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THE DENTAL REMAINS FROM KRŠKANY (SLOVAKIA) AND VEDROVICE (CZECH REPUBLIC)

ABSTRACT: The dental remains from the Linear Pottery (LnP) sites of Krškany and Vedrovice are presented for dental metrics, non-metric dental traits, dental caries and oral pathologies and dental attrition. Overall, adult males and females from Krškany and Vedrovice show greatly reduced permanent tooth size compared to a Mesolithic sample composed of specimens from western and central Europe. Deciduous tooth size also reduces, but compared to the changes in the permanent dentition the primary teeth are more stable through time. Caries incidence and severity of caries are also considerably higher in the Krškany and Vedrovice samples compared to the preceding Mesolithic groups. Attrition rates show no significant change over time, in that average dental wear does not differ between Krškany/Vedrovice and the Mesolithic. However, dental wear is considerably greater than in an Hungarian Medieval sample. About 25% of the individuals (predominantly females) from Krškany and Vedrovice show evidence of a manipulative tooth wear affecting mainly the upper lateral incisors. Results of the dental analysis are pertinent to discussions of the evolutionary course of dental reduction in post-Pleistocene Europeans and models proposed to account for dental reduction.

KEY WORDS: Teeth – Linear Pottery (LnP) – Dental metrics – Caries – Oral pathology – Manipulative wear

The dental remains from Krškany and Vedrovice are represented by 162 individuals with more than 2,600 teeth. This extensive and generally well-preserved sample represents a large dental sample from the earliest agricultural period in central Europe. The graveyard at Krškany, excavated in the mid-1960s (Pavúk 1972), is located near Nitra in Slovakia and includes 68 individuals with dental remains ranging from neonates to old adults. Individuals from Vedrovice with at least one tooth number 94 neonates to old adults and were excavated under the direction of V. Podborský (2002) between 1975–1982 outside the small town of Vedrovice (Czech Republic) in south-western Moravia. Like Krškany the graves are primarily single, flexed interments (the exceptions tend to be females with infants) spread over a nearly 100 m by 100 m area. At both sites, most corpses were buried on their left-side oriented with their heads pointing east (or southeast) and included grave goods. Pottery styles are similar between the two sites which are less than 150 km apart and ceramic analysis places both between the Moravian subphases Ib_1–II_a of the LnP. Only Vedrovice is directly dated, with human bones from graves 15 and 46 yielding ages of 5300–5260 BC (Podborský 2002: 336). These two dates are consistent with others for the LnP in central Europe which consistently dates to about 5300 BC (Price *et al.* 2001).

In this report, various aspects of the dentitions from these two sites are documented ranging in topic from size to pathology to occlusal wear. Besides being just a descriptive account, an attempt is made to place the dental observations on the Krškany and Vedrovice sample into an evolutionary perspective. Thus, comparisons are made to the European Mesolithic, a collection of teeth from other Linear Pottery (or earliest Neolithic) sites in central Europe, a later Neolithic sample from western and central Europe and a large Medieval sample from Hungary. The latter is used to represent the "modern" condition, although no inference is proffered that these skeletons typify all modern Europeans.

Comparative studies of this kind are often complicated by relying upon data collected by different investigators using different observational criteria for identifying, especially, dental wear and pathology (Hillson 1986, Powell 1985). However, in this report (except for a few dental metrics from the Mesolithic and the Hungarian Middle Ages), virtually all data were collected by the author over the past 30 years on the original specimens. While there are certainly still problems with identifying specific pathologies (such as interproximal caries in intact dentitions and other problems of intra-observer error), the fact that the comparative samples were collected by a single investigator should reduce many of the uncertainties associated with inter-observer quantitative and qualitative assessments.

METHODS

Dentitions from Krškany and Vedrovice were studied off and on over a 14 year period in the Moravské zemské muzeum, Brno beginning in 1984. All dental material from Krškany was studied first as a unit since it was excavated earlier and completely curated in the 1970s. Vedrovice was added to the data set as material from the site was discovered, cleaned, reconstructed and curated. In 1992, the dentitions from both sites were re-assessed as a group over about a two week period. At this time, sex determination was re-evaluated for the skulls and where possible the pelvis, in consultation with Jan Jelínek (Moravské zemské muzeum, Brno) and Vladimír Novotný (Masaryk University, Brno). The specimens were also aged in 1992, using the pubic symphysis whenever it was available and, when not (which was often), late closing postcranial epiphyses (e.g., the medial clavicle), cranial suture obliteration and dental wear. For all individuals lacking the pubic symphysis or a later closing epiphysis, age at death in years was not scored, but rather the individuals were assigned to young adult, mature adult, or old adult categories. For this work, similar ageing procedures were used in the comparative samples (all done by me) which provide some control of possible demographic differences among them. This is especially relevant in the section on oral pathologies. These age/sex determinations are in a few cases at odds with the inventories published by Pavúk (1972) for Krškany and Podborský (2002) for Vedrovice. I have chosen to follow my assessments (confirmed in most cases by the joint sex/ageing session with Novotný and Jelínek noted above). Whatever the inconsistencies, it is important to note that the Krškany/Vedrovice and Mesolithic samples are comprised of similar numbers of young adult, mature adult and old adult categories. On the other hand, the Hungarian Medieval sample includes more mature and old adults and, consequently, has a older average age at death.

