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Non-metric dental trait variation among Western Siberian forest-steppe populations in the Great Migration period*

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Abstract

Transition period from the Early Iron Age to the middle Ages in Western Siberian forest-steppe zone is known as Great Migration period. During this period the disintegration of the centralized early state Sargat community and the formation of new cultures are observed on the territory of Western Siberia. The main goal of this study was to find biological affinities between Early Iron Age (5th c BC – 3rd c AD) and Great Migration period (3rd – 6th cc AD) populations of Western Siberian forest-steppe zone using dental non-metric traits. The frequencies of thirty traits were observed using ASUDAS (and A.A. Zubov's program). The study was based on the dental remains of 49 individuals from four Great Migration period burial grounds (Ustyug-1, Kozlov Mis, Revda-5, Ipkul) located in Tobol River region of Western Siberia and associated with Bakal culture. For comparison were observed 424 individuals of Sargat culture (Early Iron Age) from the burial sites located in the area between the Tobol, Irtysh, and Ishim rivers including the Baraba forest-steppe zone of Western Siberia. Biological affinities between Early Iron Age Sagrat culture samples (5th c BC – 3rd c AD) and Great Migration period group were examined with MMD and Ghi-squarted test (χ2). Besides Sargat culture samples, 28 Early Iron Age dental samples from different region of Eurasia were compared with principal component analysis. As a result, it was established the Sargat population (especially from Tobol river region and Baraba forest-steppe zone) became a basis for the formation of the Great Migration period and Early Medieval tribes of Lower Tobol river region of Western Siberia.

Keywords: Western Siberia; Early Iron Age; Great Migration period; dental non-metric traits; ASUDAS

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Introduction

The relatively stable existence of the Sargat culture for nearly a thousand years (5th c BC – 3rd c AD) came to an end during the Great Migration Period. The researchers explain the decline of the culture through deterioration of natural climate-related conditions at the extreme northern (1) and southern (2) zones of the area, which resulted in an inflow of steppe and taiga migrants to the areal (3). Palynological data indicate a climatic amelioration towards greater moisture content, the spread of grassland steppe (2). This made it possible to assume suitable conditions for the migration of nomads (2; 3). All of this contributed to the emergence of new cultural genesis during in the Great Migration Period Western Siberia and, in particular, in the Lower Tobol river region (Figure 1).

Massive transfers of nomads in the steppe zone of Eurasia during the Great Migration period resulted in a transformation of cultural habitats in many regions. This transition period for the formation of new cultures played a very important role in the history of Western Siberia. Until the second half of the 3rd century AD, the material culture of Western Siberia underwent significant changes: estates disappeared, settlements became short-lived. The building of kurgans continued but in substantially smaller dimensions. Alongside the burials, cremation, “flat"-grave burial grounds, horse burials appeared (3; 4). In the territory of the Lower Tobol river region, a few key burial grounds of that era have been studied in the last two decades (4), such as the Ustyug-1, Kozlovsky, Revda-5, and Ipkulsky burials (Figure 2). According to archaeological evidence different artifacts composition were fixed within the same burial group (3). Archeological artifacts attributable to the Bakal, Karym, Kushnarenkovo, Ipkul and other cultures were found in the burial grounds (3, 5). Analyzing of material culture of 3rd – 6th cc AD, archaeologists pay great attention to possible migration processes. The researchers see the Sargat tribes as the basic element for forming the Bakal population; moreover, several superstrated components have been revealed here: the Middle Asian (Hunnic?), North Karym and Urals Kushnarenkovo cultures (3). The superstrated part includes biritualism in burials (inhumation and cremation), a mixed pottery tradition (native and foreign) and heterogeneous dress accessories, all of which characterize Bakal type sites (4). Based on archaeological data hypothesis of migration of the population in the 3rd-6th AD from Western Siberia to the Urals has been proposed (3).

