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Buccal Dental Microwear of a Barbarian Population from Prague-Zličín – a Study of the Migration Period in the Czech Republic

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ABSTRACT

Buccal dental microwear analysis was carried out on a sample of 46 individuals from the Prague-Zličín site, Czech Republic. The Prague-Zličín burial ground is dated to the Migration Period, 5th century AD. For each individual, molars or premolars were analyzed in secondary electrons of scanning electron microscope. The length, orientation and number of all observed striations were quantified using SigmaScan Pro 5.0, image analysis software. Subsequently, results obtained were compared with published datasets acquired from studies of various modern hunter-gatherers, pastoral, and agricultural populations with different dietary habits (Lalueza *et al.* 1996). The analysis yielded a similar microwear pattern within the Prague-Zličín population. The density and the length of microstriations showed no inter-group variability according to sex and age in adults; only an age-related variability, which might have resulted from different ratios of meat and vegetable intake, was observed between adults and subadults. The abrasiveness of food consumed in the Migration period was significantly higher than the other comparative Neolithic and Medieval samples in terms of striation density (NT) and length (XT). The observed amounts of abrasive particles in the diet might have originated from highly-abrasive food and/or food preparation technology. Migration period individuals were found to have a significantly higher number of vertical microwear features (NV), which were also found to be longer (XV) than other examined individuals from different periods. A possible high meat intake might be inferred in the Prague-Zličín population using NH/NT and NV/NT ratios. When comparing social status with dietary habits, a softer diet was found in individuals with higher social status.

1. Introduction

Buccal microwear analyses have been carried out on numerous past populations. Focusing mainly on inter- and intra-population variability within the non-occlusal striation pattern of postcanine dentition, these analyses have yielded valuable information on dietary habits (Puech *et al.* 1980; Pérez-Pérez *et al.* 1994; Lalueza *et al.* 1996; Pérez-Pérez 1990; 2004; Estebaranz *et al.* 2012, *etc.*). These findings have been recently supported by research on the buccal microwear patterns of African Pygmy Foragers and Bantu-Speaking Farmers and pastoralist populations that proved the different dietary habits to be independent of ecological conditions and reflected the abrasive properties of preferred foods (Romero *et al.* 2013). Proven findings show that there is a tendency for less striations and a higher frequency of vertical striations exhibited on the dental surfaces of carnivore populations rather than of vegetarian ones (Lalueza *et al.* 1996). The high incidence of abrasive particles in plant foods (phytoliths) result in higher scratch densities and an increasingly horizontally-oriented, vestibular microwear pattern in agricultural populations (Lalueza *et al.* 1996). The embedding of phytoliths in enamel surfaces and their classification has been demonstrated in the previous research of Lalueza Fox and his colleagues (1994) in a sample from La Olmeda, Spain. In addition, buccal microwear is independent of the analyzed teeth of individuals, as intergroup variability appears to be significantly higher than intragroup variability and to be independent of seasonal variations in dietary

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habits due to the long-term "turnover" effect in comparison to occlusal microwear pattern (Pérez-Pérez *et al.* 1994). Moreover, recent research of the observed long-term stability of buccal microwear patterns has shown them to be a reliable indicator of overall dietary habits (Romero *et al.* 2012).

2. Material and methods

2.1 Prague-Zličín burial ground

The archaeological site is located at the western edge of Prague (Czech Republic) and a complete skeletal burial ground was excavated here between 2005 and 2008. It is dated to the Migration Period, to the greater part of the 5th century AD, and the skeletons buried there belong to the so-called Vinařice Group (for more details, see Vávra *et al.* 2008; Vávra *et al.* 2012; Jiřík *et al.* 2015). From a historical point of view, this studied population inhabited an area just outside the Roman Empire: its members were considered as Barbarians inhabiting and migrating behind and along the fortified borders (Limes Romanus) of the Roman Empire. The analyzed skeletal sample consisted of 176 burials in 173 graves with the remains of 180 individuals. The state of bone preservation was very low (due to the geochemical and hydrological conditions, and the re-opening activities of looters), thus only 113 individuals were available for anthropological evaluation, including 19 subadults (0–14 years), and 94 adult individuals over 15 years ("adult" in terms of social status, not biological status) that consisted of 26 males, 33 females and 35 adult individuals of unknown sex (Víšková *et al.* 2012; Horáková *et al.* 2014; Horáková, Jarošová 2015). A preliminary analysis of buccal dental microwear from the Prague-Zličín population was undertaken on a random sample of 23 adult individuals (15+ yrs) and indicated a meat-based diet with large amounts of abrasive particles (NT=94.3) in their food; no statistically-significant sex- and age- (within the sample of studied age categories: 15–19 yrs; 20–35 yrs; 35–50 yrs; 50+ yrs) related differences were found within the Prague-Zličín population (Horáková *et al.* 2014).

In the current analysis, all 89 individuals from this burial ground with posterior teeth (*i.e.* premolars and molars) present were intended to be included in the dental microwear analysis, but due to postmortem enamel defects on a microscopic (*e.g.* grave 62, 64, 103, 172a, 174) or macroscopic level, only 46 individuals (51.7%) were included and the other 43 individuals (48.3%) had to be excluded. The microscopic damage found at the enamel surface can be attributed to post-mortem taphonomic processes, which affect the enamel surfaces and make it impossible to perform a dietary reconstruction (Martínez, Pérez-Pérez 2004). The damage patterns observed within the Prague-Zličín sample at the microscopic level (using SEM) included eroded surfaces with an irregular aspect, in some cases with a high density of parallel striations, or patches of slightly-damaged enamel, or an eroded enamel surface exhibiting incremental growth lines, known as perikymata. All the observed types of damage present at the microscopic level were known examples and had already been described in detail elsewhere (see Martínez, Pérez-Pérez 2004).

Thus, for the buccal microwear analysis, 7 subadult (0–14 yrs) and 39 adult (over 15 yrs) individuals with well-preserved buccal surfaces were eventually deemed suitable, and these constitute the final data collection for this population (Table 1). Data on each individual's sex and age-at-death has been adapted from previous estimations carried out in a palaeodemographic analysis (Víšková *et al.* 2012). Individuals that were tested for their dental microwear pattern were also linked with their grave goods in order to

Table 1. Demographics of the 46 individuals from Prague-Zličín tested for dental microwear pattern.

Gender \ Age	0–6 yrs	7–14 yrs	15–35 yrs	35–50 yrs	50+ yrs	Total	Subadults	Adults
Ambiguous	4	2	4	3	1	14	6	8
Females		1	3	9	4	17	1	16
Males			3	8	4	15		15
Total	**4**	**3**	**10**	**20**	**9**	**46**	**7**	**39**

Table 2. Individuals from Prague-Zličín grouped according to grave goods: GG0 = unknown grave goods; GG1 = common grave goods containing ceramic, bronze or iron objects, beads from glass; GG2 = grave goods containing precious materials as gold, silver, amber, or glass vessels.

Gender \ Grave goods	Age	GG0	GG1	GG2	Total
Ambiguous	all	2	6	6	14
	subadults		3	3	6
	adults	2	3	3	8
Females	all	2	6	9	17
	subadults			1	1
	adults	2	6	8	16
Males	all	5	7	3	15
	adults	5	7	3	15
Total	**all**	**9**	**19**	**18**	**46**

