Non-metric dental trait variation among Eastern European and Western Siberian forest-steppe Neolithic populations

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Abstract

The main goal of this study was to find a possible link between Neolithic populations of Eastern European and Western Siberian forest-steppe zones using dental non-metric traits. The second one was to verify the reasons for the similarity, using tooth crown morphology data. The frequencies of thirty traits were observed using ASUDAS in seventeen Neolithic and two Mesolithic burial grounds, belonging to nine archaeological cultures from West Siberian Plain and East European Plain. The frequency of eight key traits was used for comparative statistical analysis. These include the shoveling of upper medial incisors, the distal trigonid crest, and the deflecting wrinkle on the lower first molars, the six-cusped and four-cusped lower first molars, the four-cusped lower second molars, the Carabelli cusp on the upper first molars, and the hypocone on the upper second molars. Trigonometrically transformed trait frequencies were subjected to the principal component analysis and cluster analysis based on Euclidean distances. The Statistica software for Windows, Version 6.0, was used. The closest affinity between the populations of West Siberian and East European plains was in the Upper Paleolithic period. Eastern dental traits were almost absent there except for the six-cusped lower first molars. During the later time period, both Siberian Neolithic cultures demonstrate evidence of the influence of Eastern populations, which was absent in European groups.

Keywords: Siberian Neolithic; Upper Palaeolithic; Dental non-metric traits; ASUDAS

Introduction

The possible link between the Neolithic populations of Eastern Europe and Western Siberia is widely debated in Russian physical anthropology. A very specific combination of craniometrical traits has been observed in several groups of the Neolithic Sredneirtyshskaya archaeological culture in Western Siberia. Their nasomalar face flatness was more prominent than in contemporary European groups but less so than in Mongoloid groups. The relatively high nose bridge was combined with a small nose protrusion angle (1). A similar combination of traits was described in the meso-neolithic population of the forest-steppe zone in Eastern Europe. The origin of this combination has become the subject of extensive discussion, with two major viewpoints being developed as a result. One of them states that such an unusual combination appeared because of the ancient mixing of Mongoloid and Caucasoid populations on the border of their areas (2). Another hypothesis is that the craniometrical similarity between Siberian and European Neolithic populations is the result of the preservation of archaic features in these groups from the Paleolithic times (3).

The main goal of this study was to find a possible link between Neolithic populations of Eastern European and Western Siberian forest-steppe zones using dental non-metric traits. The second one was to verify the reasons for the similarity, using tooth crown morphology data.

Materials and Methods

The frequencies of thirty traits were observed using ASUDAS (Table 1).

The study was based on the dental remains from seventeen Neolithic and two Mesolithic burial grounds, belonging to nine archaeological cultures (Table 2, Fig.1). Eleven sites were located in various areas of Western Siberia. Five of them (Sopka-2, Protoka, Korchugan, Vengerovo-2, Omskaya stoyanka) were situated in the Baraba forest-steppe between the Ob and Irtysh rivers, near the cities of Novosibirsk and Omsk. They belong to the Sredneirtyshskaya archaeological culture dated between 6,000 and 5,000 BC. Five burial sites (Itkul', Ust'-Isha, Lebedi-2, Vas'kovo-5 and Solontsy-5) were from the Altay-Sayan Highlands. Ust'-Isha, Lebedi-2, Vas'kovo-5, Kaminnaya cave and Solontsy-5 belong to the Kuznetzk-Altayskaya culture of the first half of the 4th millennium BC. The Itkul' burial ground previously belonged to the same culture but was recently reclassified as Bolshemysskaya culture of the same time period. Six sites are from the forest-steppe zone on the Eastern European Plain. The first was from the Fomino burial ground near Ryazan and was connected to the Ryazanskaya archaeological culture, dated 3,000-2,500 BC. Three samples from Karavaikha, Modlona and Pogostice were situated in the Vologda area and belonged to the Yamochno-grebenchataya culture from the end of 4th to the first half of the 3rd millennium BC. Two more samples were obtained from the excavation of the Sakhtysh-2a site

in the Ivanovo area, near the Kojka River. The first one was dated between 6,040 and 4,555 BP and belonged to the L'alovskaya culture. The second one has been carbon dated as being 5,065-3,840 BP and is considered part of the Volosovskaya archaeological culture. Data was also used from two Mesolithic groups, as published by R. She had examined samples from the South Reindeer Island in Karelia (carbon dated 6,320-5,640 BC, Onegskaya culture) and from the Zvenieki burial ground in Latvia (carbon dated 8,240-6,760 BP, Kunda culture). The full set of dental features was not recorded in these samples but all traits for intergroup comparative analysis were present. Dental data from sites belonging to the same culture were pooled, as described in Table 3.

Eight Upper Paleolithic samples were used for comparison. Three of them were from Western Siberia (Malta, Listvenka and Afontova gora-2) and five were from the European part of Russia (Kostenki-14, Kostenki-15, Kostenki-18, Sungir'-2, Sungir'-3).