Dental measurements consist of standard length (mesial-distal) and breadth (buccal-lingual) metrics following techniques outlined in Frayer (1978). Heavily worn specimens are not included, especially for the length dimension which is commonly shortened by interproximal wear. Areas for the canine, premolars and molars were calculated as the product of length times the breadth. Since incisor lengths and breadths can never be measured on the same plane, unless considerable occlusal wear has occurred (thus markedly shortening the mesial distal dimension), calculating "areas" for these teeth is meaningless and not done here. Rather, for the upper and lower incisors, only lengths and breadths are used. In a few cases, especially third molars, there are a few cases of pegged teeth. Since these represent functional (but admittedly small) teeth, they were included in the descriptive statistics for tooth size. To exclude them, misrepresents the nature of third molar

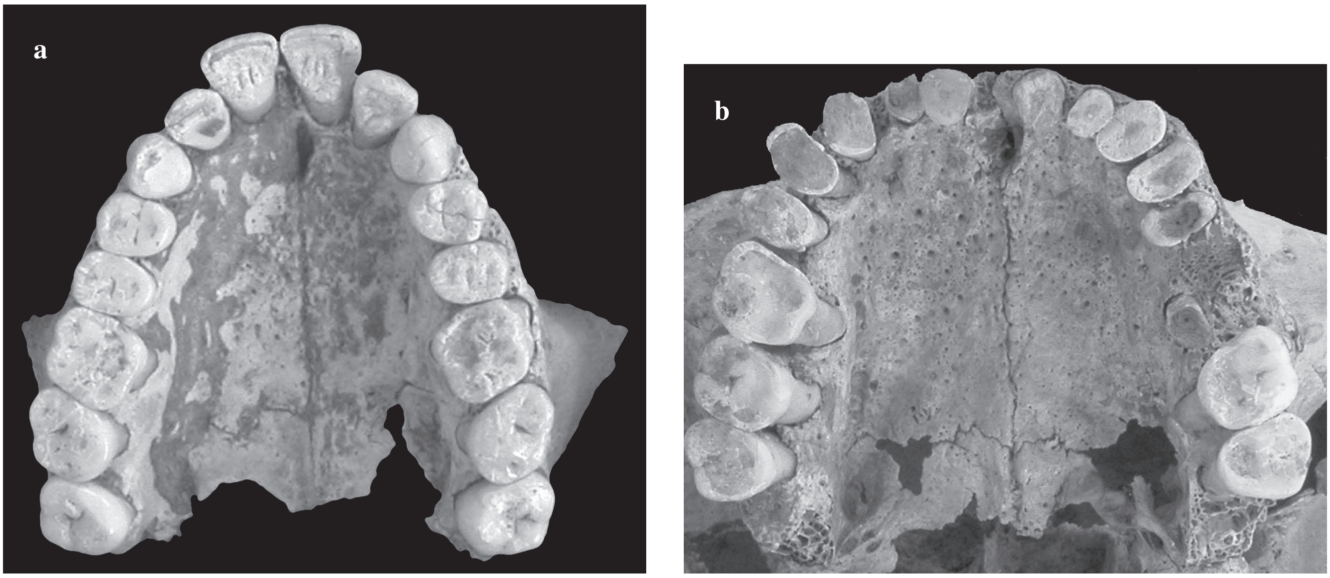

FIGURE 1. a) Maxillary dentition of a 20-year-old male showing moderate tooth wear (Vedrovice 1). Note the asymmetrical occlusal wear on the right second incisor and canine. b) Maxillary dentition of an old female (Vedrovice 70) showing very heavy attrition on all teeth anterior to the M1s. Note that caries have completely destroyed the crowns of the right I2, left P4 and the left M1.

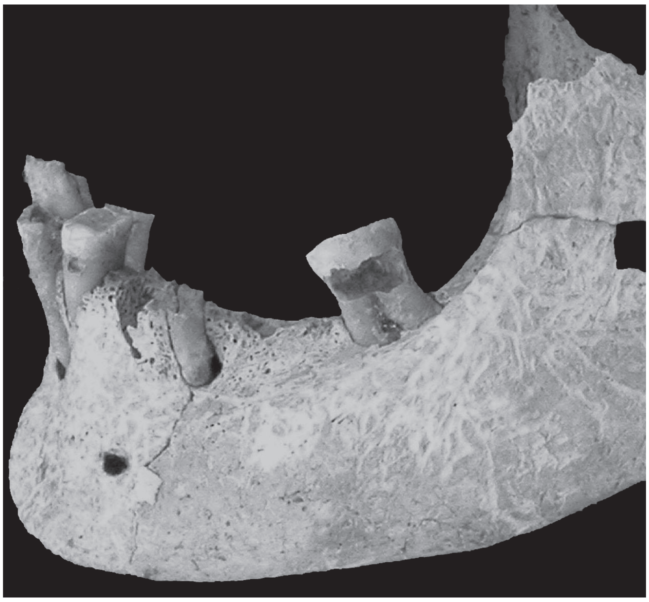

FIGURE 2. Mandibular dentition of Vedrovice 27, an unsexed, mature adult. On the left side, the individual shows multiple dental pathologies, including pre-mortem tooth loss of the two incisors (not shown) and the M2 (with alveolar resorption), an abscessed canine alveolus, an abscessed remnant of the mesial root of M1 with what must have been penetrant (pulpal) caries and root caries on the buccal face of P4 and M3. The right side (not shown) shows an edentulous corpus behind the first premolar.

FIGURE 3. Lateral view of articulated jaws of Vedrovice 70. The maxilla shows periodontal disease, but no abscesses. The lower jaw exhibits pre-mortem loss of P4, M1 and M2, which must have occurred long before death given the amount of alveolar resorption and the degree of over-eruption of the upper M1 and M2.

reduction in the samples. This procedure explains why a few posterior teeth show such small lengths and breadths. Metric data in *Tables 1–9* represent the left, right, or the average of the two when both are present. For the comparative samples, virtually all the Mesolithic (*Appendix 1*), Neolithic (*Appendix 2*) and Medieval (Zalavár and Halimba from Hungary) specimens were measured on originals by me. The exceptions are a few specimens taken from the literature in the Mesolithic sample and the Halimba tooth measurements which were provided by Milford H. Wolpoff (University of Michigan). Sexing in the comparative samples was done in a completely parallel manner to the Krškany/Vedrovice sample. Thus, the pelvis was used first, followed by the skull and other postcranial features. In no case in any of the samples was sex determined by tooth size.

