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ARTICLE

Nonmetric dental trait in human skeletal remains from Armenian Highland. Phylogenetic and evolutionary implications

A. Yu. Khudaverdyan

Institute of Archaeology and Ethnography National Academy of Science, Yerevan, Republic of Armenia

ABSTRACT Biocultural diversity of ancient Transcaucasian populations has not been studied extensively, therefore delineating some of the patterns of phenotypic variation may be useful for understanding their ongoing evolution. Dental morphological traits were employed in this study as direct indicators of biological affinities among the populations that inhabited the Transcaucasian peninsula from the Bronze Age to 20 century. Inter-group affinities were assessed by means of a principal component and cluster analysis based on trait frequencies. The samples from Armenian highland and Georgia, is identified as possessing closer affinities to the samples from Kalmykia (Pit Grave culture), Ukraine (Tripolye culture), Ural (Sintashtinskaya, Timber Grave cultures), Volga region (Pit Grave, Balanovo, Fatianovo, Potapovsky cultures), Center Asia (Gonur-Depe, Kazibaba I /Sauromatians and Late Sarmatians/), Latvia (Kiwytkalnsk), Don region (Mayackaya, Dmitrovskaya) and Lithuania (Dzemaiti). The biologically admixed group or "Mestizo" (Armenian highland: Beniamin-Vardbakh-Black Fortress I, Karmrakar) has a more complicated pattern of phenotypic relationships but from an evident European component. From an evolutionary point of view, gene flow probably is the most important factor that changed the original gene pool through Classical time (1st century BC - 3rd century AD). This group have a complex landscape of biocultural variation reflected by their different microevolutionary histories. It is, however, feasible to depict a scenario where processes of genetic mixture or replacement probably took place at different rates on a macro-regional level.
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The study of modern and archaeological human dentition, or dental anthropology, is a well-established sub-discipline of Physical Anthropology defined by S. Hillson (1996: 1) as "a study of people (and their close relatives) from the evidence provided by teeth". Such research may yield information on a variety of topics such as growth and development, health diet, occupational activity, and biological affinities. This information can be used in studies of individuals as well as populations. Nonmetric traits analysis of the dentition, when compared with similar studies, can be used to infer biological relationships between populations, as well as to track evolutionary variation related to changing settlement patterns. Dental morphology can provide insights into phenotypic group differences, and these may be suggestive of differences in genotypic affiliation (Varela and Cocilovo 2000). Nonmetric dental traits seem to be controlled in part by genetics and are relatively free of sex- and age-bias (Scott and Turner 1997). The analysis of biological relatedness using dental nonmetric traits has been helpful even in commingled samples when standardized procedures are followed (Ullinger et al. 2005). For these reasons, reconstruction of biological relationships among ancient human groups using teeth is an important research problem for Transcaucasian bioarcheologists. The aim of the present study is to establish new non-metric dental data for ancient Transcaucasian, and to compare these data with similar studies of Eastern Europe, Central Asia and Siberia populations in order to contribute to our understanding of the dental development of, and the genetic relationships between populations.

Several investigations provide information about nonmetric variation from a local scale in several human groups from Asia and the India (Gupta et al. 1962; Lukacs and Hemphill 1991), Center Asia (Rikushina et al. 2003; Bagdasarova 2000), Europe (Kaczmarek, Pyżuk 1985; Kaczmarek 1991; Segeda 1991, 1993; Gravere 1999; Coppa et al. 2007; Vargiu et al. 2009; Zubova 2010), Near East (Smith 1976; Moskona et al. 1998), Siberia (Zubova 2008; Tur 2009), Australia (Townsend, Brown 1981; Townsend et al. 1986, 1990). Surprisingly, past and present Transcaucasian populations have received little attention (Gashimova 1979; Kochiev 1979; Kashibadze, 1990, 2006; Palikyan, Nalbandyan, 2006; Khudaverdyan, 2009, 2011b,d). The study of phenotypic diversity

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*Corresponding author. E-mail: ankhudaverdyan@gmail.com; akhudaverdyan@mail.ru

can help us understand the evolution and biocultural variation of the ancient and contemporary communities that today inhabit Transcaucasian and to obtain a more complete landscape of the dynamics that configure their gene pool.

Prehistory and history of the Transcaucasian

The Caucasia were in early history a crossroads linking the worlds of East and West. From IV millennium BC to I millennium BC, tools and trinkets of copper, bronze and iron were commonly produced in this region and traded in neighboring lands where those metals were less abundant (Krupnov 1966; Trifonov 1991; Nechitailo 1991; Pystovalov 2002, etc.). The invented in the Near East of wheeled vehicles and "kibetka-houses" on wheels allowed cattlemen-farmers to move and survive with ease on the open steppes. Their movement across Eurasia in early times was not a military invasion, but a slow expansion caused by a decline in the child mortality rate and a resultant increase in population growth. The wide expanse of the Eurasian steppes, offering favorable conditions for human life and the spread of information and technology, promoted a process of wide cultural integration in the Bronze Age throughout this area (Merpert 1988; Chernykh 1988).

The Craniological data allowed identification of alien Mediterranean characteristics influencing various ethnic Eurasian samples and revealed evidence of a migratory stream from the Caucasus and Near East (Solodovnikov 2006; Khokhlov and Mimokhod 2008; Dubova 2010; Khudaverdyan 2011a). The Odontological and Craniological data also exhibit close affinities the Armenian Highland sample and the samples from Ukraine and Moldova (Tripolye culture) (Alekseeva and Krus 1999; Khudaverdyan 2011b). Hence, it is possible to outline the cultural and ethnic communications in antiquity and the known role of the Armenian Highland (Kura-Araxes culture) as the intermediary between ancient area of distribution of Tripolye cultures and the East countries (Passek 1949; Martiroyan and Mnacakanyan 1973; Lang 2005).

The Armenian highland and Georgia samples (Kura-Araxes culture) and the Catacomb culture samples from Kalmykia, Ukraine, Dnieper exhibit very close affinities to one another. If we follow a hypothesis put forward and developed by T.V. Gamkrelidze and V.V. Ivanov (1984) considering the ancestral home of Indo-European areas of the Armenian Highland and adjoining territories, whence other tribes get into the Northern Black coast both through the Caucasus and through Central Asia and the Volga region (carriers of a Catacomb culture ceremony), it is necessary to assign that movement to Aryan tribes, which were one of the first to get into Black Sea coast steppes through the Caucasus (or possibly by sea?). I.N. Khlopin (1983) connect the Catacomb culture with the Indo-Aryans, because catacomb burial ritual had roots in Southwestern Turkmenistan from the early IV millennium BC (Sumbar cemetery). V.A. Fisenko (1966) suggest that the Catacomb people were Proto-Hittites. E. Kuzmina (1998) also is a supporter of the hypothesis V.A. Fisenko. D. Anthony (2007) supposed Catacomb people to be ancestors of Greeks, while E. Berzin and E. Grantovsky (1962), L.S. Klejn (1984) determine the Indo-Aryans originated from the Catacomb culture.

The Armenian Highland sample and the Albashevo, Fatianovo, Balanovo cultures and Timber Grave samples from Volga region exhibit very close affinities to one another (Khudaverdyan 2011a). The presence of the Mediterranean components was marked also by T.A. Trofimova (1949) in carriers of Fatianovo culture, A.B. Shevchenko (1984, 1986) and A.A. Khokhlov (2000) in carriers of Timber Grave cultures of the forest-steppe Volga region, and also by R.M. Yusupov (1989) in the Southern Urals Mountains.

The craniological and odontological researches indicate some morphological association of the Siberia samples (Elunskaya and Andronovo cultures) with populations from the Caucasia, Near East and Center Asia (Solodovnikov 2006; Zubova 2008; Tur 2009; Khudaverdyan 2011a). The different rates of genetic drift and external gene flow may have contributed to the morphological differentiation and diversification amongst the different East European and Siberia populations. The initial starting area (or one of the intermediate areas), as indicated by the anthropological data, would seem to be the Armenian Highland, and the Caucasus as a whole.

In the Classical/Late Antiquity time (1st century BC – 3rd century AD) in the Caucasus the interaction of different ethno-cultural units – Iranian-speaking nomadic (Scythians, Sarmatians, Sauromatians, Saka) (Piotrovski 1959) and local. The advancement of the Scythians, Sarmatians and Saka in the territory of Transcaucasia was accompanied by not only an interaction of various cultural elements, but also a mixture. The detailed analysis of the anthropological materials from Armenian Highland allows 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 Ancient Age. Intragroup analysis revealed two groups within population (Khudaverdyan 2000). The dolichocephaly type in both cases is presented. The male skulls of the first group have been diagnosed as classical European sample. The second is the same European type, but the horizontal profile of the face (group II) is a little weakened. (A dolichocephalic type is present in both cases). The female skulls groups has the same analogical characteristics as the males. It is necessary to state that carriers of this complex remind one of Scythians from the territory of Moldova, Steppes of Black Sea Coast, Ukraine, Sarmatians from Volga region and Saka from the territory of Turkmenistan (Khudaverdyan 2012). The invasions of the various tribes all led, in stages, to a mixture of outsiders among the native Armenians and the dilution of their ranks on the plateau. The artificial modification of skulls (such as bregmatic, ring

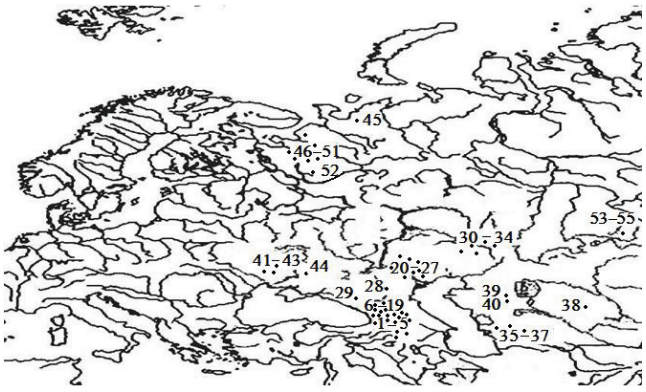

Figure 1. Localization groups from Transcaucasian, Eastern Europe, Center Asia and Siberia.

deformations of a head was known in the ancient population of the Beniamin, Shirakavan and Karmrakar, Vardbakh) and teeth (Beniamin) in Ancient on the Armenian Highland may be related to emerging social complexity and the need to differentiate among people, creating a niche for such a highly visual bodily markers (Khudaverdyan 2011c).

Materials and Methods

In total, the intergroup analysis included 55 series (Table 1) from the territory of Transcaucasian, Eastern Europe, Center Asia and Siberia (Khodjaiov 1977; Rud 1978; Kashibadze 1990, 2006, Gravere 1999; Bagdasarova 2000; Rikushina et al. 2003; Zubova 2008, 2010; Tur 2009; Khudaverdyan 2009; Kitov 2011) (Fig. 1).

First, the small sample sizes for sites (Landjik, Black Fortress) were inadequate (from 10-13 individuals) for subsequent biodistance analysis. Second, the Landjik, Black Fortress sites they represent a cemetery from Shirak Plain. Indeed, the geographic distance among sites a little. Finally, analysis of all non-metric traits examined by this study revealed that no significant differences exist among remains from the two sites, so data from these sites were combined for subsequent statistical analyses (Khudaverdyan 2009).

Remains from Lchashen site were treated as an independent sample because a sufficient number of crania from burial in Sevan pool were available for study (Kashibadze 2006). The Bronze Age sample is represented by remains from four Armenia sites (Lchashen, Shirakavan, Keti, Karchakhpyur). Two of the four Armenia sites, *i.e.*, Shirakavan and Karchakhpyur represent a samples with an date of 1st century BC - 3rd century AD (*i.e.* classical time) (Kashibadze 1990. P. 287).

Classical/Late Antiquity period (1st century BC - 3rd century AD) samples examined by this study include remains from Beniamin, Vardbakh, Black Fortress I, Karmracar (Khudaverdyan 2009). The small sample sizes for sites (Vardbakh, Black Fortress I, Karmracar) were inadequate (from 12-23 individuals) for subsequent biodistance analysis. The Beniamin, Vardbakh, Black Fortress I and Karmracar sites they represent a cemetery from Shirak Plain and the geographic distance among sites a little. V.V. Bunak (1927) after the armenian genocide the 1915 year has collected a big collection (Museum of Anthropology, Moscow) of human skulls (*i.e.* the victims a genocide). The modern population is include remains these people (Bingel Dag: armenians from Musha) (Kashibadze 2006).

Two Bronze Age samples (Digomi, Mckheti) were analyzed in this investigation from Georgia. The combination of remains from these two sites is justified because of the small number of groups (Kashibadze 2006). Remains from Chiaturia and Mckheti I sites (1st century BC - 3rd century AD) were treated as an independent samples because a sufficient number of crania from these were available for study. Nonmetric dental trait data from Mckheti, were combined to an inadequate number for subsequent analysis. The Classical/Late Antiquity period (1st century BC - 3rd century AD) samples from Georgia examined by this study include remains from Chiaturia, Mckheti I , Mckheti I (total group). An adequate number of remains were available from this site, and were therefore analyzed as a single sample. Four Early Feudal period samples (Dzinvali, Samtavro, Mckheti I, Mckheti /total group/) were analyzed in this investigation from Georgia. Average Feudal period (c. X - XII AD) samples examined by this study include remains from Dzinvali, Adjaria, Shatili, Adigeya and Mckheti. Late Feudal period (c. XIII - XIX AD) samples examined by this study include remains from Dzinvali, Rustavi, Sioni and Shatili. The modern population is include remains from Dzinvali (Kashibadze 2006). I analyze only cranial samples of tombs of Bronze Age, Classical/Late Antiquity period, Feudal Age, and Modern period from the territory of the Transcaucasian.