The frequency of eight key traits was used for comparative statistical analysis. These include the shoveling of upper medial incisors, the distal trigonid crest, and the deflecting wrinkle on the lower first molars, the six-cusped and four-cusped lower first molars, the four-cusped lower second molars, the Carabelli cusp on the upper first molars, and the hypocone on the upper second molars. The high prevalence of the first two traits is inherent to modern and ancient Mongoloid populations. The other characteristics are important for differentiating Western populations. The combination of the Carabelli trait and the deflecting wrinkle is more common in North European samples. Four-cusped lower first molars are more frequently seen in the South European populations.

Trigonometrically transformed trait frequencies were subjected to the principal component analysis and cluster analysis based on Euclidean distances. The Statistica software for Windows, Version 6.0, was used.

Results

The comparison of dental trait frequencies demonstrated a number of differences between the Siberian and European groups. All the Siberian groups displayed certain common traits such as the high frequency of the distal trigonid crest, the absence of the deflecting wrinkle and low occurrence of the Carabelli trait (Table 4). The greatest degree of similarity was observed between the KA groups, where all the individuals had shoveling of the upper incisors, and the distal trigonid crest was present in more than 50% of cases. The SI series, by contrast, exhibited uneven shoveling frequencies, which varied from 0% to 50%. These were markedly lower than in the KA population and much closer to the characteristics of European Mesolithic groups, RN and VS samples. The typical feature of most European series is the high frequency of the Carabelli trait (grade 2-7) on the upper first molars and the deflecting wrinkle on the lower first molars. These traits were absent or rare in the majority of the Siberian groups.

Labial convexity and double-shoveling were absent in the majority of the samples. Only KA1 and YG showed one case of labial convexity each. Labial marginal ridges were seen only in KA2 and BM groups. Accessory ridges in the upper canines were rare. There was only one case of a distal ridge in the SI2 sample. The mesial ridge was absent in all groups. The metacone in the upper first and second molars was slightly reduced and only grade 4-5 were observed. The hypocone reduction was more significant; however this cusp was very rarely absent. Several cases of a complete absence of the hypocone on the upper second molars were observed in KA1, KA2 and YG samples. Parastyle and anterior fovea were lacking in all samples. The posterior fovea of the upper first molar was seen only in SI1 and SI2 groups.

The mandibular premolars demonstrated a similar degree of cusp differentiation in both the Siberian and the European samples. Differentiated forms of the lower first premolars were rare. The frequency of multiple cusps on the second premolars varied between 42.86% and 88.89%. The highest occurrence of this trait was observed in LS, VS and SI2 samples. Hypoconulid was observed in almost all of the first lower molars. Several cases of four-cusped teeth were noted only in SI1, VS and LM samples. C6 frequencies were equally high in Siberia and in Europe during Neolithic times.

The results of the statistical comparison of the Siberian and European groups demonstrate three trait combinations that are especially diagnostic between 6,000 and 2,000 BC (Table 5, Fig. 2). One of them is described by the first principal component. It includes high frequencies of shoveling and the presence of the distal trigonid crest. This combination is an ‘Eastern’ complex in a broad sense, separating most of the Siberian groups from the European population. This combination was less important for SI samples than for KA, which scored the highest in this component. The second combination reveals the specificity of the groups, with a high incidence of the Carabelli trait, deflecting wrinkle and four-cusped lower molars. This combination is most pronounced in the Latvian Mesolithic sample from Zvenieky and is common for most European series. The third combination is less important than the first two and was described by the second principal component. The group that scored lowest on this component was the YG sample. It demonstrated the highest frequencies of the four-cusped M2 amongst the European samples, while the deflecting wrinkle was absent (4,5).

The Siberian and European groups fall into two different clusters on a two-dimensional scatter-plot (Fig. 2). The European cluster showed positive scores on both principal components. The majority of the Siberian groups had negative scores. Only one sample, SI1, displayed a marked resemblance to the European Neolithic populations. It is a group from the Protoka burial site, one of the most ancient Neolithic sites in Siberia. This sample also matched the European Neolithic groups in the results of the cluster analysis. It showed a closer affinity of SI groups with the VS sample and the European Neolithic cluster rather than with the population of the Altay-Sayan Highlands (Fig. 3), since they demonstrate lower frequencies of Eastern traits than the KA population. Thus we can conclude the relatively late date of Eastern migration into Western Siberia.

The KA culture is dated almost 1,000 years younger than SI, but it demonstrates more frequent Eastern traits. To verify this conclusion, the dental features of the Russian Upper Paleolithic population were studied (Table 6) and compared to the Neolithic data. The analysis results suggest a closer affinity between Siberian and European Paleolithic populations than during Neolithic times. The Siberian Paleolithic findings lack the majority of the Eastern traits. There is no shoveling or double-shoveling and no trigonid crest, which is common for Neolithic Siberian populations. The only difference between European and Siberian samples is the frequency of the entoconulid of lower first molars. Two cases of this trait were observed in Paleolithic Siberian findings (Listvenka and Afontova gora-2), while six-cusped lower first molars are absent in the European part of Russia. The combination of the Carabelli trait in the upper first molars and the deflecting wrinkle in the lower first molars was less important in the Paleolithic period than in the Neolithic. Only one European Paleolithic sample showed the presence of the deflecting wrinkle (Sungir 3). A well-developed Carabelli cusp was seen in both the European Kostenki-15 and Kostenki-18, and in the Siberian Malta, so this combination does not differentiate between Western and Eastern groups as strongly as in the Neolithic period. The cluster analysis has demonstrated the joining of the pooled Upper Paleolithic samples with the European groups and SI1 series (Fig. 4).