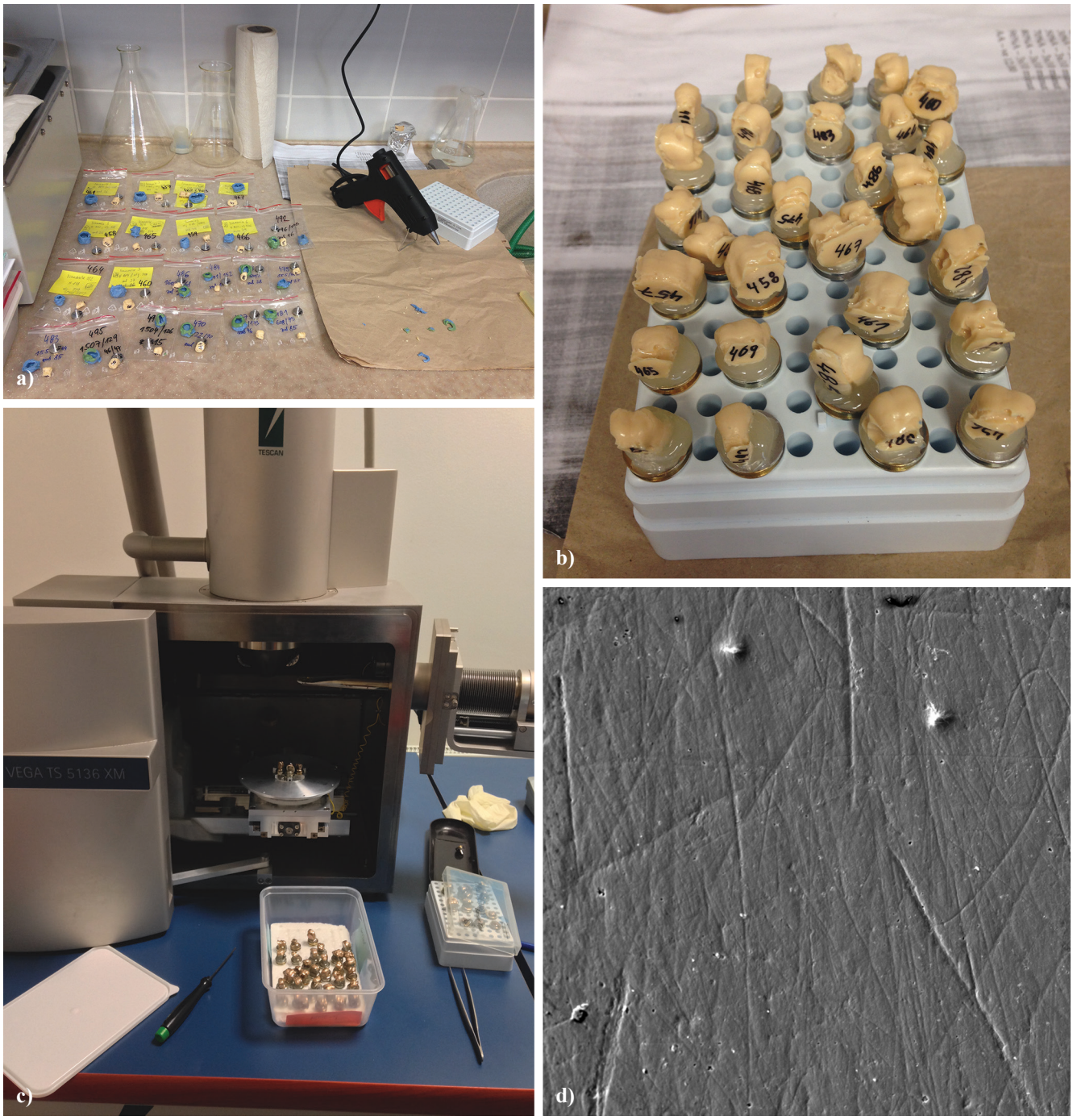


Figure 1. Preparation of dental negative and positive casts (a); preparation of scanning electron-microscope samples (b); SEM analysis (c); the surface of the first lower premolar (Pm3LR) analyzed in a male, died at age of 40–50 years from Prague-Zličín grave 594/65 (d).

show possible social stratification according to their dietary habits. Unfortunately, 44 of the 46 graves showed evidence of having been re-opened by looters, which would, of course, distort valuable information on their real social status; only graves no. 152 and 168 did not show any disruption of their burial area. Both of these graves contained grave goods made of precious materials. On the one hand, a lot of information regarding the original burial inventory is today unknown; on the other hand, the richest grave, no. 61 situated in the middle of the burial area, contained gold objects even after having been re-opened. With this information, we can only assume that the number of all objects put in the graves of this Prague-Zličín population was very high; but, up till now, only partial studies can be reasonably made. To conclude, currently the well-preserved grave goods have been categorized into three groups: all graves in group GG0 contained no objects and all of them had been re-opened (19.6%); these graves could have contained common or precious goods, but it is unknownable today. The next group of graves in category GG1 contained ceramic, bronze or iron objects, and/or glass beads (41.3%),

which represent common grave goods whose owners could be linked with common/average social status. Group GG2 graves contained grave goods made of precious materials, such as gold, silver, amber, or glass vessels (39.1%); these individuals can be linked with some higher social status (see Table 2).

2.2 Comparative modern human samples

Buccal microwear has been studied in modern hunter-gatherers, pastoralists, and agriculturists, all of whom have arisen from different ecological conditions and may have gained their food from all parts of the world (Lalueza *et al.* 1996). According to ecological criteria that, as indicated, correspond with the geographical latitude from which these people lived, these populations can be divided into four broad groups: (1) agriculturalist / vegetarian (Hindus, n=20: 7 females, 13 males); (2) mixed-diet, hunter-gatherer populations from tropical forests (Andamanese and Veddahs, n=27: 14 females, 9 males, 4 ambiguous); (3) carnivorous, hunter-gatherer and pastoralist populations, including Fueguians (mainly hunting and fishing), Inuits (exclusively hunting strategies), Vancouver Islanders (mainly fishing and hunting), and Lapps (predominantly reindeer herding) (n=62: 24 females, 30 males, 8 ambiguous); and (4) mixed-diet, hunter-gatherer populations from arid and mesothermal environments, including Bushmen, Australian Aborigines, and Tasmanians (n=44: 14 females, 18 males, 12 ambiguous) (Lalueza, Pérez-Pérez 1993; Lalueza *et al.* 1996). Except for three juvenile Bushmen skulls, only adult individuals were studied, in order to control for age variability of the striation pattern (Lalueza *et al.* 1996).

2.3 Study data collection

2.3.1 Teeth moulding

Both molars and premolars from the 46 individuals of the Prague-Zličín site were considered for buccal microwear analysis and a single tooth per individual was finally analyzed. Previous analyses of buccal microwear intra-individual variability have proved no differences between posterior tooth type for each individual (Pérez-Pérez *et al.* 1994), even if statistically-significant intra-individual differences of the XDM variable of microwear pattern between the first and second, lower-right and -left molars, and the upper-right, second premolar have been observed in a recent study made on an *Australopithecus afarensis* sample (Estebaranz *et al.* 2009).

Tooth selection of each individual in the Prague-Zličín sample depended on the preserved tooth type and the state of its enamel surface observed at a macroscopic level. If well-preserved buccal enamel was present on several teeth of a single individual, then preference was given to the first and second upper-left molars. Otherwise, the second premolars were chosen in preference. Left and upper teeth were preferred whenever possible.

Negative impressions of the tooth's buccal surface were obtained using polyvinylsiloxane Affinis Regular Body (Coltène®); afterwards, the bicomponent polyurethane resin Feroca Feropur PR55 + ER55 was used to make positive moulds (Galbany *et al.* 2004) (Figure 1a, b). Finally, the tooth replicas were sputter-coated with a 400 Å gold layer using SCD Balzers Unions 040 and then proceeded to SEM imaging.

2.3.2 SEM imaging

SEM images were obtained with a Scanning Electron Microscope Tescan Vega TS 5136XM at Masaryk University, Brno (Figure 1c). Micrographs were taken at 226 × magnification on the medial third of the buccal surface of the tooth crown (Pérez-Pérez *et al.* 1994). (Note: the 226 × magnification was calculated because of the wide-angled scanning window of the Tescan Vega. These micrographs are compatible with 100 × magnification of the SEM Cambridge Stereoscan 120 at the SCT, University of Barcelona). All SEM pictures were digitalized using SEM Vega TC Software Image Processing, obtaining 1024 x1024 pixel images that were subsequently enhanced with Adobe Photoshop v.8.0, and a 0.56 mm^2 enamel patch was cropped in all images for surface area standardization (Pérez-Pérez *et al.* 1994; Lalueza *et al.* 1996; Galbany *et al.* 2004; Figure 1d).

2.4 Data acquisition

Using image analysis software package SigmaScan Pro 5.0, the length (X), standard deviation of the length (SD), and number (N) of all striations present (T) were computed and 4 categories of orientation from 0˚ to 180˚ – in 45-degree intervals – were determined with respect to the given tooth's orientation: V = vertical; MD = mesio-occlusal to disto-cervical; DM = disto-occlusal to mesio-cervical; and H = horizontal. Mean values for each individual's tooth were characterized by a sum of 15 variables (Pérez-Pérez 1990; Lalueza, Pérez-Pérez 1993; Lalueza *et al.* 1993, 1996; Pérez-Pérez *et al.* 1994;1999; 2003). All micrographs from Prague-Zličín samples and other archaeological samples from Czech Republic were analyzed by one single researcher, Ivana Jarošová, to eliminate inter-observer error (see Galbany *et al.* 2005). All statistics were calculated and graphs obtained using the STATISTICA 10.0 StatSoft Inc. package, IBM SPSS Statistics 19.0, and PAST v2.17c. The significance of all statistical data was evaluated at the $p \leq 0.05$ level.

