the four-cusp lower second molars, and the Carabelli cusp on the upper first molar traits, the samples from the Volga region ((9) Bol`shaya Tarkhanskaya) and Georgia (Early Feudal period: (5) Dzinvali)) generally have higher frequencies of expression. The biologically admixed group (combined European and mongoloid descent) from ((9) the Volga region: Bol`shaya Tarkhanskaya) has a more complicated pattern of phenotypic relationships [25]. The craniological analysis confirms that this population (Bol`shaya Tarkhanskaya) was ethnically mixed [1]. The Early Feudal period sample from Georgia ((7) Mckheti I) is clearly separated from the other groups.

Analysis No. 2. The analysis included new groups from the Dnepr region ((14) Chernyakhov culture – total group), Latvia ((16) Latgali: c. 700–1300AD,

(17) Livi: c. 1000–1300AD), and the new non-metric traits of double shoveling, six-cusp lower first molars, distal trigonid crest.

The first two coordinate values are given in Table 4 and the placement of the samples' coordinate axis was determined by values of dimension 1 with 35.9% and dimension 2 with 27.9% of inertia, respectively. The character of attribute connection in these coordinates shows that the large first coordinate axis values correspond to groups with four-cusp lower first molars (0.899) and double shovelling (0.872). The negative weight gives the four-cusp lower second molars (–0.905). The second coordinate axis are maximum for the six-cusp lower first molars (0.748), the distal trigonid crest (0.705) and the deflecting wrinkle of metaconid (0.621). The third coordinate axis accounts for 12.3% of the intergroup, and the weight gives the Carabelli cusp on the upper first molar.

The graph of the first two dimensions in Figure 4 shows that the groups from Georgia ((3) Mckheti I: Classical/Late Antiquity period and (7) Early Feudal period), Central Asia ((12, 13) Kazibaba I, II), and Latvia ((15) Kurgan Culture) are close to one another. Georgia (Early Feudal period: (5) Dzinvali), Dnepr region ((14) Chernyakhov Culture), Armenian Plateau ((1) Beniamin, Vardbakh, Black Fortress I, Karmrakar – total group), Latvia (18): Zemgali, (16) Latgali), and Lithuania ((19) Dzemaiti) clearly separated from the other groups.

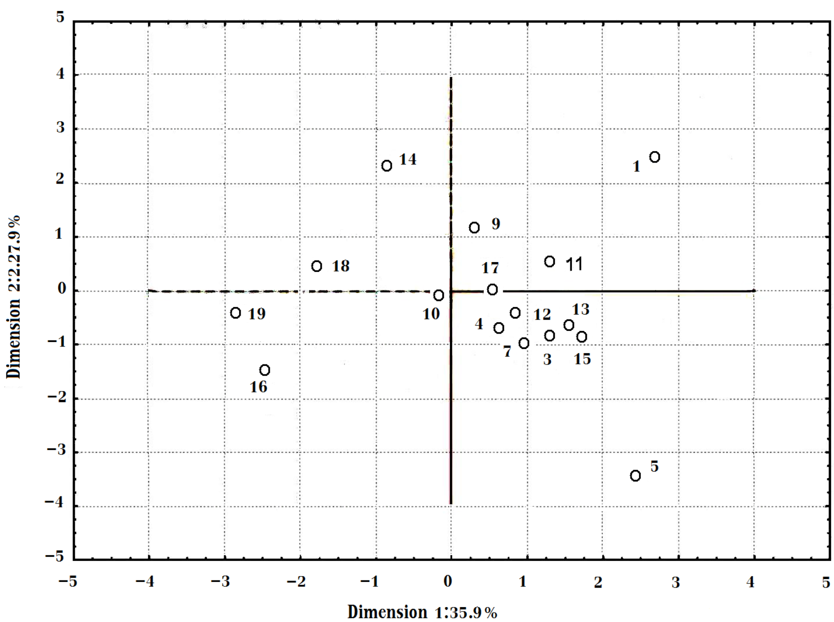

Figure 4. Multiple Correspondence Analysis; 2D plot of column coordinates: dimension 1 × 2: 16 groups from Tables 1and 2 (No 1,3, 4, 5, 7, 9–19).

I noted that on the positive coordinates of the first axis, the highest loading dental traits are the four-cusp lower first molars and double shovelling (Table 4). These traits show higher dimension in the groups from the Armenian Plateau ((1) Beniamin-Vardbakh-Black Fortress I-Karmrakar: 2.851), Central Asia ((13) Late Sarmatians: Kazibaba II: 1.690), Latvia ((15) Kurgan Culture: 1.621) and the Don region ((11) Mayackaya: 1.253). On the negative coordinates, on the other hand, the most significant trait is the four-cusp lower second molars, which shows higher dimension in the Georgia ((5) Early Feudal period: Dzinvali: –3.433), Lithuania ((19) Dzemaitiand: –3.023) and Latvia ((16) Latgali: –1.418) samples. The slightly lower dimension is in the Don region ((10) Dmitrovskaya: –0.007) and Latvia ((17) Livi: –0.027).