Human dentitions exhibit highly heritable non-metric morphological crown and roots traits that vary within and between populations. 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 (Hillson 1996; Scott, Tumer 1997; Zubov 1968, 1973, 1979). Numerous studies have demonstrated that morphological dental forms respond to microevolutionary forces of admixture (e.g. Turner 1969; Pinto-Cisternas et. al. 1995; Khudaverdyan 2011d), mutation (e.g. Morris et al. 1978), genetic drift (e.g. Turner 1969; Scott, Dahlberg 1982; Segeda 1993; Khudaverdyan 2009; Vargiu et al. 2009; Zubova 2008, 2010), and selection (e.g. Dahlberg 1963; Scott, Turner 1988), thus evincing their high degree of genetic control.

The method A.A. Zubov (1968, 1973, 1974) is the most widely employed system in Russian school of anthropology is the recommended standard for scoring dental non-metric

Table 1. Transcaucasian, Eastern Europe, Central Asia and Siberia craniological samples.

	Country	Sample name	Date, Culture	Researchers
1	Armenian highland	Landjik, Black Fortress	c. 4000- 2000BC	Khudaverdyan 2009
2	Armenian highland	Lchashen, Shirakavan, Keti, Karchakhpyur	c. 3BC – AD 3	Kashibadze 1990, 2006
3	Armenian highland	Lchashen	c. 3000 - 2000 BC	Kashibadze 2006
4	Armenian highland	Beniamin, Vardbakh, Black Fortress I, Karmracar	c. 1 BC – AD 3	Khudaverdyan 2009
5	Armenian highland	Bingel Dag	20 century	Kashibadze 2006
6	Georgia	Digomi, Mckheti	c. 3000- 2000BC	Kashibadze 1990
7	Georgia	Chiaturia	c. 1 BC – AD 3	Kashibadze 2006
8	Georgia	Mckheti I	c. 1 BC – AD 3	Kashibadze 2006
9	Georgia	Mckheti (total group)	c. 1 BC – AD 3	Kashibadze 2006
10	Georgia	Chiaturia, Mckheti I, Mckheti (total group)	c. 1 BC – AD 3	Kashibadze 2006
11	Georgia	Dzinvali	c. VI - X AD	Kashibadze 2006
12	Georgia	Samtavro	c. VI - X AD	Kashibadze 2006
13	Georgia	Mckheti I	c. VI - X AD	Kashibadze 2006
14	Georgia	Mckheti (total group)	c. VI - X AD	Kashibadze 2006
15	Georgia	Dzinvali, Samtavro, Mckheti I, Mckheti (total group)	c. VI - X AD	Kashibadze 2006
16	Georgia	Dzinvali, Adjaria, Shatili, Adigeya, Mckheti	c. X - XII AD	Kashibadze 2006
17	Georgia	Dzinvali, Rustavi, Sioni, Shatili	c. XIII – XIX AD	Kashibadze 2006
18	Georgia	Total group	c. VI-XIX AD	Kashibadze 2006
19	Georgia	Dzinvali	20 century	Kashibadze 2006
20	Volga region	Total group	Fatianovo Culture	Gravere 1999
21	Volga region	Total group	Balanovo Culture	Gravere 1999
22	Volga region	Krivaya Luka	Pit Grave Culture	Zubova 2010
23	Volga region	Taktalachuks	c. 3000 - 2000 BC	Rud 1978
24	Volga region	Total group	Potapovsky Culture	Kitov 2011
25	Volga region	Total group	Pokrovkaya Culture	Kitov 2011
26	Volga region	Total group	Petrovskaya Culture	Kitov 2011
27	Volga region	Bol`shaya Tarkhanskaya	c. 1 BC – AD 3	Gravere 1999
28	Kalmykia	Total group	Pit Grave Culture	Zubova 2010
29	Don region	Dmitrovskaya (1), Mayackaya (2)	c. 1 BC – AD 3	Gravere 1999
30	Ural	Total group	Alakul Culture	Kitov 2011
31	Ural	Total group	Timber Grave Culture	Kitov 2011
32	Ural	Total group	Timber Grave and Alakul Cultures	Kitov 2011
33	Ural	I: Total group	Sintashtinskaya Culture	Kitov 2011
34	Ural	II: Total group	Sintashtinskaya Culture	Kitov 2011
35	Turkmenia	Total group	Painted Ceramics Culture	Gravere 1999
36	Turkmenia	Gonur-Depe	c. 3000 - 2000 BC	Rikushina et al. 2003
37	Turkmenia	Altyn-Depe	c. 3000 - 2000 BC	Rikushina et al. 2003
38	Uzbekistan	Sapallitepe	c. 3000 - 2000 BC	Khodjaiov 1977
39	Center Asia	Kazibaba I /Sauromatians/	c. V BC	Bagdasarova 2000
40	Center Asia	Kazibaba II /Late Sarmatians/	c. V BC	Bagdasarova 2000
41	Ukraine	Total group	Dnieper-Donets Culture	Gravere 1999
42	Ukraine	Total group	Cucuteni-Trypillian culture	Gravere 1999
43	Ukraine	Total group	Pit Grave culture	Gravere 1999
44	Dnepr region	Total group	Chernyakhov culture	Gravere 1999
45	Karelia	Oleni ostrov	c. 5000-3000 BC	Gravere 1999
46	Latvia	Total group	c. 5000-3000 BC	Gravere 1999
47	Latvia	Kiwytkalnsk	c. 3000 - 2000 BC	Gravere 1999
48	Latvia	Total group	Kurgan Culture	Gravere 1999
49	Latvia	Latgali	c. VII - XIII BC	Gravere 1999
50	Latvia	Livi	c. X-XIII AD	Gravere 1999
51	Latvia	Zemgali	c. VI-XIII AD	Gravere 1999
52	Lithuania	Dzemaiti	c. III-VAD	Gravere 1999
53	Siberia	Forest-steppe Barabinskaya	Culture Andronovo	Zubova 2008
54	Altai	Total group	Culture Andronovo	Tur 2009
55	Siberia	Total group	Tagarskaya Culture	Zubova 2008

traits. For this study, 16 non-metric traits are used to assess the biological affinities among the 30 samples of the Bronze Age (Table 1: 1-3, 6, 20-26, 28, 30-38, 41-43, 45-47, 53-55), 15 non-metric traits - among the 16 samples of the Classical Age (Table 1: 4, 7-10, 27 29/1, 29/2, 39, 40, 44, 48-52), 9 samples of the Feudal Age (Table 1: 11-19) and 2 samples of

the 20 century (Table 1: 5, 19). Results of the comparative analysis emphasise a public place of the Caucasus on the anthropological map of Eastern Europe, Central Asia and Siberia. C. Turner and D. Hawkey (1998) have recommended that, whenever possible, no less than all traits be employed in assessment of genetic affinities. Sophisticated analyses of large numbers of traits can be analyzed profitably through the use of multivariate statistics which allows discernment of finer levels of biological distance between populations (Scott and Turner 1997). Such studies are commonly used to assess specific research questions such as the synchronic biological relatedness of segments of a particular society (e.g. Johnson and Lovell 1994), or diachronic changes in trait expressions in a particular region (e.g. Lukacs and Hemphill 1991; Cucina et al. 1999; Gravere 1999; Coppa et al. 2007).

Data are subjected to the factor correspondence and cluster analysis. A.G. Kozintseva and B.A. Kozintseva's statistical package (Museum of Anthropology and Ethnography of name of the Peter the Great, St. Petersburg) and Statistica were used.

Result and Discussion

Secular dental changes in the populations of the Transcaucasian

Diachronic tendencies in cranial and dental morphology have occurred ever since anatomically modern humans began to populate our planet. One of the major tendencies was the increase of body length. Cranially, one of the most important trends was brachycephalization (Alekseev 1974, 1986; Khudaverdyan 2010). Apart from those tendencies, irregular fructuations in body size occurred, whereas the overall proportions displayed greater stability (Godina et al. 2000). A secular increase in body length observed over most of the 20th century was not exceptional. Dental changes are related to somatic ones. Certain aspects of dentition are rather labile, as evidenced by various patterns of the gracilization process, which is probably continuing. While brachycephalization (or debrachycephalization), gracilization, dental reduction, and the increase of body length may occur in paraller, the causes of those processes are probably varied. Microevolutionary tendencies may be triggered by ontogenetic changes, specifically acceleration or deceleration of growth caused by endocrine, neurohumoral, trophic, and other factors. With our taking into account the secular changes in the dentition, an adequate reconstruction of population history is hardly possible, especially when issues of continuity versus replacement are discussed. Secular changes in dentition over the last few centuries and millennia have been studied in various countries. It has long been suggested that these changes might be caused by the transition to soft food (Dutta 1983) and the ensuing reduction of functional load. Other experts point to the importance of genetic factors (Brabant and Twiesselmann 1964; Scott and Turner 1997), environmental or biochemical processes, etc. (Dahlberg 1963). Small teeth may be the outcome of "selection by crowding", whereby reduced load on the masticatory apparatus causes the reduction of alveolar processes, resulting in too little space for teeth (Zubov and Khaldeeva 1989). Another possible factor in dental gracilization may be the high occurrence of caries, which mostly affects large teeth with complex occlusal surfaces (Khudaverdyan 2005). These processes demonstrate the importance of cultural factors in dental evolution. Transition to agriculture may lead to a reduction of dental size, as demonstrated by P. Sciulli (1979), who compared the dentition of hunters and gatherers with that of agriculturalists. It has been demonstrated that the Neolithic Revolution may have caused an abrupt decrease in tooth size. According to D. Frayer (1977), the dimensions of the facial skeleton during the Upper Paleolithic and Mesolithic in Europe decreased more rapidly than did the size of teeth.

Dental reduction in the Near East over the last six thousand years was quite pronounced (Smith 1976). As P. Smith has shown, the direction of the microevolutionary process was the same, and differences between the Near Eastern groups were mainly due to various rates of this process and to isolation. Dental reduction, therefore, can lead not only to the decrease of between-group variation, but also to its increase. The objective of this study is to compare prehistoric and recent populations of the Transcaucasian in order to trace secular changes in dental morphology. Information about the southern gracile dental types can be found in A. Zubov (1979). The southern gracile type has low percentages of Carabelli's trait, somewhat increased distal trigonid crest, $M_1$4, $M_2$4 and low variant 2 med (Khaldeeva 1992). The southern gracile type is characteristic for peoples of the Transcaucasian (Gashimova 1979; Kochiev 1979; Kashibadze 1990, 2006; Khudaverdyan 2009, 2011d), Daghestan (Gadjiev 1979) and Bulgaria (Minkov 1977). The 16 traits, their frequencies, and the number of individuals observed for each trait for the Armenian Highland and Georgia samples are provided in Table 3. The differentiation which can be traced in Transcaucasian populations is demonstrated Figures 2 and 3. In the following, patterns of dental reduction in populations of the Transcaucasian will be described.

I^1-I^1 diastema

The secular decrease in the frequency of this trait reflects one of the aspects of dental reduction. The diastema evidences the availability of vacant space in the maxilla, and its size depends on that of the alveolar process (Zubov 1973). The frequency of diastema in the Bronze Age populations of the Armenian Highland ranges from 2.4% to 23.7 %. It is rather low in the Bronze Age population of the Georgia (Table 2). In the Classical/Late Antiquity period, it drops to (10.5%), and in moderm Armenians the occurrence remains low (9.2%). The tendency, therefore, is quite pronounced. The frequency

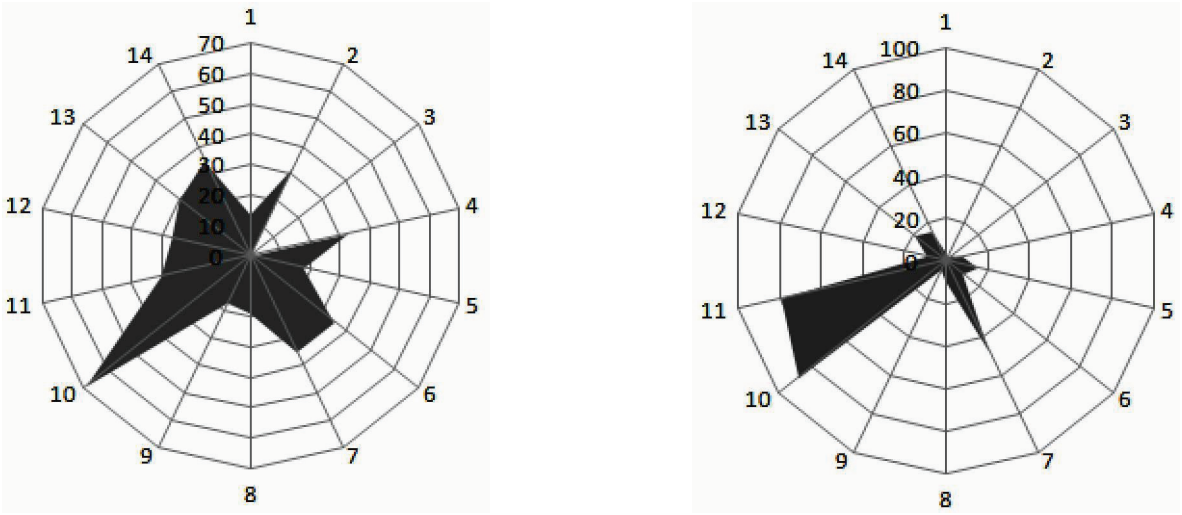

Figure 2. Ranges of dental non-metric traits in samples from Armenian Highland (1) and Georgia (2) in Bronze Age: 1: I^1-I^1 diastema, 2: I^2 crowding, 3: I^2 reduction (grades 2+3), 4: I^2 reduction (grade 1), 5: double shoveling, 6: hypocone reduction on M^2, 7: Carabelli cusp on M^1, 8: four-cusped M_1, 9: six-cusped M_1, 10: four-cusped M_2, 11: 1eo (3) M^1, 12: distal ridge of trigonid, 13: deflecting wrinkle of metaconid, 14: 2 med II M_1.

of diastema in the Classical/Late Antiquity period and Feudal Age populations of the Georgia ranges from 3.2% to 11.4 % (Table 2).

