

CONTRIBUTION TO KNOWLEDGE OF DENTAL HEALTH IN THE EARLY BRONZE AGE EUROPE

Case Study from Pata, Southwestern Slovakia¹

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The paper presents results of the dental state analysis in non-adult and adult individuals from the Early Bronze Age cemetery in Pata (Diely site), southwestern Slovakia. The aim of the study was to evaluate the prevalence of dental caries and periapical inflammatory processes and compare it with the populations living in the territory of Slovakia during the Bronze and Early Middle Ages. Non-adults consisted of individuals both with deciduous and mixed dentition. The children with deciduous dentition had all teeth intact. In group of non-adults with mixed dentition, four individuals had deciduous teeth affected by dental caries (F-CE = 12.5%, I-CE = 5.7%). In adults, the analysis was carried out in 134 individuals (54 males, 69 females and 11 individuals of undetermined sex). The caries frequency (F-CE) reached 53.7%. The caries intensity (I-CE), consisting of the frequency of carious teeth (% C = 5.2%) and ante-mortem tooth loss (% E = 8.1%), reached 13.3%. Both the F-CE and I-CE have positively growing tendency with increasing age. No significant intersexual differences in the caries frequency and the caries intensity were found. Inflammatory periapical processes were examined only in adults. In 28 (20.9%) affected individuals, 62 (3.1%) alveoli were changed by the inflammation. The abscess/osteomyelitis was the most frequent (61.3%), followed by periapical granulomas (24.2%) and radicular cysts (14.5%). The prevalence of caries among Early Bronze Age population groups from Pata, Rumanová, and Melčice was similar, while in Branč and early medieval cemeteries their prevalence was significantly higher. We assume that the observed differences are related to a different lifestyle, especially dietary habits.

Keywords: Slovakia, Early Bronze Age, cemetery, odontology, palaeopathology, caries, dental anomalies.

INTRODUCTION

The almost completely uncovered cemetery in the cadastre of the village Pata (Diely site), investigated during rescue excavation in 1997–1999, ranks among the largest burial grounds of the Early Bronze Age in Slovakia (*Cheben 1999a; 1999b; 2012*). 249 inhumation burials in total were discovered; in one case, a cremation burial was documented. The preliminary analysis of artifacts and ceramic material showed that people of the classic phase of the Únětice to classical Maďarovce cultures were buried at the cemetery (*Cheben 2012, 127*). Altogether, skeletal remains of 241 individuals were exhumed. Their preliminary paleodemographic analysis (*Miklíková 2001*) showed that there were 143 adult and 98 non-adult individuals buried in the cemetery. From the total number of adult individuals, 27.0% were males and 25.0% were females. Similarly to other contemporary cemeteries, (e. g. Jelšovce, Mýtina Nová Ves, Branč, and Sládkovičovo), increased mortality in children up to 6 years old (16.0%) and *adultus* age category (35.7%) was documented also in Pata.

The basic analysis of the skeletal remains includes – besides morphoscopic and morphometric

analyses, estimated sex and age of individuals – also a paleopathological analysis (*Miklíková 2000*), but since the condition of dentition was not recorded, we decided to pay special attention to it in this study. The main goal is to evaluate caries frequency and occurrence of inflammatory processes in alveolar bone and discover whether the frequency of pathological changes in dentition is comparable with other populations from the Bronze Age in Slovakia. Dental caries and frequency of periapical inflammatory processes are indirect indicators of dietary habits and they can partly help us restore not only the composition of food but also the life conditions of the population.

MATERIAL AND METHODS

Although skeletal remains of 241 individuals were exhumed at the burial ground in Pata, not in all individuals odontological analysis was possible, due to the bad preservation of teeth. It was possible to evaluate the condition of dentition in 185 individuals; in other 56 individuals, no teeth or alveoli were preserved. The data on sex and age

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Table 1. Pata-Diely. The number of examined individuals.

	Inf. I	Inf. II	Juv.	Ad.	Ad.–Mat.	Mat.	Mat.–Sen.	Sen.	Undetermined	Total
	0.5–6 y.	7–14 y.	15–20 y.	20–40 y.	20–60 y.	40–60 y.	40+ y.	60+ y.		
Males	0	0	4	27	8	6	3	5	1	54
Females	0	0	15	31	9	7	1	5	1	69
Undetermined	19	32	4	3	2	1	1	0	0	62
Total	19	32	23	61	19	14	5	10	2	185

of individuals were adopted from the unpublished research report (*Miklíková 2000*). In individuals with deciduous and mixed dentition, only caries was evaluated, while in individuals with permanent dentition, occurrence of periapical inflammation processes was studied besides caries.

Caries was evaluated visually according to the method of *S. Hillson (2001)* modified by *M. Thurzo* and *R. Beňuš (2004)*. Spotted non-transparent areas with shiny/opaque surface identified by *S. Hillson (2001)* as caries stage I were not considered carious lesions.

When evaluating the preservation condition of dentition, the comparative alveolar index (CAI) stating the ratio of existing alveoli to the ideal number of alveoli was monitored together with the comparative dental index (CDI) stating the ratio of examined teeth to the ideal number of teeth. As part of monitoring caries, caries frequency (F-CE) representing the percentage of individuals with at least one identified caries and/or at least one ante-mortem tooth loss was studied as well as caries intensity (I-CE) representing the sum of frequency of carious teeth (% C) and frequency of ante-mortem tooth loss (% E; *Hillson 2001*).

Inflammatory processes in alveolar bones were also assessed visually. Destructions in the periapical area were recorded only in cases of perforated periosteum on the buccal or palatal sides of alveoli. Periapical processes were assessed by means of differential diagnostics and radicular cysts, periapical granulomas and abscesses/osteomyelitis were distinguished. Spherical cavities with smooth surface and diameter exceeding 5 mm were classified as cysts. Smaller cavities were classified as periapical granulomas. Cavities with irregular edges and rough surface as well as areas without cavity but obviously affected by inflammatory processes were classified in the category of abscess/osteomyelitis (*Dias/Taylor 1997*).

Intersexual differences in the above stated indicators of caries and inflammatory processes were tested by Fisher's exact test on the significance level $\alpha = 0.05$. To detect age differences, Pearson's chi-squared test of independence on the significance

level $\alpha = 0.05$ was used. Frequency of caries and inflammatory processes were compared with results found at burial grounds from the Early Bronze Age in Rumanová (*Masnicová 2004*), Branč (*Kyselíková 2012*) and Melčice (*Horňák/Jarošová/Rejdovianová 2010*) and from the Middle Ages (*Bodoriková et al. 2006*; *Selecká 2006*; *Selecká/Bodoriková/Beňuš 2008*; *2009*; *Selecká et al. 2010*; *Vondráková 1994*). In all comparative assemblages, with the exceptions of Melčice and Malé Kosihy II, the condition of dentition was assessed by the same method (*Hillson 2001*; *Thurzo/Beňuš 2004*). Fisher's exact test on the significance level $\alpha = 0.05$ was used for statistical comparison.

Besides pathological changes in teeth, presence of anomalies and epigenetic traits including e. g. variations in the number of teeth, tooth roots and molar cusps, shovel-shaped incisors, and occurrence of enamel pearls, were monitored.

RESULTS

Dental caries in individuals with deciduous and mixed dentition

In the age of 0.5–6 years (*infans I*), there were 19 individuals with deciduous teeth and in the age of 7–14 years (*infans II*), there were 32 individuals with mixed dentition (Table 1). Skeletal remains of children are subject to negative taphonomical circumstances to a much greater extent and are preserved in a considerably worse condition than skeletons of juvenile and adult individuals (*Thurzo/Beňuš 2005*). The rather poor condition of alveoli and teeth is another evidence of bad preservation of skeletal remains of children. Individuals with deciduous teeth had only 60 alveoli and 121 teeth present, which means only 15.8% preservation of alveoli (CAI), or 31.8% preservation of teeth (CDI). It is not possible to calculate indices of preservation in individuals with mixed dentition. In this group of children, deciduous teeth were changed for permanent teeth and different ages correspond with different number of teeth. Since the age is only

Table 2. Pata-Diely. The number of alveoli and teeth, frequency (F-CE) and intensity (I-CE) of caries in individuals with primary and mixed dentition.

	Inf. I	Inf. II
	0.5–6 y.	7–14 y.
Number of individuals	19	32
Alveoli of deciduous teeth	60	38
CAI index	15.8	–
Deciduous teeth	121	141
CDI index	31.8	–
Alveoli of permanent teeth	–	169
CAI index	–	–
Permanent teeth	–	298
CDI index	–	–
Individuals with intact teeth	19	28
%	100.0	87.5
Individuals with carious teeth	0	4
F-CE	0.0	12.5
Deciduous teeth with caries	0	8
I-CE	0.0	5.7
Permanent teeth with caries	–	–
I-CE	–	0.0

estimated and we do not know the exact age, we do not know how many teeth these individuals should have preserved.

We did not record any caries in individuals of *infans I* age group. In *infans II* age category, there were four individuals by caries (F-CE = 12.5%); we found eight teeth affected with caries in those individuals (I-CE = 5.7%). All these teeth were deciduous. We did not detect any carious lesion on permanent teeth (I-CE of permanent teeth was 0.0%). Numbers of preserved alveoli and teeth, frequency and intensity of caries in both categories are stated in Table 2.

Dental caries in individuals with permanent dentition

Preservation of alveoli and teeth

1,986 alveoli were preserved in 134 examined individuals in the age categories *juvenis* to *senilis*, the comparative alveolar index CAI reached 45.0% (Appendix 1). In 54 males, 741 alveoli were assessed (42.9%). 1,095 alveoli in 69 females (49.6%) and 150 alveoli in individuals of undetermined sex

(42.6%) were assessed. It follows from the presented data that preservation of alveoli was rather low since individuals had less than half of all alveoli preserved.

Preservation of teeth was slightly better than preservation of alveoli. In total, we examined 2,385 teeth, the comparative dental index CDI reached value of 55.6%. In males, we assessed 938 teeth (54.3%); we assessed 1,232 teeth in females (55.8%) and 215 teeth in individuals of undetermined sex (61.1%).

There were 1,697 teeth lost post-mortem (39.6%). 717 teeth lost post-mortem belonged to males (41.5%), 858 belonged to females (38.9%) and 122 teeth belonged to individuals of undetermined sex (34.7%).