Dental attrition was scored on a 0–8 scale using Smith's (1984) wear code system. Examples of moderately and heavily worn teeth are illustrated in *Figure 1*. All permanent teeth were scored in the initial study, then checked and recoded where necessary in the 1992 re-study. Only individuals with an erupted third molar or other indications of adult (or near adult) status were included in the analysis of dental wear. Dental chipping was also scored, but this was difficult to verify without microscopic analysis and is not reviewed in this report. Due to the extensive dental wear only a few surface traits were scored. These included degree of upper incisor shovelling following Hrdlička's scale (1920) and the expression of Carabelli's cusp, modified from Dahlberg (1963). Agenesis was determined from macroscopic procedures only. In cases where much of the posterior tooth row was edentulous, a missing third molar was never scored as agenesis, but rather as a pre-mortem loss. Thus, while the level of third molar agenesis appears to be high at Krškany/Vedrovice, this is not due to scoring teeth lost before death as agenesis.

Oral pathologies were first located by eye or hand lens, but caries and abscesses were always probed to verify their presence. Caries were differentiated into occlusal (non-penetrant), pulpal (penetrant) and root caries types (*Figure 2*). Procedures used for identifying and classifying caries were similar to those reviewed in Frayer (1989) and only specimens scored by me are included in the comparative tables. Thus, while data exist for dental pathologies at other LnP sites (Baum 1990), I have not included such data here because of problems in the consistency of scoring caries. Abscesses were recorded when a cloaca penetrated the exterior (or rarely the interior) alveolar margin or when the root sockets were expanded by pockets which greatly exceeded their original dimensions (*Figure 2*). Teeth lost pre-mortem were identified mainly by resorption of the socket(s) or bone loss in the mandibular or maxillary alveolar margins. Resorbed sockets were often accompanied by forward migration and tilting of the more distal tooth and sometimes by the over-eruption of the maxillary (or mandibular) opponent (*Figure 3*). Teeth were scored as lost post-mortem if the tooth was missing from the mandible or maxilla and the socket showed no evidence of infilling. If anything, the data for pre-mortem lost teeth are an underestimate in all the samples since the observational requirements were conservative. No attempt was made to determine why teeth were lost pre-mortem, although many times this was likely due to caries, given their high frequency in both Krškany and Vedrovice. As shown in *Figure 3,* evidence that caries destroyed the crown is sometimes substantiated by the persistence of carious root stubs. Finally, dental hypoplasia was scored by eye as present or absent. Initially an attempt was made to score enamel hypoplasia by severity and frequency of the lines, but so few individuals showed hypoplastic lines that it was decided to only score them as present or absent, irrespective of the severity. Since inter-observer error is likely to be high in recording these lines (such as described for Harris lines by Macchiarelli *et al.* 1994), comparative data are only presented for specimens scored by me on original specimens from the Mesolithic and Hungarian Neolithic.

DENTAL METRICS

Dental size – permanent teeth

Dental metrics for all specimens (males, females and unknowns) from Krškany and Vedrovice are presented in *Table 1*. Combining data from the two sites is justified given the common archaeological affiliation, the similar chronological dates, the overlap in appearance of a unique upper incisor wear pattern (discussed below) and the similarity in the non-metric and morphological cranial features. Besides these justifications, when comparing the means for total samples (males, females and unknowns) with each other, not a single mean reaches even a minimally statistically significant difference ($p<0.05$) between Krškany and Vedrovice. Nearly identical results occur when only males or females are compared between the two sites. Thus, when averaged values for male tooth size are compared between the two sites, only mandibular I2 length shows a significant difference ($p<0.0283$) for the 22 length, breadth and area dimensions. For females, only the mandibular P3 length ($p<0.0257$) and the maxillary I2 length ($p<0.0333$) reach the 0.05 level of significance. It is important to note that using the Bonferroni protection for conjoint statistical tests, none of these three values reaches statistical significance. As discussed below, the Krškany/Vedrovice sample does differ significantly for a few measurements when compared to other early Neolithic sites. This suggests that the two sites are metrically homogeneous to each other, but not always to other Neolithic samples. Thus, based on cultural, morphological and metric similarities, the individuals from these two cemeteries are justifiably grouped together. Finally, it is important to note that Krškany and Vedrovice have an unbalanced sex ratio (considerably more females than males), so direct comparisons of the data in *Table 1* with other samples (where males generally outnumber females, contrary to most prehistoric cemeteries – Weiss 1972) can be misleading without adjusting for the skewed sex ratio. In the following analysis, to avoid making comparisons with other male-biased samples, data are presented separately for males and females.

Tables 2 and *3* provide descriptive statistics for lengths, breadths and areas for males and females respectively and serve as the basis for all subsequent metric comparisons. The sample sizes of these sex-based samples are smaller than the sums for both sites presented in *Table 1*, since this table includes all permanent teeth. Many of these are found in jaws of unsexable subadults. In the comparative tables

TABLE 1. Mandibular and maxillary tooth measurements for Krškany and Vedrovice (males, females and unsexed).