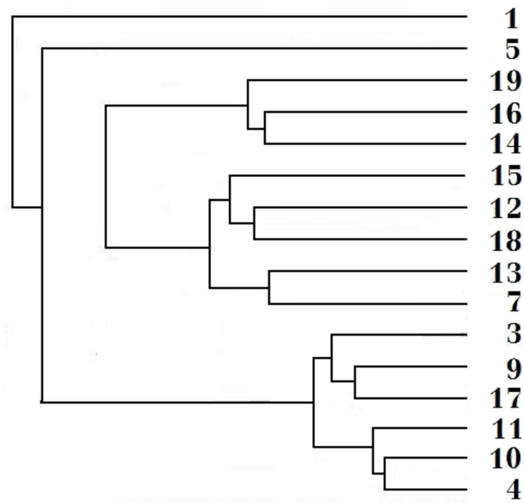

Figure 5. UPGMA tree: 16 groups from Tables 1 and 2 (No 1, 3, 4, 5, 7, 9–19).

The distance between the samples is checked in the cluster tree in Figure 5. The results there show that the Ancient time sample from Georgia ((4) Mckheti – total group) exhibits the closest affinity with the samples from the Don region ((10) Dmitrovskaya and (11) Mayackaya). The Georgia sample ((7) Early Feudal period: Mckheti I) and that from (13) Kazibaba II (Late Sarmatians) are identified as possessing the closest affinities to one another. Affinities are closest between the Central Asian sample from (12) Kazibaba I (Sauromatians) and the samples from Latvia ((18) Zemgali, (15) Kurgan Culture). The sample from Latvia ((17) Livi) is associated with the samples from Georgia (Classical period: (3) Mckheti I) and the Volga region ((9) Bol`shaya Tarkhanskaya).

The Classical/Late Antiquity period sample from Armenia ((1) Beniamin-Vardbakh-Black Fortress I-Karmrakar) and the Early Feudal period samples from Georgia ((5) Dzinvali, (7) Mckheti I) clearly separated from the other groups.

The analysis of the main odontological traits in these series indicates that their frequencies fit within the range characteristic for the European dental complex and the biologically admixed groups.

The biologically admixed group ((1) Armenian Highland: Beniamin-Vardbakh-Black Fortress I-Karmrakar) has a more complicated pattern of phenotypic relationships. The sample from the Armenian Plateau (1) is not similar to any other sample. As it is seen from Table 2 the high value of dental morphological traits is revealed – double shoveling, distal ridge of trigonid and deflecting wrinkle of metaconid.

The ratio of results of migration and the autochthonic development of populations during ethnogenetic processes – one of the main questions of historical science. Anthropological data for historical reconstruction allow to establish the migration fact (through fixing of changes in an anthropological cover within this region on this chronological cut). The elements of material culture and language extend not only as a result of migration, but also water of interpopulation, interethnic contacts. Meanwhile the emergence of a new anthropological complex in that territory where it is not recorded earlier is always the result of migration of the new population. So, frequencies of deflecting wrinkle of metaconid, distal ridge of trigonid and double shoveling in the territory of Armenia during the Bronze Age are lower [23], than in Classical/Late Antiquity time. The odontological material to a big degree will be coordinated with craniological [22] and non-metric cranial traits [24, 29].

The samples from Georgia (Classical/Late Antiquity period and Early Feudal period) have also a complicated pattern of phenotypic relationships. The increase is observed in the groups from the territory of Georgia, too [16]. So deflecting the wrinkle of metaconid increases from the Bronze Age to Classical/Late Antiquity. In (5) Dzinvali's group (Early Feudal period) the increase in the distal ridge of trigonid is observed. In (7) Mtskheti's I group the increase in the frequency of double shoveling is observed. Morphological characteristics of the population of Transcaucasia could be transformed by the influence of the other population at which the odontological type there was double shoveling, the distal ridge of trigonid, deflecting the wrinkle of metaconid. You should not exclude that Ronsky, Zikarsky, Mamisonsky and other pass along with the military-Georgian road, which could be the channel of an infiltration of Scythians, Sakas, etc. tribes from the North Caucasus to Georgia and the Armenian Plateau, confirming archaeological data [9, 31, 44].

This assertion requires further exploration. In spite of this possibility, it is clear that the techniques employed in this study would have made it more likely to find significant differences among the samples, if any existed.