We recorded 160 teeth lost ante-mortem, thus, its frequency (% E) is 8.1%. We recorded 61 (8.2%) ante-mortem tooth loss in males, 87 (7.9%) in females and 12 (8.0%) in individuals of undetermined sex.

The last monitored category regarding the level of preservation of dentition included absent teeth. There were 46 (2.3%) such teeth in total. However, we included alveoli in which we could not distinguish between unerupted/undeveloped or ante-mortem lost teeth in this category, since the examination was only visual.

Caries frequency

Intact dentitions belonged to 23 males (42.6%), 33 females (47.8%) and six individuals of undetermined sex (54.5%), i. e. 62 individuals in total (46.3%; Appendix 2).

72 individuals in total had dentitions affected by caries and/or ante-mortem tooth loss, caries frequency (F-CE) reached value 53.7%. The affected individuals include 31 males (57.4%), 36 females (52.2%) and five individuals of undetermined sex (45.5%). The caries increased from the *juvenis* age category (17.4%) to the *maturus-senilis* age category (100.0%) and it slightly decreased in the *senilis* age category (70.0%).

33 individuals (45.8%) had their dentitions affected only by caries (% *ind C*); there were 15 males (48.4%), 16 females (44.4%) and only two individuals of undetermined sex (40.0%).

We identified ante-mortem tooth loss (% *ind E*) in 15 (20.8%) individuals including six males (19.4%), seven females (19.4%) and two individuals of undetermined sex (40.0%).

24 individuals (33.3%) had their dentitions affected by caries as well as ante-mortem tooth loss (% *ind CE*); there were 10 males (32.3%), 13 females (36.1%) and one individual of undetermined sex (20.0%).

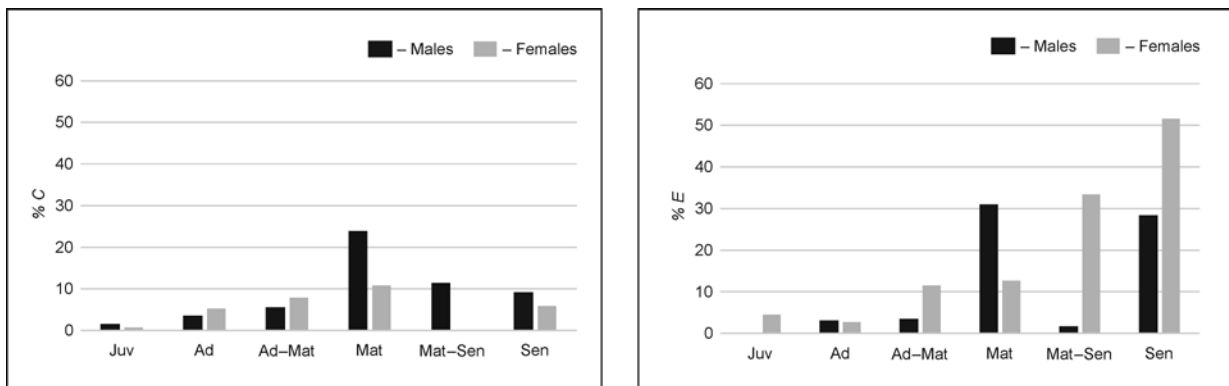


Fig. 1. Pata-Diely. Frequency of carious teeth (% C) and ante-mortem tooth lost (% E) in males and females.

Intersexual and age differences were not statistically significant in any of the monitored indicators.

Caries intensity

From the 2,385 examined teeth in total, 124 were affected by caries, frequency of carious teeth (% C) is 5.2% (Appendix 3). There were 160 ante-mortem tooth loss altogether (% E), which makes 8.1%. The sum of the two above stated values (% C + % E) represents caries intensity (I-CE), in our case reaching 13.3%.

In males, 56 carious teeth (6.0%) were identified as well as 61 intravital losses (8.2%), caries intensity was 14.2%. As for females, 59 carious teeth were found (4.8%) together with 87 intravital losses (7.9%); caries intensity was 12.7%. Nine carious teeth (4.2%) together with 12 ante-mortem lost teeth (8.0%) were observed in individuals of undetermined sex. Caries intensity reached 12.2%.

It follows from the values of I-CE that intersexual differences in the frequency of caries as well as frequency of ante-mortem tooth loss were not statistically significant.

Age differences in the frequency of caries and ante-mortem tooth loss were statistically significant. However, we do not consider them very cogent, since skeletal remains of some individuals were very poorly preserved and their estimated age was, thus, rather imprecise. As many as 19 individuals (14.18%) were classified in the age category of *adultus-maturus* with age span from 20 to 60 years of age (Miklíková 2000). We should also mention a female of *juvenis* age (16–20 years) from grave 60 in whom we recorded eight healed alveoli after ante-mortem tooth loss. Such a high number of teeth lost ante-mortem does not correspond with her age, since in juvenile individuals, ante-mortem losses are very rare. Eight preserved teeth showed a high level of abrasion, as mentioned also in the research report (Miklíková 2000). As only the calvaria and fragments of facial

bones from the skull and only fragments of long bones from the postcranial skeleton were preserved, we must consider several possibilities: i) the woman does not belong to the *juvenis* age group because her age was incorrectly estimated, ii) the woman's age was estimated correctly but the fragments of the upper jaw and mandible belong to another individual, iii) the age of the woman was estimated correctly, the fragments of the upper jaw and mandible belong to her, but – for some reason, e. g. using the dentition for paramasticatory purposes – her teeth were affected by heavy wear or prematurely lost.

At several burial grounds from the territory of Slovakia, a clear trend of increase in the caries intensity (I-CE) with the increasing age of individuals was observed; the percentage of carious teeth decreased with age and the percentage of ante-mortem tooth loss increased with the individuals' age (Bodoriková/Siváková/Veselá 1998; Bodoriková et al. 2006; Kyselíková 2012; Selecká 2006; Selecká/Bodoriková/Beňuš 2008; 2009). At the burial ground in Pata, the trend of increase in the caries intensity (I-CE) was recorded; however, the frequency of caries (% C) in both sexes does not have a clearly increasing tendency and the frequency of ante-mortem tooth loss (% E) in males is not clearly decreasing (Fig. 1). The frequency of caries is increasing from the *juvenis* age group to the *maturus* group, but then it shows a decreasing trend. Frequency of ante-mortem tooth loss in males is also highest in the *maturus* age (30.9%) and slightly lower in the *senilis* age (28.3%). In other groups, it does not reach higher than 3.5%. A clear trend was only identified in the frequency of ante-mortem tooth loss in females which increased from the *adultus* age category and reached its maximum in the *senilis* category. The differences in comparison with other burial grounds can be caused by inaccurately estimated ages of individuals and their further classification into age categories with wide age spans (e. g. 20–60 years, 40+ years, etc.).

Comparison of dental caries in Pata and at selected burial grounds in Slovak

To compare tooth decay of individuals from Pata, we had selected the burial grounds from the Early Bronze Age in Rumanová (*Masnicová 2004*), Branč (*Kyseliová 2012*) and Melčice (*Horňák/Jarošová/Rejdovianová 2010*) and early medieval burial grounds in Komárno-Lodenica (*Selecká/Bodoriková/*

Beňuš 2009), Nitra-Lupka (*Bodoriková et al. 2006*), Tvrdošovce (*Selecká 2006*), Pobedim-Hradištia (*Selecká et al. 2010*), Malé Kosihy II (*Vondráková 1994*) and Pobedim-Na Laze (*Selecká/Bodoriková/Beňuš 2008*). With the exceptions of Melčice and Malé Kosihy II, the condition of dentitions at all the above mentioned burial grounds was assessed by the same method (*Hillson 2001; Thurzo/Beňuš 2004*). The aim was to compare Pata with burial grounds

Table 3. Statistical comparison of frequency (F-CE) and intensity (I-CE) of caries in Pata and selected cemeteries from Western Slovakia dated to the Early Bronze Age and Early Middle Ages.

	Total		Males		Females	
	F-CE	p-value	F-CE	p-value	F-CE	p-value
Pata	53.7	–	57.4	–	52.2	–
Rumanová ¹	49.1	0.631	60.7	0.4610	32.0	0.1550
Branč ²	72.7	0.0137*	67.6	0.3840	80.0	0.0179*
Melčice ³	64.3	0.576	85.7	0.2290	50.0	1.0000
Komárno-Lodenica ⁴	84.6	0.0004*	93.8	0.0069*	80.0	0.0382*
Nitra-Lupka ⁵	80.0	0.0031*	73.7	0.2770	85.7	0.0098*
Tvrdošovce ⁶	86.4	0.0044*	90.0	0.0760	75.0	0.2800
Pobedim-Hradištia ⁷	84.1	0.0003*	88.9	0.1350	86.7	0.0013*
Malé Kosihy II ⁸	74.4	< 0.0001*	72.1	0.0750	78.3	0.0003*
Pobedim-Na Laze ⁹	83.1	0.0002*	87.0	0.0169*	80.6	0.0057*
	% C	p-value	% C	p-value	% C	p-value
Pata	5.2	–	6.0	–	4.8	–
Rumanová ¹	5.7	0.6540	7.6	0.4660	4.1	0.5920
Branč ²	16.6	< 0.0001*	14.7	< 0.0001*	19.7	< 0.0001*
Melčice ³	2.3	0.0350*	3.3	0.2510	1.0	0.0750
Komárno-Lodenica ⁴	19.6	< 0.0001*	19.1	< 0.0001*	20.6	< 0.0001*
Nitra-Lupka ⁵	20.5	< 0.0001*	19.1	< 0.0001*	21.7	< 0.0001*
Tvrdošovce ⁶	24.0	< 0.0001*	27.3	< 0.0001*	18.2	< 0.0001*
Pobedim-Hradištia ⁷	14.5	< 0.0001*	18.1	< 0.0001*	13.8	< 0.0001*
Malé Kosihy II ⁸	6.1	0.1770	4.9	0.1640	7.3	0.0216*
Pobedim-Na Laze ⁹	15.3	< 0.0001*	18.3	< 0.0001*	13.5	< 0.0001*
	% E	p-value	% E	p-value	% E	p-value
Pata	8.1	–	8.2	–	7.9	–
Rumanová ¹	2.7	< 0.0001*	3.7	0.0044*	2.0	< 0.0001*
Branč ²	7.5	0.5930	8.9	0.6460	5.4	0.0720
Melčice ³	4.7	0.0394*	4.1	0.0810	5.9	0.4960
Komárno-Lodenica ⁴	13.1	0.0003*	8.5	0.9080	19.1	< 0.0001*
Nitra-Lupka ⁵	15.1	< 0.0001*	18.3	0.0002*	12.8	0.0065*
Tvrdošovce ⁶	17.9	< 0.0001*	24.3	< 0.0001*	13.6	0.0292*
Pobedim-Hradištia ⁷	4.6	0.0011*	6.3	0.4640	4.9	0.0287*
Malé Kosihy II ⁸	12.2	< 0.0001*	11.0	0.1860	13.5	0.0002*
Pobedim-Na Laze ⁹	6.1	0.0363*	6.6	0.3470	5.7	0.0690

* p < 0.05

Notice 1. With regard to the fact that the caries intensity (I-CE) is made up of the sum of frequency of carious teeth (% C) and the frequency of ante-mortem tooth loss (% E), for statistical comparison it is necessary to test each indicator separately.