3. Results and discussion

3.1 Historical context of the Prague-Zličín population

Late Antique reports of the dietary habits of central European Populations are extremely rare. One of them is a notice by Jordanes (Getica XLIX, 257–258) describing the funeral ceremonies of the Huns (and perhaps also their Germanic vassals), in the case of the burial of King Attila. Among the rites we are told that "a strava, as they call it, was celebrated over his tomb with great revelling". The nature of this rite and especially its "culinary charge", as well as the linguistic origin of the word itself, remains unclear. Ambiguity of the

written sources is in this case so great that we can mostly judge based on the indirect evidence. This is the case for another report of Jordanes (Getica, XLIX, 273) describing the conflict between the Goths and Sueves, which was started by a raid on Dalmatia resulting in cattle robbery, from which we can infer that cattle played a special role in the economy (and, perhaps, also nutrition) of the Barbarians. Therefore, the archaeological and especially paleoenvironmental and natural science data (*i.e.* osteology of the burial provisions, archaeobotany, stable isotopes and dental microwear) remain a unique source of our knowledge concerning nutrition during the Migration Period.

3.2 Archaeobotanical and osteoarchaeological research at Prague-Zličín

An archaeobotanical macro-remain analysis of the carbonized and non-carbonized remains of useful plants was performed on the infill of the graves at Prague-Zličín. Even though the concentration of macro-remains samples was low, the results yielded the structure of their crops, where barley (*Hordeum vulgare*) was confirmed as being dominant. This crop structure was influenced by certain modern elements of the plant economy, which could have come from trade contacts, cultural exchange and/or migrants from different regions (perhaps the central Danube region) (see

Table 3. Descriptive statistics of all 15 variables in the 46 individuals from Prague-Zličín.

	PRG-ZL: all (n=46)				Adults (n=39)				Subadults (n=7)			
	Mean	**Minimum**	**Maximum**	**Std.Dev.**	**Mean**	**Minimum**	**Maximum**	**Std.Dev.**	**Mean**	**Minimum**	**Maximum**	**Std.Dev.**
NH	13.2	4.0	39.0	8.3	13.5	4.0	39.0	8.5	13.1	5.0	22.0	6.7
XH	159.7	79.1	314.7	53.7	170.1	79.1	314.7	56.1	118.3	86.8	138.5	19.3
SDH	134.4	46.8	243.5	58.4	144.5	51.1	243.5	59.2	90.7	46.8	165.5	41.9
NV	48.2	7.0	105.0	20.2	49.3	7.0	105.0	20.9	38.9	21.0	58.0	12.4
XV	205.3	117.6	323.9	57.1	214.5	120.5	323.9	56.6	153.8	117.6	184.9	23.5
SDV	151.1	78.3	240.7	38.1	155.0	78.3	240.7	38.1	123.4	102.0	143.2	17.7
NMD	20.2	5.0	53.0	12.8	20.4	5.0	53.0	12.3	20.0	5.0	42.0	15.6
XMD	158.9	81.8	290.6	52.3	165.5	96.2	290.6	51.2	116.3	81.8	154.2	25.5
SDMD	132.9	46.8	272.0	54.4	138.4	46.8	272.0	54.2	95.7	48.8	143.3	32.9
NDM	21.3	4.0	54.0	13.0	21.1	4.0	54.0	12.4	21.6	4.0	51.0	17.8
XDM	150.1	67.3	252.5	46.6	156.6	79.7	252.5	46.3	119.4	67.3	181.3	37.1
SDDM	123.2	33.8	222.0	47.1	125.0	33.8	222.0	45.5	106.9	51.2	215.1	58.9
NT	102.8	49.0	175.0	30.4	104.3	52.0	175.0	30.2	93.6	49.0	135.0	33.2
XT	179.0	101.1	296.3	44.3	187.1	101.1	296.3	42.8	135.2	101.9	175.9	24.4
SDNT	147.7	67.2	207.7	34.5	152.9	67.2	207.7	32.9	115.4	84.1	151.6	20.9
NH/NT	0.14	0.03	0.39	0.08	0.14	0.03	0.39	0.08	0.13	0.09	0.17	0.04
NV/NT	0.46	0.12	0.74	0.13	0.47	0.12	0.74	0.13	0.44	0.25	0.64	0.12
	Males (n=15)				**Females (n=16)**				**Ambiguous, Adults (n=8)**			
	Mean	**Minimum**	**Maximum**	**Std.Dev.**	**Mean**	**Minimum**	**Maximum**	**Std.Dev.**	**Mean**	**Minimum**	**Maximum**	**Std.Dev.**
NH	13.1	4.0	29.0	7.4	13.6	5.0	37.0	8.5	14.3	4.0	39.0	11.2
XH	190.1	111.4	312.7	52.0	167.7	95.5	314.7	57.4	137.2	79.1	214.1	49.8
SDH	162.5	81.2	237.7	51.0	138.0	51.1	242.3	57.4	124.0	52.6	243.5	74.2
NV	49.0	9.0	88.0	19.1	41.8	7.0	63.0	16.1	64.9	33.0	105.0	25.9
XV	224.8	161.5	323.9	48.6	225.2	121.8	303.5	61.8	174.0	120.5	266.9	45.9
SDV	164.6	103.1	240.7	33.2	151.2	78.3	218.0	42.1	145.0	86.7	187.3	38.9
NMD	18.7	8.0	37.0	8.4	20.2	5.0	49.0	14.2	23.9	9.0	53.0	15.3
XMD	187.0	108.4	290.6	60.0	160.9	110.9	263.2	43.0	134.7	96.2	183.2	30.5
SDMD	159.3	71.8	272.0	60.4	129.3	46.8	221.8	51.6	117.4	68.0	169.7	35.9
NDM	19.5	4.0	43.0	11.8	19.7	7.0	38.0	8.5	26.9	4.0	54.0	18.9
XDM	172.2	94.5	232.4	38.6	158.8	79.7	252.5	55.3	123.3	104.9	156.5	17.0
SDDM	137.5	60.6	217.4	42.7	123.1	33.8	222.0	54.8	105.6	73.9	129.8	19.2
NT	100.3	52.0	142.0	26.1	95.2	54.0	132.0	27.0	129.9	76.0	175.0	32.3
XT	204.5	148.4	296.3	41.7	187.2	101.1	249.1	39.2	154.5	112.2	215.6	35.9
SDNT	164.9	100.5	207.7	27.3	149.7	67.2	192.4	35.3	136.8	88.5	178.9	32.9
NH/NT	0.14	0.04	0.39	0.09	0.15	0.05	0.33	0.08	0.11	0.03	0.27	0.07
NV/NT	0.48	0.12	0.62	0.13	0.43	0.13	0.59	0.12	0.50	0.27	0.74	0.16

Šálková *et al.* 2016 – this IANSA issue). As confirmed by the osteoarchaeology analysis, the main source of meat was accounted for by domestic animals (cattle 21.0%, pig 16.5%, sheep/goat 0.3%), which was supplemented by hunting wild fauna (Nohálová *et al.* 2016 – this IANSA issue). On the one side, the results of both these analyses seem to provide the expected data (see Dreslerová, Kočár 2013); on the other, it is necessary to take into account that these results might be somewhat skewed or distorted. The whole area of the burial ground was full of burrows as evidenced by the extremely high proportion of rodent bones (56.4%) (Nohálová *et al.* 2016 – this IANSA issue); rodents had been living and tunnelling there for centuries and thus disturbing the original distribution of plant macro-remains by moving plant seeds into different archaeological layers (see C^{14} data, in Šálková *et al.* 2016 – this IANSA issue). For this reason, data from the archaeobotanical and osteoarchaeological research of the grave-infill should not be used for a diet reconstruction of the Prague-Zličín individuals, as such results would be misleading and only cause bias.

3.3 The Prague-Zličín dental buccal microwear pattern

Mean values, medians, minimums, maximums and standard deviation values of the studied population from Prague-Zličín with the analyzed categories are shown in Table 3. No deviations from the normal distribution (Kolmogorov-Smirnov normality test, $p<0.05$) in all 15 variables was observed in the Prague-Zličín population (tests were performed using groups of both adults and subadults, including only adults and only subadults). The density of microstriations (NT) in the modern human hunter-gatherer groups ranged between 32.0 and 74.8 (Lalueza *et al.* 1996), whereas the Prague-Zličín sample reached higher values (NT from 49.0 to 175.0 with a mean of 102.8; Figure 2a, Table 3). This result may be indicative of a high abrasive diet in the Prague-Zličín sample. By comparing the average striation lengths (XT), the Prague-Zličín population approaches that (XT=179.0) of all mixed-diet, gatherer populations and also hunter (carnivorous) populations (Figure 2a). By using the non-parametric Kolmogorov-Smirnov test, statistical significant differences at $p<0.05$ were found in the XH ($p<0.025$), XV ($p<0.01$), SDV ($p<0.025$), XT ($p<0.005$) and SDNT ($p<0.05$) variables between adults and subadults, which is in accordance with previously-analyzed populations, where a different buccal microwear pattern was observed between groups of adults and infants (Pérez-Pérez *et al.* 1994; Pinilla Pérez *et al.* 2011). By comparing both the NT and XT values of the Prague-Zličín sample, we see a tendency towards a lower striation density (NT) and shorter scratches (XT) in subadults compared to the adult sample. The observed high amounts of abrasive particles (NT) in the diet of both adults and subadults might have originated from certain highly abrasive foods, or to the type of food preparation technology; or it can be concluded that this density of microstriations is of unclear origin – as this studied population, dated to the Migration period, has not been identified in historical sources, and hence there is no available information on the food composition of typical diets and their processing techniques. The extensive microwear pattern might be explained by the coarsely-processed foods, which include relatively large amounts of exogenous grits in the Prague-Zličín buccal microwear pattern (for detailed information, see Salazar-García *et al.* 2016; Romero, De Juan 2007). For all subsequent analysis, these data were treated separately for the adult and subadult sample of the Prague-Zličín population.