CONCLUSIONS

Dental non-metric traits differentiated markedly the comparative populations that belong to different ethnic and cultural complexes. Therefore, they are a good method for studying the biological differentiation of skeletal populations. The analysis results do not allow to concretize sources of components of odontological structure of the Classical/Late Antiquity period populations of the Armenian Highland reducing them to the direct influence of the representatives of any cultures or communities. Future dental morphology investigation in Armenia should focus on characterizing, with the aid of an identified skeletal collection, the frequencies of traits on an Armenia large sample. This would be only a gateway to a wider (geographically and, more important, chronologically) dental morphology characterization of Armenian peoples. That would be an important achievement in the search for the genetic influences behind the several culturally diversified groups who passed through in the current Armenia territory, coloring our history books and defining our present identity

REFERENCES

1. Akimova M. S. (1964). Materials on anthropology of Early Bulgarians. In: Genin V. G., Xalikov A. Kh. (Eds), Early Bulgarians on the Volga (Bol`shaya Tarkhanskaya burial), Moscow, 167–170.
2. Alt K. W., Vach W. (1991). The reconstruction of "genetic kinship" in prehistoric burial complexes: problems and statistics. In: Bock H. H., Ihm P. (Eds), Classification, Data Analysis, and Knowledge Organization. Proceedings of the 14th Annual Conference of the Gesellschaft für Klassifikation e.V., Springer, Berlin, 299–310.
3. Alt K. W., Vach W. (1998). Kinship studies in skeletal remains: concepts and examples. In: Alt K. W., Rösing F. W., Teschler-Nicola M. (Eds.), Dental Anthropology, Springer, Wien, 537–554.
4. Arakelyan V. N. (1976). Outline of the history of ancient Armenian art, 6st century BC – 3rd century AD. Yerevan: National Academy of Science of Armenia.
5. Bagdasarova H. A. (2000). Odontologic the characteristic of nomads Sauromatians and Sarmatians Age (on materials of burial ground Kazibaba). In: Rikushina G. V. (Ed), Anthropological and ethnographic data on the population of Central Asia, vol. 2. Moscow, 113–124.
6. Benzecri J.-P. (1992). Correspondence analysis handbook. New York: Dekker.
7. Dahlberg A. A. (1963). Dental evolution and culture. Hum Biol, 35, 237–249.
8. Eremyan S. T. (1968). Invasions Cimmerian and Scythian tribes and fight Assyria and Urartu against nomads. Journal of History and Philology, 2 (41), 89–116.

9. Il'inskaya V. A., Terenozhkin A. I. (1983). Scythia 7th–4th centuries BC. Kiev.
10. Gravere R. U. (1999). Odontological aspect in ethnogenesis and ethnic history of Eastern Slavic peoples. In: Alexeeva T. I. (Ed), Eastern Slavs. Anthropology and Ethnic history. Moscow, 205–219.
11. Greenacre M. J. (1994). Correspondence analysis and its interpretation. In: Greenacre M. J., Blasius J. (Eds), Correspondence analysis in the social sciences. London: Academic Press, 3−22.
12. Hillson S. W. (1996). Dental Anthropology. Cambridge: Cambridge University Press.
13. Herodotus 1972. History in Nine Books. Translation and Notes by Stratanovsky G. A. Leningrad: Science.
14. Hewsen R. H. (1997). The geography of Armenia. In: Hovannisian R. G. (Ed), The Armenian people from ancient to modern times, vol. 1. St. New York: Martin's Press, 1–17.
15. Jobson J. D. (1992). Applied multivariate data analysis. Volume II: Categorical and multivariate methods (springer texts in statistics). New York: Springer-Verlag.
16. Kashibadze V. F. (2006). Odontological data for an anthropological history of the Caucasus. Ethnographic Reviews, 5, 117–133.
17. Khorenatsy M. (1893). History of Armenia. Moscow: Gattsuk.
18. Khudaverdyan A. Yu. (2000). The population of the Armenian uplands during Antiquity, based on data from the Beniamin cemetery. Yerevan: Tigran Mec.
19. Khudaverdyan A. Yu. (2009). The bronze population of Armenian highland. Ethnogenesis and ethnic history. Yerevan: Van Aryan.
20. Khudaverdyan A. (2011a). Artificial modification of skulls and teeth from ancient burials in Armenia. Anthropos, 106 (2), 602–609.
21. Khudaverdyan A. Yu. (2011b). Secular dental changes in the populations of the Armenian highland: evolutionary and ecological aspects. Archeology, Ethnography & Anthropology of Eurasia, 1 (45), 139–146.
22. Khudaverdyan A. Yu. 2012. Bioarchaeological analysis of populations Armenian Highlands and Transcaucasia in Ancient time. The Mankind Quarterly, 53 (1), 3–35.
23. Khudaverdyan A. Yu. (2013a). A dental nonmetric analysis of Bronze Age population from Armenian Plateau. Anthropological Review, 76 (1), 63–82.
24. Khudaverdyan A. Yu. (2013b). Nonmetric dental trait in human skeletal remains from Armenian highland. Phylogenetic and evolutionary implications. Acta Biologica Szegediensis, 57 (1), 59–82.
25. Konduktorova T. S., Segeda S. P. (1990). Craniological and odontological characteristic people from Saltovo-Mayak Culture of the Dmitrovskaya village. Questions anthropology, 84, 94–105.