Notice 2. Comparison between individuals of undetermined sex was not realized due to low numbers of cases, however, they were included in the comparison of whole populations.

¹Masnicová 2004; ²Kyseliová 2012; ³Horňák/Jarošová/Rejdovianová 2010; ⁴Selecká/Bodoriková/Beňuš 2009; ⁵Bodoriková et al. 2006; ⁶Selecká 2006; ⁷Selecká et al. 2010; ⁸Vondráková 1994; ⁹Selecká/Bodoriková/Beňuš 2008.

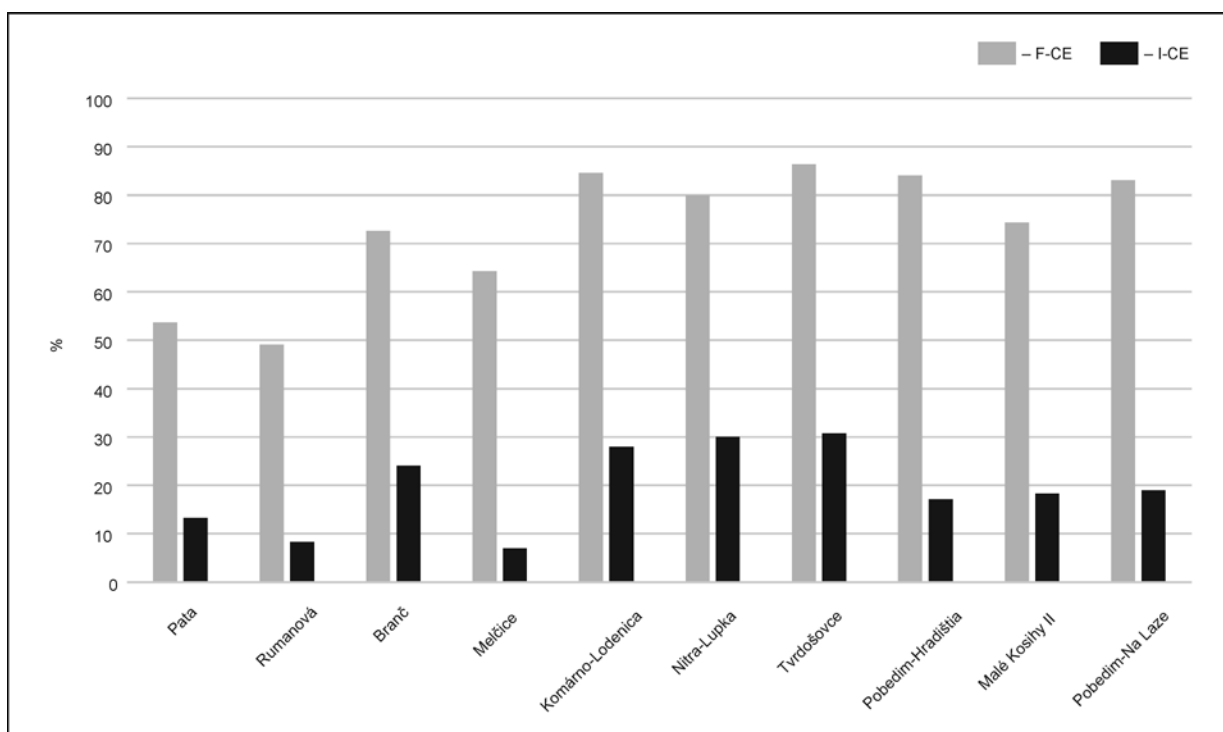


Fig. 2. Frequency (F-CE) and intensity (I-CE) of caries in Pata and selected cemeteries from Western Slovakia dated to the Early Bronze Age and Early Middle Ages.

dated to various periods and monitor diachronous changes in the caries prevalence in historical populations. Nevertheless, we discovered that besides the population of the Early Bronze Age, all cemeteries suitable for statistical comparison come from the Early Middle Ages (Table 3; Fig. 2).

When comparing burial grounds from the Early Bronze Age, it is obvious that the frequency of caries (F-CE) was lowest at the cemetery in Rumanová. On the other hand, the highest frequency of caries was detected in individuals from the cemetery in Branč. However, Pata was significantly different only from the cemetery in Branč, while differences were detected between whole assemblages and assemblages of females. The frequency of caries at all burial grounds from the Early Middle Ages was statistically significantly higher when whole populations were compared. The caries frequency in males was higher at all medieval burial grounds, but only men from Komárno-Lodenica and Pobeďim-Na Laze were statistically significantly different. The frequency of caries in females was statistically significantly higher at all medieval burial grounds with the exception of Tvrdošovce.

With regard to the fact that the caries intensity (I-CE) is made up of the sum of frequency of carious teeth (% C) and the frequency of ante-mortem tooth loss (% E), for statistical comparison it is necessary to test each indicator separately. Among the Early

Bronze Age populations, the individuals from Melčice had the lowest caries intensity and those from Branč had the highest caries intensity. As for the frequency of carious teeth (% C), statistically significant differences were detected between Pata and Branč – between whole populations, males and females. The frequency of carious teeth of the whole population from Melčice was significantly lower than in the individuals from Pata; however, the populations of males and females were not different. Nevertheless, we must point to the fact that the population in Melčice was small, made up by only 14 individuals. Since the frequency of carious teeth at early medieval cemeteries reached much higher values than at the cemetery in Pata, differences between whole populations as well as between males and females were highly significant ($p < 0.0001$), with the exception of the cemetery in Malé Kosihy II. This cemetery was analyzed by *M. Vondráková (1994)* using a different method and in comparison with other early medieval burial grounds, she detected a very low frequency of carious teeth (% C = 6.1%). As for the frequency of ante-mortem tooth loss (% E), the situation at early medieval cemeteries is different. The ante-mortem tooth loss frequency in Pata was statistically significantly higher than in Rumanová. As the percentage of ante-mortem tooth loss at Branč was approximately identical with Pata, we did not de-

Table 4. Pata-Diely. The number of individuals affected by periapical inflammatory processes.

		Juv.	Ad.	Ad.–Mat.	Mat.	Mat.–Sen.	Sen.	Undetermined	Total	p-value	p-value
		15–20 y.	20–40 y.	20–60 y.	40–60 y.	40+ y.	60+ y.			sex	age
Males	N	4	27	8	6	3	5	1	54	–	0.304
	Np	0	3	2	4	1	2	0	12	–	–
	%	0.0	11.1	25.0	66.7	33.3	40.0	0.0	22.2	–	–
Females	N	15	31	9	7	1	5	1	69	–	0.473
	Np	2	4	4	2	1	1	0	14	–	–
	%	13.3	12.9	44.4	28.6	100.0	20.0	0.0	20.3	–	–
Undetermined	N	4	3	2	1	1	0	0	11	–	–
	Np	0	0	1	0	1	–	–	2	–	–
	%	0.0	0.0	50.0	0.0	100.0	–	–	18.2	–	–
Total	N	23	61	19	14	5	10	2	134	0.827	–
	Np	2	7	7	6	3	3	0	28	–	–
	%	8.7	11.5	36.8	42.9	60.0	30.0	0.0	20.9	–	–

N – number of examined individuals; Np – number of affected individuals.

Table 5. Pata-Diely. The frequency of periapical inflammatory processes.

	Males	Females	Undetermined	Total
Granuloma	7	7	1	15
%	11.3	11.3	1.6	24.2
Cyst	2	6	1	9
%	3.2	9.7	1.6	14.5
Abscess/osteomyelitis	22	13	3	38
%	35.5	21.0	4.8	61.3
Total	31	26	5	62
%	50.0	41.9	8.1	100.0

tect differences between these two burial grounds. Melčice – similarly to the situation with caries – had statistically lower frequency of ante-mortem tooth loss only on the level of whole population. As far as early medieval burial grounds are concerned, all cemeteries differ from Pata statistically significantly, but the frequency of ante-mortem tooth loss was lower at both burial grounds in Pobedim. If we look at the population of males, a significantly higher frequency of ante-mortem tooth loss was identified only in individuals from Nitra-Lupka and Tvrdošovce. As for females, all early medieval populations – with the exception of both burial grounds in Pobedim – had significantly higher frequency of ante-mortem tooth loss. In Pobedim, the frequency of ante-mortem tooth loss was lower than in females from Pata.

Based on the results of the statistical comparison of the Early Bronze Age burial grounds, we can state that while in Pata, Rumanová and Melčice dental caries frequency in the adult population was similar, it was higher at the cemetery in Branč. Since the comparative populations from the Bronze Age

were relatively small, it is questionable whether the detected differences in caries are accidental or if the reason should be searched in e. g. a different diet. We cannot exclude influence of an interindividual failure at evaluation of skeletal remains either, because we have previous experience with underrated caries (Bodoriková *et al.* 2006).

Periapical inflammatory processes

Inflammatory processes in alveolar bones were detected in 28 individuals (20.9%), including 12 males (22.2%), 14 females (20.3%) and two individuals and undetermined sex (18.2%). Intersexual or age differences were not statistically significant (Table 4).

In 28 individuals, 62 alveoli were affected by an inflammatory process (Table 5), which makes up 3.1% of all 1,986 examined alveoli. The most frequent inflammatory processes in the population from Pata were abscesses/osteomyelitis, which affected 38 (61.3%) of alveoli (Fig. 3: 3, 5–6; 4: 4, 6).