I^2 crowding

Crowding (mainly that of incisors and canines) is one of the anomalies in the position of teeth, being a phenotypic dental response to the reduction of jaws. Although crowding is morphologically opposed to the diastema, the secular tendencies in these traits are not necessarily directed oppositely; in fact, they sometimes occur in parallel. The frequency of lateral maxillary incisors crowding in populations of the Armenian Highland ranges from 1.2% to 78.5%. It was high in Classical/Late Antiquity period people of Beniamin, Black Fortress I, Vardbakh, and Karmrakar. The drop of frequency to 3% in 20th centry Armenians is rather unusual. Crowding of the teeth in Early Feudal Age Georgia to be higher than in Bronze Age. It is very rare in Georgia populations.

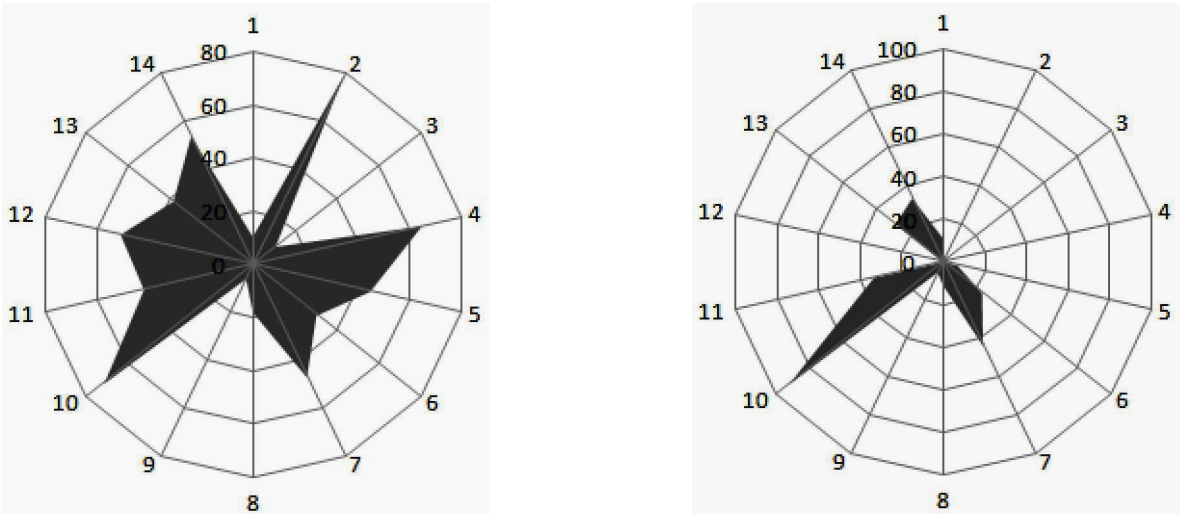

Figure 3. Ranges of dental non-metric traits in samples from Armenian Highland (1) and Georgia (2) in Ancient Age: 1 – I^1-I^1 diastema, 2 - I^2 crowding, 3 - I^2 reduction (grades 2+3), 4 - I^2 reduction (grade 1), 5 - double shoveling, 6 - hypocone reduction on M^2, 7 - Carabelli cusp on M^1, 8 - four-cusped M_1, 9 - six-cusped M_1, 10 - four-cusped M_2, 11 – 1eo (3) M^1, 12 – distal ridge of trigonid, 13 – deflecting wrinkle of metaconid, 14 - 2 med II M_1.

Table 2. Frequency of traits at Transcaucasian samples*.

	Traits	Armenia		Armenia	Armenia	Georgia	Armenia		Georgia	Georgia	Georgia	Georgia	Armenia	Georgia
	N groups	1		2	3	6	4		10	15	16	17	5	19
		A/	O	A	A	A	A/	O	A	A	A	A	A	A
1	I^1-I^1 diastema	23.7	17	2.4	3.6	4.9	10.5	86	11.4	3.2	3.2	5.2	9.2	-
2	I^2 crowding	62.5	16	1.2	1.8	1.7	78.5	79	0.0	4.6	1.2	1.7	3.0	-
3	I^2 reduction (grades 2+3)	0	15	0	0.0	3.6	10.9	83	0.0	0.0	0.32	0.0	1.0	-
4	I^2 reduction (grade 1)	67.5	15	12.9	0.0	8.2	65.1	83	-	0.0	0.0	0.0	19.4	-
5	Double shoveling	35.8	15	0	0.0	15.5	45.1	62	7.1	7.7	4.0	33.4	-	-
6	Hypocone reduction on M^2	37.5	14	34.2	32.7	10.3	30.5	69	23.8	25.7	20.6	32.9	40.6	33.3
7	Carabelli cusp on M^1	31.3	16	43.4	38.7	47.1	46.7	75	43.8	28.6	36.7	60.1	58.8	100.0
8	Four-cusped M_1	14.3	15	16.7	23.3	9.7	17.8	79	10.8	11.8	8.92	5.1	-	66.7
9	Six-cusped M_1	0	15	2.8	3.3	4.9	5.8	52	5.4	0.0	6.5	2.3	-	0.0
10	Form +5 on M_1	26.8	15	-	-	-	-		-	-	-	-	-	-
11	Four-cusped M_2	64.7	17	-	72.4	-	71.3	66	93.0	83.6	93.3	95.0	-	100.0
12	1 eo (3) on M^1	21.5	16	43.4	38.4	78.6	41.94	31	33.3	25.0	38.8	40.5	41.7	-
13	Distal trigonid crest	42.5	18	7.1	10	8.9	50.9	57	0.0	0.0	6.6	2.1	-	-
14	Deflecting wrinkle of metaconid	42.5	18	16.7	16.7	18.5	38.1	42	28.5	8.3	7.5	0.0	-	-
15	TAMI	10	18	-	-	-	17.6	57	-	-	-	-	-	-
16	2 med II on M_1	29.2	17	41.7	40.0	14.8	53.4	45	33.3	12.5	17.5	12.5	-	-

* O: number of crania actually observed; A: number of crania showing trait (data of the author of the article), number of crania in the work of V. Kashibadze (1990, 2006) are not listed.

I^2 reduction

Lateral incisors are frequently smaller than medial ones. Maximal reduction of the lateral maxillary incisors, ultimately resulting in peg-shaped incisors, was rare of the Transcaucasian. A small increase of frequency of grades 2+3 is observed in the Classical/Late Antiquity period from Armenian Highland (10.9%) and in the Bronze Age from Georgia (3.6%). Grade 1 reduction, however, was frequent during both the Bronze Age (Landjik, Black Fortress) and the Classical/Late Antiquity period (Beniamin, Vardbakh, Black Fortress I, Karmracar) in populations of the Armenian Highland. Its low frequency (19.4%) is observed in moderm (20th century) Armenians. Whereas the frequency of reduction (grade 1) in Bronze Age people of the Georgia is 8.2%, not a single case has been registered in the series from burials of the Classical/Late Antiquity period and Feudal Age.

Double shoveling

The mesial and distal lingual ridges of the incisors may be elevated producing a 'shovel-shaped' incisor. This trait is quite variable on the world scale and displays clear-cut geographical regularities. According to A. Zubov (1973), evolutionary tendencies, too, are quite different: while in the Eastern groups the trait remained stable or tended to become more common, the frequencies of the shoveling gene in the West decreased quite markedly and in a regular fashion. At present, the frequency of the shoveling gene in the West appears to continue dropping, making the East-West differences even more pronounced (Zubov 1973). This process is counterbalanced by admixture. In Bronze Age from Armenian Highland the mean total shoveling frequency is 35.8, and it increases in Classical/Late Antiquity period (45.1%). People of the Classical/Late Antiquity period exhibit the highest frequency possibly evidencing admixture. It was high and in Late Feudal Age people of Georgia (33.4%).

High variation among the medieval Eastern and Western Slavs attests to genetic heterogeneity: Gruczno (Poland, 12^{th} – 13^{th} centyry), 43.2%; Cedynia, (Poland, 12^{th} centyry), 1.1%; Izera (Poland, 11^{th}-13^{th} centuries), 5.0%; Krivichi (11^{th}-13^{th} centuries) 14.1%; Severyane, 11.1%; Polyane, zero; Novgorod Slavs, zero (9^{th}-13^{th} centuries) (Donina 1969; Gravere 1999).

Molar shape

Hypocone (distolingual cusp) reduction of maxillary second permanent molar. Dahlberg's diagrams of degrees of cusp

reduction were used for recording (Zubov 1973). The total occurrence of reduced forms 3+ and 3 of the upper second molars gradually increases from the Bronze Age to the 20th century. In the Armenian Highland, the distinctive feature of the Bronze Age populations is a relatively high frequency of hypocone reduction on the upper second molar; later, the trait becomes less frequent in groups of the Classical/Late Antiquity period. Its highest frequency is observed in modern (20th century) Armenians. In people of the Georgia the variation range is considerable: Bronze Age 10.3%, Classical/Late Antiquity period 23.8 %, Early Feudal Age (c. VI - X AD) 25.7%, Middle Feudal Age (c. X - XII AD) 20.6%; Late Feudal Age (c. XIII – XIX AD) 32.9%, modern Georgians (20 century) 33.3%. The trait, therefore, is temporally unstable, and its variation is rather erratic of the Georgia. In 20th century Russians, compared to the medieval (9th – 14th century) Slavs, the occurrence of grade 3+ increases more than three fold (29.7% versus 9.3%) and that of grade 3, nearly twofold (13.5% versus 7.0%) (Donina 1969).

Number of cusps on the lower molars

The frequency of the sixth cusp on the lower first molar is low in nearly all populations of the Transcaucasian. The trait is virtually absent in the Bronze Age population (Landjik, Black Fortress) of the Armenian Highland and Early Feudal Age of the Georgia. People of the Classical/Late Antiquity period of the Armenian Highland (5.8%) and Middle Feudal Age of the Georgia (6.5%) exhibit the relatively highest frequency sixth cusp. The occurrence of reduced four-cusp lower first molars in the Bronze Age population of the Armenian Highland ranges within 14.3 - 23.3%. People of the burial from Lchashen exhibit the highest frequency. In people of the Classical/Late Antiquity period of the Armenian Highland the mean total four-cusp score in 17.8%. The frequency of four-cusp in populations of the Georgia ranges from 5.1% to 66.7%. Its highest frequency is observed in modern Georgians (Dzinvali). In Eastern Slavs, the trait varies widely – from zero in Krivichi to very high in some Novgorod Slavs and Polyane (Gravere 1999).

In populations of the Armenian Highland, the frequency of the four-cusped lower second molars tends to increase over time. People of the Georgia display a high degree of the lower second molar reduction. In 20th century Russians, the frequency of the five-cusped M_2 is lower than in medieval Slavs (9th-14th centuries) – 10.5% as against 16.1%; where as the respective frequencies of the four-cusped type are 86.7% versus 81.8% (Donina 1969). Therefore the lower molars, like the upper ones, undergo reduction.

Carabelli cusp on the upper first molar

Certain researchers have noted that the frequency of this trait tends to increase over the last centuries (Brabant, Twiesselmann 1964; Donina 1969). A similar tendency is observed in Armenian Highland groups (Bronze Age: 31.3 – 43.4%; Classical/Late Antiquity period: 46.7%, moderm Armenians: 58.8 %). In people of the Georgia the variation range is considerable: Bronze Age 47.1%, Classical/Late Antiquity period 43.8 %, Early Feudal Age (c. VI - X AD) 28.6%, Middle Feudal Age (c. X - XII AD) 36.7%; Late Feudal Age 60.1%, modern Georgians 100%. In medieval Eastern and Western Slavs, the variation range is considerable, too: Pomorze (Poland), 15%; Izera (Poland) (11th-13th centuries), 6.3%; Krivichi (11th-13th centuries) 58.1%; Severyane, 30.7%; Polyane, 35.2%; Novgorod Slavs, 45.7% (9th-13th centuries) (Gravere 1999).

Table 3. The loadings of 10 dental traits in the first 3 dimensions for 11 groups.

Trait	I	II	III
I^1-I^1 diastema	0.597	-0.324	0.745
I^2 crowding	0.541	0.116	0.117
Hypocone reduction on M^2	0.494	-0.746	0.351
Carabelli cusp on M^1	-0.421	0.672	0.632
Four-cusped M_1	0.979	0.501	-0.492
Four-cusped M_2	-0.814	-0.134	0.541
Distal trigonid crest	-0.158	0.689	0.221
Deflecting wrinkle of metaconid	0.771	0.352	0.426
1eo (3) M^1	0.686	0.511	-0.269
2 med II M_1	0.501	0.203	-0.462
Values	54.561	28.671	20.352

Accessory central cusp (TAMI)

According to N. Khaldeeva (1992), this is an ancient trait, which is rather stable. Its frequencies in populations of the Armenian Highland vary within 10-17.6%. The occurrence is highest in Classical/Late Antiquity period populations. Period even rarer in 20th century Armenians (1.9%) (Kochiev 1979).