Skulls with artificial deformation are recorded in Early Iron Age (5th c BC – 3rd c AD) craniological collections of Western Siberian, but their number a highly increase in the Great Migration period (3rd – 6th cc AD) (6). The territory of Tobol River region is no exception, where deformations first appear in the 2nd century AD and disappear in the 9th century AD. In the Great Migration period sample the deformations of all 27 (51.7 % of the total sample (7)) craniums can definitely be categorized as circular (ring) type deformations. With this deformation, the forehead appears to be backward-slanted, the posterior portions of the parietal bones and the superior portion of the occipital bone are flattened, the parietal ridges are prominent, which results in the sagittal border of the cranium becoming closer to pentagonal and the cerebral capsule itself enlarging. The listed changes made impossible to use craniometric methods to investigate biological affinities of Early Iron Age and Great Migration period populations.

Thus, to clarify the hypothesis of the population history in the Great Migration period and early Middle Ages, more numerous dental non-metric data are used for the first time. It should be noted that there is no information on the dental non-metric of the populations of the synchronous period in Western Siberia and neighboring territories.

The purpose of this study is to clarify the hypothesis of the population history of the tribes lived in the Lower Tobol river region in the transition period from the early Iron Age to the Middle Ages, find biological affinities between Early Iron Age (5th c BC – 3rd c AD) and Great Migration period (3rd – 6th cc AD) populations of Western Siberian forest-steppe zone, based on the dental non-metric data. To achieve this goal, several tasks were set: introducing dental characteristics of the studied series into scientific discourse, comparing them with the available dental non-metric data and reconstructing the main biological affinities between populations.

Materials and Methods

Materials and study areas

The frequencies of thirty traits were observed using ranked traits (Zubov scheme) (8; 9) and the Arizona State University Dental System (ASUDAS scheme) (10-12) (Table 1). The study was based on the dental remains of 49 individuals from four Great Migration period burial grounds (Ustyug-1, Kozlov Mis, Revda-5, Ipkul).

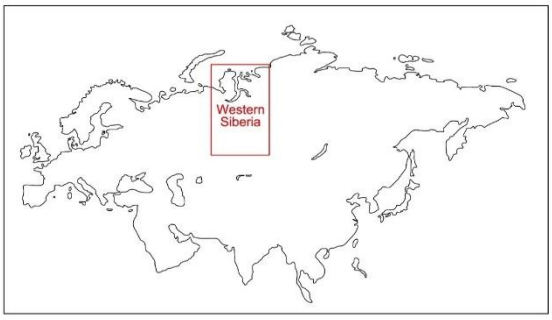

Figure 1. Western Siberia on the Eurasian continent.

Methods

At the first stage Chi-square test was applied for each of the Sargat culture sample and the Great Migration period group. The p value of ≤ 0.05 was considered to be statistically significant (13).

Secondary, the degree of distance between Sargat culture and Great Migration period groups was determined using the mean measure of divergence (MMD) (14; 15). Microsoft Office Excel 2007 and the software package AnthropMMD from the program R (version 3.6.1)