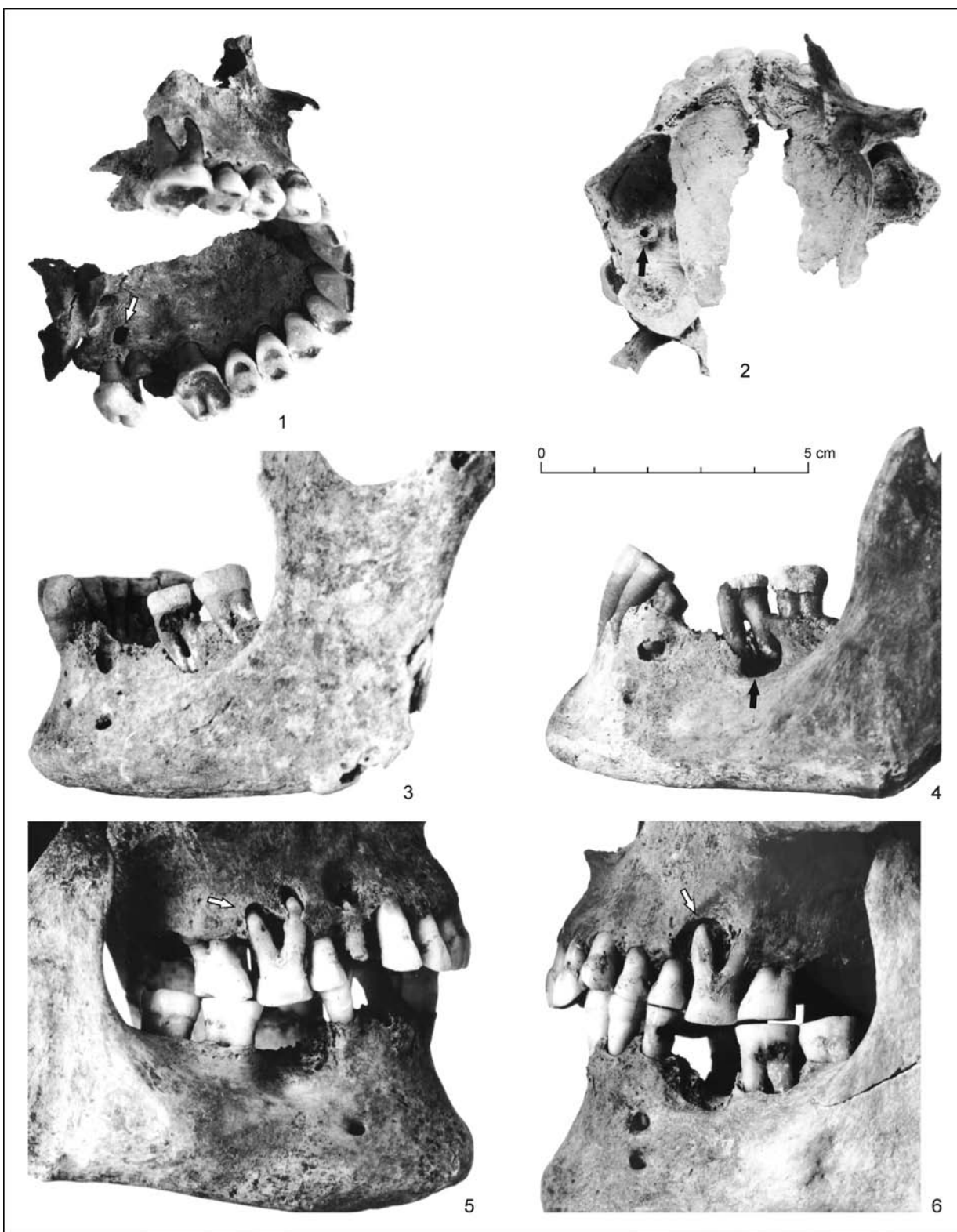


Fig. 3. Pata-Diely. Selection of dental pathologies. 1, 2 – abscess with fistulae leading to the palatal surface (1) and to the maxillary sinus (2) in 30–40-year-old male (?) from grave 4; 3 – alveolus of the lower left first molar affected by osteomyelitis in 40–60-year-old male from grave 32; 4 – alveolus of the lower left second premolar affected by periapical granuloma and alveolus of the lower left second molar affected by cyst in 50+-year-old individual of undetermined sex from grave 88; 5, 6 – 42–44-year-old male (?) from grave 80 had alveolus of the upper right first premolar affected by cyst and alveolus of the upper right first molar affected by abscess (5), alveoli of the upper left first molar, upper left third molar and the lower first molar affected by abscesses, and alveolus of the lower second premolar affected by periapical granuloma (6).

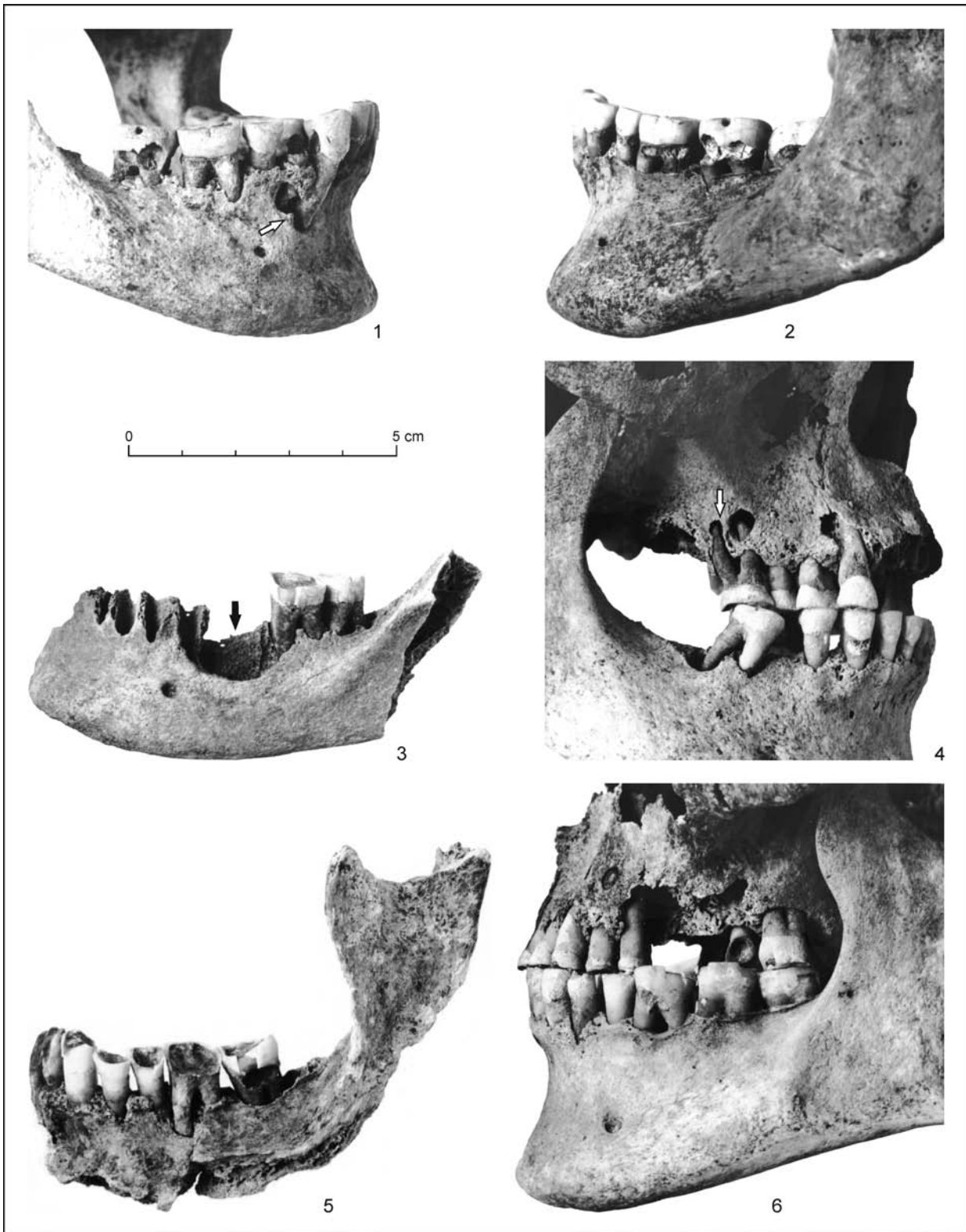


Fig. 4. Pata-Diely. Selection of dental pathologies. 1, 2 – 22–26-year-old female from grave 97 had alveolus of the lower right first premolar affected by cyst (1), and caries localized on buccal surfaces of lower molars necks (1, 2); 3 – radicular cyst localized in the alveoli of the lower left second premolar and first molar in 20–60-year-old female (?) from grave 105; 4 – alveoli of the upper and lower first molars affected by cysts and alveoli of the second and third molars affected by abscesses in more than 60-year-old female from grave 120; 5 – caries localized on buccal surface of the lower left second molar neck in 55–64-year-old male from grave 160A; 6 – alveolus of the upper left first premolar affected by periapical granuloma and alveoli of the upper left first and second molars affected by abscess/osteomyelitis in 35–40-year-old male from grave 223.

Table 6. Interpopulation differences of inflammatory processes between Pata and selected cemeteries from Western Slovakia dated to the Early Bronze Age and Early Middle Ages.

	Total		Males		Females	
	%	p-value	%	p-value	%	p-value
Pata	20.9	–	22.2	–	20.3	–
Rumanová ¹	5.5	0.0089*	6.7	0.0760	3.8	0.0610
Branč ²	40.9	0.0041*	57.1	0.0028*	36.0	0.1730
Nitra-Lupka ³	40.0	0.0218*	26.3	0.7570	52.4	0.0104*
Komárno-Lodenica ⁴	25.8	0.6440	18.8	1.000	25.0	0.7580
Tvrdošovce ⁵	54.5	0.0025*	50.0	0.1140	50.0	0.0810
Pobedim-Hradištia ⁶	18.2	0.8300	22.2	1.000	20.0	1.000
Pobedim-Na Laze ⁷	16.7	0.5610	20.8	1.000	13.9	0.5940

* p < 0.05

Notice. Comparison between individuals of undetermined sex was not realized due to low numbers of cases, however, they were included in the comparison of whole populations.