26. Kramer C. (1977). Pots and peoples. In: Levine L. D., Young T. C. (Eds), Mountains and Lowlands: Essays in the Archaeology of Greater Mesopotamia, Malibu: Undena Publications, 91–112.
27. Krupnov E. I. (1960). Ancient History of the Northern Caucasus. Moscow: Science.
28. Martirosyan A. A. (1964). Armenia during of Bronze Age and Early Iron. Erevan: National Academy of Science of Armenia.
29. Movsesyan A. A., Kochar N. R. (2001). Ancient populations of Armenia and their role in contemporary Armenian type formation. The Anthropology Bulletin, 7, 95–116.
30. Palikyan A. K., Nalbandyan K. G. (2006). On some momentous changes in the dental system in Armenia. In: Kalantaryan A. (Ed), Armenian Folk Culture. Yerevan, 269–272.
31. Petrenko V. G. (1983). Scythian Culture in the Northern Caucasus. Archaeological Collection of Articles of the State Hermitage, 23. Leningrad.
32. Pinto-Cisternas J., Moggi-Cecchi J., Pacciani E. (1995). A morphological variant of the permanent upper lateral incisor in two Tuscan samples from different periods. In: Moggi-Cecchi J. (Ed), Aspects of dental biology: Paleonthology, anthropology and evolution. Florence: International Institute for the Study of Man, 333–339.
33. Piotrovsky B. B. (1959). Vansky kingdom (Urartu). Moscow: East literature.
34. Scott G. R. (2008). Dental morphology. In: Katzenberg M. A., Saunders S. R. (Eds), Biological Anthropology of the Human Skeleton. John Wiley & Sons, Inc. 2nd, 265–298.
35. Scott G. R., Dahiberg A. A. (1982). Microdifferentiation in tooth crown morphology among indians of the American Southwest. In: Kurten B. (Ed), Teeth: Form. Function and Evolution. New York, 259–291.
36. Scott R. G., Turner C. G. (1997). The anthropology of modern human teeth: dental morphology and its variation in recent human populations. Cambridge: Cambridge University Press.
37. Segeda S. P. (1991). Pozdneyam population of the northwest Black Sea region from physical anthropological data. In: Segeda S. P. (Ed), Very ancient societies agriculturalists and herdsmen of the northern Back Sea region (1000 BC – 100 AD). Materials of an international conference (Kishinev 1990). Kiev, 97–99.
38. Segeda S. P. (1993). Odontological data for the Chernyakov culture population. Dental Anthropology Newsletter, 7(2), 5–7.
39. Strabo 1964. The Geography XI, IV. Translation and Notes by Stratanowski G. Moscow: Science.
40. Swindler D. R. (2002). Primate Dentition: An Introduction to the Teeth of Non-Human Primates. Cambridge: Cambridge University Press.

41. Tyrrell A. (2000). Skeletal non-metric traits and the assessment of inter- and intra-population diversity: past problems and future potential. In: Cox M., Mays S. (Ed). Human osteology in archaeology and forensic science. London: Greenwich Medical Media, 289–306.
42. Turner C. G. (1969). Directionality in the canine field model. J Dent Res, 48, 1310.
43. Vargiu R., Cucina A., Coppa A. (2009). Italian populations during the Copper Age: Assessment of biological affinities through morphological dental traits. Hum Biol 81, 479–493.
44. Vinogradov V. B., Dudarev S. L. (1983). Chronology of Some Monuments and Complexes at the Beginning of the 1st Millennium BC from Karachaevo-Cherkesia and Pyatigor'e. Problems of Archaeology and Ethnography of Karachaevo-Cherkesia. Issue 2. Cherkessk.
45. Zubov A. A. (1973). Ethnic odontology. Moscow: Science.
46. Zubov A. A. (1974). Odontoglyphics. In: Zubov A. A. (Ed), Racialgenetic processes in ethnic history. Moscow: Science, 11–42.
47. Zubov A. A. (1979). Conclusion. In: Zubov A. A., Khaldeeva N. I. (Eds), Ethnic odontology of the USSR, Moscow: Science, 229–254.

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