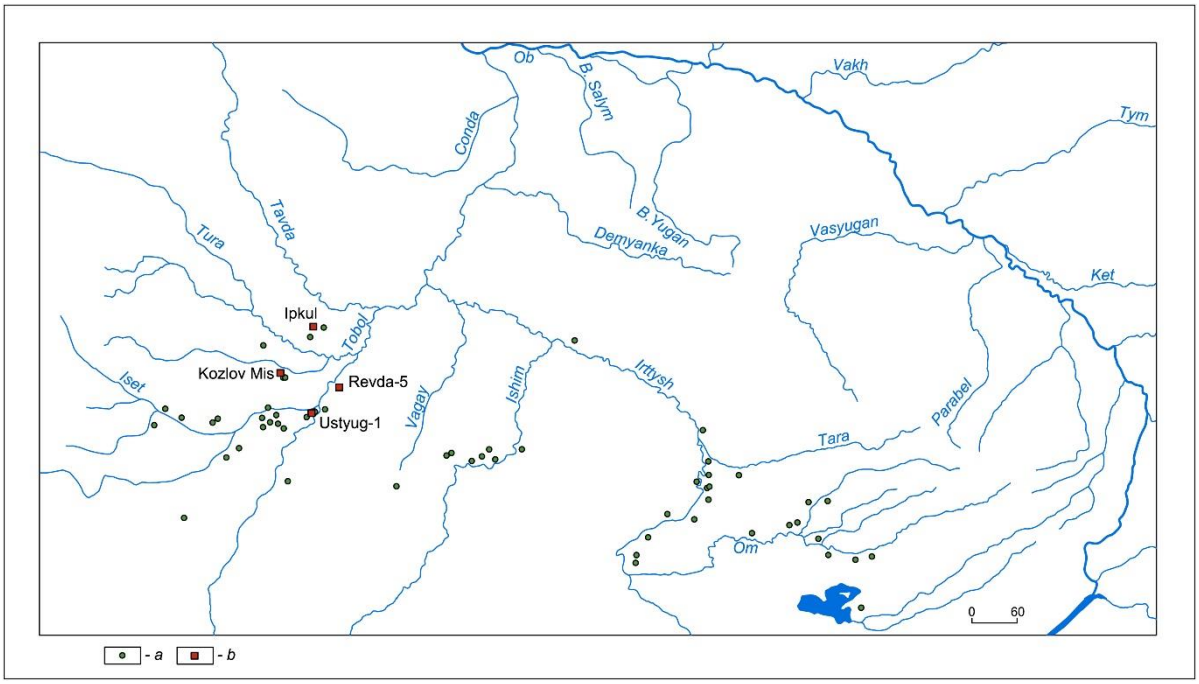

Figure 2. Great Migration period burial grounds (b) and Early Iron Age burial grounds of Sargat culture (a) located in the Southern part of Western Siberia.

These burials associated with Bakal culture (3rd – 6th cc AD) and located in Tobol river region of Western Siberia (Figure 2). Besides that, dental non-metric data of 424 individuals of Sargat culture (5th c BC – 3rd c AD) from 68 Early Iron Age burials were observed and used in analysis for determine possible relatedness between populations. Sargat culture burial sites located in the area between the Tobol, Irtysh, and Ishim rivers including the Baraba forest-steppe zone of Western Siberia. Each trait was registered on the key teeth of its class, and the individual count method was used. The series was pooled by sex and age.

developed by Santos (16) were used for the calculation.

At the third stage Great Migration period and Early Iron Age dental samples were comparing used to the principal component analysis. The Statistica software for Windows, Version 10.0, was used. 28 Early Iron Age dental samples from Western Siberia, Urals, Altai, Minusinsk Basin and Central Asia were used for statistical comparison (Table 2).

Results

Dental non-metric traits and Chi-square test

The characteristic of the Great Migration period group include low frequency of shoveling of the upper incisors and Carabelli trait (grade 2-7) on

the upper first molars (Table 3). One case of four-cusped lower first molars were noted, six-cusp teeth were absent. Distal trigonid crest were fixed in two cases. The first lower molars demonstrated high frequency of deflecting wrinkle and very high occurrence of tami (C7).

The characteristics of the Sargat culture samples show a decreased frequency of the shovel shape of the maxillary central incisors, and a medium frequency of the Carabelli cusp. Low frequency of the 6-cusp form combines with the occurrence of 4-cusp variant structures of the first lower molars, and an increased frequency of the deflecting wrinkle and tami. Samples from the Baraba of early and middle periods of the Sargat culture stand apart from all the Sargat series of Western Siberia (17). A number of features distinguish them from the series of the Tobol, Ishim and Irtysh river regions. In the groups from the Baraba, the shovel shape is of medium frequency, and the series has the lowest percentage of distal trigonid crest and the highest percentage of tami (C7).

The Great Migration period sample and Sargat culture groups from Tobol river region displayed certain common traits such as the low frequency of shovel shape incisors, high frequency of the deflecting wrinkle (Table 3). The results of the comparison of the early Middle Age and Sargat culture samples of the Tobol, Ishim, Irtysh River regions and the Baraba forest-steppe zone (Ghi-squarted test) showed only a few statistically significant differences (Table 4). Sargat culture samples from Irtysh river region and Baraba forest-steppe zone have significantly higher frequencies of the 4-cusp lower second molars than the Great Migration period sample.

MMD distances

The MMD distance between the Great Migration period group and Sargat culture samples from Irtysh and Ishim river regions is statistically significant (Table 5). But between the Great Migration period group and Sargat culture samples from Tobol river region and Barabe forest-steppe zone there are no significant differences. The most interesting result is MMD between the groups of Bakal (Great Migration period) and Sargat (Early Iron Age) culture samples from the same region (Tobol river region) is 0.003 and, therefore, not significant (Figure 3).