		Mandible				Maxilla			
		X	n	s.d.	range	X	n	s.d.	range
I1	lt	5.0	65	0.3	4.2–5.9	8.3	64	0.5	7.4–9.7
	br	5.8	84	0.5	5.0–7.0	6.9	79	0.5	5.5–8.2
I2	lt	5.6	82	0.4	4.7–6.7	6.4	56	0.6	4.9–8.0
	br	6.2	96	0.4	5.2–7.0	6.2	75	0.5	5.1–7.5
C	lt	6.4	107	0.5	5.5–7.5	7.4	81	0.4	6.5–8.4
	br	7.5	110	0.7	5.4–9.5	8.2	88	0.6	6.7–10.0
P3	lt	6.6	101	0.4	5.8–7.4	6.6	79	0.4	5.7–8.2
	br	7.6	101	0.5	6.2–9.0	6.4	88	0.6	7.3–10.5
P4	lt	6.8	94	0.5	5.5–8.7	6.4	87	0.5	5.1–7.6
	br	8.1	96	0.7	6.4–10.0	9.1	86	0.9	6.9–10.7
M1	lt	10.6	110	0.6	9.1–12.4	9.9	100	0.6	8.8–11.1
	br	10.3	98	0.5	8.9–11.5	11.3	104	0.6	9.6–12.8
M2	lt	10.2	99	0.6	8.5–11.9	9.1	90	0.7	7.2–10.6
	br	9.9	99	0.6	8.1–11.2	11.1	90	0.9	8.6–13.6
M3	lt	9.9	63	0.8	8.3–11.7	8.5	71	0.8	6.4–10.1
	br	9.6	63	0.7	8.1–11.2	10.4	71	1.0	8.1–13.5
Areas									
C		48.5	104	7.3	37.0–68.0	60.7	81	7.5	44.9–79.9
P3		49.5	101	5.6	36.3–63.3	59.3	78	7.6	42.7–78.7
P4		54.7	91	7.6	38.7–80.0	58.2	84	8.0	36.9–80.4
M1		108.4	110	9.7	83.2–134.6	111.8	100	11.3	88.8–138.8
M2		100.5	97	11.9	73.1–133.3	100.6	89	13.1	68.8–127.7
M3		95.5	63	13.3	67.2–120.5	88.7	71	14.1	55.7–119.9

TABLE 2. Mandibular tooth measurements for Krškany and Vedrovice males and females.

		Mandible				Maxilla			
		X	**n**	**s.d.**	**range**	**X**	**n**	**s.d.**	**range**
I1	lt	5.0	20	0.4	4.3–5.9	4.9	26	0.3	4.2–5.4
	br	6.0	33	0.4	5.2–7.0	5.6	35	0.4	5.2–7.0
I2	lt	5.7	28	0.4	4.9–6.3	5.6	35	0.4	4.7–6.7
	br	6.4	35	0.4	5.6–7.0	6.1	45	0.4	5.4–7.0
C	lt	6.6	38	0.4	5.7–7.4	6.2	50	0.4	5.6–7.5
	br	8.1	39	0.7	6.8–9.5	7.2	54	0.6	5.4–9.0
P3	lt	6.6	38	0.4	5.9–7.3	6.5	51	0.4	5.8–7.4
	br	7.8	38	0.5	6.7–9.0	7.4	51	0.5	6.2–8.5
P4	lt	6.9	36	0.4	6.0–7.6	6.6	48	0.5	5.5–8.0
	br	8.4	37	0.6	7.3–10.0	7.8	50	0.6	6.4–9.5
M1	lt	10.8	34	0.4	9.9–11.8	10.2	46	0.5	9.1–11.2
	br	10.5	37	0.5	10.5–11.5	10.1	49	0.5	8.9–11.2
M2	lt	10.3	33	0.7	8.5–11.9	10.0	50	0.7	8.7–11.9
	br	10.3	33	0.6	8.6–11.1	9.6	50	0.5	8.1–11.2
M3	lt	10.2	29	0.6	8.8–11.7	9.6	31	0.8	8.3–11.2
	br	9.9	29	0.5	8.7–11.2	9.3	31	0.7	8.1–10.6
Areas									
C		53.4	37	7.2	38.8–68.0	44.9	50	5.7	37.0–62.1
P3		51.9	38	5.1	41.4–62.3	47.9	51	5.4	36.2–61.3
P4		57.6	35	6.2	43.1–69.5	51.8	48	6.8	38.7–75.6
M1		114.3	34	8.1	96.0–128.8	103.1	46	9.1	83.2–124.9
M2		106.1	32	11.7	73.1–127.6	96.0	50	11.1	73.7–133.3
M3		101.1	29	10.8	80.1–120.5	89.3	31	13.2	67.2–118.7

TABLE 3. Maxillary tooth measurements for Krškany and Vedrovice males and females.

		Mandible				Maxilla			
		X	**n**	**s.d.**	**range**	**X**	**n**	**s.d.**	**range**
I1	lt	8.4	21	0.6	7.4–9.7	8.1	26	0.4	7.4–9.2
	br	7.2	26	0.5	6.2–8.2	6.8	38	0.5	5.5–7.9
I2	lt	6.6	20	0.6	5.6–8.0	6.1	24	0.6	4.9–7.3
	br	6.5	27	0.4	5.9–7.5	6.0	36	0.4	5.1–6.9
C	lt	7.6	30	0.4	6.9–8.4	7.2	39	0.4	6.5–7.9
	br	8.7	31	0.6	7.4–10.0	7.9	45	0.5	6.7–9.0
P3	lt	6.7	30	0.5	5.8–7.6	6.5	36	0.4	5.7–8.2
	br	9.2	31	0.6	8.2–10.5	8.8	44	0.5	7.3–9.8
P4	lt	6.6	32	0.6	8.2–7.8	6.2	43	0.4	5.4–7.3
	br	9.4	30	0.7	7.4–10.7	8.9	44	0.7	6.9–10.4
M1	lt	10.0	30	0.5	8.9–11.0	9.6	40	0.5	8.8–10.9
	br	11.6	31	0.5	10.5–12.8	11.0	43	0.6	9.6–12.1
M2	lt	9.3	33	0.7	7.4–10.6	8.9	46	0.6	7.3–10.4
	br	11.5	32	0.6	9.8–12.7	10.7	47	0.8	8.6–12.4
M3	lt	8.6	31	0.6	7.2–9.8	8.3	36	0.8	6.4–10.0
	br	10.9	31	0.9	9.0–13.6	9.9	36	0.8	8.1–11.6
Areas									
C		66.6	30	7.0	50.4–79.9	56.1	39	5.0	44.9–67.3
P3		62.3	30	7.5	47.6–77.4	57.3	36	6.8	42.7–78.7
P4		61.9	31	8.9	37.7–80.4	55.2	41	6.6	36.9–76.1
M1		116.3	30	10.7	93.5–136.4	106.1	40	10.0	88.8–130.8
M2		107.6	32	11.4	83.9–127.7	95.3	46	11.2	68.8–126.8
M3		94.1	31	12.5	66.6–119.9	82.7	36	13.3	55.7–107.5