¹Masnicová 2004; ²Kyselicová 2012; ³Selecká/Bodoriková/Beňuš 2009; ⁴Bodoriková et al. 2006; ⁵Selecká 2006; ⁶Selecká et al. 2010; ⁷Selecká/Bodoriková/Beňuš 2008.

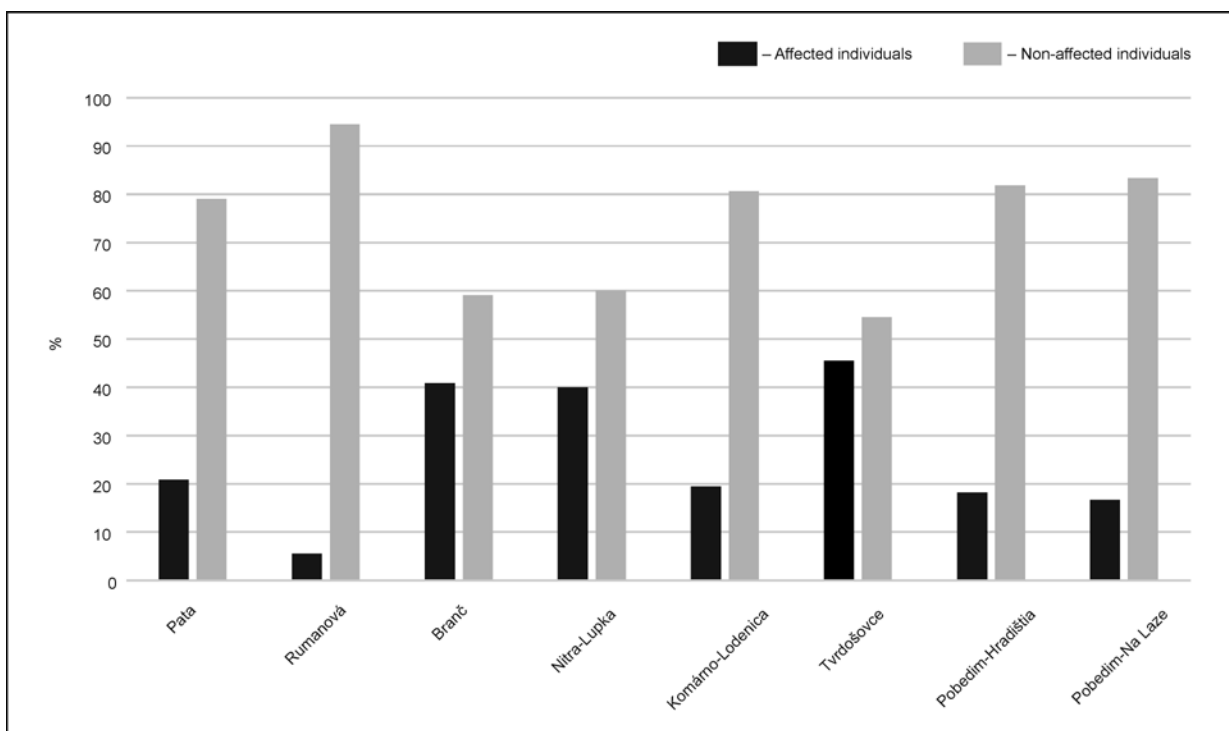


Fig. 5. Frequency of the periapical inflammatory processes in Pata and selected cemeteries from Western Slovakia dated to the Early Bronze Age and Early Middle Ages.

The second most frequent illness was periapical granuloma (24.2%; Fig. 3: 4, 6; 4: 6), radicular cyst was the least frequent (14.5%, Fig. 3: 4, 5; 4: 1, 3–4).

The abscess in a probably male individual in the *adultus II* age group was an interesting find (Miklíková 2000). It was located in the periapical part of the maxillary left second molar (tooth 27). In this individual, the pulp cavity was opened probably as a result of a deep caries and, thus, the inflammation penetrated to the apex of the root. Later, the pressure of the produced pus created three fistulas ending in the vestibular and palatal areas of the alveolus and in *sinus maxillaris* (Fig. 3: 1, 2).

Comparison of the occurrence of inflammatory processes in Pata and at selected Slovak burial grounds

The frequency of inflammatory processes in the alveolar bone at the burial ground in Pata was – similarly to caries – compared with its occurrence at Early Bronze Age and early medieval cemeteries localized in the territory of western Slovakia (Table 6; Fig. 5).

The lowest frequency of the affected individuals among the Early Bronze Age cemeteries was in Rumanová. On the other hand, the highest frequency occurred in Branč. The higher occurrence of inflammatory processes is probably closely associated with the high frequency and intensity of caries (Kyselíková 2012). Nevertheless, significant differences were only detected between whole populations and in males from Rumanová.

At the medieval cemeteries, statistically significant frequency of inflammatory processes was identified only at the cemeteries in Nitra-Lupka and Tvrdošovce. Statistically higher occurrence of periapical inflammatory processes was also detected in females from Nitra-Lupka. No significant differences were recorded in other populations.

Data on inflammatory processes in the individuals from the cemeteries in Melčice and Malé Kosihy were not available.

Dental anomalies

Except for pathological changes, we recorded also some anomalies of dentition associated with the morphology of dental crowns, number of teeth and tooth roots. Assessment of dental traits is considerably complicated by tooth wear of the occlusal surfaces and incisal edges of dental crowns. With regard to the fact that the level of preservation of teeth at the cemetery in Pata was rather low and

tooth wear was, on the contrary, significant, we limited our work to creating a list of the observed anomalies (Table 7; Fig. 6).

Enamel pearls

On maxillary premolars and molars, the edge of enamel can be widened in apical direction. It is so-called “enamel extension”. C. H. Turner, C. R. Nichol and G. R. Scott (1991) created a 4-stage classification. An enamel pearl can be created in any of the stages by overlapping enamel. A pearl can also occur on teeth without enamel extension. Some authors do not recommend recording presence of enamel pearls because they can be covered by the alveolar bone and are not necessarily visible during evaluation.

At the burial ground in Pata, enamel pearls occurred in four individuals (Fig. 6: 1, 2). It is noteworthy that they were all located in the upper left quadrant of dentition; one pearl was located on the second molar and other three were on third molars.

Shovel-shaped incisors

This means that the marginal cingulum on the palatal side of the incisor's or canine tooth's crown is more distinct, which creates a depression in the central part and the crown is, thus, shovel-shaped (Hrdlička 1920). This feature is highly frequent (more than 90%) in the Mongoloid variety, i. e. in Asian populations and American Indians (Mizoguchi 1985). In the territory of Slovakia, shovel-shaped incisors are observed mainly in the population from Slav-Avar cemeteries, as it is a feature indicating presence of Mongoloid elements.

At the burial ground in Pata, we detected eight shovel-shaped maxillary incisors in four individuals.

Hyperdontia

Hyperdontia is the opposite of hypodontia, it means presence of supernumerary teeth in dentition. They can occur in any part of the dental arch, with significant predilection in the area of premaxilla. Supernumerary teeth can be present in deciduous as well as permanent dentition (Schulze 1987). Frequency of hyperdontia in deciduous dentition is very low, it varies between 0.0% and 0.75%. For permanent dentition, frequency of hyperdontia is mainly between 0.15% and 3.8% (Grahnen/Granath 1961; Luten 1967; Sykaras 1975).

The most frequent form of hyperdontia is *mesiodens*, a supernumerary tooth located in the midline

Table 7. Pata-Diely. List of dental anomalies.

Anomalies	Grave No.	Sex	Age	Location
Shovel-shaped incisor	9	Undetermined	Inf. II	tooth 11
Shovel-shaped incisors	46A	Female	Juv.	teeth 12 and 22
Shovel-shaped incisors	77	Female	Juv.	teeth 12 and 22
Shovel-shaped incisors	110	Undetermined	Inf. II	teeth 12, 21 and 22
Hypodontia	9	Undetermined	Inf. II	teeth 31 and 41?
Hypodontia	137	Undetermined	Juv.	tooth 35, persistence of deciduous molar (tooth 75)
Hyperdontia (?)	19A	Probably male	Juv.–Ad. I	one more tooth (52), persistence of deciduous tooth? alveoli not preserved
Hyperdontia (?)	106	Probably male	Mat.	rudimentary or supernumerary tooth 35
Hyperdontia	132	Probably male	Ad.–Mat.	supernumerary tooth between teeth 15 and 16
Hyperdontia	228	Female	Ad.	supernumerary second incisor between teeth 11 and 12
Mesiodens (?)	38	Male	Ad.	two peg-shaped teeth with S-shaped roots
Rudimentary tooth structure	6A	Female	Ad. I–II	rudimentary shape structure made of dentine located between teeth 15 and 16
Supernumerary root	220	Male	Ad.–Mat.	tooth 37 rudimentary root located mesiolingually
Supernumerary root	137	Undetermined	Juv.	teeth 15 and 25 – two-rooted; teeth 17 and 27 – four-rooted
Carabelli tubercle	177	Undetermined	Inf. I	tooth 16 – not erupted yet
Paramolare tubercle	69	Undetermined	Inf. I	teeth 36 and 46
6-cusps molars	162	Undetermined	Inf. I–II	teeth 16 and 26
Enamel pearls	184	Male	Juv.–Ad. I	tooth 27
Enamel pearls	138	Female	Ad. II–Mat. I	tooth 28
Enamel pearls	33C	Female	Juv.–Ad. I	tooth 28
Enamel pearls	33B	Undetermined	Ad.	tooth 28



Fig. 6. Pata-Diely. Selection of dental anomalies. 1 – enamel pearl in the upper left third molar localized lingually in 20–25-year-old individual of undetermined sex from grave 33B; 2 – enamel pearl in the upper left third molar localized distally in 18–23-year-old individual of undetermined sex from grave 33C; 3 – peg-shaped teeth with sigmoid curved roots in 20–40-year-old male from grave 38; 4 – six cusps in the upper first molars in 6–7-year-old child of undetermined sex from grave 162.

of maxilla between the maxillary central incisors (Garvey/Barry/Blake 1999). Frequency of its occurrence is stated between 0.15% and 1.9% (Sykaras 1975). The *mesiodens* crown usually has form of a peg or cone. However, the root is usually normally evolved. In deciduous dentition, *mesiodens* is considerably less frequent (Prabhu/Rebeca/Munshi 1998).