Conclusion

Several conclusions can be deduced from the above.

1) The closest affinity between the populations of West Siberian and East European plains was in the Upper Paleolithic period. Eastern dental traits were almost absent there except for the six-cusped lower first molars, so the migration from the east Eurasia began only in postpaleolithic time.

2) During the later time period, both Siberian Neolithic cultures demonstrate evidence of the influence of Eastern populations, with higher frequencies of shoveling and the presence of the distal trigonid crest. This was less obvious in SI groups than in KA or BM, and SI groups generally appeared more similar to the European populations, especially to the VS sample, than the KA population. The presence of this component varied in the samples from each burial ground of SI culture. In Protoka and Sopka-2 it was markedly less than in Korchugan and Vengerovo-2.

3) The combination of craniometrical and dental characteristics of the population from the Protoka and Sopka-2 burial sites indicate that the Siberian Upper Paleolithic features have been preserved there for longer than at other locations.

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Trait	Key Tooth	Breakpoints ASUDAS
Labial convexity	UI1	2-6
Shovel	UI1, UI2	2-7
Double shovel	UI1, UI2	3-6
Mesial ridge	UC	2-3
Distal acc. Ridge	UC, LC	2-5
Metacone	UM1, UM2	3-5
Hypocone	UM1, UM2	2-5
Carabelli trait	UM1, UM2	0, 2-7
C5	UM1, UM2	2-5
C6	UM1, UM2	2-5
Parastyle	UM1, UM2	2-5
Anterior fovea	UM1, LM1	+
Posterior fovea	UM1, LM1	+
Enamel extension	UM1, UM2	2-3
Multiple cusps	LP3, LP4	2-5
Hypoconulid (Cusp 5)	LM1, LM2	1-5
Entoconulid (Cusp 6)	LM1, LM2	2-5
6-cusped M1	LM1	+
5-cusped M1	LM1	+
4-cusped M1	LM1	+
6-cusped M2	LM2	+
5-cusped M2	LM2	+
4-cusped M2	LM2	+
Groove pattern	LM1, LM2	Y, X, +
Tami (Cusp 7)	LM1, LM2	2-4
Deflecting wrinkle	LM1	2-3
Distal trigonid crest	LM1	+
Epicristid	LM1	+
Protostylid	LM1	3-5
Protostylid pit	LM1	1

Table 1. Dental features used in analysis

Region	Archaeological culture	Site	Number of individuals	Date	References
Western Siberian Plane	Sredneirtyshskaya	Protoka	32	6355-6200 ybp (C14)	Чикишева, 2012, Zubova, present study
	Sredneirtyshskaya	Sopka-2	6	VI-V millenia b.c.	Чикишева, 2012, Zubova, present study
	Sredneirtyshskaya	Korchugan	2	VI-V millenia b.c.	Чикишева, 2012, Zubova, present study
	Sredneirtyshskaya	Vengerovo-2a	3	VI-V millenia b.c.	Zubova, unpublished
	Sredneirtyshskaya	Omskaya stoyanka	2	VI-V millenia b.c.	Zubova, unpublished
	Kuznetzk-Altayskaya	Solontsy-5	8	5810-5325 ybp (C14)	Чикишева, 2012, Zubova, present study
	Kuznetzk-Altayskaya	Ust'-Isha	7	5135-5055 ybp (C14)	Zubova, present study
	Kuznetzk-Altayskaya	Lebedy-2	2	V-IV millenia b.c.	Чикишева, 2012, Zubova, present study
	Kuznetzk-Altayskaya	Vas'kovo-5	1	V-IV millenia b.c.	Чикишева, 2012, Zubova, present study
	Kuznetzk-Altayskaya	Kaminnaya cave	1	5320+-100 ybp (C14)	Чикишева, 2012, Zubova, present study
	Bolshemysskaya	Itkul'	9	5930-5485 ybp (C14)	Zubova, present study
Eastern European plane	Ryazanskaya	Fomino	11	3000-2500 ybc	Zubova, present study
	Yamocno-grebenchataya	Karavaikha	6	the end of IV - the first half of III millenia b.c.	Zubova, present study
	Yamocno-grebenchataya	Modlona	1	3555+-167 ybc (C14)	Zubova, present study
	Yamocno-grebenchataya	Pogostice	1	the end of IV - the first half of III millenia b.c.	Zubova, present study
	L'alovskaya	Sakhtysh-2a	16	6040-4555 ybp (C14)	Zubova, present study
	Volosovskaya	Sakhtysh-2a	45	5065-3840 ybp (C14)	Zubova, present study
	Kunda	Zveinieki	56	8240-6760 ybp (C14)	Gravere, 1999
	Onegskaya	South Oleniy island	38	6320-5640 ybc (C14)	Gravere, 1999; Zubova unpublished