Principal component analysis

Dental non-metric data of the Great Migration period sample were compared with the Early Iron Age samples using principal component analysis (Table 2, 6; Figure 4). PC 1 and PC 2 present 54.67% of total variation. In the positive field of PC 1 located series with increased frequencies of 4-cusp lower first and second molars and hypocone reduction of upper second molar. In the negative field of the graph located the groups with an increased frequency of 6-cusp mandibular first molars and deflecting wrinkle of the first lower molar. The second principal component breaks down the samples by the shovel shape of the maxillary central incisors and distal trigonid crest of the first lower molar.

Researched samples of Bakal and Sargat culture located close to each other in the negative field of the graph (Figure 4). Besides Great Migration period Bakal culture sample, in the negative field located other groups from Western Siberia, associated with Sargat and Bolsherechenskaya Culture, as well as Early Sarmatians from Southern Urals.

Discussion

The results of Chi-square test, MMD values and comparative statistical analysis suggest a close affinity between Early Iron Age (Sargat culture) and Great Migration period (Bakal cuture) populations of Western Siberia. Besides that, investigated samples located close to Early Sarmatians (Southern Urals). There is craniometrical and dental non-metric characteristics data indicate affinity of Sargat and Sarmatians populations (17, 18).

The results of this paper cannot elaborate to the hypothesis about affinities of the Great Migration period Western Siberia group and the Middle Asian (Hunnic?), North Karym and Urals Kushnarenkovo cultures tribes (3) because there is no dental non-metric data of the mentioned groups.

Conclusion

Several conclusions can be deduced from the above.

1) Sargat population (especially from Tobol river region and Baraba forest-steppe zone) and Great Migration period group of Lower Tobol River region had strong biological affinities.

2) Great Migration period and Sargat groups from Tobol river region displayed certain dental non-metric common traits, but 3rd-6th AD GMP population includes lower frequencies of 4-cusp lower first and second molars and the presence of the distal trigonid crest. Thus, migration of the groups from the taiga zone to the south in the 3rd-6th centuries AD, proposed based on the results

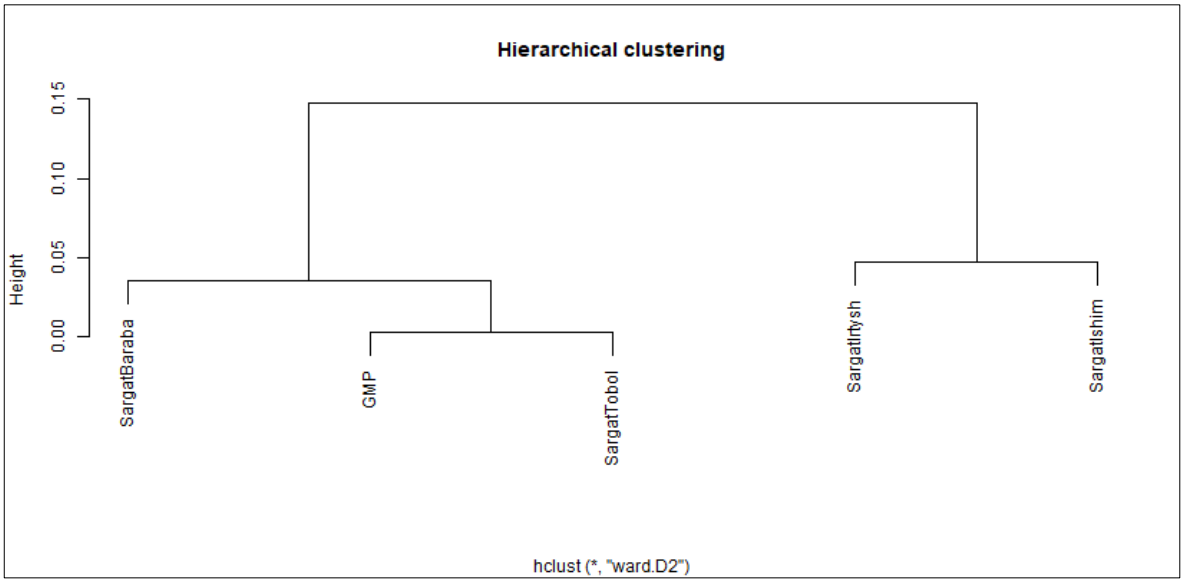

Figure 3. Dendrogram of the distances of the s Sargat culture and Great Migration period groups based on the MMD values in Table5.