Distal trigonid crest (DTC)

This trait is likewise ancient and stable. Some specialists believe that it is highly diagnostic (Zubov 1973, 1979; Khaldeeva 1992). The frequency of distal trigonid crest in populations of the Bronze Age Armenian Highland ranges from 7.1% to 42.5%. In Classical/Late Antiquity period from Armenian Highland the frequency of the distal trigonid crest is 50.9 (Khudaverdyan 2011d), and it decreases in 20th century Armenians (13.35%) (Kochiev 1979). People of the Georgia display a low degree of the distal trigonid crest (Bronze Age 8.9; Middle Feudal Age (c. X - XII AD) 6.6%; Late Feudal Age 2.1%).

Deflecting wrinkle of metaconid (DW)

In Bronze Age Armenians (Landjik, Black Fortress, 42.5%), the frequency of the deflecting wrinkle of metaconid is higher

than Classical/Late Antiquity period (38.1%). It was low in Bronze Age people of the Georgia (18.5%), being maximal in the Classical period (28.5%). Interestingly, the frequency of deflecting wrinkle of metaconid in Early Feudal Age (8.3%) and Middle Feudal Age (7.5%) is low.

Type 3 of the first eocone groove on the upper first molar (1 eo (3) on M^1)

The frequency of type 3 of the first eocone groove on the upper first molar in populations of the Bronze Age Armenian Highland ranges from 21.5% to 43.4%. The population of the Classical/Late Antiquity period (41.94%) and the early 20th century Armenian series described in Bingel Dag (41.7%) reveal rather similar frequencies. Population of the Bronze Age display a high degree of the type 3 of the first eocone groove on the upper first molar. Later, the trait becomes less frequent in groups of the Classical/Late Antiquity period (33.3%) and even rarer in Early Feudal Age (25.0%).

2(II) med is notation for an odontoglyphic trait on the metaconid (med) of lower molars. 2 (II) indicates that furrow 2 (a second order furrow that occurs closer to the fovea centrale than furrow 1) goes into furrow II (a first order furrow that separates the protoconid from the metaconid) (Zubov 1973). The frequency of 2(II) med in populations of the Bronze Age Armenian Highland ranges from 29.2% to 41.7%. In Classical/Late Antiquity period from Armenian Highland of the 2(II) med frequency is 53.4. The trait is low in the Bronze Age population Georgia (14.8%). In Classical/Late Antiquity period from Georgia the frequency of the 2(II) med is 33.3, and it decreases in Feudal Age (Early Feudal Age 12.5%, Middle Feudal Age 17.5%; Late Feudal Age 12.5%).

Traits examined in this article differ in heritability, correlation with other traits, nature of between-group variation (continuous versus discontinuous), and temporal stability, and are quite diverse in terms of reduction patterns. The variation of the lateral incisor shoveling, number of cusps on the lower first molars, distal trigonid crest, deflecting wrinkle of metaconid, accessory central cusp, type 3 of the first eocone groove on the upper first molar, and crowding are quite efficient for group Transcaucasian differentiation, showing little if any transgression. The remaining traits (Carabelli cusp, variant 2 of the second groove of metaconid, hypocone reduction, diastema, etc.) can be informative in certain situations, but not in others.

For the crowding (I^2), hypocone reduction of maxillary second permanent molar, from Georgia in Bronze Age samples have the lowest frequencies of expression, while the Carabelli cusp on the upper first molar and type 3 of the first eocone groove on the upper first molar are characterized by relatively higher levels of expression. For the four-cusp lower second molars, the Armenian Highland in Classical/Late Antiquity period samples have the lowest frequencies of expression, while the crowding (I^2), reduction of incisors (grade 1), double shoveling, hypocone reduction of maxillary second permanent molar, four-cusp lower first molars, type 3 of the first eocone groove on the upper first molar, distal ridge of trigonid, deflecting wrinkle of metaconid, 2 med II on M_1 are characterized by relatively higher levels of expression (Figs. 2-3). Thus, the higher frequencies diastema, reduction of incisors (grade 1), hypocone reduction of maxillary second permanent molar, four-cusp lower first molars, distal ridge of trigonid, 2 med II on M_1 and low frequencies - Carabelli cusp on the upper first molar, six-cusp lower first molars, four-cusp lower second molars, type 3 of the first eocone groove on the upper first molar between samples from Armenian Highland and Georgia in Bronze Age.

Carabelli cusp on the upper first molar, four-cusp lower first molars show a slight frequencies of expression (modern period) than hypocone reduction of maxillary second permanent molar characterized by higher frequencies of expression in populations from Armenian Highland (Table 2).

The analysis 1.

To assess the general patter of secular tendencies in the dentition of populations of the Armenian Highland and Georgia, the data were processed using the factor and cluster analysis. In total, the intergroup analysis included 11 craniological series (N 1-6, 10, 15-18).

As is to be expected, the first axis accounts for the majority (54.5%) of the intergroup discrimination (Table 3). Taking into account character of connection of attributes in this coordinates, it is possible to tell that the large values till I coordinate axes correspond to groups with the four-cusp lower first molars (0.979), the deflecting wrinkle of metaconid (0.771), the 1eo (3) M^1 (0.686), diastema (I^1-I^1) (0.597), the crowding (I^2) (0.541), and the 2 med II M_1 (0.501). The negative weight gives a four-cusp lower second molars (-0.814). The second axis (28.6% of the total variability) are maximum for distal ridge of the trigonid (0.689), the Carabelli cusp on the upper first molar (0.672), the type 3 of the first eocone groove on the upper first molar (0.511), and the four-cusp lower first molars (0.501). The negative weight gives a the hypocone reduction of maxillary second permanent molar (-0.746). The third axis accounts for the 11.4% of the intergroup. The weight gives a the diastema (I^1-I^1) (0.745), the Carabelli cusp on the upper first molar (0.632), and the four-cusp lower second molars (0.541).

Figure 4, the graph obtained using the first two axes, shows how homogeneous the groups from Armenian Highland in Bronze Age are, since all are close to one another. The first axis shows groups Bronze Age and Classical/Late Antiquity period in Armenian Highland on the positive-coordinate axis, and clearly separated from the other groups. Classical group (Beniamin, Vardbakh, Black Fortress I, Karmracar) are well distinguished from the groups Bronze Age. On the negative-

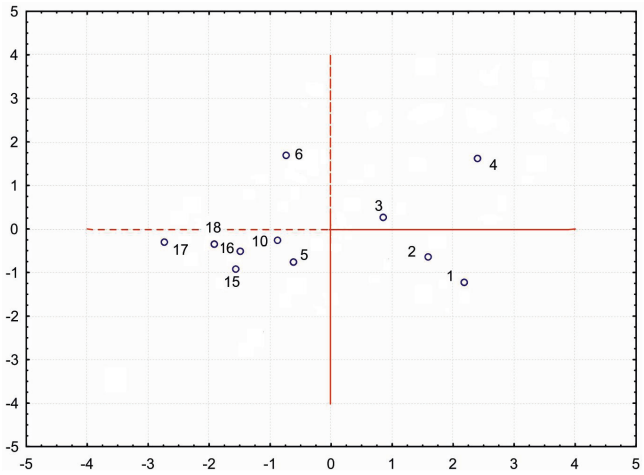

Figure 4. Correspondance analysis.

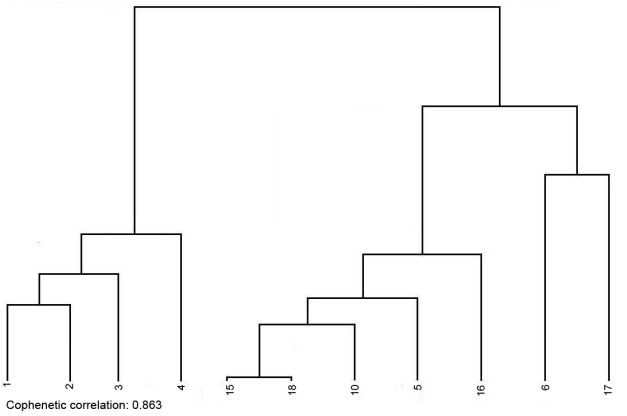

Figure 5. Cluster tree: 1 - Armenian Highland (Landjik, Black Fortress), 2 - (Lchashen, Shirakavan, Keti, Karchakhpyur), 3 - Armenian Highland (Lchashen), 4 - Armenian highland (Beniamin, Vardbakh, Black Fortress I), 5 - Armenian Highland (Bingel Dag), 6 - Georgia (Digomi, Mckheti), 10 - Georgia (Chiaturia, Mckheti I, Mckheti /total group/), 15 - Georgia (Dzinvali, Samtavro, Mckheti I, Mckheti /total group/), 16 - Georgia (Dzinvali, Adjaria, Shatili, Adigeya, Mckheti), 17 - Georgia (Dzinvali, Rustavi, Sioni, Shatili), 18 - Georgia (Feudal period).

coordinate axis, Digomi, Mckheti (Bronze Age) are set toward detached, while the other groups from Georgia (Classical/Late Antiquity period and Feudal Age) tend to cluster together. On the negative coordinates, on the other hand, Bingel Dag are well distinguished from the groups in Bronze Age and Classical/Late Antiquity period samples from Armenian Highland, which are located near the axes' intersection.

We have pointed out the relationships between human samples and their non-metric dental traits only according to the first axis, and we did not consider the second axis, because of its low variability. On the positive coordinates of the first axis, the more discriminant dental traits are the four-cusp lower first molars, the deflecting wrinkle of metaconid, and the type 3 of the first eocone groove on the upper first molar. The first two traits show higher frequencies in the Lchashen (3), Landjik, Black Fortress (1) and Beniamin, Vardbakh, Black Fortress I, Karmracar (4), and slightly lower frequencies in the groups from Georgia. On the negative coordinates, on the other hand, the most significant trait is the four-cusp lower second molars, which shows higher frequencies in the groups from Georgia.

Next, we applied the cluster analysis (Figure 5, Table 4). Two main clusters can be illustrated if the dendrogram, obtained by using hierarchic method from the first 3 axes, is considered. The first cluster is represented by samples in Bronze Age from Armenian Highland, differentiated from the second cluster composed of all the other groups. Within the

Table 4. Matrix of distance, values for twelve Transcaucasian samples examined in this study.

Sample	1	2	3	4	5	6	10	15	16	11	12
1. Armenian highland (Bronze Age: Landjik, Black Fortress)	-										
2. Armenian highland (Bronze Age and Classical period: Lchashen, Shirakavan, Keti, Karchakhpyur)	1.65	-									
3. Armenian highland (Bronze Age: Lchashen)	4.08	2.47	-								
4. Armenian highland (Classical period: Beniamin, Vardbakh, Black Fortress I, Karmracar)	2.76	2.36	3.84	-							
5. Moderm Armenians (Bingel Dag)	4.72	3.96	3.31	5.34	-						
6. Georgia (Bronze Age: Digomi, Mckheti)	7.09	5.76	4.08	5.64	4.59	-					
10. Georgia (Classical period: Chiaturia, Mckheti I, Mckheti / total group/)	4.65	3.46	2.18	4.50	1.59	3.24	-				
15. Georgia (Early Feudal Age: Dzinvali, Samtavro, Mckheti I, Mckheti /total group/)	5.48	4.26	2.55	6.05	2.44	4.82	2.35	-			
16. Georgia (Middle Feudal Age: Dzinvali, Adjaria, Shatili, Adigeya, Mckheti)	5.92	4.64	2.77	5.78	2.17	3.11	1.41	1.90	-		
17. Georgia (Late Feudal Age: Dzinvali, Rustavi, Sioni, Shatili)	7.22	6.41	5.31	7.06	2.89	3.95	3.17	4.38	2.93	-	
18. Georgia (Feudal Age)	5.82	4.69	3.14	5.88	1.61	3.50	1.38	2.02	0.71	2.44	-

Table 5. The loadings of 7 dental traits in the first 3 dimensions for 11 groups.

Trait	I	II	III
I^1-I^1 diastema	0.782	-0.455	-0.042
Double shoveling	0.698	-0.301	0.560
Hypocone reduction on M^2	0.279	-0.113	0.742
Carabelli cusp on M^1	-0.227	0.650	0.455
Four-cusped M_1	0.853	0.079	-0.447
Form +5 on M_1	0.440	0.827	0.190
Four-cusped M_2	0.529	0.592	-0.310
Values	34.701	25.315	20.074

latter, two sub-groups can be shown. The first is formed by the Bingel Dag (20th century Armenian) and the Feudal and Classical/Late Antiquity period samples of Georgia. The Classical/Late Antiquity period sample can be chronologically sex between periods Early Feudal Age and Middle Feudal Age, but may have maintained archaic traits because of their geographical isolation. The 2 sup-group consists of the Digomi, Mckheti (Bronze Age) and the Late Feudal Age samples. All this was already illustrated by Figure 5.

From the analysis of nonmetric dentan traits, a common biological background can be hypothesized among the populations that inhabited Transcaucasian. The Armenian Highland groups perfectly fit this pattern, showing a high degree of biological continuity between the two periods (Bronze Age - Classical/Late Antiquity period). The 20th century Armenian (Bingel Dag) be strictly linked between the groups from Georgia (Feudal and Classical/Late Antiquity periods). Clear affinities are visible between the samples of Georgia.

An in-depth analysis of diachronic changes in the dentition of the populations of the Transcaucasian may provide a basis for certain predictions. Our results disagree with the traditional idea that evolutionary biological changes in Homo sapiens gradually diminished after the Upper Paleolithic and have eventually ceased. Theoretically, this idea appears plausible because the greater the role of cultural evolution, the less the relative importance of biological factors, specifically natural selection, the intensity of which is indeed known to be very low at present. However, while the directional secular changes in human morphology (specifically in cranio-facial structures) have generally slowed down to a considerable extent, this does not imply that stabilizing selection has ceased to operate, although this form of selection is less noticeable. In fact, the "cessation" of directional changes itself is indicative of stabilizing selection.