The non-parametric Kruskal-Wallis ANOVA for 15 variables gave no statistically-significant sex-related differences in the adult sample within the Prague-Zličín population. Both adult females (n=16) and males (n=15) exhibited a similarly-increased number of microwear pattern (NT) without there being a statistically-significant difference in their average length (XT), which in infants (0–6 years), and partially in females and males, overlap with the values reported for arid, tropical and vegetarian populations (Figure 2a). As a conclusion, no sexual dimorphism in dietary strategy, with no predominance in either a vegetable or meat-based diet, may be hypothesized. When comparing the 15 variables using non-parametric Kruskal-Wallis ANOVA, between the age categories of the subadult- (0–6 yrs and 7–14 yrs) and adult-analyzed sample (15–35 yrs, 35–50 yrs, 50+ yrs), we find statistically-significant differences in the average length of all striations (XT), and the length of horizontal (XH) and vertical (XV) striations. Statistically-significant differences between adults and subadults were also present in the standard deviations of all (SDNT) and vertical striations (SDV). When comparing the three adult age categories within the adult population, no statistically-significant difference was observed using Kruskal-Wallis ANOVA. These results are consistent with the previous preliminary analysis of buccal dental microwear performed on randomly-selected adult individuals from Prague-Zličín (n=23), that confirmed no statistically-significant sex- and age-related differences in adults (Horáková *et al.* 2014).

Finally, all analyzed individuals were compared using the NH/NT and NV/NT ratio in order to highlight differences found in the ratio of number of horizontal (NH) and vertical striations (NV), which reduces the differences between the densities of microstriations (NT) in the Prague-Zličín population in comparison with a modern human sample with known diet (Figure 3). Males show an increased number of vertical striations and this group overlaps with the hunters depending on meaty food (Figure 3a); females also show higher values of vertical striations associated with lower values of horizontal striations, which overlaps with that of a carnivorous diet, but some of the females in their horizontal striations (individuals 60 and 78) can be inferred as of mixed-food habits. Individual no. 61, with a high social status due to the presence of golden grave goods, displayed the highest values for vertical striations and the lowest for horizontal striations from all the individuals studied. His/her diet can be assumed as one with a high meat intake of unusual composition within the studied population. Only two individuals (female no. 35, male no. 119) do not show a

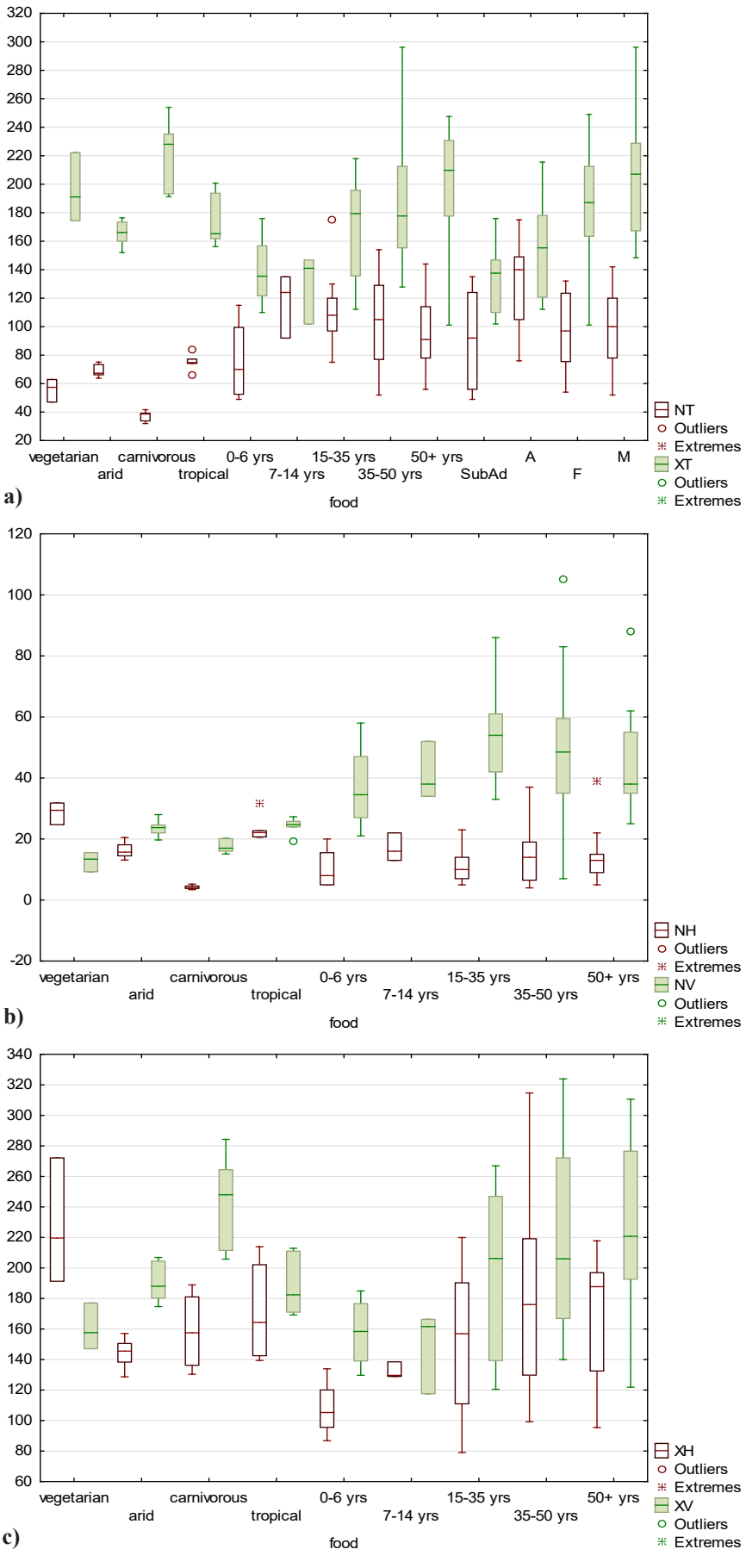
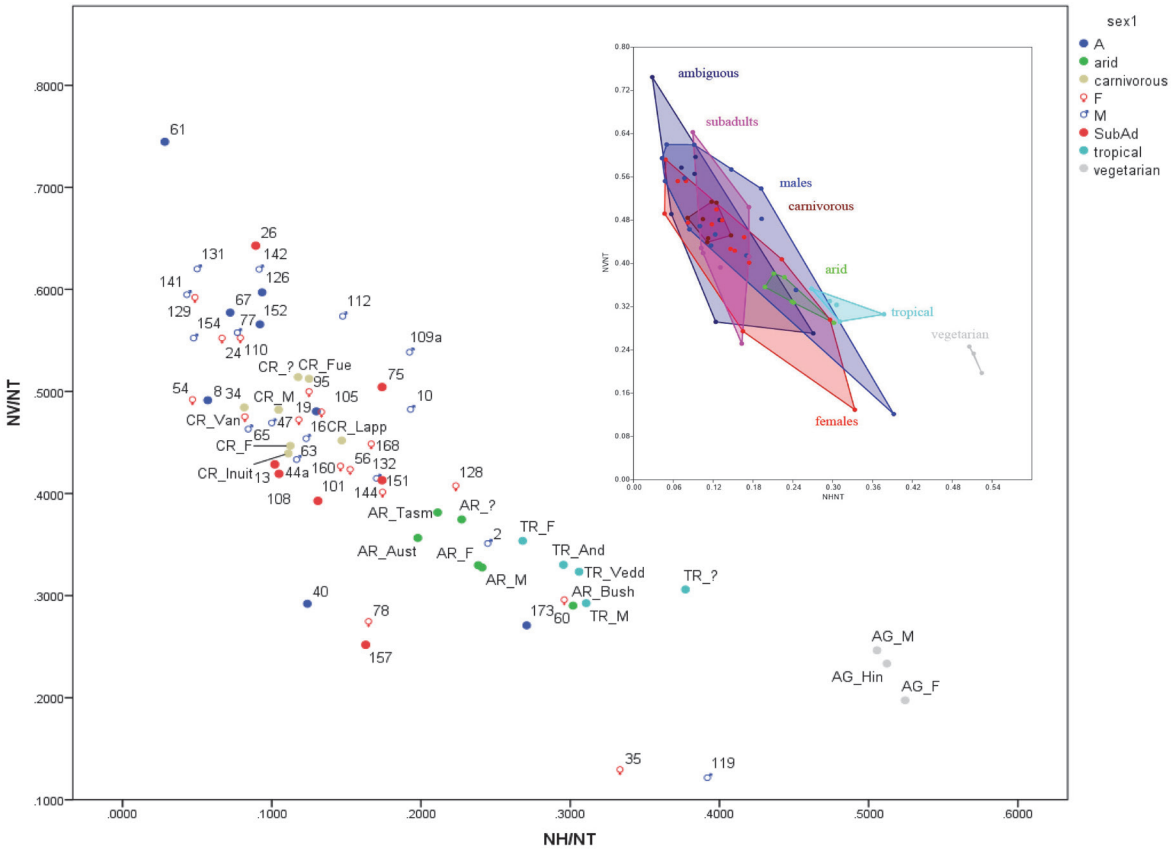


Figure 2. Boxplot showing the density of microstriations (NT), the length of microstriations (XT) (a) and number and length of horizontal (NH, XH) and vertical striations (NV, XV) (b, c) observed in the teeth of arid, tropical, vegetarian and carnivorous populations in comparison with males (M), females (F), ambiguous (A) and according to age categories from the Prague-Zličín population.