(*Tables 4–7*), the Krškany and Vedrovice sample means are compared to a series of others, separately for males and females and for the mandible and maxilla. The Mesolithic sample is from western and central Europe and considerably updated from Frayer (1978), the Linear Pottery (hereafter referred to as LnP) Neolithic individuals derive solely from central Europe (primarily consisting of specimens from Stuttgart-Muhlhausen, but with a few Early Neolithic specimens from Hungary), the Later Neolithic is composed mainly of teeth from western/northern Europe and the Medieval sample comes from the Hungarian Middle Ages. For males, it is evident that tooth size reduced markedly from the Mesolithic to the Krškany/Vedrovice sample. In the mandible (*Table 4*) every dimension is larger in the Mesolithic and most differences are statistically significant, even using the conservative $p<0.002$ level as

TABLE 4. Mean mandibular tooth dimensions and percent differences for Krškany and Vedrovice males and the comparative samples (+ indicates K/V mean exceeds the comparative sample; significant difference in means between Krškany/Vedrovice (K/V) and the comparative sample with two-tailed student's t-test; * p<0.05, ** p<0.002).

		K/V	Mesolithic		LnP neo		Later neo		Medieval	
		mean	**mean**	**diff.**	**mean**	**diff.**	**mean**	**diff.**	**mean**	**diff.**
I1	lt	5.0	5.6	12.0**	5.2	4.0	5.1	2.0	5.4	8.0*
	br	6.0	6.3	5.0*	5.9	+1.6	6.0	0.0	6.1	1.7
I2	lt	5.7	6.1	7.0**	6.0	5.3*	5.7	0.0	5.8	1.8
	br	6.4	6.6	3.1*	6.3	+1.6	6.4	0.0	6.4	0.0
C	lt	6.6	7.1	7.6**	6.6	0.0	6.8	3.0	6.9	4.3*
	br	8.1	8.1	0.0	7.9	+2.5	7.9	+2.5	7.9	+2.7
P3	lt	6.6	7.0	6.1**	6.6	0.0	6.7	1.5	6.7	1.5
	br	7.8	8.1	3.7*	7.5	+3.8*	7.7	+1.3	7.6	+2.6
P4	lt	6.9	7.0	1.4	6.8	+1.4	6.9	0.0	6.8	+1.4
	br	8.4	8.5	1.2	8.2	+2.4*	8.3	+1.2	8.2	+2.4*
M1	lt	10.8	11.5	6.5**	10.6	+1.9	10.9	0.9	11.0	2.8*
	br	10.5	11.1	5.7**	10.3	+1.9*	10.7	1.9	10.5	0.0
M2	lt	10.3	10.9	5.8**	10.2	+1.0	10.5	1.9	10.4	1.0
	br	10.3	10.8	4.9**	10.0	+2.9	10.3	0.0	10.1	+1.9
M3	lt	10.2	10.7	4.9*	9.9	+2.9	10.6	3.9	10.4	2.0
	br	9.9	10.4	5.1**	9.6	+3.0	10.0	1.0	9.8	+1.0
Areas										
C		53.4	57.4	7.5*	52.0	+4.1	53.5	0.2	55.0	3.0
P3		51.9	56.6	9.1**	49.8	+3.9	52.2	0.6	51.3	+1.2
P4		57.6	59.7	3.6	55.4	+3.8	57.2	+0.7	56.1	+2.6
M1		114.3	128.2	12.2**	109.7	+4.0*	116.9	2.3	115.6	1.1
M2		106.1	117.3	10.6**	102.5	+3.4	108.6	2.4	104.9	+1.1
M3		101.1	111.7	10.5**	95.6	+5.4	105.9	4.7	102.1	1.0
Average percent differences										
Lengths and breadths			5.0%		+1.1%		0.7%		0.7%	
Lengths			6.4%		0.3%		1.7%		2.5%	
Breadths			3.6%		+2.5%		+0.3%		+1.3%	
Anteriors			5.8%		0.6%		0.4%		2.2%	
Posteriors			4.5%		+2.1%		0.6%		+2.0%	
Posterior areas			9.2%		+4.1%		1.9%		+0.6%	

required by the Bonferroni correction (0.05/22 = 0.002). The maximum reduction involves the central incisor length (12.0%) and half of the length/breadth dimensions reduce by 5.0% or more. For the canine and posterior tooth areas, each of the molars reduces significantly and more than 10%, while the third premolar is 9.1% smaller. Overall, posterior tooth areas reduce 9.2%. The average percent differences between Krškany/Vedrovice and the Mesolithic show that lengths reduced more than the breadths and the anterior teeth more than the posteriors. Compared with the other samples, there are only minor differences in size and none reach the p<0.002 Bonferroni requirement. The greatest difference with the other comparative samples involves the Krškany/Vedrovice – Medieval I1 length which is 8.0% larger in the Hungarian sample, but even this difference does not reach the required 0.002 level. For the average percent differences there is a tendency for the LnP Neolithic comparative sample to have slightly smaller dimensions than Krškany/Vedrovice and the Later Neolithic sample to have larger averages, but the percent differences are small and overall not statistically significant.

In the maxilla (*Table 5*) a similar pattern is evident with a high number of statistically significant differences between males from Krškany/Vedrovice and the Mesolithic. As in the mandible, the central incisor length shows the greatest reduction (11.9%). Nine of the sixteen length/breadth means are significantly greater in the Mesolithic at p<0.002 and seven of these are 5.0% larger in the Mesolithic. Like in the mandible, lengths reduce more than breadths and anteriors more than posteriors. For the areas, four of six are significantly smaller in the Krškany/Vedrovice sample. When the Krškany/Vedrovice males are compared to the other samples, only minor differences appear. The greatest difference concerns the LnP Neolithic maxillary third molar area which is 10.2% larger in the Krškany/Vedrovice sample and this difference just reaches the required Bonferroni value.