The further analysis is to compare odontological variation among the ancient inhabitants of Transcaucasian with samples from the Eastern European, European-Russian steppe, Central Asia, and Siberia of the Bronze Age, in order help clarify the origins and interactions between the inhabitants of the Transcaucasian and neighboring Eurasia. The anthropological cover of Eurasia, generated during exclusively difficult historical events (Abdushelishvili 1982, 2003; Alekseeva and Krus 1999; Khudaverdyan, 2011a,b). The advancement of the Mediterraneans in the territory of Eastern European was accompanied by not only an interaction of various cultural elements, but also a mixture - a distribution sometimes at considerable distances from their centre of formation. On the basis of the received information, cluster analysis will has shown the epigenetic condensations of groups from Transcaucasian, Eastern European, Central Asia, and Siberia and factors of relatives or, conversely, distinctions between them.

The analysis 2.

Seven non-metric traits from 11 groups (N 1, 20-22, 28, 35-38, 45-47) Eastern Europe and Central Asia were selected for analysis. The analysis included the group in which the researchers fixed non-metric traits. Placement of the samples coordinate axis determined by the values of dimensions I (34.7% of the total variability) and II (25.3% of the total variability) (Table 6). The positive weight (I coordinates) given for maximum the four-cusp lower first molars (0.853), the diastema (I^1-I^1) (0.782) and the double shoveling (0.794). The positive weight (II coordinates, 25.3% of the total vari-

Table 6. Matrix of distance, values for eleven Transcaucasian, Eastern Europe and Central Asia samples examined in this study.

Sample name	1	20	21	22	28	35	36	38	45	46	47
1. Armenian highland (Landjik, Black Fortress)	-										
20.Volga region (Fatianovo Culture)	4.20	-									
21.Volga region (Balanovo Culture)	3.72	2.85									
22.Volga region (Krivaya Luka - Pit Grave Culture)	3.41	2.98	4.64								
28.Kalmykia (Pit Grave Culture)	1.20	3.78	4.11	2.31							
35.Turkmenia (Painted Ceramics Culture)	3.47	1.59	1.30	3.63	3.51						
36.Turkmenia (Altyn-Depe)	3.09	4.76	2.83	4.83	3.71	3.49					
38. Uzbekistan (Sapallitepe)	4.46	4.01	3.99	3.45	4.11	3.80	3.25				
45.Karelia (Oleni ostrov)	2.93	2.23	2.83	3.52	2.92	1.93	4.48	5.10			
46. Latvia (c. 5000-3000 BC)	4.00	1.17	2.65	3.63	3.81	1.49	4.86	4.85	1.38		
47. Latvia (Kiwytkalnsk)	3.23	1.27	1.82	3.00	3.08	0.63	3.54	3.48	1.85	1.46	-

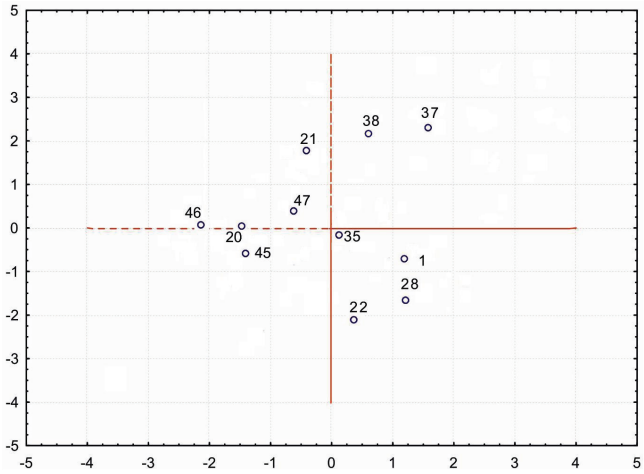

Figure 6. Correspondance analysis.

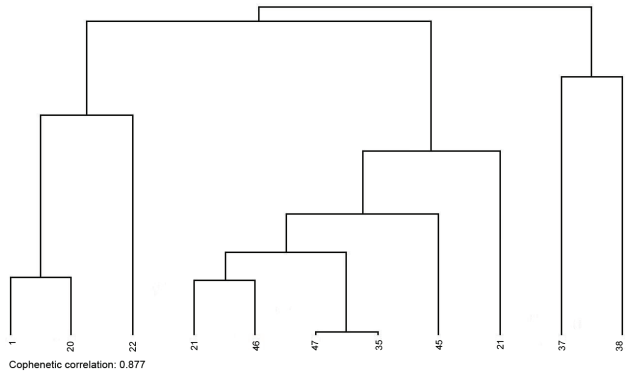

Figure 7. Cluster tree: 1 - Armenian highland (Landjik, Black Fortress), 20 - Volga region (Fatianovo culture), 21 - Volga region (Balanovo culture), 22 - Volga region (Krivaya Luka - Pit Grave culture), 28 - Kalmykia (Pit Grave culture), 35 - Turkmenia (Painted Ceramics culture), 37 - Turkmenia (Altyn-Depe), 38 - Uzbekistan (Sapallitepe), 45 - Karelia (Oleni ostrov), 46 - Latvia (c. 5000-3000 BC), 47 - Latvia (Kiwytkalnsk).

ability) given for maximum the form +5 on Ð (0.827), the Carabelli cusp on M^1 (0.650) and the four-cusp lower second molars (0.592).

The third coordinates accounts for the 20.0% of the intergroup. The positive weight gives a the hypocone reduction on M^2 (0.742).

Figure 6, the graph obtained using the first two axes, shows how the groups demonstrate a geographic or ethnic trend. The first axis shows the populations of the Armenian highland (Landjik, Black Fortress), Volga region (Krivaya Luka - Pit Grave Culture), Turkmenia (Painted Ceramics Culture) and Kalmykia (Pit Grave Culture) on the positive-coordinate axis, and clearly separated from the other groups. On the positive-coordinate axis, Altyn-Depe and Sapallitepe tend to cluster together. On the negative-coordinate axis, the groups of the Volga region (Fatianovo Culture), Karelia (Oleni ostrov) and Latvia (Kiwytkalnsk, c. 5000-3000 BC) tend to cluster together.

The diagonal matrix is provided in Table 6. Once again, the samples from Kalmykia (Pit Grave culture) and Volga region (Krivaya Luka - Pit Grave culture) is identified as the most near with samples from Armenian Highland (Landjik, Black Fortress) (Fig. 7). Kiwytkalnsk features a affinity with the sample from Turkmenia (Painted Ceramics culture). The Latvia (c. 5000-3000 BC) sample and the Bronze Age sample from Volga region (Fatianovo culture) exhibit very close affinities to one another. The Center Asia (Altyn-Depe, Sapallitepe) samples are identified as possessing the closest affinities to one another (Fig. 7).

Table 7. Elements of three initial components for 20 groups.

Trait	I	II	III
Hypocone reduction on M^2	0.646	0.147	-0.284
Carabelli cusp on M^1	0.269	0.621	0.483
Four-cusped M_1	0.710	0.558	0.037
Four-cusped M_2	-0.079	0.749	-0.444
Deflecting wrinkle of metaconid	0.767	-0.446	-0.185
2med (II)	0.388	-0.118	0.755
Distal trigonid crest	0.747	-0.282	-0.214
Values	32.807	22.457	16.618

The analysis 3.

Undertaken here is a analysis of more than 20 samples from the territory of Eastern Europe, Central Asia and Siberia (N 1-2, 6, 20-21, 23-25, 30-31, 35-37, 41-43, 45-47, 54). The analysis included the new groups from the Ukraine, the Volga region, Ural and Siberia and new non-metric traits - deflecting wrinkle of metaconid, 2med (II), distal trigonid crest. The value for the first three coordinate are given in Table 7. As is to be expected, the first axis accounts for the majority (32.8%) of the intergroup discrimination. Taking into account character of connection of attributes in this coordinates, it is possible to tell that the large values till I coordinate axes correspond to groups with the deflecting wrinkle of metaconid (0.767), the distal trigonid crest (0.747), the four-cusp lower first molars (0.710), and the hypocone reduction on M2 (0.646) (Table 7).

The second coordinate axis (22.4% of the total variability) are maximum for the four-cusp lower second molars (0.749) and the Carabelli cusp on the upper first molar (0.621). The third coordinate axis accounts for the 16.6% of the intergroup. The weight gives a 2med (II).

Figure 8, the graph obtained using the first two axes, shows the populations of the Georgia (Digomi, Mckheti), Latvia (Kiwytkalnsk), Volga region (Potapovsky and Pokrovkaya Cultures) close to the axes' intersection. The Armenian Highland sample (Lchashen, Shirakavan, Keti, Karchakhpyur)

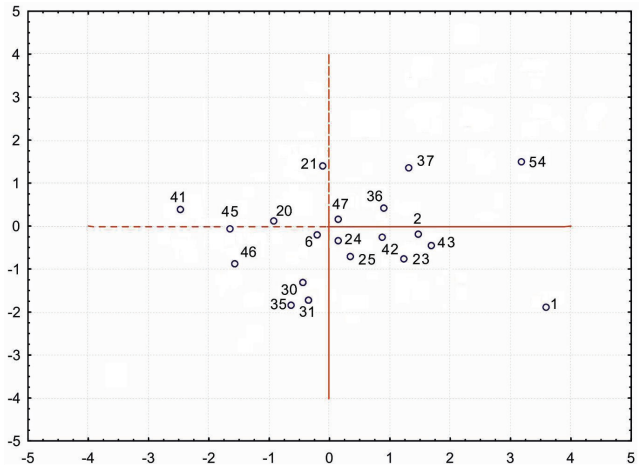

Figure 8. Correspondance analysis.

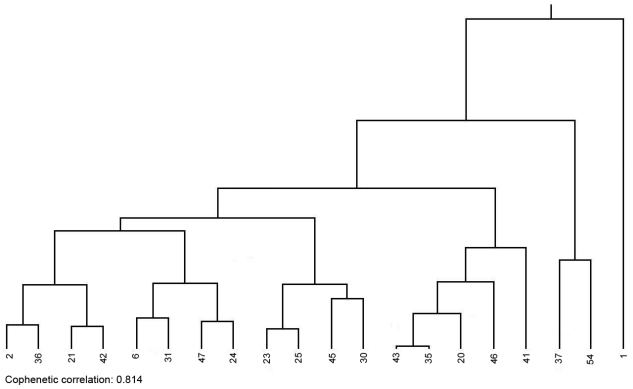

Figure 9. Cluster tree: 1 - Armenian Highland (Landjik, Black Fortress), 2 - Armenian Highland (Lchashen, Shirakavan, Keti, Karchakhpyur), 6 - Georgia (Digomi, Mckheti), 20 - Volga region (Fatianovo culture), 21 - Volga region (Balanovo culture), 23 - Taktalachuks, 24 - Volga region (Potapovsky culture), 25 - Volga region (Pokrovkaya culture), 30 - Ural (Alakul culture), 31 - Ural (Timber Grave culture), 35 - Turkmenia (Painted Ceramics culture), 36 - Turkmenia (Gonur-Depe), 37 - Turkmenia (Altyn-Depe), 41 - Ukraine (Dnieper-Donets culture), 42 - Ukraine (Cucuteni-Trypillian culture), 43 - Ukraine (Pit Grave culture), 45 - Karelia (Oleni ostrov), 46 - Latvia (c. 5000-3000 BC), 47 - Latvia (Kiwytkalnsk), 54 - Altai (Andronovo culture).

serve as a link between samples Volga region (Taktalachuks), and Ukraine (Cucuteni-Trypillian and Pit Grave Cultures) that feature the affinities to one another. The other groups from Ural (Alakul and Timber Grave Cultures) and Turkmenia (Painted Ceramics Culture) tend to cluster together close to the center. On the positive coordinates of the first axis, the more discriminant dental traits are the distal trigonid crest, and the four-cusp lower first molars. These traits show higher frequencies in the Armenian highland, Altai (Culture Andronovo) and Turkmenia (Altyn-Depe).

The diagonal matrix of values is provided in Table 8. The Armenian Highland (Lchashen, Shirakavan, Keti, Karchakhpyur) and Turkmenia (Gonur-Depe) samples exhibit closest affinities to samples Cucuteni-Trypillian tribe cultures (aka Tripolye) (from Ukraine) and Balanovo (Volga region) (Fig. 9). The samples from Moldova and Ukraine (Tripolye culture) occupies a unique position among Ukraine and Moldova samples by exhibiting much closer affinities to the Armenian Highland (craniological analysis) (Khudaverdyan 2011a). The Georgia sample (Digomi, Mckheti), serve as a link between Ural sample (Timber Grave culture) that feature the closest affinities to one another. The presence of the Mediterranean components was marked by A.B. Shevchenko (1984, 1986), A.A. Khokhlov (2000) A.Yu. Khudaverdyan (2009, 2011a) in carriers of Timber Grave cultures of the forest-steppe Volga region, and also by R.M. Yusupov (1989) in the Southern Urals Mountains (craniological analysis). The Potapovsky culture sample from the Volga region are identified as the steppe sample with closest affinities sample from Latvia (Kiwytkalnsk) (Fig. 9). The sample from Turkmenia (Altyn-Depe) is identified as the most near with sample from Altai (culture Andronovo). Intersample affinities among samples the Turkmenia (Painted Ceramics culture) and Ukraine (Pit Grave culture) also show up.