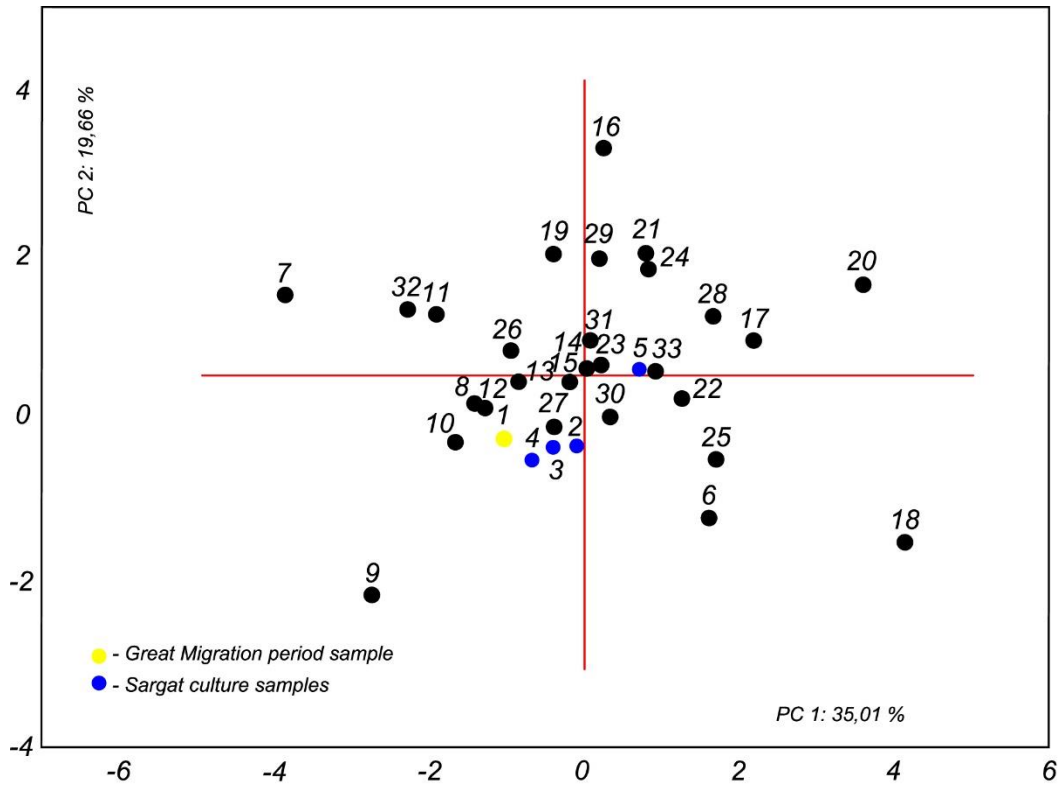

Figure 4. The position of Early Iron Age groups and Great Migration period sample on the first two principal components. Great Migration period: 1 – Bakal Culture. Early Iron Age: 2-5 – Sargat Culture; 6 – Gorokhovo Culture; 7 – Kashino Culture; 8 -12 – Bolsherechenskaya Culture; 13-15 – Kamen Culture; 16 – Staroaleyka Culture; 17 – Pazyryk Culture; 18 – Karakobin Culture; 19, 20 – Aldy-belsk Culture; 21 – Uyuk-Saglyn Culture; 22 – Tagar Culture; 23, 24 – Jetyasar Culture; 25 – Tasmolinian Culture; 26 – Korgantas period; 27 – Early Sarmatians; 28 – Late Sarmatians; 29, 30 –Sauromats; 31 – Early Sarmatians; 32 – Ananyin Culture; 33 – Saka.

of craniometric analysis of undeformed cranials (19), is not excluded.
3) The combination of dental characteristics and results of statistical comparison not indicate the migration of the population in the 3rd-6th AD from Western Siberia to the Urals, although this assumption has been repeatedly described in archaeological literature (3).