Hyperdontia was recorded in five individuals from Pata. In three cases, the diagnosis is not clear due to absent alveoli. In the individual from grave 19A, the deciduous maxillary right second incisor was present together with the permanent maxillary right second incisor; alveoli were not preserved. If the deciduous tooth belonged to that individual, it could be persistence of a deciduous tooth. In the individual from grave 106, we recorded a mandibular left second premolar of changed shape and size. The tooth was located in the tooth socket, but the posterior part of the mandibula was absent, so we cannot decide whether it was a rudimentary or a supernumerary tooth. Two peg-shaped teeth with S-shaped roots (Fig. 6: 3) were also interesting. They were found in the individual from grave 38. With regard to the fact that alveoli were not preserved, we assume that these could be *mesiodentes* – only based on their shapes typical of such teeth.

Hypodontia

Hypodontia means developmental absence (agenesis) of less than six teeth. Agenesis most frequently affects teeth of permanent dentition; in deciduous dentition, it is rather rare and its frequency varies between 0.5% and 0.9%. Frequency of hypodontia in permanent dentition occurs in 1.6–6.5% of individuals, depending on the studied population (Polder *et al.* 2004). Agenesis can occur as a result of factors of external environment, such as infectious diseases, tumors or teratogens. An important role in agenesis is played by heredity. Currently, we know more than 300 genes interfering in the process of odontogenesis. Mutations in these genes, however, only cause approx. 15% of hypodontia cases, while pathogenesis of most cases remains unexplained (Vastardis 2000).

We recorded two individuals with hypodontia in Pata. In one of them, hypodontia of the mandibular left second premolar tooth was combined with persistence of the mandibular left second deciduous molar tooth in its place.

Rudimentary dental structure

In *vestibulum oris*, pathological dental structures, such as e. g. peripheral odontomas, occasionally occur. They are benign tumors of odon-

togenic origin located in the soft tissue outside dentition and bone. Some peripheral odontomas can have structures very similar to teeth. A similar finding was recorded by Hovořáková *et al.* (2016) in the jaw of an elderly female at the cemetery in Gáň. Two rudimentary dental structures were located in the alveolar bone externally of the dental arch. Their surface was covered by enamel and they even had holes, probably for nerves and blood vessels.

One case of a rudimentary dental structure was recorded also at the burial ground in Pata – in the female from grave 6a. This rudimentary dental structure will be subject to a more detailed analysis. Based on visual examination, it seems that the rudimentary structure is made exclusively of dentine and it is not covered by enamel on the surface.

Supernumerary roots

Individual types of teeth have various numbers of roots. Incisors, canine teeth and premolars with the exception of maxillary first premolars, are single-rooted. Maxillary first premolars and mandibular molars have two roots and maxillary molars have three roots. Anomalies in roots are expressed in changes in their numbers, shapes and lengths. Supernumerary roots were detected in two individuals. The individual from grave 220 had a supernumerary mesiolingual rudimentary root on the mandibular left second molar. The male from grave 137 was more interesting. He had both maxillary second premolars with two roots and both maxillary second molars with four roots. Besides, a combination of hypodontia and persistence of a deciduous molar mentioned earlier was detected in this individual.

Supernumerary cusps

Various additional cusps can occur on dental crowns. *Tuberculum (anomale) Carabelli* is the best known type of additional cusps. It occurs on maxillary molars, on the palatal surface of the mesiopalatal cusp. At the cemetery in Pata, it was identified only on one crown of an unerupted maxillary first molar.

Protostylid also called *tuberculum paramolare* is an analogy to Carabelli' cusp. It is located on the mesiolingual cusp. Protostylid was recorded in one case.

6-cusped first upper molars in the non-adult individual from grave 162 (Fig. 6: 4) was also an interesting find. First molars usually have four cusps – two vestibular and two lingual cusps. Rarely, there are only three or five cusps – the fifth one is usually a *tuberculum Carabelli*.

DISCUSSION

Caries and factors influencing its occurrence

Tooth decay (*caries dentium*) is an infectious disease damaging the hard tissues of a tooth (Javorka 1994). Creation of caries is a multifactorial process, which means that it is conditioned by several simultaneous factors. Besides exogenous factors, such as diet, creation of caries is influenced by endogenous factors, such as hereditary predisposition, sex, hormonal influences, shape and position of teeth, way of chewing, various illnesses, metabolic disorders, etc. Dental plaque also has a damaging effect as it contains Gram-positive bacteria, such as *Streptococcus mutans*, *S. salivarius*, *S. oralis*, *S. milleri*, *Actinomyces* and *Lactobacillus*. Present Gram-negative bacteria include *Neisseria*, *Veillonella*, *Haemophilus*, *Prevotella*, *Porphyromans* and *Fusobacterium*. Virulence of cariogenic bacteria is given by the extent and intensity of production of acids, spatial arrangement of bacteria in plaque and possible metabolic activity in acid pH. Thus, dental caries is a result of interaction of microbial flora in plaque, amount of intaken saccharides in diet and resistibility of hard tissues of teeth (Hillson 1996). Bacteria of *Streptococcus sp.* are most frequent in dental caries on smooth and occlusal surfaces, while *Actinomyces* prevail in dental caries on root surface. Bacteria of *Lactobacillus* family are most frequent in deep dentin caries (Sansone et al. 1993). In the creation of caries, processes of demineralization and remineralization alternate. Acids as metabolic products of bacteria in dental plaque are responsible for demineralization of enamel. Thus produced acids lower pH values, while the critical pH value for enamel is 5.2–5.7. When pH is lowered, a state undersaturated by phosphate and calcium ions occurs, thus, these ions have a tendency to diffuse from enamel. Remineralization occurs when pH values increase and saliva has the ability to transport these ions back to enamel. In the course of day, the processes of demineralization and remineralization often alternate depending on oral hygiene and food intake (Votava/Broukal/Vaněk 2007). Teeth have so-called predilection sites, where caries occur most frequently. Such sites include gingival and approximal areas and fissures. Occurrence of caries is also supported by angle, rotation and closeness of teeth.

For the occurrence of dental caries, interaction between four basic factors is necessary – dental tissue, microbial flora of the oral cavity, diet and time (Kilian/Fialová/Hubková 1999). Besides, there are factors increasing or decreasing the effect of the four basic factors – type of food, amount of

plaque, composition of saliva and their neutralizing effect on acids, activity of tongue and facial muscles.

Dental caries in historical populations

Dental caries has been accompanying humans since their beginnings, but in the distant past it was not a frequent disease. When people obtained their food as hunters and collectors, their teeth were only exceptionally affected by caries. A more significant increase in the frequency of caries was brought by the transformation to the agricultural way of life and the beginning of growing cereals in the Neolithic. In that period, flour contributed to stronger tooth wear, since it contained numerous lithic admixtures created during grinding. In the Neolithic, caries could have affected 20–30% of population in Central Europe (Hillson 1996). Caries in the populations living in the territory of Slovakia in the Neolithic is not known, as no study dealing with this topics has been elaborated yet.

Nevertheless, C. A. Roberts and M. Cox (2007), who analyzed skeletal remains from the territory of Britain, found out that caries did not have a clear increasing tendency from the Neolithic to the middle 19th century. During the Iron Age, as well as the Early Middle Ages, they recorded decrease in the frequency of caries in the population, which they attribute to the rural way of life with a limited access to saccharose, although the diet must have included honey and fruit. A great increase in the number of individuals and teeth affected by caries was recorded in the Late Middle Ages and the Postmedieval period. In the period studied in this article – the Bronze Age – the frequency of caries in the territory of Britain was approx. 15%.

N. Nicklisch et al. (2016) monitored dental caries in historical populations from the territory of central Germany. Skeletal remains from 13 neolithic sites and one burial ground from the Early Bronze Age were subject of the analysis. Frequency of caries in adult individuals from the Early Bronze Age burial ground reached 35.6%, caries intensity reached 5.8%. However, the authors did not include ante-mortem tooth loss in caries intensity. In non-adult individuals, caries frequency was also low (F-CE = 11.4%; I-CE = 0.9%), carious teeth occurred only in *infans II* and *juvenis* age groups. When comparing all analyzed populations, the authors found out that caries frequency was the highest in neolithic populations, in the individuals of the Linear Pottery culture in particular. On the contrary, caries frequency in the Early Bronze

Age population was the lowest. This tendency of decrease in dental caries is – according to the authors – associated with the higher share of meat and animal proteins in diet, which is also confirmed by isotope analyses.

When comparing the above stated findings with results for the territory of Slovakia, the individuals from Pata, Rumanová and Branč were affected by dental caries to a much greater extent. On the basis of the obtained results, we can state that more than half of the population with permanent dentition in Pata was affected by caries (53.7%); in Rumanová, it was almost half the population (49.1%) and in Branč, it was as much as 72.2% of the population. A similar value of caries frequency (50.0%) was recorded also by *P. Stránská* (2013), who monitored caries at selected Czech burial grounds. Differences in caries between the populations in the territories of Britain and Germany and the individuals from Slovakia and the Czech Republic could also be caused by different composition of diet. The higher caries frequency indicates food richer in saccharides, i. e. with prevalence of vegetal element probably represented by cereals and fruit.

The most significant increase in caries occurrence within Europe was clearly associated with the beginning of a more massive consumption of sugar which started to be imported in larger amounts in the 18th century. In the 19th century, growing of sugar beet and processing it into sugar spread in Europe. Together with the absence of dental care, it literally caused an epidemic of caries (*Winston/Bhaskar 1998*). Thus, it is obvious that the intensity of dental caries increased in direct proportion to the increased living standards. It was mainly associated with consumption of tastier and softer food with a growing proportion of saccharides at the expense of harder food with fibre removing plaque with its abrasive effect.

Nowadays, dental caries belongs to the most wide-spread diseases in people and affects mainly young individuals (*Javorka 1994, 26*). However, we recorded a very low level of caries in this age category in Pata. In 19 children with deciduous teeth (0.5–6 years), caries did not occur at all and in 32 children with mixed dentition (7–14 years), caries was recorded in four individuals. Although we have less data about non-adults, the situation was similar at the cemetery in Rumanová (*Masnicová 2004*). Children with deciduous teeth had completely intact teeth and only one child out of 31 children with mixed dentition had caries (6.25%). The diet of children and adults could have been different, but the negligible dental caries occurrence in children is rather a reflection

of the generally lower share of cariogenic food in the diet compared to today.