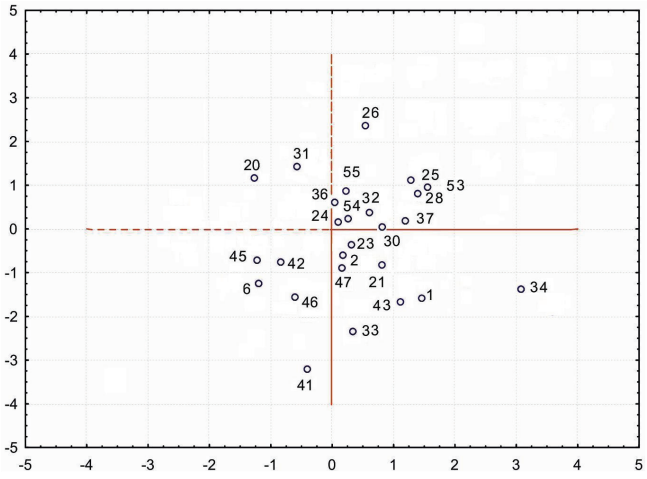

Figure 10. Correspondance analysis.

The analysis 4.

Undertaken here is a analysis of more than 26 samples from the territory of Eastern Europe, Central Asia and Siberia. I reduced the number of non-metric traits and included in the analysis of new groups (N 26, 28, 32-34, 53, 55). The presence of the southern gracile components was marked by A. Zubova (2008) in Forest-steppe Barabinskaya, S. Tur (2009) of the Altai, E. Kitow (2011) in some groups of Volga region and Ural.

Table 8. Matrix of distance, values for twenty Transcaucasian, Eastern Europe, Central Asia and Siberia samples examined in this study.

Sample name	1	2	6	20	21	23	24	25	30	31	35	36	37	41	42	43	45	46	47	54
1.Armenian highland (Landjik, Black Fortress)	-																			
2. Armenian highland (Lchashen, Shirakavan, Keti, Karchakhpyur)	3.82	-																		
6. Georgia (Digomi, Mckheti)	4.37	2.26	-																	
20. Volga region (Fatianovo Culture)	5.41	2.89	1.08	-																
21.Volga region (Balanovo Culture)	5.31	2.42	1.92	1.57	-															
23.Taktalachuks	3.16	1.30	1.87	2.83	3.00	-														
24. Volga region (Potapovsky Culture)	3.37	2.58	1.55	2.31	2.40	2.16	-													
25. Volga region (Pokrovkaya Culture)	3.92	3.49	1.91	2.44	2.88	2.95	0.98	-												
30. Ural (Alakul Culture)	4.62	4.39	2.41	2.79	3.76	3.61	2.14	1.30	-											
31. Ural (Timber Grave Culture)	5.70	4.52	2.32	2.10	3.23	4.03	2.63	1.93	1.40	-										
35. Turkmenia (Painted Ceramics Culture)	6.11	3.94	2.12	1.28	1.97	3.94	2.76	2.53	2.79	1.66	-									
36. Turkmenia (Gonur-Depe)	4.46	2.32	1.75	1.89	1.04	2.66	1.51	2.08	3.19	3.00	2.21	-								
37. Turkmenia (Altyn-Depe)	4.02	3.03	2.72	3.05	2.26	3.26	1.62	2.09	3.37	3.52	3.10	1.29	-							
41.Ukraine (Dnieper-Donets Culture)	6.70	4.52	2.52	1.87	3.36	4.16	3.77	3.51	3.10	2.08	2.03	3.70	4.73	-						
42. Ukraine (Cucuteni-Trypillian culture)	5.63	1.99	2.25	2.02	1.52	2.76	3.27	3.89	4.59	4.10	2.94	2.29	3.51	3.50	-					
43. Ukraine (Pit Grave culture)	6.16	3.68	1.89	0.85	1.91	3.68	2.92	2.83	3.02	1.95	0.71	2.35	3.44	1.59	2.51	-				
45. Karelia (Oleni ostrov)	4.04	2.39	1.47	2.33	3.21	1.38	2.43	2.82	2.98	3.28	3.47	3.05	3.85	3.10	2.95	3.11	-			
46.Latvia (c. 5000-3000 BC)	5.52	3.25	1.57	1.55	2.96	2.75	3.05	3.13	3.00	2.61	2.56	3.18	4.26	1.58	2.71	2.02	1.62	-		
47. Latvia (Kiwytka-Insk)	4.23	2.27	0.91	1.36	1.45	2.18	1.06	1.56	2.48	2.39	1.97	0.91	1.84	3.07	2.34	2.01	2.26	2.42		
54.Altai (Culture Andronovo)	5.63	4.00	4.24	4.18	2.80	4.75	3.58	4.01	5.22	5.00	4.01	2.49	2.04	5.90	3.97	4.35	5.47	5.62	3.38	-

Table 9. Elements of three initial components for 26 groups.

Trait	I	II	III
Hypocone reduction on M^2	0.821	0.192	0.168
Carabelli cusp on M^1	-0.482	-0.254	0.833
Four-cusped M_1	0.756	0.041	0.307
Four-cusped M_2	-0.038	0.920	0.206
Deflecting wrinkle of metaconid	0.681	-0.406	0.058
Values	38.865	22.297	17.245

Placement of the 26 samples coordinate axis determined by the values of dimensions I (38.8% of the total variability) and II (22.2% of the total variability) (Table 9). The first coordinate axis has its strongest value hypocone reduction of maxillary second permanent molar (0.821), the four-cusp lower first molars (0.756) and the deflecting wrinkle of the metaconid (0.681). The second coordinate axis are maximum for the four-cusp lower second molars (0.920). The third coordinate axis accounts for the 17.2% of the intergroup. The positive weight gives the Carabelli cusp on the upper first molar.

Figure 10, the graph obtained using the first two axes, shows how the groups from Volga region (Potapovsky Culture, Taktalachuks), Ural (Timber Grave and Alakul Cultures), Turkmenia (Gonur-Depe), Latvia (Kiwytkalnsk), Armenian highland (Lchashen, Shirakavan, Keti, Karchakhpyur), Siberia (Tagarskaya Culture), are close to one another and gathered towards the axes' intersection. The first axis shows the populations of the Armenian highland (Landjik, Black Fortress), Ukraine (Pit Grave Culture) and Volga region (Balanovo Culture) on the positive-coordinate axis, and are close to each other. Populations of the Ural (Total group II: Sintashtinskaya Culture), Ukraine (Dnieper-Donets Culture) and Volga region (Petrovskaya Culture) far are located to the axes' intersection. On the negative-coordinate axis, Ukraine (Cucuteni-Trypillian Culture), Georgia (Digomi, Mckheti), and the Karelia (Oleni ostrov) samples which are located near the axes' intersection. The Volga region (Fatianovo Culture) sample and sample from Ural (Timber Grave Culture) exhibit very close affinities to one another.

We have pointed out the relationships between human samples and their non-metric dental traits only according to the first axis, and we did not consider the second axis, because of its low variability. On the positive coordinates of the first axis, the more discriminant dental traits are the hypocone (distolingual cusp) reduction of maxillary second permanent molar, the four-cusp lower first molars and the deflecting wrinkle of the metaconid. These traits show higher frequencies in the Ural (Total group II: Sintashtinskaya Culture), Volga region (Petrovskaya Culture), and Armenian highland (Landjik, Black Fortress) groups and slightly lower frequencies in the Turkmenia (Gonur-Depe, Altyn-Depe), Altai (Culture Andronovo), Armenian highland (Lchashen, Shirakavan, Keti, Karchakhpyur), Volga region (Potapovsky Culture, Taktalachuks) samples.

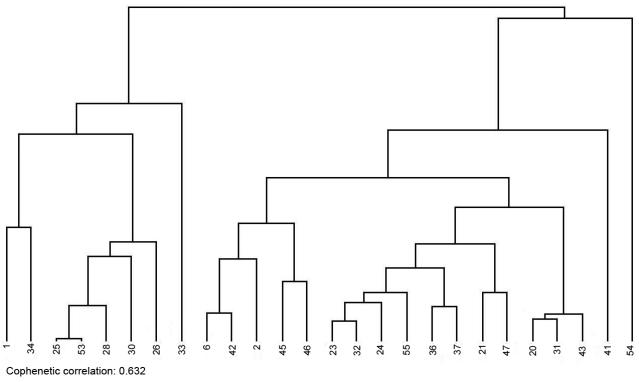

Figure 11. Cluster tree: 1 - Armenian highland (Landjik, Black Fortress), 2 - Armenian highland (Lchashen, Shirakavan, Keti, Karchakhpyur), 6 - Georgia (Digomi, Mckheti), 20 - Volga region (Fatianovo culture), 21 - Volga region (Balanovo culture), 23 - Taktalachuks, 24 - Volga region (Potapovsky culture), 25 - Volga region (Pokrovkaya culture), 26 - Volga region (Petrovskaya culture), 28 - Kalmykia (Pit Grave culture), 30 - Ural (Alakul culture), 31 - Ural (Timber Grave culture), 32 - Ural (Timber Grave and Alakul cultures), 33 - Ural (total group I: Sintashtinskaya culture), 34 - Ural (total group II: Sintashtinskaya culture), 36 - Turkmenia (Gonur-Depe), 37 - Turkmenia (Altyn-Depe), 41 - Ukraine (Dnieper-Donets culture), 42 - Ukraine (Cucuteni-Trypillian culture), 43 - Ukraine (Pit Grave culture), 45 - Karelia (Oleni ostrov), 46 - Latvia (c. 5000-3000 BC), 47 - Latvia (Kiwytkalnsk), 53 - Forest-steppe Barabinskaya (culture Andronovo), 54 - Altai (culture Andronovo), 55 - Siberia (Tagarskaya culture).

The diagonal matrix of values is provided in Table 10. Armenian Highland (Landjik, Black Fortress) group share several dental morphological affinities with other Ural (total group II: Sintashtinskaya culture) dental sample (Fig. 11). The sample from Forest-steppe Barabinskaya (culture Andronovo) features a affinity with the samples from Volga region (Pokrovkaya and Petrovskaya cultures), Kalmykia (Pit Grave culture), Ural (Alakul culture). The Georgia (Digomi, Mckheti) sample and samples from Ukraine (Cucuteni-Trypillian culture) and Armenian Highland (Lchashen, Shirakavan, Keti, Karchakhpyur) exhibit very close affinities to one another.

The origin and development of ancient cultures is clearly connected with the general laws of social and economic development and environmental influence. The physical environment has played a significant role in all stages in the development of mankind, being a factor of paramount value favoring or constraining the cultural and economic progress of a society. In conjunction with the expansion of cattle-breeding and the emergence of ancient metallurgy, the Eurasian steppe, from serving as a factor dividing ethnic groups, became a factor uniting them in a larger community. The expansion into the steppes of wheeled vehicles invented in the Near East and "kibetka-houses" on wheels allowed cattlemen-farmers to move and survive with ease on the open steppes. Their movement across Eurasia in early times was not a military

invasion, but a slow expansion caused by a decline in the child mortality rate and a resultant increase in population growth (Sarianidi 2010). The wide expanse of the Eurasian steppes, offering favorable conditions for human life and the spread of information and technology, promoted a process of wide cultural integration in the Bronze Age throughout this area. The steppe was not only a conductor of new ideas and new people, but it also absorbed them, synthesizing and adapting to them new conditions. In what does the association consist? First of all, in a way of life that favored the strengthening of contacts between different groups that led to the occurrence of identical or very similar religious and ideological representations. A similar environment promoted the leveling of culture of the various ethnics living in the steppe. Owing to similar circumstances, assimilation processes were facilitated that resulted in the contemporary ethnic diversity of the population of this territory, reflecting s it does a great variety of anthropological types. Reference to the morphological features of the ancient population of Eastern Europe, Central Asia and Siberia was made in some previous works (Khudaverdyan 2009, 2011a; Khokhlov Mimokhod 2008; Solodovnikov 2006; Dubova 2010), which showed the participation of the indigenous population from the Near East, the Armenian highlands and Caucasus in the formation of the anthropological character of certain tribes and their movements, and also the desire to track the roots of the local substrate.

These analyses provide abundant evidence in support of a migration of population from the Transcaucasian. This scenario is consistent with recent genetic studies supporting a Near Eastern contribution to the European gene pool (the

Table 10. Matrix of distance, values for 26 Transcaucasian, Eastern Europe, Central Asia and Siberia samples examined in this study.