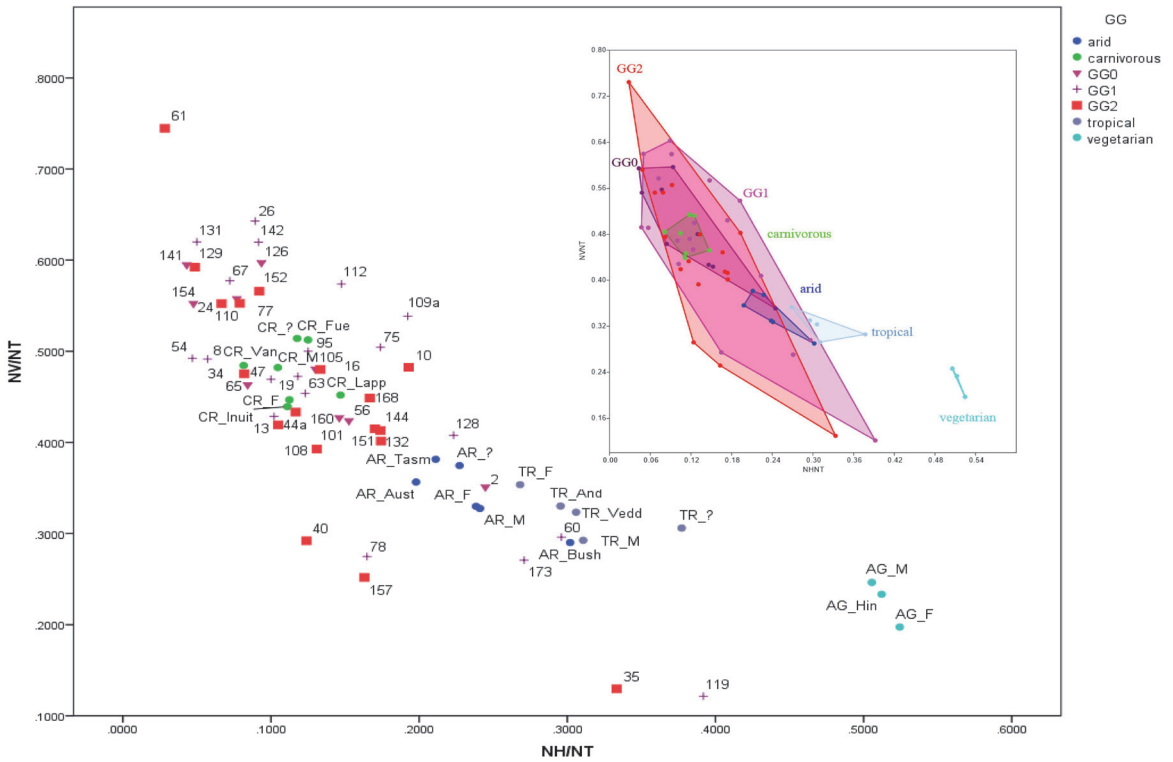


Figure 3. Scatterplot of NH/NT index with respect to NV/NT index for all individuals from the Prague-Zličín population: M (adult males), F (adult females), A (ambiguous adults), SubAd (aubadult individuals 0–15 yrs) and populations with recently studied samples with known dietary pattern (AG_Hin = Hindu, vegetarian agriculturalist; populations from tropical areas: TR_And = Andamanese, TR_Vedd = Veddahs; populations from arid areas AR_Bush = Bushmen, AR_Tasm = Tasmanians, AR_Aus = Australian aborigines; carnivorous populations: CR_Fue = Fueguians, CR_Inuit = Inuits, CR_Van = Vancouver islanders, CR_Lapp = Lapps; see Lalueza *et al.* 1996): (a) scatterplot according to sex /age with convex hull showing the areas occupied by studied groups, using different colours, representing the smallest convex polygon that contains all points; (b) scatterplot according to grave goods with convex hull: GG0 = unknown grave goods, GG1 = common grave goods, GG2 = grave goods containing precious materials such as gold, silver, amber, or glass vessels. The populations with known diets are presented as mean values only, whereas the population from Prague-Zličín shows raw data.

clear food pattern. For female no. 35 we can assume a high social status, and for male no. 119 we assume a common/average social status; however, no conclusion can be made on these two individuals. In summary, it is possible to infer meat predominance in the diet of both the male and female adult sample from Prague-Zličín through the NH/NT and NV/NT ratios, with a minimal number of horizontal and a high number of vertical striations, which are present in carnivorous hunters. When using the ratios for NH – NV – NT for inferences of diet composition, we can assume that 4 out of 7 subadults (about 57%) and 29 of 39 adults (about 75%) (6 of 8 ambiguous adults, 11 of 16 females and 12 of 15 males) have a significant meat intake in their diet. Taking into account their well-preserved grave goods, then 11 adult and 3 subadults have common grave goods, whereas 10 adults and one subadult have grave goods made of precious materials, which can be linked to higher social status. For 8 adult individuals it was impossible to estimate their social status – as their graves had been re-opened and were without any objects. All other examined individuals can be associated with either a mixed or unknown diet. When analyzing the ratio of abrasive particles in a diet, a relatively soft diet (within the Prague-Zličín specimens) with very short striations was observed in 4 out of 7 (57%) analyzed subadults individuals, whereas in the adults it was possible to observe a relatively soft diet in 25 out of 39 individuals (about 64%). In the adults there was a relatively soft diet linked with a wide range of average length of all striations (XT), which does not produce such a clear pattern. The highly-abrasive diet (within the Prague-Zličín specimens) linked with the short or very short striations were present in 7 out of 39 (18%) adult individuals and only 1 immature individual (14%).

When comparing separate groups of adult males, adult females and subadults according to their grave goods (Figure 3b), there is no statistically-significant difference between the GG1 and GG2 groups at p=0.05 using the non-parametric Kolmogorov-Smirnov two-sample test, even though 4 out of 7 subadults and 9 of 17 females have objects made of precious materials in their graves. Males had mostly common grave goods in their graves, with only 3 out of 15 having goods made of precious materials, but one third of their graves had been re-opened and possibly for this reason these graves were also empty. When comparing grave goods with respect to an individual's age, statistical differences were confirmed, according to age category, between the subadult (0–6/7–14 years) and adult age categories. Comparing the group of meat eaters according to their grave goods, one can point out that a meat-dependent diet was eaten by 11 of the 18 individuals with higher social status *(i.e.* the group with precious grave goods, GG2) and by 14 of the 19 individuals with common/average social status (*i.e.* the group with common grave goods, GG1). It is thus possible to assume that meat was eaten very often in the population of Prague-Zličín, independent of their social status. When comparing the composition of diet with respect to the corresponding

Table 4. Mean values of selected buccal microwear variables in adults.