Table 2. Dental samples used in present study

Name of serie	Short name	Sites
Sredneirtyshskaya 1	SI1	Protoka
Sredneirtyshskaya 2	SI2	Sopka-2, Korchugan, Vengerovo-2a, Omskaya stoyanka,
Kuznetsk-altayskaya 1	KA1	Solontsy-5
Kuznetsk-altayskaya 2	KA2	Ust'-Isha, Kaminnaya cave, Lebedy-2, Vas'kovo-5
Bolshemysskaya	BM	Itkul'
Ryazanskaya	RN	Fomino
Yamocno-grebenchataya	YG	Karavaikha, Modlona, Pogostice
L'alovskaya	LS	Sakhtysh-2a
Volosovskaya	VS	Sakhtysh-2a
Latvian Mesolithik	LM	Zvenieki
Karelian Mesolithic	KM	South Oleniy (Reindeer) island

Table 3. Pooled Neolithic series

	SI1		SI2		KA1		KA2		BM	
Maxilla	**n(N)**	**%**	**n(N)**	**%**	**n(N)**	**%**	**n(N)**	**%**	**n(N)**	**%**
Labial convexity	0(2)	0	0(2)	0	1(4)	25	0(3)	0	0(4)	0
Shovel I1	0(2)	0	3(6)	50	3(3)	100	5(5)	100	3(3)	100
Shovel I2	3(4)	75	6(6)	100	4(4)	100	6(6)	100	3(3)	100
Double shovel I1	0(2)	0	0(2)	0	0(4)	0	1(3)	33,3	2(4)	50
Double shovel I2	0(4)	0	0(2)	0	0(2)	0	0(5)	0	2(4)	50
Mesial ridge	0(6)	0	0(4)	0	0(3)	0	0(2)	0	0(1)	0
Distal acc. Ridge	0(6)	0	1(4)	25	0(3)	0	2(2)	100	1(1)	100
Metacone M1	11(11)	100	13(13)	100	6(6)	100	8(8)	100	5(5)	100
Metacone M2	10(10)	100	13(13)	100	5(5)	100	7(7)	100	5(5)	100
Hypocone M1	11(11)	100	13(13)	100	7(7)	100	8(8)	100	5(5)	100
Hypocone M2	10(10)	100	13(13)	100	7(8)	87,5	6(7)	85,71	5(5)	100
Carabelly trait grade 0, M1	10(10)	100	8(11)	72,73	4(5)	80	6(6)	100	5(5)	100
Carabelly trait grade 2-7, M1	0(10)	0	1(11)	9,09	1(5)	20	0(6)	0	0(5)	0
Carabelly trait grade 0, M2	8(8)	100	12(12)	100	5(5)	100	6(6)	100	5(5)	100
Carabelly trait grade 2-7, M2	0(8)	0	0(12)	0	0(5)	0	0(6)	0	0(5)	100
C5 M1	1(11)	9,09	0(12)	0	3(5)	60	0(5)	0	0(1)	0
C5 M2	0(7)	0	1(12)	8,33	1(5)	20	0(3)	0	0(1)	0
C6 M1	1(11)	9,09	1(12)	8,33	1(5)	20	0(5)	0	0(1)	0
C6 M2	0(7)	0	1(12)	8,33	0(5)	0	0(3)	0	0(1)	0
Parastyle M1	0(11)	0	0(12)	0	0(5)	0	0(5)	0	0(1)	0
Parastyle M2	0(7)	0	0(12)	0	1(5)	20	0(3)	0	0(1)	0
Anterior fovea	0(11)	0	0(4)	0	0(3)	0	-	-	-	-
Posterior fovea	1(11)	9,09	1(5)	20	0(3)	0	-	-	0(1)	0
Enamel extension M1	2(10)	20	4(8)	50	2(4)	50	3(7)	42,86	3(3)	100
Enamel extension M2	5(9)	55,6	7(12)	58,33	5(5)	100	5(8)	62,5	4(5)	80
Mandible	**n(N)**	**%**	**n(N)**	**%**	**n(N)**	**%**	**n(N)**	**%**	**n(N)**	**%**
Multiple cusps P3	0(12)	0	1(8)	12,5	0(1)	0	0(6)	0	0(1)	0
Multiple cusps P4	6(13)	46,2	7(11)	63,64	0(1)	0	3(7)	42,86	0(1)	0
Hypoconulid (Cusp 5) M1	18(19)	94,7	9(9)	100	5(5)	100	8(8)	100	2(2)	100
Hypoconulid (Cusp 5) M2	9(23)	39,1	4(11)	36,36	1(3)	33,3	4(8)	50	1(2)	50
Entoconulid (Cusp 6) M1	6(19)	31,6	2(9)	22,22	1(5)	20	0(8)	0	1(2)	50
Entoconulid (Cusp 6) M2	0(23)	0	0(11)	0	0(3)	0	0(8)	0	0(2)	0