Sample name	1	2	6	20	21	23	24	25	26	28	30	31	32
1. Armenian highland (Landjik, Black Fortress)	-												
2. Armenian highland (Lchashen, Shirakavan, Keti, Karchakhpyur)	1.56	-											
6. Georgia (Digomi, Mckheti)	2.81	1.60	-										
20. Volga region (Fatianovo Culture)	4.04	2.95	2.84	-									
21. Volga region (Balanovo Culture)	3.52	2.08	2.35	1.95	-								
23. Taktalachuks	1.69	1.02	1.82	2.37	2.26	-							
24. Volga region (Potapovsky Culture)	2.09	1.07	1.96	2.02	1.67	0.66	-						
25. Volga region (Pokrovkaya Culture)	3.04	2.77	3.77	2.37	2.76	2.14	1.86	-					
26.Volga region (Petrovskaya Culture)	2.54	3.09	4.31	3.66	3.91	2.49	2.56	1.51	-				
28. Kalmykia (Pit Grave Culture)	2.88	2.91	3.85	2.65	3.27	2.11	2.06	0.73	1.10	-			
30. Ural (Alakul Culture)	2.43	2.44	3.08	2.44	3.18	1.45	1.70	1.56	1.70	1.09	-		
31. Ural (Timber Grave Culture)	3.79	2.67	2.28	0.68	2.00	2.10	1.89	2.69	3.80	2.86	2.38	-	
32. Ural (Timber Grave and Alakul Cultures)	2.28	1.73	2.59	1.94	2.15	0.97	0.76	1.20	1.96	1.31	1.09	1.96	-
33. Ural (I: Sintashtinskaya Culture)	2.13	2.58	2.57	4.07	4.29	2.19	2.84	3.95	3.61	3.56	2.56	3.59	2.96
34. Ural (II: Sintashtinskaya Culture)	1.70	3.11	4.49	5.21	4.78	3.09	3.37	3.48	2.33	3.22	3.20	5.11	3.27
36. Turkmenia (Gonur-Depe)	2.50	1.30	2.26	2.14	1.12	1.40	0.77	1.99	2.88	2.41	2.34	2.15	1.26
37. Turkmenia (Altyn-Depe)	3.06	2.03	3.03	2.42	1.24	2.15	1.52	1.98	3.01	2.58	2.82	2.63	1.75
41. Ukraine (Dnieper-Donets Culture)	5.00	3.80	2.49	2.59	3.28	3.52	3.50	4.71	5.66	4.80	4.08	2.05	3.80
42. Ukraine (Cucuteni-Trypillian Culture)	2.57	1.10	0.75	2.75	1.81	1.63	1.57	3.42	4.02	3.61	3.03	2.34	2.31
43. Ukraine (Pit Grave Culture)	4.09	2.79	2.49	0.71	1.52	2.44	2.04	2.82	4.09	3.16	2.88	0.76	2.22
45. Karelia (Oleni ostrov)	2.47	1.70	1.06	2.58	2.73	1.32	1.72	3.27	3.66	3.17	2.25	2.01	2.09
46. Latvia (c. 5000-3000 BC)	3.49	2.43	1.34	2.06	2.58	2.04	2.16	3.56	4.29	3.57	2.74	1.38	2.49
47. Latvia (Kiwytkalnsk)	2.99	1.59	1.66	1.53	0.98	1.48	1.03	2.50	3.50	2.81	2.45	1.32	1.56
53. Forest-steppe Barabinskaya (Culture Andronovo)	3.48	3.15	4.02	2.28	2.90	2.47	2.17	0.46	1.82	0.93	1.78	2.68	1.51
54. Altai (Culture Andronovo)	3.14	2.15	3.19	3.79	2.01	2.90	2.46	3.44	4.04	3.93	4.01	3.81	2.98
55. Siberia (Tagarskaya Culture)	1.96	1.33	2.65	2.55	1.95	1.21	0.82	1.55	2.11	1.86	1.89	2.58	0.94

Table 10. Continued.

Sample name	33	34	36	37	41	42	43	45	46	47	53	54	55
1. Armenian highland (Landjik, Black Fortress)													
2. Armenian highland (Lchashen, Shirakavan, Keti, Karchakhpyur)													
6. Georgia (Digomi, Mckheti)													
20. Volga region (Fatianovo Culture)													
21. Volga region (Balanovo Culture)													
23. Taktalachuks													
24. Volga region (Potapovsky Culture)													
25. Volga region (Pokrovkaya Culture)													
26.Volga region (Petrovskaya Culture)													
28. Kalmykia (Pit Grave Culture)													
30. Ural (Alakul Culture)													
31. Ural (Timber Grave Culture)													
32. Ural (Timber Grave and Alakul Cultures)													
33. Ural (I: Sintashtinskaya Culture)	-												
34. Ural (II: Sintashtinskaya Culture)	3.36	-											
36. Turkmenia (Gonur-Depe)	3.55	3.67	-										
37. Turkmenia (Altyn-Depe)	4.32	3.95	0.82	-									
41. Ukraine (Dnieper-Donets Culture)	4.16	6.57	3.74	4.31	-								
42. Ukraine (Cucuteni-Trypillian Culture)	2.91	4.19	1.68	2.40	2.95	-							
43. Ukraine (Pit Grave Culture)	4.17	5.39	2.02	2.33	2.25	2.37	-						
45. Karelia (Oleni ostrov)	1.79	4.06	2.33	3.14	2.60	1.49	2.49	-					
46. Latvia (c. 5000-3000 BC)	2.77	5.05	2.60	3.32	1.53	1.82	1.86	1.10	-				
47. Latvia (Kiwytkalnsk)	3.40	4.38	1.02	1.64	2.73	1.31	1.22	1.80	1.71	-			
53. Forest-steppe Barabinskaya (Culture Andronovo)	4.26	3.91	2.27	2.20	4.73	3.71	2.79	3.52	3.69	2.67	-		
54. Altai (Culture Andronovo)	4.70	4.05	1.83	1.65	5.00	2.44	3.49	3.68	4.03	2.53	3.75	-	
55. Siberia (Tagarskaya Culture)	3.27	2.91	0.83	1.21	4.29	2.15	2.63	2.46	2.98	1.68	1.95	2.15	

great majority of the Y chromosomes of Europeans have their origins in the Neolithic expansion) (Richards et al. 2000, Chikhi et al. 2002, Balaresque et al. 2010). If true, it is suggested that the dispersal of the Indo-European languages have been accompanied by migration and some gene flow from the Armenian Highland and Transcaucasian homeland to the various historical seats of the Indo-European languages. The different rates of genetic drift and external gene flow may have contributed to the morphological differentiation and diversification amongst the different Eastern Europe populations.

The factor correspondence and cluster analysis has revealed a non-metric odontologic analogies (on a complex of traits) in populations from Transcaucasian, Eastern Europe, Central Asia and Siberia. The Armenian Highland sample (Landjik, Black Fortress) and samples from the Volga region (Krivaya Luka - Pit Grave Culture; Balanovo Culture), Kalmykia (Pit Grave Culture), and Ukraine (Pit Grave Culture) exhibit very close affinities to one another. The Odontological data also exhibit close affinities the Armenian Highland sample (Lchashen, Shirakavan, Keti, Karchakhpyur) and the samples from Ukraine (Tripolye culture) and the Volga region (Taktalachuks, Balanovo Culture). The Georgia (Digomi, Mckheti) group features a close affinity with those of the Latvia (Kiwytkalnsk), Volga region (Potapovsky and Pokrovkaya Cultures) samples. The Turkmenia (Altyn-Depe) sample exhibit closest affinities to sample culture Andronovo (Altai). Affinities are closest between the Turkmenia (Painted Ceramics Culture) samples and samples from Latvia (Kiwytkalnsk), Ukraine (Pit Grave culture).

The initial starting area (or one of the intermediate areas), as indicated by the anthropological data, would seem to be the Armenian Highland, and the Caucasus as a whole (Khudaverdyan 2011a).

The analysis 5.

Global processes led to cultural and genetic transformations within Transcaucasia. In the present study, we investigate the potential effects of gene flow by among the population samples of Transcaucasia. According to the results of craniological analysis, it gives some typical picture of infiltration, with VIII centuries BC up to the 3rd century AD, alien to the ethnic groups of the Transcaucasia. This scenario is consistent with

Table 11. Elements of three initial components for 16 groups.

Trait	I	II	III
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
Values	32.643	25.524	16.024

archaeological and historical studies supporting (Piotrovski 1959; Krupnov 1960; Ter-Martirosov 1999). According to archeologists, the Scythian presence in the Caucasus had been permanent (Vinogradov and Dudarev 1983; Petrenko 1983; Il'inskaya and Terenozhkin 1983). Undertaken here is a odontologic analysis of more than 19 groups from the territory of Transcaucasian, Eastern Europe, Central Asia (N 4, 7, 8, 9, 11-14, 27, 29 /1 and 2/, 39-40, 44, 48-52).

The value for the first three dimensions are given in Table 11. The first axis (32.6% of the total variability) accounts for the majority of the intergroup discrimination. Taking into account character of connection of attributes in this coordinates, it is possible to tell that the large values till I coordinates axes correspond to groups with the deflecting wrinkle of the hypocone (distolingual cusp) reduction of maxillary second permanent molar (0.824), Carabelli cusp on the upper first molar (0.700) and 2med (II) (0.699). The negative weight gives a the four-cusp lower second molars (-0.637). The second dimension (25.5%) are maximum for the four-cusp lower second molars (0.672) and diastema (I^1-I^1). The negative weight gives a the four-cusp lower first molars (-0.731). The third dimension accounts for the 16.0% of the intergroup. The positive weight gives a deflecting wrinkle of metaconid.

Figure 12, the graph obtained using the first two axes, shows how the groups from Georgia (Classical/Late Antiquity period: Mckheti I /total group/), Center Asia (Kazibaba I /Sauromatians/), and Latvia (Zemgali), are close to one another. The first axis shows the populations of the Georgia (Samtavro /Early Feudal period/) and Don region (Mayackaya) on the positive-coordinate axis, and are close to each other. The Georgia (Mckheti /Early Feudal period/) sample and sample from Center Asia (Kazibaba II /Late Sarmatians/) exhibit very close affinities to one another. I noted, that on the positive coordinates of the first axis, the more dental traits are the hypocone reduction of maxillary second permanent molar, carabelli cusp on the upper first molar. These traits show higher frequencies in the groups from Armenian highland (Beniamin, Vardbakh, Black Fortress I, Karmrakar) and Georgia (Classical/Late Antiquity period: Chiaturia), and slightly lower frequencies in the Latvia (Kurgan Culture) and

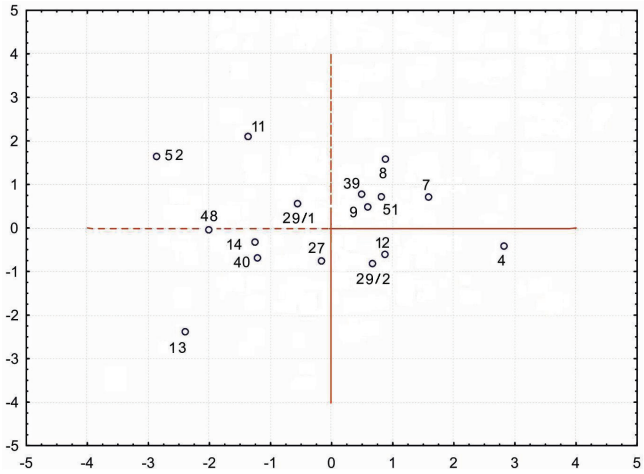

Figure 12. Correspondance analysis.

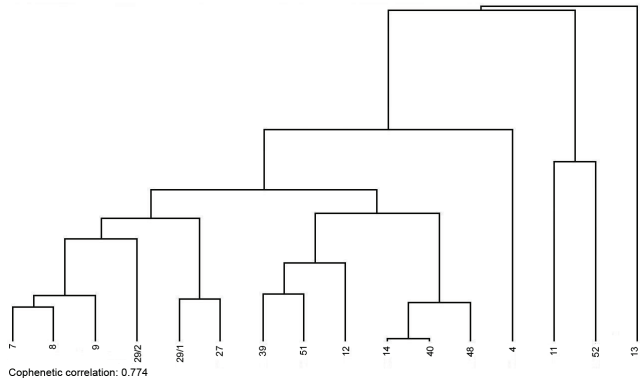

Figure 13. Cluster tree: 4 - Armenian highland (Beniamin, Vardbakh, Black Fortress I, Karmrakar), 7 - Georgia (Chiaturia: Classical period), 8 - Georgia (Mckheti I: Classical period), 9 - Georgia (Mckheti I /total group: Classical period), 11 – Georgia (Dzinvali /Early Feudal period/), 12 - Georgia (Samtavro /Early Feudal period/), 13 - Georgia (Mckheti I /Early Feudal period/), 14 - Georgia (Mckheti /Early Feudal period/), 27 - Volga region (Bol`shaya Tarkhanskaya), 29/1 - Don region (Dmitrovskaya), 29/2 - Don region (Mayackaya), 39 - Center Asia (Kazibaba I /Sauromatians/), 40 - Center Asia (Kazibaba II /Late Sarmatians/), 48 - Latvia (Kurgan culture), 51 - Latvia (Zemgali), 52 - Lithuania (Dzemaiti).

Center Asia (Kazibaba I /Sauromatians/) samples. On the negative coordinates, on the other hand, the most significant trait is the the four-cusp lower second molars, which shows higher frequencies in the Lithuania (Dzemaiti) and Georgia (Mckheti I /Early Feudal period/) samples.

The diagonal matrix of values is provided in Table 12. The steppe Classical/Late Antiquity period sample from the Don region (Mayackaya, Dmitrovskaya) exhibits a phenetic link with Georgia (Chiaturia, Mckheti I, Mckheti I (total group) samples (Fig. 13). 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

Table 12. Matrix of distance, values for 16 Transcaucasian, Eastern Europe and Central Asia samples examined in this study.