Population (only adults over 15 years)	n	NT	XT	SD NT	SD XT	NH	NV	SD NH	SD NV	NH/NT	NV/NT	Reference
Carnivorous	62	37.1	217.2	16.2	48.5	4.0	17.6	2.6	8.5	0.1078	0.4744	Lalueza *et al.* 1996
Tropical	27	74.6	168.7	22.7	42.3	22.3	24.4	8.5	12.6	0.2989	0.3271	Lalueza *et al.* 1996
Arid	44	68.5	164.6	18.5	32.2	16.2	23.4	7.9	8.9	0.2365	0.3416	Lalueza *et al.* 1996
Vegetarian/agriculturalist	20	57.4	191.1	17.8	49.6	29.4	13.4	12.4	8.1	0.5122	0.2334	Lalueza *et al.* 1996
Neol_LBK, Linear pottery in Moravian settlements, including Vedrovice cemetery, 55–49 century BC, CZ	29	87.6	144.2	21.2	34.1	19.3	30.1	10.1	14.8	0.2202	0.3434	Jarošová *et al.* 2008, Jarošová 2008
Neol_LgK, Lengyel culture in Moravian settlements, 49–37 century BC, CZ	11	89.6	149.6	22.9	22.8	13.5	35.5	7.7	10.5	0.1513	0.3959	Jarošová *et al.* 2008, Jarošová 2010, Trampota *et al.* 2012
Migration_period Prague-Zličín, 5 century AD, CZ	39	104.3	187.1	30.2	42.8	13.5	49.3	8.5	20.9	0.1294	0.4727	this paper
Late Roman, Tossal de les Basses, 4–8 century AD, Spain	26	104.5	96.9	46.2	20.1	NA	NA	NA	NA	NA	NA	Salazar-García *et al.* 2016
Old_Slavonic_population (Early Medieval period), Dolní Věstonice Na Pískách, 9–10 century AD, CZ	60	82.4	158.9	22.3	30.5	14.6	31.2	7.8	12.5	0.1773	0.3792	Jarošová 2007a,b, Jarošová *et al.* 2012
Middle_Ages, Dolní Věstonice Vysoká Zahrada, 12 century AD, CZ	36	84.5	166.2	15.5	32.2	15.6	30.4	7.4	8.8	0.1847	0.3595	Jarošová 2007a,b

grave goods, it is possible to conclude that a soft, or very soft, diet was eaten by 16 of the18 individuals with higher social status (*i.e.* the GG2 group with precious grave goods), whereas a very abrasive diet was eaten by 4 individuals with common grave goods (group GG1) and only 2 individuals with higher social status (group GG2).

3.4 Comparative archaeological samples

The Neolithic and Medieval samples represent populations from the Czech Republic used to compare buccal microwear patterns with the studied archaeological population from Prague-Zličín dated to the Migration period (see Table 4). As proved by previous studies, all of these populations depended only on a terrestrial diet (Zvelebil, Pettitt 2013; Bickle *et al.* 2014; Richards *et al.* 2008; Jarošová *et al.* 2008; Jarošová 2008). The Early Neolithic sample dated to Linear Pottery (Linearbandkeramik, LBK) represents early farmers depending mainly on domesticated plant species (Zvelebil, Pettitt 2013; Jarošová *et al.* 2008; Jarošová 2008), whereas the Late Neolithic sample dated to the Lengyel culture (LgK / Moravian Painted Ware) represents the dramatic changes in diet that comes with a reliance on hunting wild animals (Jarošová *et al.* 2008). Medieval samples from Dolní Věstonice (Czech Republic) represent both the Old Slavonic epoch, *i.e.* Early Medieval period (historically known as the Great Moravian epoch) and the Medieval population well known for its intensive farming with grain cultivation. Both samples were highly dependent on cereal resources, since their meat consumption was low (Jarošová 2007a; 2007b; Jarošová *et al.* 2012). The Late Roman sample from Spain falls into an identical period as the Prague-Zličín sample (5th century AD). The Late Roman sample represents a terrestrial diet with no evidence of marine protein consumption, which appears to be softer compared to other analyzed Neolithic and Medieval samples from the same geographical area in Spain (Salazar-García *et al.* 2016).

When comparing the Prague-Zličín sample with other archaeological populations dated to the Neolithic, Late Roman and Medieval period, only adults (over 15 years) were included and only the differences in buccal microwear pattern were observed. Subadults were not examined for their buccal microwear pattern due to the small number of individuals available for analysis in each group. Buccal-microwear data for the populations analyzed are shown in Table 4 and Figures 4 and 5. Significant statistical differences among the Neolithic, Medieval and Migration period groups in terms of their microwear pattern were found (Kruskal-Wallis ANOVA; $p<0.05$: NV, XV, SDV, XMD, SDMD, SDDM, NT, XT, SDNT and ratios NH/NT and NV/NT). Migration period individuals were found to have a significantly higher number of vertical microwear features (NV), which were also found to be longer (XV) than other examined individuals from the other periods. The abrasiveness of the food consumed in the Migration period was also significantly the highest among

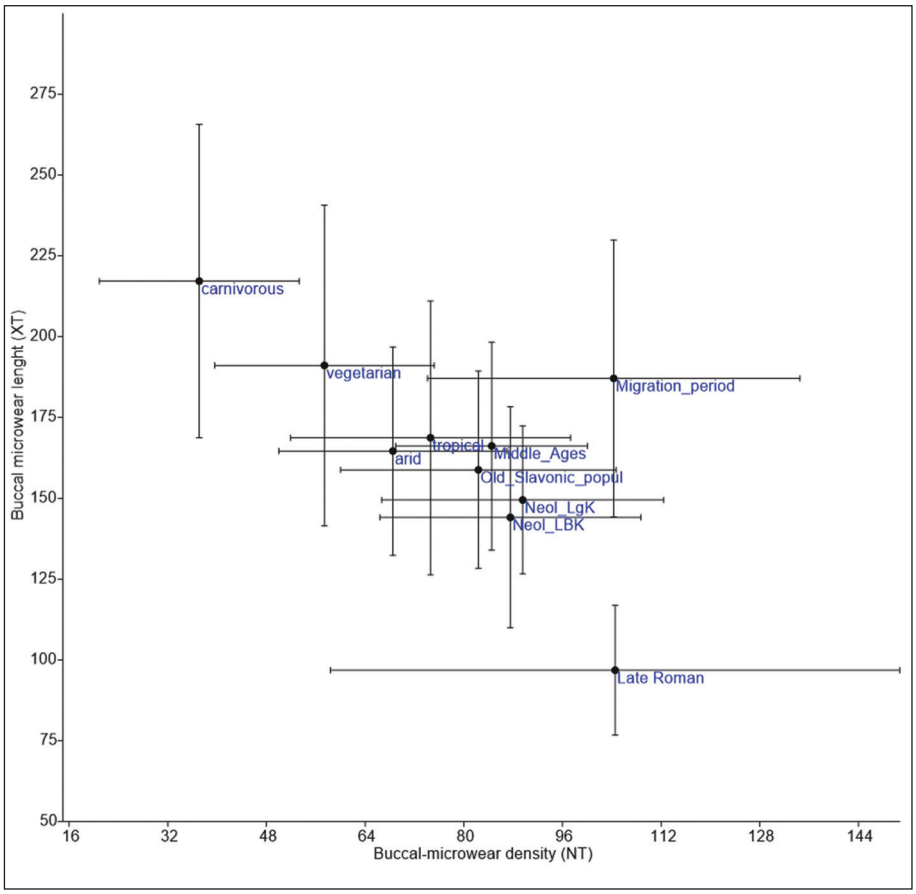


Figure 4. Bivariate plot comparing buccal microwear density (NT) and length (XT, in μm) related to the dietary abrasiveness between those adult populations (*i.e.* over 15 years old) analyzed. Error bars denote ± standard deviation. For data source, see Table 4.