From the aspect of sex, females are more susceptible to caries (*Lukacs/Thompson 2008*). The higher frequency of caries can be influenced by their reproductive and social role. Their higher susceptibility to caries is most frequently attributed to the hormonal changes during pregnancy and associated biochemical processes. The traditional anthropological explanation of gender-caused differences in the occurrence of caries also includes differences in the preparation of diet, frequency of consumption, where it is assumed that as women prepared food, they had easier access to it. A certain role can be also played by division of labour and other culturally conditioned elements of behaviour. In the individuals from Pata, intersexual differences in caries occurrence were not recorded, which might indicate that the diets of males and females did not differ much.

Periapical inflammatory processes

Inflammations in apical tissues of tooth root, periodontium and the surrounding alveolar bone is also a result of agency of aerobic and anaerobic bacteria in the oral cavity. Infection spreads in the periapical and periradicular areas by root canal through the root-end opening if the pulp chamber is open as a result of caries, tooth wear or injury. Immune response depends on the balance between the infection's virulence and the individual's immunity. If the individual overcomes the infection, inflammation disappears and the tissues return to their original state. In case that the infection remains, the acute inflammatory reaction gradually changes into a chronic state. The most frequent inflammatory response is creation of a periapical granuloma. Radicular cysts are less frequent. Unlike granulomas, they have progressive character, which means that their sizes grow bigger in time, even when the source of infection has been removed, e. g. by extraction of tooth (*Dias/Tayles 1997*). Occurrence of inflammatory processes in the alveolar bone is associated with the prevalence of caries, but significant abrasion of occlusal surface of teeth leading to opening of the tooth's pulp chamber can also have certain influence. Prevalence of periapical processes at the compared Early Bronze Age burial grounds was probably not influenced by abrasion so much, since it reflects the values of frequency and intensity of caries. The lowest numbers of affected individuals, teeth and inflammations of the alveolar bone were recorded in Rumanová. On the other hand, the highest values of all indicators were recorded in Branč.

CONCLUSION

Evaluation of the state of dentition in the population from the Early Bronze Age burial ground in Pata follows from the basic anthropological analysis of skeletal remains (Miklíková 2000) and is part of the prepared extensive paleoanthropological analysis. With its unique results and summary of previous knowledge, the study significantly contributes to our knowledge of oral health in the population of Slovakia in the Early Bronze Age. The dental analyses will be confronted with results of stable isotope and nitrogen analyses which are supposed to bring a more exact answer to the questions associated with diet, proportions of animal and vegetal segments in the diet, differences in the composition of diet in males and females or adult and non-adult individuals.

The presented results follow from the examination of 185 individuals, 19 of whom had deciduous teeth, 32 had mixed dentition and 134 individuals had permanent dentition. In the individuals with deciduous teeth (*infans I*), caries did not occur. In the group of children with mixed dentition (*infans II*), four individuals (F-CE = 12.5%) had eight teeth affected by caries (I-CE = 5.7%). All carious teeth were deciduous. Permanent teeth remained intact. Out of 134 individuals with permanent dentition, 72 people had dentition affected by dental caries and/or intravital loss, caries frequency F-CE reached 53.7%. Intersexual and age differences in this indicator were not statistically significant. Frequency of carious teeth (% C) was 5.2%, frequency of ante-mortem tooth loss (% E) was 8.1%. Thus, intensity of caries (I-CE) reached 13.3%. Intersexual differences in the frequency of caries as well as ante-mortem tooth loss were not statistically significant. Age differences in the frequency of caries and ante-mortem tooth loss were statistically significant; however, we can state that caries frequency was similar in Pata, Rumanová and Melčice, while it was considerably higher in Branč. Frequency of caries at all early medieval cemeteries was higher than in Pata.

As for the intensity of caries, the situation is more complicated. While prevalence of caries was higher at medieval burial grounds than in Pata, the values of frequency of ante-mortem tooth loss at the burial grounds in Pobedim-Hradištia and Pobedim-Na Laze were significantly lower. Inflammatory processes in the alveolar bone occurred in 28 individuals (20.9%). Intersexual and age differences were not observed. 62 alveoli were affected by an inflammatory process, which represents 3.1% of the total 1,986 examined alveoli. Abscess/osteomyelitis were the most frequent inflammatory processes (61.3%); the second most frequent inflammatory process was periapical granuloma (24.2%). Radicular cysts were the least frequent (14.5%). Among the Early Bronze Age cemeteries, Rumanová had the lowest number of affected individuals. On the other hand, the highest frequency occurred in Branč, which is probably associated with the high frequency and intensity of dental caries. Nitra-Lupka and Tvrdošovce were the only medieval burial grounds with significantly higher frequency of inflammatory processes. The differences in tooth decay and in the prevalence of inflammatory processes between the burial grounds might be caused by different lifestyles, mainly diets. Nevertheless, their interpretation is not easy because they can be influenced by the number of analyzed individuals, different methodology in assessing caries at some burial grounds as well as interindividual error of evaluation.

Except for pathological changes, some anomalies in the morphology of dental crowns, number of teeth and tooth roots were recorded in dentitions of the individuals from Pata. In four individuals, shovel-shaped incisors occurred; hypodontia occurred in two individuals, hyperdontia affected five individuals and two individuals had supernumerary tooth roots. There were also supernumerary cusps on dental crowns – one case of *tuberculum Carabelli*, one case of *tuberculum paramolare* and two cases of 6-cusped maxillary second molars. Enamel pearls occurring in four individuals were an interesting discovery.

Appendix 1. Pata-Diely. The number of examined alveoli and teeth in individuals with permanent dentition.

	Juv.	Ad.	Ad.–Mat.	Mat.	Mat.–Sen.	Sen.	Undetermined	Total
	15–20 y.	20–40 y.	20–60 y.	40–60 y.	40+ y.	60+ y.		
Preserved alveoli	280	1040	231	224	91	117	3	1986
CAI index	34.5	48.2	40.2	64.3	52.4	24.4	3.1	45.0
Males	45	397	88	97	61	53	0	741
CAI index	35.2	45.9	34.4	50.5	63.5	33.1	0.0	42.9
Females	201	607	113	95	12	64	3	1095
CAI index	41.9	61.2	39.2	42.4	37.5	40.0	9.4	49.6
Undetermined	34	36	30	32	18	–	–	150
CAI index	26.6	37.5	46.9	100.0	56.3	–	–	42.6
Teeth	459	1251	279	197	82	106	11	2385
CDI index	62.4	64.1	45.9	44.0	51.3	33.1	17.2	55.6
Males	69	542	129	67	70	55	6	938
CDI index	53.9	62.7	50.4	34.9	72.9	34.4	18.8	54.3
Females	308	637	128	102	1	51	5	1232
CDI index	64.2	64.2	44.4	45.5	3.1	31.9	15.6	55.8
Undetermined	82	72	22	28	11	–	–	215
CDI index	64.1	75.0	34.4	87.5	34.4	–	–	61.1
Post-mortem loss	252	655	303	202	66	166	53	1697
%	34.2	33.6	49.8	45.1	41.3	51.9	82.8	39.6
Males	55	305	122	94	25	90	26	717
%	43.0	35.3	47.7	49.0	26.0	56.3	81.3	41.5
Females	152	328	143	105	27	76	27	858
%	31.7	33.1	49.7	46.9	84.4	47.5	84.4	38.9
Undetermined	45	22	38	3	14	0	0	122
%	35.2	22.9	59.4	9.4	43.8	0.0	0.0	34.7
Ante-mortem loss	9	28	20	43	12	48	0	160
% E	3.2	2.7	8.7	19.2	13.2	41.0	0.0	8.1
Males	0	12	3	30	1	15	0	61
% E	0.0	3.0	3.4	30.9	1.6	28.3	0.0	8.2
Females	9	16	13	12	4	33	0	87
% E	4.5	2.6	11.5	12.6	33.3	51.6	0.0	7.9
Undetermined	0	0	4	1	7	–	–	12
% E	0.0	0.0	13.3	3.1	38.9	–	–	8.0
Impacted/missing teeth	16	18	6	6	0	0	0	46
%	5.7	1.7	2.6	2.7	0.0	0.0	0.0	2.3
Males	4	5	2	1	0	0	0	12
%	8.9	1.3	2.3	1.0	0.0	0.0	0.0	1.6
Females	11	11	4	5	0	0	0	31
%	5.5	1.8	3.5	5.3	0.0	0.0	0.0	2.8
Undetermined	1	2	0	0	0	–	–	3
%	2.9	5.6	0.0	0.0	0.0	–	–	2.0

Appendix 2. Pata-Diely. The frequency of caries.