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Table 1. Dental features used in analysis.

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	+
3-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 2. Dental samples used in present study.

№	Region	Archaeological culture	Site	Date	References
1	Western Siberia Tobol river region	Bakal Culture	Ustyug-1, Kozlov Mis, Revda-5, Ipkul	3rd – 6th cc AD	Sleptsova, present study
2	Western Siberia Tobol river region	Sargat Culture	Several sites	5th c BC – 3rd c AD	
3	Western Siberia Irtysh river region		Several sites	5th c BC – 4rd c AD	
4	Western Siberia Ishim river region		Several sites	5th c BC – 4rd c AD	
5	Western Siberia Baraba forest-steppe zone		Several sites	6th c BC – 1st c AD	
6	Western Siberia Tobol-Iset' river region	Gorokhovo Culture	Several sites	5th – 2rd cc BD	Sleptsova, 2021 (17)
7	Western Siberia Ishim river region	Kashino Culture	Abatsky 3	4th – 5st cc AD	
8	Western Siberia Upper Ob' river region	Bolsherechenskaya Culture	Verkh-Suzun-5	6th – 2rd cc BD	Kishkurno, 2018a; 2018b (20; 21)
9			Bystrovka-1	Second half of the 1st millennium BC	
10			Bystrovka-2		
11			Bystrovka-3		
12			Select sample		
13	Forest-Steppe Altai	Kamen Culture	Rogozikha-1, Obyezdnoye-1	6th – 4th cc BC	Leibova, Tur, 2020 (22)
14			Kamen-2, Kirillovka-3, Novotroitskoye 1 and 2	5th – 3rd cc BC	
15			Maslyakha-1	3rd –2nd cc BC	
16		Staroaleyka Culture	Firsovo-14, Obskiye Plesy 2	6th –5th cc BC	
17	Altai Mountains	Pazyryk Culture	Several sites	5th – 3rd cc BC	Chikisheva, 2012 (23)
18		Karakobin Culture	Several sites		
19		Aldy-belsk Culture	Arzhan II	7th c BC	
20			Copto	5th – 4th cc BC	
21		Uyuk-Saglyn Culture	Dogee-Baary II	6th – 4th cc BC	
22	Minusinsk Basin	Tagar Culture	Chernogorka	8th – 3rd cc BC	Gulevskaya, unpubl.
23	Aral Sea region	Jetyasar Culture	Kosasar-2	5th c BC	Rykushina, 1993a (24)
24			Kosasar-3, Tompakasar, Bedaikasar	4th c AD	Rykushina, 1993б (25)
25	Central Asia	Tasmolinian Culture	Several sites	8th –5th cc BC	Kitov, 2015 (26)
26		Korgantas period	Several sites	4th –2nd cc BC	
27	Southern Urals	Early Sarmatians	Pokrovka X	4th – 2nd cc BC	Suvorova, 2008 (27)
28		Late Sarmatians		2nd – 4th cc AD	
29		Sauromats	Novyy Kumak	6th –4th cc BC	Segeda, 2006 (28)
30			Kazy-Baba	5th – 4th cc BC	Bagdasarova, 2000 (29)
31		Early Sarmatians	Lebedevka	5th – 3rd cc BC	Segeda, 2006 (28)
32		Ananyin Culture	Lugovskoy	8th – 3rd cc BC	Gravere, 1987 (30)
33	Middle Asia Tian Shan region	Saka	Several sites	5th – 2nd cc BC	Kitov, 2019 (31)

Table 3. Dental trait percentages and number of individuals scored for Great Migration period group and Sargat culture samples. n – number of trait presence, N – number of individuals.