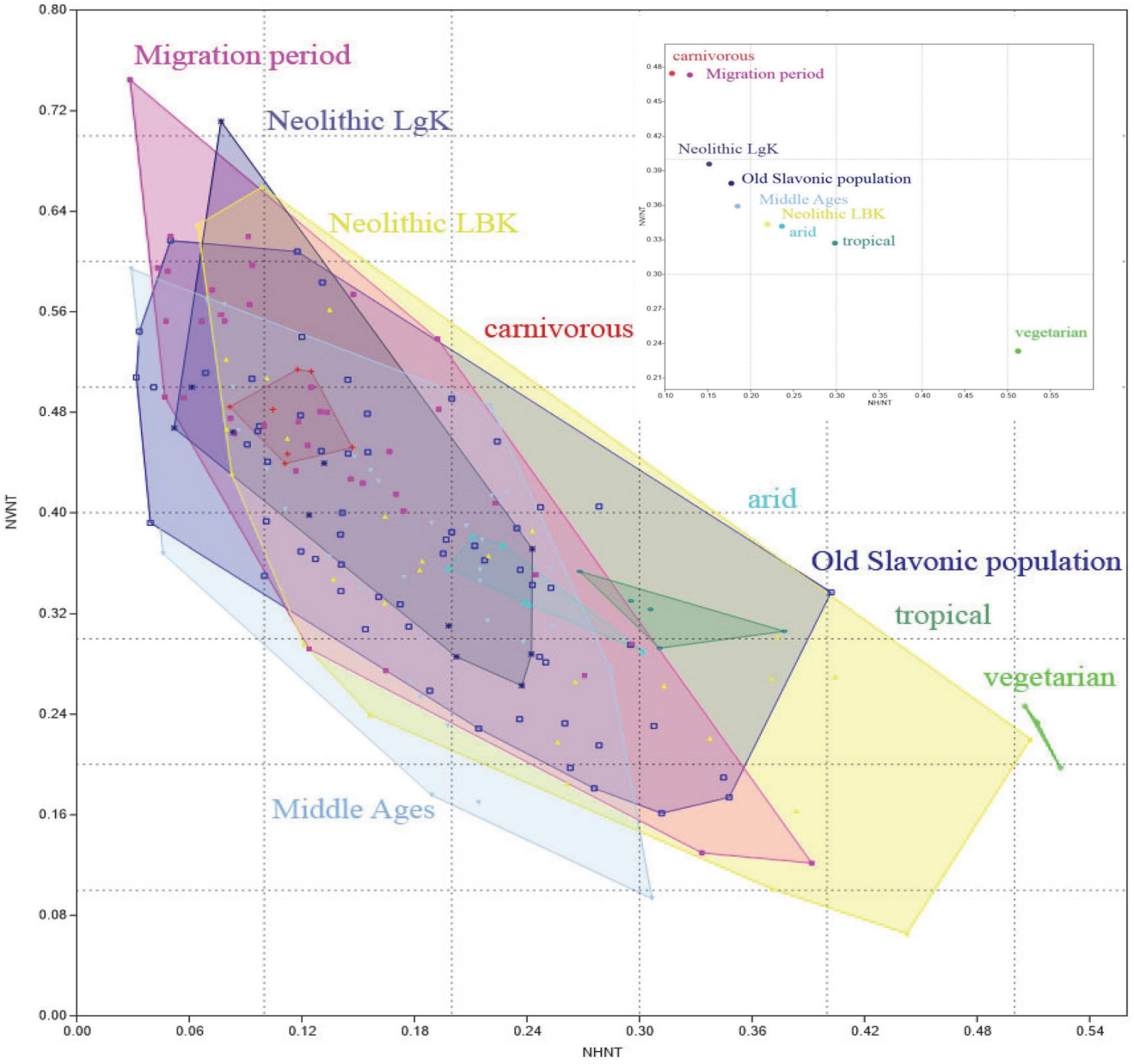


Figure 5. Scatterplot of NH/NT index with respect to NV/NT index for adult individuals from the Prague-Zličín population (Migration period) and other comparative samples of adult individuals [populations with known diet: vegetarian agriculturalist, populations from tropical and arid areas and carnivorous populations (Lalueza *et al.* 1996); Neolithic samples dated to Linear Pottery (LBK) and Lengyel culture (LgK); and samples from Dolní Věstonice comparing Old Slavonic population (Early Medieval period) with Middle Ages sample]. The scatterplot with convex hull shows the areas occupied by the studied groups (using different colours) representing the smallest convex polygon that contains all points. Populations with known diet are presented as mean values only, whereas archaeological populations show raw data. Mean values of each comparative sample are presented in the small chart above right; for data sources, see Table 4.

the other comparative archaeological samples in terms of striation density (NT) and length (XT).

By comparing both the Neolithic groups with both the Medieval samples and the Migration period samples for dietary abrasiveness (NT and XT), we found that the buccal microwear of the Neolithic and Medieval populations is characterized by a lower density of smaller microwear length, indicative of a less abrasive diet than that of individuals of the Late Roman and Migration periods (Table 4 and Figure 4). Moreover, adults in the Migration period sample have an identical dietary abrasiveness as adults in the Late Roman sample; both samples differing only in the length of their microstriations, being twice as long in the Migration period sample. This could indicate the same abrasiveness of food in both samples, but with differences in food processing methods between the Migration and Late Roman samples, *i.e.* between the Barbarian and Late Roman populations during the 5th century in the two different geographical areas.

When comparing both Neolithic groups with both the Medieval and Migration period samples for the ratio of

Table 5. List of individuals from the Prague-Zličín site included in the dental microwear analysis (F = female, M = male, A = ambiguous, Ad = adult, SubAd = subadult, GG0 = unknown grave goods, GG1 = common grave goods, GG2 = grave goods containing precious materials as gold, silver, amber, or glass vessels).

Grave no.	Context / grave	Archeological context	Grave goods	Sex	Age-at-death	Sex category	Age category	Age category 1	Tooth	FDI code	NH/NT	NV/NT	NT	XT	Dietary inferrences through NH – NV – NT ratio	Composition of diet	Lenght of striations
2	501/2	re-opened grave	GG0	M	30–40	M	Ad	35–50 yrs	M3UL	28	0.2447	0.3511	94	150.1	lower NV, higher NH….. mixed-diet	soft diet	short striations
8	518/8	re-opened grave	GG1	?	14–17	A	Ad	15–35 yrs	M1LL	36	0.0571	0.4914	175	113.5	high NV, low NH…meat	highly abrasive diet	very short striations
10	522/10	re-opened grave	GG2	M?	50+	M	Ad	50+ yrs	M2UL	27	0.1930	0.4825	114	219.5	high NV, low NH…meat	soft diet	long striations
13	523/13	re-opened grave	GG1	?	4,5–5	A	SubAd	0–6 yrs	m1UL	64	0.1020	0.4286	49	133.3	high NV, low NH…meat	very soft diet	very short striations
16	527/16	re-opened grave	GG2	F	16–19	F	Ad	15–35 yrs	M1UR	16	0.1333	0.4800	75	194.4	high NV, low NH…meat	very soft diet	short striations
19	530/19	re-opened grave	GG1	F?	45–50	F	Ad	35–50 yrs	M2UR	17	0.1181	0.4724	127	180.8	high NV, low NH…meat	soft diet	short striations
24	535/24	re-opened grave	GG2	F	30–40	F	Ad	35–50 yrs	Pm3UL	24	0.0667	0.5524	105	159.1	high NV, low NH…meat	soft diet	short striations
26	537/26	re-opened grave (?)	GG1	?	3–4	A	SubAd	0–6 yrs	m2UL	65	0.0893	0.6429	56	175.9	high NV, low NH…meat	very soft diet	short striations
34	544/34	re-opened grave	GG2	F	30–40	F	Ad	35–50 yrs	M1UL	26	0.0820	0.4754	122	210.0	high NV, low NH…meat	soft diet	long striations
35	545/35	re-opened grave	GG2	F	45–50	F	Ad	35–50 yrs	Pm3LR	44	0.3333	0.1296	54	167.9	low NV, high NH…. mixed / unknown diet	very soft diet	short striations
40	550/40	re-opened grave	GG2	?	24–30	A	Ad	15–35 yrs	Pm4LR	45	0.1239	0.2920	113	112.2	lower NV, higher NH….. mixed-diet	soft diet	very short striations
44a	555/44a	re-opened grave	GG2	M?	16–20	M	Ad	15–35 yrs	M2UL	27	0.1167	0.4333	120	195.8	high NV, low NH…meat	soft diet	short striations
47	563/47	re-opened grave	GG1	?	30–35	M	Ad	15–35 yrs	M2UL	27	0.1000	0.4692	130	176.0	high NV, low NH…meat	soft diet	short striations
54	572/54	re-opened grave	GG1	F	35–45	F	Ad	35–50 yrs	M1UR	16	0.0469	0.4922	128	153.0	high NV, low NH…meat	soft diet	short striations
56	574/56	re-opened grave	GG0	F	35–45	F	Ad	35–50 yrs	Pm4LR	45	0.1525	0.4237	59	215.1	high NV, low NH…meat	very soft diet	long striations
60	587/60	re-opened grave	GG1	F	35–40	F	Ad	35–50 yrs	M1UL	26	0.2960	0.2960	141	157.4	lower NV, higher NH….. mixed-diet	highly abrasive diet	short striations
61	586/61	re-opened grave	GG2	?	35–40	A	Ad	35–50 yrs	Pm4LL	35	0.0284	0.7447	125	209.3	high NV, low NH…meat	soft diet	long striations
63	591/63	re-opened grave	GG1	M	45	M	Ad	35–50 yrs	Pm4LR	45	0.1231	0.4538	130	167.3	high NV, low NH…meat	soft diet	short striations

Table 5. List of individuals from the Prague-Zličín site included in the dental microwear analysis (F = female, M = male, A = ambiguous, Ad = adult, SubAd = subadult, GG0 = unknown grave goods, GG1 = common grave goods, GG2 = grave goods containing precious materials as gold, silver, amber, or glass vessels). *(Continuation)*