6-cusped M1	6(19)	31,6	2(9)	22,2	1(5)	20	0(8)	0	1(2)	50
5-cusped M1	12(19)	63,2	7(9)	77,78	4(5)	80	8(8)	100	1(2)	50
4-cusped M1	1(19)	5,26	0(9)	0	0(5)	0	0(8)	0	0(2)	0
6-cusped M2	0(23)	0	0(11)	0	0(3)	0	0(8)	0	0(2)	0
5-cusped M2	9(23)	39,1	4(11)	36,36	1(3)	33,3	4(8)	50	1(2)	50
4-cusped M2	14(23)	60,9	7(11)	63,64	2(3)	66,7	4(8)	50	1(2)	50
YM1	11(18)	61,1	8(9)	88,89	3(5)	60	5(8)	62,5	-	-
XM1	2(18)	11,1	1(9)	11,11	2(5)	40	2(8)	25	-	-
+ M1	7(18)	38,9	0(9)	0	0(5)	0	2(8)	25	-	-
YM2	5(23)	21,7	3(11)	27,27	0(3)	0	3(8)	37,5	0(2)	0
XM2	14(23)	60,9	6(11)	54,55	2(3)	66,7	5(8)	62,5	1(2)	50
+ M2	5(23)	21,7	3(11)	27,27	1(3)	33,3	0(8)	0	1(2)	50
Tami (Cusp 7) M1	1(23)	4,35	1(9)	11,11	0(5)	0	1(7)	14,3	0(4)	0
Tami (Cusp 7) M2	0(21)	0	0(10)	0	0(3)	0	0(7)	0	1(4)	25
Deflecting wrinkle	0(5)	0	0(3)	0	0(3)	0	0(2)	0	0(1)	0
Distal trigonid crest	8(18)	44,4	3(7)	42,86	2(4)	50	3(4)	75	0(2)	0
Epicristid	0(18)	0	0(7)	0	0(4)	0	1(4)	25	1(2)	50
Protostylid	0(23)	0	0(9)	0	0(5)	0	0(8)	0	0(3)	0
Protostylid pit	4(23)	17,4	5(9)	55,56	1(2)	50	3(8)	37,5	2(3)	66,7

	RN		***YG***		***LS***		***VS***	
Maxilla	***n(N)***	***%***	***n(N)***	***%***	***n(N)***	***%***	***n(N)***	***%***
Labial convexity	*0(4)*	*0*	*1(4)*	*25*	*-*	*-*	*-*	*-*
Shovel I1	*1(4)*	*25*	*0(5)*	*0*	*0(7)*	*0*	*2(17)*	*11,76*
Shovel I2	*-*	*-*	*-*	*-*	*0(8)*	*0*	*5(19)*	*26,32*
Double shovel I1	*0(4)*	*0*	*0(4)*	*0*	*0(7)*	*0*	*0(17)*	*0*
Double shovel I2	*0(4)*	*0*	*0(5)*	*0*	*0(8)*	*0*	*0(19)*	*0*
Mesial ridge	*0(4)*	*0*	*0(5)*	*0*	*-*	*-*	*-*	*-*
Distal acc. Ridge	*0(4)*	*0*	*0(5)*	*0*	*-*	*-*	*-*	*-*
Metacone M1	*-*	*-*	*-*	*-*	*13(13)*	*100*	*31(31)*	*100*
Metacone M2	*-*	*-*	*-*	*-*	*8(8)*	*100*	*30(30)*	*100*
Hypocone M1	*8(8)*	*100*	*6(6)*	*100*	*13(13)*	*100*	*32(32)*	*100*
Hypocone M2	*11(11)*	*100*	*5(6)*	*83,33*	*8(8)*	*100*	*28(30)*	*93,33*
Carabelly trait grade 0, M1	*1(8)*	*12,5*	*3(6)*	*50*	*3(12)*	*25*	*17(26)*	*65,38*
Carabelly trait grade 2-7, M1	*6(8)*	*75*	*3(6)*	*50*	*4(12)*	*33,3*	*2(26)*	*7,69*
Carabelly trait grade 0, M2	*11(11)*	*100*	*6(6)*	*100*	*6(8)*	*75*	*26(28)*	*92,86*
Carabelly trait grade 2-7, M2	*0(11)*	*0*	*0(6)*	*0*	*1(8)*	*12,5*	*0(28)*	*0*
C5 M1	*-*	*-*	*-*	*-*	*6(12)*	*50*	*2(24)*	*8,33*
C5 M2	*-*	*-*	*-*	*-*	*5(8)*	*62,5*	*9(21)*	*42,86*
C6 M1	*-*	*-*	*-*	*-*	*3(12)*	*25*	*1(24)*	*4,17*
C6 M2	*-*	*-*	*-*	*-*	*1(8)*	*12,5*	*0(21)*	*0*
Parastyle M1	*-*	*-*	*-*	*-*	*0(12)*	*0*	*0(24)*	*0*
Parastyle M2	*-*	*-*	*-*	*-*	*0(8)*	*0*	*0(21)*	*0*
Anterior fovea	*0(6)*	*0*	*0(6)*	*0*	*-*	*-*	*-*	*-*
Posterior fovea	*0(6)*	*0*	*0(6)*	*0*	*-*	*-*	*-*	*-*
Enamel extension M1	*-*	*-*	*-*	*-*	*1(4)*	*25*	*4(17)*	*23,53*
Enamel extension M2	*-*	*-*	*-*	*-*	*1(3)*	*33,3*	*8(16)*	*50*
Mandible	***n(N)***	***%***	***n(N)***	***%***	***n(N)***	***%***	***n(N)***	***%***
Distal acc. Ridge						*-*		
Multiple cusps P3	*-*	*-*	*-*	*-*	*0(7)*	*0*	*2(18)*	*11,1*
Multiple cusps P4	*-*	*-*	*-*	*-*	*8(9)*	*88,89*	*14(18)*	*77,78*
Hypoconulid (Cusp 5) M1	*9(9)*	*100*	*5(5)*	*100*	*13(13)*	*100*	*22(23)*	*95,65*
Hypoconulid (Cusp 5) M2	*3(8)*	*37,5*	*0(5)*	*0*	*3(11)*	*27,27*	*3(32)*	*9,38*
Entoconulid (Cusp 6) M1	*1(9)*	*11,1*	*1(5)*	*20*	*3(13)*	*23,08*	*0(23)*	*0*
Entoconulid (Cusp 6) M2	*0(8)*	*0*	*0(5)*	*0*	*0(11)*	*0*	*0(32)*	*0*