Based on these data, it is apparent that in the mandible and maxilla the greatest dental changes in the males involve the Mesolithic and Krškany/Vedrovice comparisons and that only minor and generally insignificant differences are found between Krškany/Vedrovice males and those from the comparative samples.

For females in the mandible (*Table 6*) all length and breadth measurements for Krškany/Vedrovice are significantly smaller than the Mesolithic at the p<0.002

TABLE 5. Mean maxillary tooth dimensions and percent differences for Krškany and Vedrovice males and the comparative samples (+ indicates k/v mean exceeds the comparative sample; significant difference in means between Krškany/Vedrovice (K/V) and the comparative sample with two-tailed student's t-test; * p<0.05, ** p<0.00).

		K/V	Mesolithic		LnP neo		Later neo		Medieval	
		mean	mean	diff.	mean	diff.	mean	diff.	mean	diff.
I1	lt	8.4	9.4	11.9**	8.6	3.9	8.4	0.0	8.6	2.4
	br	7.2	7.5	4.1**	7.1	+1.6	7.3	1.4	7.4	2.8
I2	lt	6.6	7.2	8.3**	6.6	0.0	6.6	0.0	6.7	1.5
	br	6.5	6.6	1.5	6.4	+1.5	6.5	0.0	6.5	0.0
C	lt	7.6	8.1	6.2**	7.5	+1.3	7.6	0.0	7.7	1.3
	br	8.7	8.9	2.3	8.5	+2.3	8.5	+2.3	8.6	+1.1
P3	lt	6.7	7.0	4.5*	6.5	+3.0	6.7	0.0	6.7	0.0
	br	9.2	9.6	4.3**	8.9	+3.3*	9.0	+2.2	9.1	+1.1
P4	lt	6.6	6.7	1.5*	6.4	+1.5	6.5	+1.5	6.5	+1.5
	br	9.4	9.7	3.2*	9.1	+1.1	9.3	+1.1	9.3	+1.1
M1	lt	10.0	10.6	6.0**	9.8	+2.0	10.2	2.0	10.2	2.0
	br	11.6	12.2	5.2**	11.4	+1.7	11.6	0.0	11.5	+0.9
M2	lt	9.3	9.8	5.4**	9.1	+2.2	9.4	1.1	9.2	+1.1
	br	11.5	12.1	5.2**	11.0	+4.3*	11.5	0.0	11.2	+2.6
M3	lt	8.6	8.7	1.2	8.3	+3.5	8.7	1.2	8.6	0.0
	br	10.9	11.4	4.6*	10.2	+6.4*	10.8	+0.9	10.7	+1.8
Areas										
C		66.0	72.0	9.1*	63.3	+4.1	64.9	+1.7	66.6	1.0
P3		62.3	67.7	8.7*	58.3	+6.4*	60.4	+3.0	61.2	+1.8
P4		61.9	65.4	4.0*	58.7	+5.2	60.3	+2.6	60.3	+2.6
M1		116.3	128.7	10.7**	111.7	+4.0	118.3	1.7	116.6	0.3
M2		107.6	117.7	9.4**	100.7	+6.4*	108.5	0.8	103.0	+4.3
M3		94.1	99.4	5.6	84.5	+10.2*	94.3	0.2	92.3	+1.9
Average percent differences										
Lengths and breadths			4.7%		+2.0%		+0.1%		0.1%	
Lengths			5.6%		+1.2%		0.4%		+0.6%	
Breadths			3.8%		+2.8%		+0.6%		+0.8%	
Anteriors			5.7%		+0.5%		+0.1%		1.2%	
Posteriors			4.1%		+3.1%		0.0%		+0.8%	
Posterior areas			7.7%		+6.4%		+0.6%		+2.1%	

level, except for P4 and M2 length. The lower central incisor length shows the greatest percent decrease (10.2%) and eleven of the 16 length/breadth dimensions have reduction levels exceeding 5.0%. All the areas reach or exceed 10.0% reduction and each is significant beyond p<0.002. Between the Mesolithic and Krškany/Vedrovice samples, lengths reduce more than breadths and the anterior teeth more than the posteriors, as in the male comparisons. However, compared to trends affecting the males, females from Krškany/Vedrovice show proportionally more tooth size reduction. Thus, compared to males who show an average percent reduction of 5.0% for the mandibular lengths and breadths, the females reduce 6.4%, approximately 30% more than the males. The same is true for the mandibular posterior tooth areas which reduce nearly a third more in the females (12.3% in females; 9.2% in males). For the other sample comparisons in the mandible, the LnP Neolithic females are virtually identical to the Krškany/Vedrovice females with low percent differences and no significant difference reaching p<0.002. However, unlike the males, compared to the Later Neolithic and the Hungarian Middle Ages, tooth size in the Krškany/Vedrovice female sample is significantly smaller for some dimensions (C length, M1 length, breadth and area in the Later Neolithic; I1 and M1 length in the Medieval comparison). While the number of these statistically significant increases are not numerous, they provide some evidence for an increase in dental dimensions in females from earliest Neolithic to the later time periods.