Grave no.	Context / grave	Archeological context	Grave goods	Sex	Age-at-death	Sex category	Age category	Age category 1	Tooth	FDI code	NH/NT	NV/NT	NT	XT	Dietary inferrences through NH – NV – NT ratio	Composition of diet	Lenght of striations
65	594/65	re-opened grave	GG0	M	40–50	M	Ad	35–50 yrs	Pm3LR	44	0.0842	0.4632	95	254.5	high NV, low NH…meat	soft diet	long striations
67	599/67	re-opened grave	GG1	?	16–20	A	Ad	15–35 yrs	M2UL	27	0.0722	0.5773	97	215.6	high NV, low NH…meat	soft diet	long striations
75	608/75	re-opened grave	GG1	?	4–5	A	SubAd	0–6 yrs	m2LR	85	0.1739	0.5043	115	137.6	high NV, low NH…meat	soft diet	very short striations
77	721/77	re-opened grave	GG0	M	40–50 (50)	M	Ad	35–50 yrs	M1UR	16	0.0769	0.5577	52	296.3	high NV, low NH…meat	very soft diet	long striations
78	722/78	re-opened grave	GG1	F	45–55	F	Ad	50+ yrs	M2UL	27	0.1648	0.2747	91	101.1	lower NV, higher NH….. mixed-diet	soft diet	very short striations
95	778/95	re-opened grave	GG1	F	50	F	Ad	50+ yrs	Pm3LR	44	0.1250	0.5000	56	193.5	high NV, low NH…meat	very soft diet	short striations
101	785/101	re-opened grave (?)	GG2	?	3–4	A	SubAd	0–6 yrs	m2UR	55	0.1310	0.3929	84	110.0	high NV, low NH…meat	soft diet	very short striations
105	789/105	re-opened grave	GG0	?	35–40	A	Ad	35–50 yrs	M2UL	27	0.1299	0.4805	154	127.8	high NV, low NH…meat	highly abrasive diet	very short striations
108	796/108	re-opened grave	GG2	?	10	A	SubAd	7–14 yrs	M1LR	46	0.1048	0.4194	124	146.8	lower NV, lower NH….. meat / mixed-diet	soft diet	very short striations
109	797/109	re-opened grave	GG1	M	40?	M	Ad	35–50 yrs	Pm4UR	15	0.1923	0.5385	78	228.8	high NV, low NH…meat	soft diet	long striations
110	798/110	re-opened grave	GG2	F	40–50	F	Ad	35–50 yrs	Pm3LL	34	0.0789	0.5526	76	249.1	high NV, low NH…meat	soft diet	long striations
112	800/112	re-opened grave	GG1	M	45–55	M	Ad	50+ yrs	M1LL	36	0.1475	0.5738	61	247.6	high NV, low NH…meat	very soft diet	long striations
119	807/119	re-opened grave	GG1	M	45–50 (50)	M	Ad	35–50 yrs	M2LR	47	0.3919	0.1216	74	186.0	low NV, high NH…. mixed / unknown diet	very soft diet	short striations
126	1504/126	re-opened grave	GG0	?	30–40	A	Ad	35–50 yrs	Pm4UR	15	0.0935	0.5971	139	153.3	high NV, low NH…meat	highly abrasive diet	short striations
128	1506/128	re-opened grave	GG1	F	20–25	F	Ad	15–35 yrs	M1UL	26	0.2233	0.4078	103	135.7	lower NV, higher NH….. mixed-diet	soft diet	very short striations
129	1507/129	re-opened grave	GG2	F	15–17	F	Ad	15–35 yrs	M1UL	26	0.0485	0.5922	103	180.4	high NV, low NH…meat	soft diet	short striations
131	1509/131	re-opened grave	GG1	M	50+	M	Ad	50+ yrs	Pm3LL	34	0.0500	0.6200	100	209.8	high NV, low NH…meat	soft diet	long striations
132	1544/132	re-opened grave	GG2	M?	35–45	M	Ad	35–50 yrs	M2UL	27	0.1702	0.4149	94	207.1	lower NV, lower NH….. meat / mixed-diet	soft diet	long striations

Table 5. List of individuals from the Prague-Zličín site included in the dental microwear analysis (F = female, M = male, A = ambiguous, Ad = adult, SubAd = subadult, GG0 = unknown grave goods, GG1 = common grave goods, GG2 = grave goods containing precious materials as gold, silver, amber, or glass vessels). *(Continuation)*

Grave no.	Context / grave	Archeological context	Grave goods	Sex	Age-at-death	Sex category	Age category	Age category 1	Tooth	FDI code	NH/NT	NV/NT	NT	XT	Dietary inferrences through NH – NV – NT ratio	Composition of diet	Lenght of striations
141	1553/141	re-opened grave	GG0	M	15–17	M	Ad	15–35 yrs	M1UL	26	0.0431	0.5948	116	218.0	high NV, low NH…meat	soft diet	long striations
142	1555/142	re-opened grave	GG1	M	50+	M	Ad	50+ yrs	Pm4LL	35	0.0915	0.6197	142	161.6	high NV, low NH…meat	highly abrasive diet	short striations
144	1557/144	re-opened grave	GG2	?	12	A	SubAd	7–14 yrs	m2LR	85	0.1739	0.4130	92	101.9	lower NV, lower NH….. meat / mixed-diet	soft diet	very short striations
151	1570/151	re-opened grave	GG2	F	40–50	F	Ad	35–50 yrs	Pm4LL	35	0.1742	0.4015	132	174.6	lower NV, lower NH….. meat / mixed-diet	highly abrasive diet	short striations
152	1571/152	intact (?)	GG2	?	24–30	A	Ad	15–35 yrs	Pm4UR	15	0.0921	0.5658	76	178.5	high NV, low NH…meat	soft diet	short striations
154	1573/154	re-opened grave	GG0	M	35–45	M	Ad	35–50 yrs	Pm3LR	44	0.0476	0.5524	105	148.4	high NV, low NH…meat	soft diet	very short striations
157	1576/157	re-opened grave	GG2	F	13–14	F	SubAd	7–14 yrs	M1UR	16	0.1630	0.2519	135	141.0	lower NV, higher NH….. mixed-diet	highly abrasive diet	very short striations
160	1594/160	re-opened grave	GG0	F	50+	F	Ad	50+ yrs	M1LR	46	0.1461	0.4270	89	240.5	high NV, low NH…meat	soft diet	long striations
168	1602/168	intact (?)	GG2	F	55+	F	Ad	50+ yrs	M2UL	27	0.1667	0.4487	78	230.7	high NV, low NH…meat	soft diet	long striations
173	1611/173	re-opened grave	GG1	?	55+	A	Ad	50+ yrs	M1LR	46	0.2708	0.2708	144	177.7	lower NV, higher NH….. mixed-diet	highly abrasive diet	short striations

horizontal and vertical striations (NH/NT and NV/NT), we found differences between the Neolithic adult samples in terms of higher number of vertical striations and lower number of horizontal striations in the Lengyel sample, which can be an indicator of a more meat-based diet in comparison to the LBK sample that has a higher number of horizontal striations as evidence of a mixed diet. Both the Medieval adult samples present similar buccal microwear patterns with NH/NT and NV/NT ratios that can be associated with a mixed diet. The Migration period represented by the Prague-Zličín population has the highest values of vertical striations (in terms of NH/NT and NV/NT) with the lowest number of horizontal striations among all comparative samples, which is similar to the carnivorous populations as shown in Figure 5. This buccal microwear pattern can thus be associated with the high meat intake of the adult Prague-Zličín population.

4. Conclusion

The analysis of buccal microwear pattern, carried out on the Migration Period specimens from the Prague-Zličín site (5th century AD), the so-called Barbarians, was performed on the whole possible sample (n=46) as the rest of individuals with molars or premolars showed postmortem enamel defects (n=43). The buccal microwear pattern indicates a meat-dependent diet with relatively high amounts of abrasive particles in the food. The diet of the Prague-Zličín population was probably highly dependent on meat resources independent of their social status, since cereal/vegetable consumption was decreased. The relatively soft, or very soft, diet was eaten predominantly by Prague-Zličín individuals with higher social status. Comparing Prague-Zličín adult individuals over 15 years old with other archaeological populations dated to the Neolithic, Late Roman, Early Medieval and Medieval period, significant statistical differences in buccal microwear patterns were observed in 9 out of 15 variables. The abrasiveness of the food consumed in the Migration period was significantly the highest among all the comparative archaeological samples in terms of striation density (NT) and length (XT). The Neolithic and Medieval populations were characterized by a lower density of smaller microwear length, indicative of a less abrasive diet than that of individuals of the Late Roman and Migration period. The abrasiveness analysed in Late Roman and Migration period individuals was found to be identical; both groups differed only in the length of microstriations, which were twice as long in the Migration period sample. In the Prague-Zličín population we found the highest number of vertical striations (NV), which were also found to be longer (XV) than in any of the other samples. When comparing all Czech samples for the ratio of horizontal and vertical striations, the lowest number of horizontal striations with the highest number of vertical striations (in terms of NH/NT and NV/NT) was found in the Prague-Zličín population. This can be associated with the higher meat intake of the adult Prague-Zličín population compared to the Neolithic and Medieval samples. These results will contribute to our knowledge of the buccal microwear variability for past populations dated to the Migration period as this is the first and biggest sample in central Europe yet analyzed for buccal dental microwear.

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