6-cusped M1	*1(9)*	*11,1*	*1(5)*	*20*	*3(13)*	*27,27*	*0(23)*	*0*
5-cusped M1	*8(9)*	*88,9*	*4(5)*	*80*	*10(13)*	*76,92*	*22(23)*	*95,65*
4-cusped M1	*0(9)*	*0*	*0(5)*	*0*	*0(13)*	*0*	*1(23)*	*4,35*
6-cusped M2	*0(8)*	*0*	*0(5)*	*0*	*0(11)*	*0*	*0(32)*	*0*
5-cusped M2	*3(8)*	*37,5*	*0(5)*	*0*	*4(11)*	*36,36*	*3(32)*	*9,38*
4-cusped M2	*5(8)*	*62,5*	*5(5)*	*100*	*7(11)*	*63,63*	*29(32)*	*90,63*
YM1	*-*	*-*	*-*	*-*	*7(12)*	*58,33*	*17(20)*	*85*
XM1	*-*	*-*	*-*	*-*	*0(12)*	*0*	*0(20)*	*0*
+ M1	*-*	*-*	*-*	*-*	*5(12)*	*41,67*	*3(20)*	*15*
YM2	*-*	*-*	*-*	*-*	*1(11)*	*9,09*	*0(29)*	*0*
XM2	*-*	*-*	*-*	*-*	*7(11)*	*63,64*	*20(29)*	*68,97*
+ M2	*-*	*-*	*-*	*-*	*4(11)*	*36,36*	*13(29)*	*44,83*
Tami (Cusp 7) M1	*-*	*-*	*-*	*-*	*1(13)*	*7,69*	*1(27)*	*3,7*
Tami (Cusp 7) M2	*-*	*-*	*-*	*-*	*-*	*-*	*0(26)*	*0*
Deflecting wrinkle	*1(5)*	*20*	*0(5)*	*0*	*1(5)*	*20*	*1(13)*	*7,69*
Distal trigonid crest	*2(8)*	*25*	*0(5)*	*0*	*2(11)*	*18,18*	*2(21)*	*9,52*
Epicristid	*0(8)*	*0*	*0(5)*	*0*	*0(11)*	*0*	*0(21)*	*0*
Protostylid	*0(9)*	*0*	*0(5)*	*0*	*0(13)*	*0*	*0(28)*	*0*
Protostylid pit	*0(9)*	*0*	*0(5)*	*0*	*0(13)*	*0*	*1(28)*	*3,57*

Table 4. Dental trait percentages and number of individuals scored for Neolithic samples. n – number of trait presence, N – number of individuals

	Factor 1	**Factor 2**
Shovel I1	-0,72	-0,37
Carabelli trait, grade 2-7 M^1	0,80	0,06
Hypocone reduction M^2	0,27	-0,85
6-cusped M1	0,00	-0,36
4-cusped M1	-0,02	0,67
4-cusped M2	0,73	-0,33
Distal trigonid crest M_1	-0,72	0,26
Deflecting wrinkle M_1	0,56	0,64

Table 5. Trait loadings on the first two factors.

	Malta 2	**Listvenka**	**Kostenky-18**	**Kostenki-14**	**Kostenki-15**	**Sungir'-2**	**Sungir'-3**
Maxilla							
Labial convexity	weak	-	+	0	-	+	+
Shovel I1	0	-	-	0	-	0	0
Shovel I2	+	-	+	+	-	0	
Double shovel I1	0	-	0	0	-	0	0
Double shovel I2	0	-	0	0	-	0	0
Mesial ridge	0	-	-	0	-	0	+
Distal acc. Ridge	0	-	-	0	-	0	-
Metacone M1	+	-	+	+	+	+	+

Metacone M2	-	-	+	+	-	+	+
Hypocone M1	+	-	+	+	+	+	+
Hypocone M2	-	-	+	+	-	+	0
Carabelly trait grade 0, M1	0	-	0	+	0	0	+
Carabelly trait grade 2-7, M1	+	-	+	0	+	+	0
Carabelly trait grade 0, M2	-	-	+	+	-	+	-
Carabelly trait grade 2-7, M2	-	-	0	0	-	0	-
C5 M1	0	-	0	-	0	-	0
C5 M2	-	-	+	-	-	-	0
C6 M1	+	-	0	-	0	-	0
C6 M2	-	-	0	-	-	-	0
Parastyle M1	0	-	0	0	0	0	0
Parastyle M2	-	-	0	0	-	0	-
Anterior fovea	0	-	0	-	0	0	-
Posterior fovea	0	-	+	-	+	0	-
Enamel extension M1	-	-	+	+	-	-	-
Enamel extension M2	-	-	-	+	-	0	-
References	Zubov, Gokhman, 2003, Zubova, present study	Zubova, present study	Khaldeeva, 2006	Zubova, present study	Zubova, present study	Zubov, 2000, Zubova, present study	Zubov, 2000, Zubova, present study