Sample name	4	7	8	9	11	12	13	14	27	29/1	29/2	39	40	48	51	52
4.Armenian highland (Beniamin, Vardbakh, Black Fortress I, Karmrakar)	-															
7. Georgia (Chiaturia)	1.92	-														
8.Georgia (Mckheti I)	2.85	0.99	-													
9. Georgia (Mckheti I /total group/)	2.47	1.08	1.20	-												
11. Georgia (Dzinvali /Early Feudal period/)	5.06	3.32	2.49	2.65	-											
12. Georgia (Samtavro / Early Feudal period/)	3.19	2.82	3.43	2.74	4.64	-										
13. Georgia (Mckheti I / Early Feudal period/)	5.80	5.35	5.33	4.32	4.53	5.18	-									
14. Georgia (Mckheti /Early Feudal period/)	3.68	3.18	3.56	2.50	4.00	1.73	3.47	-								
27. Volga region (Bol`shaya Tarkhanskaya)	3.88	2.81	2.69	1.74	2.39	3.15	2.78	1.92	-							
29/1. Don region (Dmitrovskaya)	3.95	2.56	2.37	1.69	2.16	2.64	3.71	1.89	1.09	-						
29/2.Don region (Mayackaya)	2.21	2.07	2.56	1.44	3.72	2.78	3.62	2.12	1.87	2.38	-					
39. Center Asia (Kazibaba I /Sauromatians/)	3.10	1.75	1.90	1.29	2.85	1.82	4.51	1.86	1.86	1.14	2.13	-				
40. Center Asia (Kazibaba II /Late Sarmatians/)	4.01	3.42	3.67	2.59	3.79	2.28	2.95	0.57	1.60	1.77	2.19	2.07	-			
48. Latvia (Kurgan Culture)	3.80	3.72	4.24	3.16	4.87	1.85	3.73	0.87	2.69	2.76	2.47	2.59	1.22	-		
51. Latvia (Zemgali)	3.10	2.04	2.45	2.16	3.80	1.31	5.52	2.38	2.99	2.21	2.87	1.16	2.78	2.86	-	
52. Lithuania (Dzemaiti)	6.66	5.00	4.48	4.37	2.88	4.69	5.24	4.17	3.58	2.85	5.22	3.60	3.97	4.94	4.13	-

the upper first molar, the Classical samples from Don region and Georgia generally have higher frequencies of expression for these traits. Center Asia sample from Kazibaba I (Sauromatians) serve as a phenetic link between Georgia (Samtavro /Early Feudal period/) and the Latvia (Zemgali) samples that feature the closest affinities to one another. Affinities are closest between the Center Asia sample from Kazibaba II (Late Sarmatians) and sample from Georgia (Mckheti /Early Feudal period/). The Early Feudal period sample (Dzinvali) from Georgia and Lithuania (Dzemaiti) exhibit moderate affinities.

The biologically admixed group or "Mestizo" (Armenian Highland: Beniamin-Vardbakh-Black Fortress I-Karmrakar) has a more complicated pattern of phenotypic relationships but from an evident European component. From an evolutionary point of view, gene flow probably is the most important factor that changed the original gene pool this population.

The analysis 6.

I have included new non-metric traits (I^2 crowding, six-cusp lower first molars, distal trigonid crest) in the analysis and group (N 44, 49, 50). The value for the first three factors are given in Table 13.

Dimension I (35.9% of the total variability) has its strongest value the four-cusp lower first molars lower first molars (0.899) and crowding (I^2) (0.872). The negative weight gives a the four-cusp lower second molars (-0.905). The second dimension (27.9% of the total variability) 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 dimension accounts for the 12.3% of the intergroup. The positive weight gives a the Carabelli cusp on the upper first molar.

Table 13. Elements of three initial components for 16 groups.

Trait	I	II	III
I^2 crowding	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
Values	35.989	27.942	12.386

Table 14. Matrix of distance, values for 16 Transcaucasian, Eastern Europe and Central Asia samples examined in this study.

Sample name	4	8	9	11	13	27	29/1	29/2	39	40	44	48	49	50	51	52
4.Armenian highland (Beniamin, Vardbakh, Black Fortress I, Karmrakar)	-															
8.Georgia (Mckheti I: Classical period)	4.16	-														
9.Georgia (Mckheti I / Classical period: total group/)	3.94	0.96	-													
11.Georgia (Dzinvali / Early Feudal period/)	6.51	3.52	4.14	-												
13.Georgia (Mckheti I / Early Feudal period/)	4.47	4.04	3.23	5.79	-											
27. Volga region (Bol`shaya Tarkhanskaya)	3.04	2.14	1.68	4.25	2.36	-										
29/1Don region (Dmitrovskaya)	3.92	1.78	0.83	4.76	2.60	1.65	-									
29/2Don region (Mayackaya)	2.60	2.41	1.78	5.60	3.10	1.84	1.52	-								
39. Center Asia (Kazibaba I /Sauromatians/)	3.68	3.13	2.27	5.49	1.17	1.61	1.59	1.94	-							
40. Center Asia (Kazibaba II /Late Sarmatians/)	3.85	4.05	3.22	6.10	0.77	2.23	2.57	2.68	0.98	-						
44. Dnepr region (Chernyakhov Culture)	6.29	3.77	3.04	5.77	3.06	3.77	2.53	3.86	2.90	3.49	-					
48. Latvia (Kurgan Culture)	4.04	3.64	2.81	6.92	3.30	3.27	2.18	1.84	2.37	2.94	3.29	-				
49. Latvia (Latgali)	6.70	4.13	3.48	5.49	3.01	3.94	3.06	4.45	3.16	3.61	1.03	4.13	-			
50. Latvia (Livi)	3.56	1.66	0.99	4.16	2.42	0.79	0.95	1.72	1.54	2.41	3.12	2.91	3.38	-		
51.Latvia (Zemgali)	4.49	3.17	2.24	5.61	1.51	2.25	1.46	2.33	0.97	1.66	1.96	2.18	2.37	1.84		
52. Lithuania (Dzemaiti)	6.68	2.65	2.79	4.12	5.14	4.24	3.15	4.42	4.53	5.44	3.09	4.69	3.39	3.51	3.98	-

The graph obtained using the first two axes, shows how the groups from Georgia (Mckheti I: Classical/Late Antiquity period and Early Feudal period, N 8, 9, 13), Center Asia (Kazibaba I, N 39, 40), and Latvia (Kurgan Culture) close to one another (Fig. 14). The Georgia (Dzinvali /Early Feudal period/), Dnepr region (Chernyakhov Culture), and Armenian highland (total group: Beniamin, Vardbakh, Black Fortress I, Karmrakar) clearly separated from the other groups. Latvia (Livi) and Don region (Dmitrovskaya) samples are close to the axes' intersection.

The diagonal matrix of values is provided in Table 14. The Ancient time sample from the Georgia exhibit the closest affinities with the sample with Don region (Dmitrovskaya) (Fig. 15). The Georgia sample (Mckheti I /Early Feudal period/) and that from Kazibaba II (Late Sarmatians) are identified as possessing the closest affinities to one another. Affinities are closest between the Center Asia sample from Kazibaba I (Sauromatians) and the sample from Latvia (Zemgali). The sample from Latvia (Latgali) are associated with the sample from Dnepr region (Chernyakhov culture).

Analysis of the main odontological traits in these series indicated that their frequencies fit within the range characteristic for the European race and Mestizo. In addition, definite geographical regularities occur in the distribution of frequencies, thereby supporting the definition of three regional complexes in the Eastern Europe, Central Asia and Transcaucasian. The first complex, the Volga region, Don

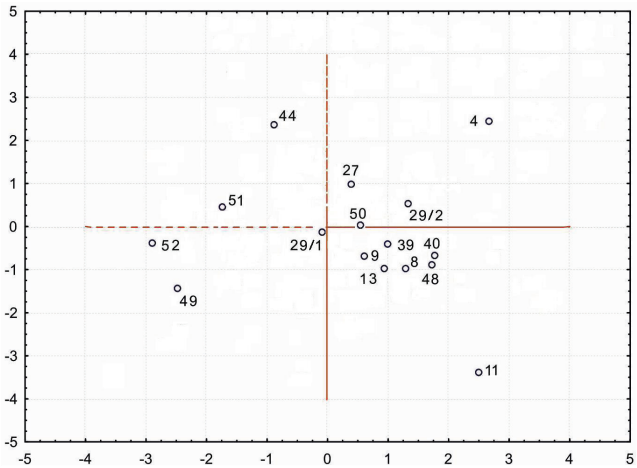

Figure 14. Correspondance analysis.

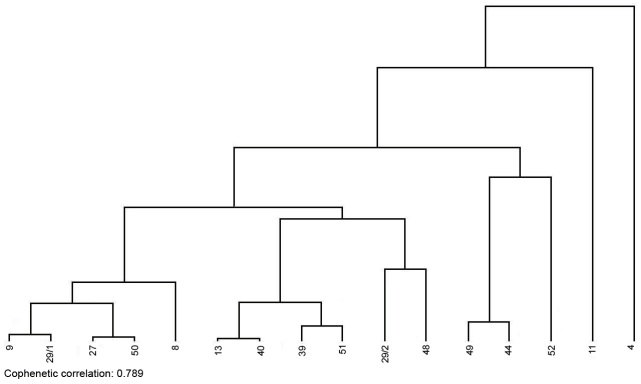

Figure 15. Cluster tree: 4 - Armenian Highland (total group: Beniamin, Vardbakh, Black Fortress I), 8 - Georgia (Mckheti I: Classical period), 9 - Georgia (Mckheti I / Classical period: total group/), 11 - Georgia (Dzinvali /Early Feudal period/), 13 - Georgia (Mckheti I /Early Feudal period/), 27 - Volga region (Bol`shaya Tarkhanskaya), 29/1 - Don region (Dmitrovskaya), 29/2 - Don region (Mayackaya), 39 - Center Asia (Kazibaba I /Sauromatians/), 40 - Center Asia (Kazibaba II /Late Sarmatians/), 44 - Dnepr region (Chernyakhov culture), 48 - Latvia (Kurgan culture), 49 - Latvia (Latgali), 50 - Latvia (Livi), 51 - Latvia (Zemgali), 52 - Lithuania (Dzemaiti).

region series. On a European scale, this complex is characterized by an average amount of reduction of the lower first molar, moderate percentages of traits which originate in the East (shovel-shaped upper central incisors, distal trigonid crest, deflecting wrinkle, etc.), moderate frequencies of Carabelli's cusp, and a moderately low frequency of variant 2 (II) med. A similar combination of features has been described as the Central European odontological type (Zubov 1979). One of the modifications of the Central European type is characteristic for tribes of Dnepr region (Chernyakhov Culture). This provides reason to think that the odontological type of the Dnepr Complex was formed on a local Scythian base (Segeda 1993).

The second complex, occurs in the Transcaucasian series, which are close to one another. The Complex is characterized by a moderately high frequency of reduction of the lower first molar, very high percentage of Carabelli's cusp, fairly high frequency of some eastern traits, and a very low percentage of variant 2 (II) med. This combination of traits is characteristic for of the southern gracile type, which existed in the Caucasus during the of the Eneolithic-Bronze Age. According to my data and data of other researchers, with the III millennium BC features of the southern gracile type were widespread among some tribes of the Ukraine (Segeda 1991; Gravere 1999). According to data S. Segeda and R. Gravere, during first millennium BC to the beginning of the first millennium AD, features of the the southern gracile type were widespread also among some Scythian and especially Sarmatian tribes of the Ukraine and Dnepr region (Segeda 1991).

The third odontological complex is found in the Lithuania and Latvia. Characteristic traits are a high percentage of reduction of the upper molars, absence of eastern features, and a high percent of Carabelli's cusp and variant 2 (II) med. These frequencies were characteristic of the northern gracile type (Zubov 1979; Gravere 1999)

The Beniamin-Vardbakh-Black Fortress I-Karmrakar pooled series, however, is characterized by a very distinctive combination of traits, which does not possible belong to any of the defined complexes. The odontological type of the Classical/Late Antiquity period of Armenian Highland was formed through the interaction of different components. This provides reason to think that the odontological type of the Armenian Highland Complex was formed on a local and newcomers. However, the paucity of a odontological data from the Classical period from Eastern Europe, Central Asia has hindered the solution of this problem: whence came this group. Comes to the rescue cranial data. The Transcaucasia samples serve as a phenetic link between the samples from Volgo-Uralja (Kuzin) and the Ukraine (Zolotaya Balka, Naples, the Steppes of the Black Sea Coast, Nikalaevka-Cosackoe, the populations of the European Bosphorus and Moldova (Budeshti, Nikolaevka) that feature the closest affinities to one another. Global processes led to cultural and genetic transformations within Transcaucasia in Classical/Late Antiquity period (Khudaverdyan 2012). The results suggest infiltration from the 8th century BC to the 3rd century AD, alien to the ethnic groups of the Caucasus.

Conclusions

Based on the biodistance results presented here, we suggest that at the beginning of the Bronze period in the Transcaucasian, there appears to have been a degree of genetic closeness among inland populations. The biodistances reported here suggest that there was a decrease in isolation (i.e., increased gene flow) among Classical populations during 1st century BC - 3rd century AD. In fact, the samples from Armenian highland and Georgia, is identified as possessing closer affinities to the samples from Kalmykia (Pit Grave culture), Ukraine (Tripolye culture), Ural (Sintashtinskaya, Timber Grave cultures), Volga region (Pit Grave, Balanovo, Fatianovo, Potapovsky cultures), Center Asia (Gonur-Depe, Kazibaba I /Sauromatians and Late Sarmatians/), Latvia (Kiwytkalnsk), Don region (Mayackaya, Dmitrovskaya) and Lithuania (Dzemaiti). Based on comparison of dental samples representing populations which inhabited the Transcaucasian in various periods, from the Bronze Age to the present, several diachronic tendencies were revealed. These tendencies were apparently caused by population history and secular trends, the principal one being dental reduction. The traits vary in stability versus lability, correlation with other features, heritability, and the nature of variation (continuous versus discrete). Our data suggests that dental reduction was a tendency shared by all populations of the Transcaucasian. The analysis of dental and craniological data generally attests to the biological continuity

of populations of the Transcaucasian at least from the Bronze Age onward (Abdushelishvili 1982, 2003; Alekseev 1974; Khudaverdyan 2011a,d). Judging by the biological data, ethnic and cultural changes as evidenced by archaeological sites and by written sources did not disrupt continuity in the process of the formation of the Transcaucasian people. As whole, the odontological data substantially broaden the conception of the physical anthropological composition and genetic sources of the population from Transcaucasian.

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