In the maxilla, as in the mandible, the Krškany/Vedrovice females show markedly reduced dental dimensions from the Mesolithic averages (*Table 7*). Twelve of the sixteen length/breadth dimensions are significantly smaller at the p<0.002 level and most (10/16) of the comparisons show reductions greater than 5.0%. For the areas, each is significantly smaller in the Krškany/Vedrovice sample and the percentage differences tend to be greater than 10.0% in the Mesolithic. Here, departing from all previous comparisons, lengths and breadths reduce at the same average percent and the posterior teeth reduce slightly more than the anterior. But, as in the mandible, the females show greater levels of percent reductions than males. For example, while female maxillary lengths and breadths reduce an average 6.3%, the same dimensions in males reduce only 4.7%, a differential of 34.0%. For posterior tooth areas, females show a reduction from the

TABLE 6. Mean mandibular tooth dimensions and percent differences for Krškany and Vedrovice females and the comparative samples (+ indicates K/V mean exceeds the comparative sample; significant difference in means between Krškany/Vedrovice (K/V) and the comparative sample with two-tailed student's t-test; * p<0.05, ** p<0.002).

		K/V	Mesolithic		LnP neo		Later neo		Medieval	
		mean	mean	diff.	mean	diff.	mean	diff.	mean	diff.
I1	lt	4.9	5.4	10.2**	5.1	4.1*	5.1	4.1	5.2	6.1*
	br	5.6	6.0	7.1**	5.7	1.8	5.8	3.6*	5.8	3.6*
I2	lt	5.6	6.0	7.1**	5.7	1.8	5.7	1.8	5.7	1.8
	br	6.1	6.4	4.9**	6.1	0.0	6.2	1.6	6.1	0.0
C	lt	6.2	6.7	8.1**	6.2	0.0	6.4	3.2**	6.4	3.2*
	br	7.2	7.5	4.2**	7.2	0.0	7.3	1.3	7.3	1.4
P3	lt	6.5	6.8	4.6**	6.4	+1.5	6.6	1.5	6.4	+1.6
	br	7.4	7.8	5.4**	7.2	+2.8	7.5	1.4	7.2	+2.8
P4	lt	6.6	6.8	3.0*	6.6	0.0	6.8	3.0	6.6	0.0
	br	7.8	8.3	6.4**	7.7	+1.3	8.1	3.8*	7.8	0.0
M1	lt	10.2	11.1	8.8**	10.2	0.0	10.6	3.9**	10.6	3.9**
	br	10.1	10.8	6.9**	9.9	+1.9	10.4	3.0**	10.0	+1.0
M2	lt	10.0	10.3	3.0*	9.7	+3.0*	10.1	1.0	10.0	0.0
	br	9.6	10.3	7.3**	9.5	+1.1	9.8	2.1*	9.5	+1.1
M3	lt	9.6	10.3	7.3**	9.5	+1.1	10.0	4.2*	9.8	2.1
	br	9.3	10.0	7.5**	9.1	+2.2	9.5	2.2	9.1	+2.2
Areas										
C		44.9	50.2	11.8**	44.8	0.0	47.3	5.3*	46.6	3.8
P3		47.9	53.0	10.6**	46.5	+2.2	49.4	3.1	46.4	+3.2
P4		51.8	57.0	10.0**	51.5	+0.1	54.6	5.4*	50.8	+2.0
M1		103.0	119.3	15.8**	101.2	+1.8	110.3	7.1**	106.7	3.6
M2		96.0	106.0	10.4**	91.2	+5.3	99.3	3.4	95.4	+0.6
M3		89.3	102.5	14.8**	86.4	+3.4	95.1	6.4*	89.6	0.3
Average percent differences										
Lengths and breadths			6.4%		+0.4%		2.6%		0.8%	
Lengths			6.5%		0.4%		2.8%		1.9%	
Breadths			6.2%		+0.9%		2.4%		+0.3%	
Anteriors			6.9%		1.3%		2.6%		2.7%	
Posteriors			6.0%		+1.5%		2.6%		+2.7%	
Posterior areas			12.3%		+2.6%		5.1%		+0.4%	

Mesolithic of 12.8%, while males have areas 7.7% smaller, resulting in a differential of nearly 66.2%. Thus, in both the mandible and maxilla females consistently show a greater rate of tooth size reduction from the Mesolithic to the Krškany/Vedrovice sample. As discussed in the following section on sexual dimorphism, this pattern of greater reduction in females results in high values of dental sexual dimorphism in the Krškany/Vedrovice sample. For the other comparisons in the maxilla, the Krškany/ Vedrovice sample has slightly larger dimensions than the LnP Neolithic and, compared to the Later Neolithic and Medieval samples, average dimensions are greater in these samples. Yet, unlike the female mandibular comparisons, none of these mean differences in the maxillary teeth reach the required p<0.002 level.

In summary, it is apparent that both males and females in the Krškany/Vedrovice sample have significantly smaller teeth than typical of the Mesolithic sample. While the latter sample is composed of specimens from all over Europe, it seems reasonable to infer that tooth size reduced dramatically from the Mesolithic to the Neolithic. This reduction of tooth size from hunter-gatherer to agricultural groups is not unexpected given the world-wide pattern for dental reduction between these different economic types. What is surprising is the tentative evidence for an increase in tooth size from Neolithic to later groups, as seen especially in the females and the differential rate of reduction between males and females from Mesolithic to Neolithic times. As discussed below, this differential rate between the sexes results in very elevated rates of sexual dimorphism in the Neolithic samples compared to the Mesolithic groups.

Dental size – deciduous teeth

Summary statistics for the mandibular and maxillary deciduous teeth are given in *Table 8*. As above, data from Krškany and Vedrovice are combined into one sample since there are no statistically significant differences between means for the two sites. For the sample comparisons (*Tables 9* and *10*), it was not possible to include other Neolithic sites since the primary teeth were not measured in my earlier work on these groups. Consequently, only data for the Mesolithic and the Medieval period are included. While the Mesolithic is sampled over many of the same sites

TABLE 7. Mean maxillary tooth dimensions and percent differences for Krškany and Vedrovice females and the comparative samples (+ indicates K/V mean exceeds the comparative sample; significant difference in means between Krškany/Vedrovice (K/V) and the comparative sample with two-tailed student's t-test; * p<0.05, ** p<0.002).