	Great Migration period		Sargat culture							
			Tobol region		Irtysh region		Ishim region		Baraba region	
	n(N)	%	n(N)	%	n(N)	%	n(N)	%	n(N)	%
Maxilla										
Labial convexity	0 (13)	0,0	0 (29)	0,0	0 (32)	0,0	2 (14)	14,3	0 (13)	0,0
Shovel I1	3 (13)	23,1	7 (29)	24,1	1 (32)	3,1	4 (18)	22,2	4 (15)	26,7
Shovel I2	6 (15)	40,0	8 (28)	28,6	10 (50)	20,0	0 (14)	0,0	9 (19)	47,4
Double shovel I1	1 (13)	7,7	1 (29)	3,4	0 (32)	0,0	1 (12)	8,3	0 (13)	0,0
Double shovel I2	1 (15)	6,7	1 (28)	3,6	0 (50)	0,0	1 (14)	7,1	0 (19)	0,0
Mesial ridge	2 (15)	13,3	0 (24)	0,0	2 (26)	7,7	0 (9)	0,0	1 (11)	9,1
Distal acc. Ridge	3 (15)	20,0	15 (24)	62,5	11 (26)	42,3	4 (9)	44,4	1 (11)	9,1
Metacone M1	3 (37)	8,1	3 (83)	3,6	11 (119)	9,2	4 (45)	8,9	3 (48)	6,3
Metacone M2	16 (28)	57,1	33 (73)	45,2	41(91)	45,1	20 (43)	46,5	20(38)	52,6
Hypocone M1	0 (37)	0,0	0 (83)	0,0	1 (119)	0,8	0 (45)	0,0	0 (48)	0,0
Hypocone M2	11 (33)	33,3	18 (73)	24,7	21 (91)	23,1	6 (43)	14,0	14 (38)	36,8
Carabelly trait grade 0, M1	12 (24)	50,0	29 (51)	56,9	40 (80)	50,0	18 (31)	58,1	26 (37)	70,3
Carabelly trait grade 2-7, M1	3 (24)	12,5	12 (51)	23,5	19 (80)	23,8	5 (31)	16,1	9 (37)	24,3
Carabelly trait grade 0, M2	24 (25)	96,0	48 (49)	98,0	67 (69)	97,1	27 (28)	96,4	29 (32)	90,6
Carabelly trait grade 2-7, M2	0 (25)	0,0	0 (49)	0,0	0 (69)	0,0	0 (28)	0,0	1 (32)	3,1
C5 M1	4 (17)	23,5	12 (30)	40,0	14 (44)	31,8	6 (22)	27,3	7 (18)	38,9
C5 M2	3 (18)	16,7	11 (34)	32,4	11 (52)	21,2	4 (17)	23,5	6 (18)	33,3
C6 M1	5 (17)	29,4	6 (30)	20,0	3 (44)	6,8	0 (22)	0,0	3 (18)	16,7
C6 M2	1 (18)	5,6	3 (34)	8,8	2 (52)	3,8	0 (17)	0,0	0 (18)	0,0
Parastyle M1	1 (17)	5,9	0 (30)	0,0	0 (44)	0,0	0 (22)	0,0	0 (18)	0,0
Parastyle M2	0 (18)	0,0	0 (34)	0,0	0 (52)	0,0	0 (17)	0,0	0 (18)	0,0
Anterior fovea	0 (17)	0,0	0 (31)	0,0	1 (41)	2,4	0 (21)	0,0	0 (19)	0,0
Posterior fovea	0 (17)	0,0	0 (31)	0,0	1 (41)	2,4	0 (21)	0,0	0 (19)	0,0
Enamel extension M2	2 (34)	5,9	10 (41)	24,4	14 (68)	20,6	10 (27)	37,0	7 (19)	36,8
Mandible										
6-cusped M1	0 (19)	0,0	1 (46)	2,2	2 (79)	2,5	0 (25)	0,0	1 (32)	3,1
5-cusped M1	18 (19)	94,7	42 (46)	91,3	74 (79)	93,7	24 (25)	96,0	31 (32)	96,9
4-cusped M1	1 (19)	5,3	4 (46)	8,7	3 (79)	3,8	1 (25)	4,0	1 (32)	3,1
6-cusped M2	3 (21)	14,3	1 (41)	2,4	2 (71)	2,8	2 (26)	7,7	1 (33)	3,0
5-cusped M2	9 (21)	42,9	13 (41)	31,7	21 (71)	29,6	9 (26)	34,6	3 (33)	9,1
4-cusped M2	9 (21)	42,9	28 (41)	68,3	50 (71)	70,4	18 (26)	69,2	29 (33)	87,9
3-cusped M2	0 (21)	0,0	0 (41)	0,0	0 (71)	0,0	0 (26)	0,0	1 (33)	3,0
YM1	20 (24)	83,3	43 (50)	86,0	77 (81)	95,1	30 (30)	100,0	26 (31)	83,9
XM1	3 (24)	12,5	7 (50)	14,0	6 (81)	7,4	0 (30)	0,0	3 (31)	9,7
+ M1	1 (24)	4,2	2 (50)	4,0	0 (81)	0,0	1 (30)	3,3	3 (31)	9,7
YM2	9 (23)	39,1	23 (59)	39,0	43 (93)	46,2	16 (37)	43,2	15 (34)	44,1
XM2	11 (23)	47,8	35 (59)	59,3	52 (93)	55,9	22 (59)	37,3	11 (34)	32,4
+ M2	7 (23)	30,4	8 (59)	13,6	6 (93)	6,5	3 (59)	5,1	14 (34)	41,2
Tami (Cusp 7) M1	4 (19)	21,1	5 (44)	11,4	9 (76)	11,8	3 (26)	11,5	6 (28)	21,4
Tami (Cusp 7) M2	0 (21)	0,0	0 (41)	0,0	0 (71)	0,0	0 (26)	0,0	0 (34)	0,0
Deflecting wrinkle	4 (15)	26,7	7 (26)	26,9	9 (30)	30,0	1 (7)	14,3	1 (12)	8,3
Distal trigonid crest	2 (25)	8,0	0 (42)	0,0	5 (67)	7,5	0 (24)	0,0	2 (27)	7,4
Epicristid	0 (25)	0,0	0 (42)	0,0	1 (67)	1,5	0 (24)	0,0	0 (27)	0,0
Protostylid	0 (25)	0,0	0 (60)	0,0	1 (96)	1,0	0 (40)	0,0	0 (33)	0,0
Protostylid pit	11 (25)	44,4	27 (60)	45,0	62 (96)	64,6	27 (40)	67,5	10 (33)	30,3