	Juv.	Ad.	Ad.–Mat.	Mat.	Mat.–Sen.	Sen.	Undetermined	Total	p-value	p-value
	15–20 y.	20–40 y.	20–60 y.	40–60 y.	40+ y.	60+ y.			sex	age
Individuals with intact teeth	19	31	6	1	0	3	2	62	–	–
%	82.6	50.8	31.6	7.1	0.0	30.0	100.0	46.3	0.589	0.293
Males	3	15	3	0	0	1	1	23	–	–
%	75.0	55.6	37.5	0.0	0.0	20.0	100.0	42.6	–	–
Females	13	13	3	1	0	2	1	33	–	–
%	86.7	41.9	33.3	14.3	0.0	40.0	100.0	47.8	–	–
Undetermined	3	3	0	0	0	–	–	6	–	–
%	75.0	100.0	0.0	0.0	0.0	–	–	54.5	–	–
Individuals with carious teeth	4	30	13	13	5	7	0	72	–	–
<i>F-CE</i>	17.4	49.2	68.4	92.9	100.0	70.0	0.0	53.7	0.589	0.790
Males	1	12	5	6	3	4	0	31	–	–
<i>F-CE</i>	25.0	44.4	62.5	100.0	100.0	80.0	0.0	57.4	–	–
Females	2	18	6	6	1	3	0	36	–	–
<i>F-CE</i>	13.3	58.1	66.7	85.7	100.0	60.0	0.0	52.2	–	–
Undetermined	1	0	2	1	1	–	–	5	–	–
<i>F-CE</i>	25.0	0.0	100.0	100.0	100.0	–	–	45.5	–	–
At least one caries without AMTL	3	19	6	2	2	1	0	33	–	–
% <i>ind C</i>	75.0	63.3	46.2	15.4	40.0	14.3	0.0	45.8	0.652	0.253
Males	1	8	3	0	2	1	0	15	–	–
% <i>ind C</i>	100.0	66.7	60.0	0.0	66.7	25.0	0.0	48.4	–	–
Females	1	11	2	2	0	0	0	16	–	–
% <i>ind C</i>	50.0	61.1	33.3	33.3	0.0	0.0	0.0	44.4	–	–
Undetermined	1	0	1	0	0	–	–	2	–	–
% <i>ind C</i>	100.0	0.0	50.0	0.0	0.0	–	–	40.0	–	–
At least one AMTL without caries	0	5	2	4	1	3	0	15	–	–
% <i>ind E</i>	0.0	16.7	15.4	30.8	20.0	42.9	0.0	20.8	0.764	0.730
Males	0	2	1	2	0	1	0	6	–	–
% <i>ind E</i>	0.0	16.7	20.0	33.3	0.0	25.0	0.0	19.4	–	–
Females	0	3	0	1	1	2	0	7	–	–
% <i>ind E</i>	0.0	16.7	0.0	16.7	100.0	66.7	0.0	19.4	–	–
Undetermined	0	0	1	1	0	–	–	2	–	–
% <i>ind E</i>	0.0	0.0	50.0	100.0	0.0	–	–	40.0	–	–
Both caries and AMTL	1	6	5	7	2	3	0	24	–	–
% <i>ind CE</i>	25.0	20.0	38.5	53.8	40.0	42.9	0.0	33.3	1.000	0.463
Males	0	2	1	4	1	2	0	10	–	–
% <i>ind CE</i>	0.0	16.7	20.0	66.7	33.3	50.0	0.0	32.3	–	–
Females	1	4	4	3	0	1	0	13	–	–
% <i>ind CE</i>	50.0	22.2	66.7	50.0	0.0	33.3	0.0	36.1	–	–
Undetermined	0	0	0	0	1	–	–	1	–	–
% <i>ind CE</i>	0.0	0.0	0	0.0	100.0	–	–	20.0	–	–

F-CE – Frequency of caries; % ind C – Frequency of individuals with caries; % ind E – Frequency of individuals with ante-mortem tooth loss; % ind CE – Frequency of individuals with caries and ante-mortem tooth loss; AMTL – Ante-mortem tooth loss.

Appendix 3. Pata-Diely. The intensity of caries.

	Juv.	Ad.	Ad.–Mat.	Mat.	Mat.–Sen.	Sen.	Undetermined	Total	p-value	p-value
	15–20 y.	20–40 y.	20–60 y.	40–60 y.	40+ y.	60+ y.			sex	age
Carious teeth and AMTL	14	80	41	70	23	56	0	284	–	–
<i>I-CE</i>	4.3	6.8	16.2	32.9	26.6	48.6	0.0	13.3	–	–
Males	1	31	10	46	9	20	0	117	–	–
<i>I-CE</i>	1.4	6.5	8.8	54.8	13.1	37.4	0.0	14.2	–	–
Females	11	49	23	23	4	36	0	146	–	–
<i>I-CE</i>	5.1	7.8	19.3	23.4	33.3	57.4	0.0	12.7	–	–
Undetermined	2	0	8	1	10	–	–	21	–	–
<i>I-CE</i>	2.4	0.0	31.5	3.1	66.2	–	–	12.2	–	–
Carious teeth	5	52	21	27	11	8	0	124	–	–
% C	1.1	4.2	7.5	13.7	13.4	7.5	0.0	5.2	0.246	0.0157*
Males	1	19	7	16	8	5	0	56	–	–
% C	1.4	3.5	5.4	23.9	11.4	9.1	0.0	6.0	–	–
Females	2	33	10	11	0	3	0	59	–	–
% C	0.6	5.2	7.8	10.8	0.0	5.9	0.0	4.8	–	–
Undetermined	2	0	4	0	3	–	–	9	–	–
% C	2.4	0.0	18.2	0.0	27.3	–	–	4.2	–	–
AMTL	9	28	20	43	12	48	0	160	–	–
% E	3.2	2.7	8.7	19.2	13.2	41.0	0.0	8.1	0.861	0.0000*
Males	0	12	3	30	1	15	0	61	–	–
% E	0.0	3.0	3.4	30.9	1.6	28.3	0.0	8.2	–	–
Females	9	16	13	12	4	33	0	87	–	–
% E	4.5	2.6	11.5	12.6	33.3	51.6	0.0	7.9	–	–
Undetermined	0	0	4	1	7	–	–	12	–	–
% E	0.0	0.0	13.3	3.1	38.9	–	–	8.0	–	–

* p < 0.05

I-CE – Intensity of caries; % C – Frequency of carious teeth; % E – Frequency of ante-mortem tooth loss; AMTL – Ante-mortem tooth loss.

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Príspevok k poznaniu dentálneho zdravia v Európe v staršej dobe bronzovej

Prípadová štúdia z Paty, juhozápadné Slovensko

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SÚHRN

Hodnotenie stavu chrupu populácie z pohrebiska zo staršej bronzovej doby v Pate-Dieloch nadväzuje na základný antropologický a paleodemografický rozbor kostrových pozostatkov (*Mikliková 2000; 2001*) a je súčasťou pripravovanej detailnej paleopatologickej analýzy. Táto pilotná štúdia novými výsledkami a ich porovnaním v rámci pohrebísk zo staršej doby bronzovej a včasného stredoveku významne prispieva k poznaniu orálneho zdravia historických populácií Slovenska. Dentálne analýzy budú ďalej konfrontované s výsledkami analýz stabilných izotopov uhlíka a dusíka, ktoré by mali priniesť presnejšiu odpoveď na otázky týkajúce sa spôsobu stravovania, podielu živočíšnej a rastlinnej

zložky v potrave, rozdielov v zložení stravy mužov a žien, resp. dospelých a nedospelých jedincov v Pate.

Prezentované výsledky vychádzajú zo štúdia 185 jedincov, z ktorých bolo 19 jedincov s mliečnym chrupom, 32 jedincov so zmiešaným chrupom a 134 jedincov s trvalým chrupom. U jedincov s mliečnym chrupom (infans I) sa zubný kaz nevyskytol. V skupine detí so zmiešaným chrupom (infans II) mali štyria jedinci (F-CE = 12,5 %) zubným kazom postihnutých osem mliečnych zubov (I-CE = 5,7 %). Trvalé zuby boli intaktné. Zo 134 jedincov s trvalým chrupom malo 72 individuí chrup postihnutý zubným kazom a/alebo intravitálnou stratou jedincov,

frekvencia kazivosti F-CE dosiahla 53,7 %. Intersexuálne ani vekové rozdiely ukazovateľov neboli štatisticky významné. Frekvencia kariéznych zubov (% C) predstavuje 5,2 %, frekvencia intravitálnych strát (% E) je 8,1 %, intenzita kazivosti (I-CE) dosiahla 13,3 %. Intersexuálne rozdiely vo frekvencii kazov, ako aj intravitálnych strát, neboli štatisticky významné. Vekové rozdiely vo frekvencii kazov aj intravitálnych strát štatisticky významné boli, avšak vzhľadom na široké rozpätie niektorých vekových kategórií (napr. adultus–maturus, t. j. 20–60 rokov) je ich interpretácia problematická. Pri porovnaní Paty s pohrebiskami zo staršej doby bronzovej, je možné skonštatovať, že v Pate, Rumanovej a Melčiciach bola kazivosť zubov podobná, na pohrebisku v Branči však bola signifikantne vyššia. Frekvencia kazivosti bola na všetkých včasnostredovekých pohrebiskách vyššia ako v Pate. V prípade intenzity kazivosti je situácia komplikovanejšia. Kým prevalencia kazov bola na stredovekých pohrebiskách vyššia ako v Pate, v prípade frekvencie intravitálnych strát mali pohrebiská Pobodim-Hradišťa a Pobodim-Na laze signifikantne nižšie hodnoty. Zápalové procesy alveolárnej kosti sa vyskytli u 28 jedincov (20,9 %). Intersexuálne ani vekové rozdiely sme nezistili. Zápalovým procesom bolo postihnutých 62 alveol, čo z celkového počtu 1986 vyšetrených alveol predstavuje 3,1 %. Najfrekvencovanejšími zápalovými procesmi boli absces/osteomyelitída (61,3 %), druhý najčastejší bol periapikálny granulóm (24,2 %), najmenej

často sa vyskytovala radikulárna cysta (14,5 %). Z pohrebisk zo staršej doby bronzovej mala najnižšie percento postihnutých jedincov Rumanová, naopak najvyššia frekvencia sa vyskytla v Branči, čo zrejme súvisí s pomerne vysokou frekvenciou a intenzitou kazivosti chrupu. Na stredovekých pohrebiskách mali štatisticky významne vyššiu frekvenciu zápalových procesov len pohrebiská z Nitry-Lupky a Tvrdošoviec. Rozdiely v kazivosti zubov a v prevalencii zápalových procesov medzi pohrebiskami môžu byť spôsobené odlišným spôsobom života, najmä stravovacími návykmi. Ich interpretácia však nie je jednoduchá, pretože môžu byť ovplyvnené počtom analyzovaných jedincov, odlišnou metodikou hodnotenia kazivosti na niektorých pohrebiskách, ale aj interindividuálnou chybou hodnotenia.

Okrem patologických zmien bolo na chrupe jedincov z Paty zaznamenaných aj niekoľko anomálií týkajúcich sa morfológie zubných koruniek, počtu zubov a zubných koreňov. U štyroch jedincov sa vyskytla lopatovitost rezákov, u dvoch jedincov hypodoncia, u piatich jedincov hyperdoncia a u dvoch jedincov nadpočetné korene na zuboch. Prítomné boli tiež nadpočetné hrbčky na zubných korunkách, konkrétne jeden prípad *tuberculum Carabelli*, jeden prípad *tuberculum paramolare* a dva prípady 6-hrbčkových horných druhých molárov. Zaujímavým nálezom boli sklovinové perly, ktoré sa vyskytli u štyroch jedincov.