	Malta 2	**Listvenka**	**Kostenky-18**	**Kostenki-14**	**Kostenki-15**	**Sungir-2**	**Sungir-3**
Mandible							
Mesial ridge	0	-	-	-	-		
Distal acc. Ridge	0	-	-	-	-		
Multiple cusps P3	-	-	-	0	-	0	
Multiple cusps P4	-	-	-	0	-	+	-
Hypoconulid (Cusp 5) M1	+	+	+	+	+	+	+
Hypoconulid (Cusp 5) M2	-	-	0	0	-	0	0
Entoconulid (Cusp 6) M1	0	+	0	0	0	0	0
Entoconulid (Cusp 6) M2	-	-	0	0	-	0	0
6-cusped M1	0	+	0	0	0	0	0
5-cusped M1	+	0	+	+	+	+	+
4-cusped M1	0	0	0	0	0	0	0
6-cusped M2	-	-	0	0	-	0	0
5-cusped M2	-	-	0	0	-	0	0

4-cusped M2	-	-	+	+	-	+	+
YM1	+	+	+	-	0	+	+
XM1	0	0	0	-	+	0	0
+ M1	0	0	0	-	0	0	0
YM2	-	-	0	0	-	0	0
XM2	-	-	0	0	-	+	0
+ M2	-	-	+	+	-	0	+
Tami (Cusp 7) M1	0	0	0	0	0	0	0
Tami (Cusp 7) M2	-	-	0	0	-	0	0
Anterior fovea	0	+	-	-	0	0	0
Posterior fovea	0	0	+	-	0	0	0
Deflecting wrinkle	0	0	0	-	0	+	0
Distal trigonid crest	0	0	0	-	0	0	0
Epicristid	0	0	0	-	0	0	0
Protostylid	0	0	0	0	0	0	0
Protostylid pit (grade 1)	0	+	0	0	0	+	0
References	Zubov, Gokhman, 2003, Zubova, present study	Zubova, present study	Khaldeeva, 2006	Zubova, present study	Zubova, present study	Zubov, 2000, Zubova, present study	Zubov, 2000, Zubova, present study

Table 6. Dental trait presence in Upper Paleolithic samples.

Figure 1. The map of Neolithic sites location.

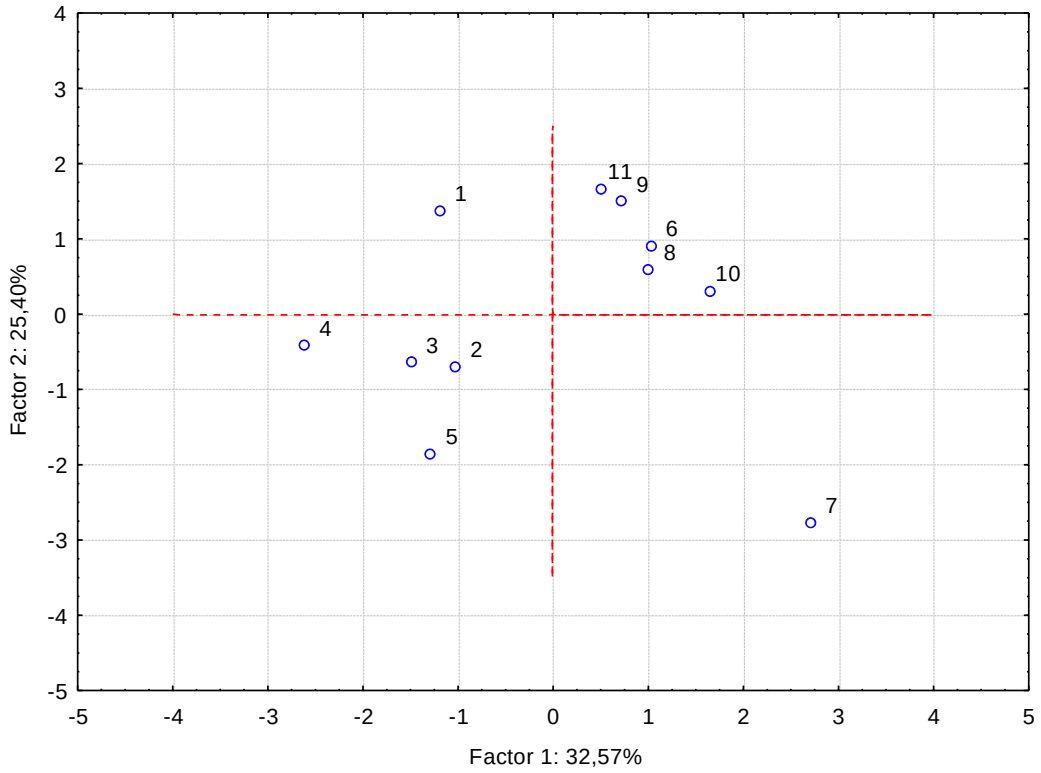

Figure 2. The position of groups on the first two principal components 1 – SI1, 2 – SI2, 3 – KA1, 4-KA2, 5-BM, 6-RN, 7-YG, 8-LS, 9-VS, 10-LM, 11-KM