Table 4. Results of the comparison of the Great Migration period sample and Sargat culture samples from different regions. Ghi-squarted test (χ2).

	Great Migration period	Great Migration period	Great Migration period	Great Migration period
	Sargat of Tobol river region	Sargat of Irtysh river region	Sargat of Ishim river region	Sargat of Baraba forest-steppe zone
Shovel UI1	0.006	4.544	0.003	0.048
Carabelly trait grade 2-7, UM1	1.241	1.401	0.143	1.288
Hypocone UM2	0.861	1.331	4.038	0.095
6-cusped LM1	0.419	0.491	-	0.606
4-cusped LM1	0.223	0.084	0.040	0.145
4-cusped LM2	3.734	**5.353***	3.305	**12.476***
Distal trigonid crest LM1	3.463	0.007	2.002	0.006
Deflecting wrinkle LM1	0.000	0.054	0.417	1.485

* - statistically significant differences, p <0.05

Table 5. The degree of distance between the Sargat culture and Great Migration period groups indicated by the mean measure of divergence (MMD); MMD values of 8 dental non-metric traits (upper triangular part) and associated SD values (lower triangular part), calculated with AnthropMMD.

	GMP	SargatTobol	SargatIrtysh	SargatIshim	SargatBaraba
GMP	0.000	0.003	**0.058***	**0.111***	0.039
SargatTobol	0.036	0.000	0.031	0.025	0.019
SargatIrtysh	0.032	0.019	0.000	0.047	**0.107***
SargatIshim	0.044	0.032	0.028	0.000	0.173
SargatBaraba	0.042	0.030	0.026	0.038	0.000

*Signifcant

Table 6. Trait loadings on the first two factors.

	PC 1	PC 2
Shovel I1	-0,07	**0,70**
Carabelli trait, grade 2-7 M1	-0,45	0,54
Hypocone reduction M2	**0,68**	0,00
6-cusped M1	**-0,89**	-0,05
4-cusped M1	**0,60**	0,06
4-cusped M2	**0,78**	0,25
Distal trigonid crest M1	-0,09	**0,83**
Deflecting wrinkle M1	**-0,60**	-0,16