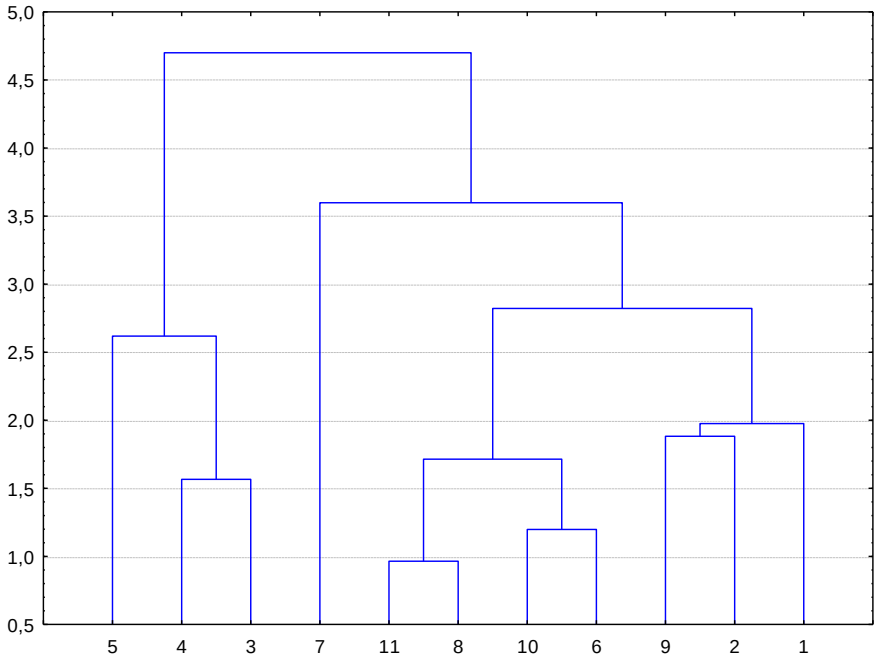

Figure 3. Dendrogram shoving the results of the cluster analysis of the frequencies of dental traits in Mesolithic and Neolithic groups. 1 – SI1, 2 – SI2, 3 – KA1, 4-KA2, 5-BM, 6-RN, 7-YG, 8-LS, 9-VS, 10-LM, 11-KM

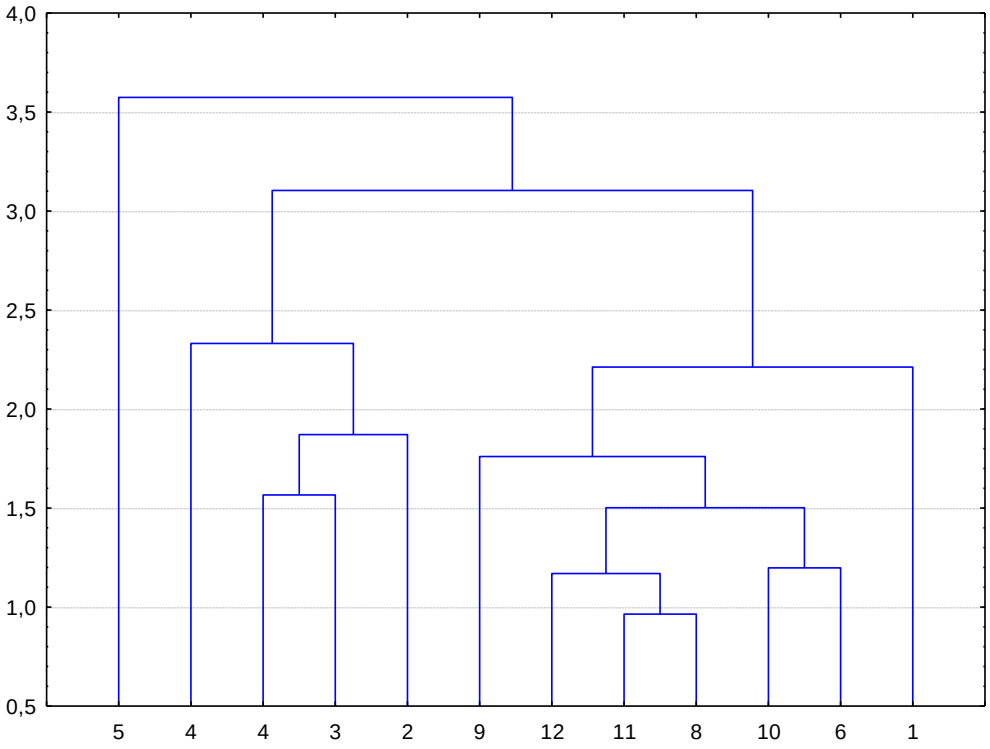

Figure 4. Dendrogram shoving the results of the cluster analysis of the frequencies of dental traits in Mesolithic, Neolithic and Upper Paleolithic samples. 1 – SI1, 2 – SI2, 3 – KA1, 4-KA2, 5-BM, 6-RN, 7-YG, 8-LS, 9-VS, 10-LM, 11-KM, 12 - Pooled Upper Paleolithic sample