		K/V	Mesolithic		LnP neo		Later neo		Medieval	
		mean	**mean**	**diff.**	**mean**	**diff.**	**mean**	**diff.**	**mean**	**diff.**
I1	lt	8.1	8.8	8.6**	8.0	+1.3	8.2	1.2	8.3	2.5
	br	6.8	7.2	5.9**	7.0	2.9	7.0	2.9*	7.0	2.9*
I2	lt	6.1	6.7	9.8*	6.2	1.6	6.4	4.9	6.4	3.2*
	br	6.0	6.2	3.3	6.2	3.3	6.2	3.3*	6.2	3.3*
C	lt	7.2	7.5	4.2**	7.2	0.0	7.4	2.8*	7.3	1.4*
	br	7.9	8.2	3.8**	7.8	+1.3	8.1	2.5	7.9	0.0
P3	lt	6.5	6.7	3.1*	6.3	+3.2	6.6	1.5	6.5	0.0
	br	8.8	9.3	5.7**	8.6	+2.3	8.7	+1.1	8.6	+2.3
P4	lt	6.2	6.6	6.5**	6.2	0.0	6.4	3.2	6.2	0.0
	br	8.9	9.4	5.6**	8.8	+1.1	8.9	0.0	8.8	+1.1
M1	lt	9.6	10.2	6.3**	9.6	0.0	9.9	3.1*	9.9	3.1*
	br	11.0	11.7	6.4**	10.9	+0.9	11.2	1.8	11.0	0.0
M2	lt	8.9	9.5	6.7**	8.6	+3.5*	9.1	2.2	8.8	+1.1
	br	10.7	11.5	9.5**	10.3	+3.9*	11.0	2.8*	10.6	+0.9
M3	lt	8.3	8.7	4.8*	8.1	+2.5	8.4	1.2	8.3	0.0
	br	9.9	10.9	10.1**	9.7	+2.1	10.2	3.0	10.0	1.0
Areas										
C		56.1	62.0	10.5**	55.3	+1.4	59.5	6.1*	58.0	3.3
P3		57.3	63.0	9.9**	53.8	+0.7	57.6	0.1	56.0	+2.3
P4		55.2	62.0	12.3**	53.8	+2.6*	56.7	2.7	54.8	+0.7
M1		106.1	118.9	12.1**	104.1	+1.9	111.3	4.9*	108.0	1.8
M2		95.3	109.1	14.9**	88.1	+8.2*	100.3	5.2*	93.5	+2.0
M3		82.7	94.8	14.6**	78.9	+4.8	87.1	5.3	83.4	0.8
Average percent differences										
Lengths and breadths				6.3%		+0.9%		2.2%		0.8%
Lengths				6.3%		+1.1%		2.5%		1.9%
Breadths				6.3%		+0.7%		1.9%		+0.3%
Anteriors				5.9%		0.9%		2.9%		2.2%
Posteriors				6.5%		+2.0%		1.8%		+1.3%
Posterior areas				12.8%		+3.6%		3.6%		+0.5%

TABLE 8. Mandibular and maxillary deciduous tooth measurements for Krškany and Vedrovice.

		Mandible				Maxilla			
		mean	**n**	**s.d.**	**range**	**mean**	**n**	**s.d.**	**range**
dI1	lt	4.2	8	0.2	3.8–4.6	6.4	16	0.4	5.7–7.1
	br	3.8	8	0.2	3.4–4.1	5.0	16	0.3	4.4–5.6
dI2	lt	4.6	16	0.4	4.1–5.3	5.3	12	0.4	4.6–6.0
	br	4.3	15	0.3	3.8–4.8	5.0	13	0.4	4.4–5.9
dC	lt	5.8	23	0.3	5.2–6.4	6.9	26	0.3	6.2–7.5
	br	5.7	22	0.5	4.7–6.5	6.2	26	0.4	5.3–7.0
dM1	lt	7.9	25	0.5	7.0–9.0	7.0	25	0.5	6.1–8.1
	br	6.9	25	0.5	6.1–8.0	8.3	25	0.5	7.4–9.5
dM2	lt	9.8	24	0.4	8.8–10.5	8.8	25	0.6	7.2–9.7
	br	8.8	24	0.3	8.0–9.3	9.8	24	0.5	8.4–11.0
Areas									
dC		33.0	22	3.5	26.5–40.3	42.7	26	4.2	35.0–52.5
dM1		54.7	25	5.9	43.4–68.0	58.0	26	6.5	45.1–58.0
dM2		86.2	24	6.0	74.8–95.7	86.9	23	7.5	72.7–103.5

which comprise the permanent tooth sample, the Hungarian Medieval sample includes only Zalavár. In addition, to increase the small sample size, a few other Hungarian Medieval sites were included. But even with these additional specimens, sample sizes for the Hungarian Medieval group remain small for some teeth.

Compared to the Mesolithic sample, the Krškany/Vedrovice deciduous teeth are consistently smaller in size. In the mandible (*Table 9*), the dI2 length represents the greatest difference and is nearly 11% smaller in the Krškany/Vedrovice sample. The other differences between the Krškany/Vedrovice and Mesolithic samples range from

TABLE 9. Mean mandibular tooth dimensions and percent differences for Krškany and Vedrovice subadults and the comparative samples (+ indicates K/V mean exceeds the comparative sample; significant difference in means between Krškany/Vedrovice (K/V) and the comparative sample with two-tailed student's t-test: * p<0.05, ** p<0.004).

		K/V	Mesolithic		Medieval	
		mean	mean	diff.	mean	diff.
dI1	lt	4.2	4.2	0.0	3.8	+10.5*
	br	3.8	4.0	5.3	3.7	+2.7
dI2	lt	4.6	5.1	10.9**	4.5	+2.2
	br	4.3	4.5	4.7	4.1	+4.9
dC	lt	5.8	6.1	5.2*	5.6	+3.6
	br	5.7	5.8	1.8	5.3	+7.5*
dM1	lt	7.9	8.1	2.5	7.9	0.0
	br	6.9	7.2	4.3	6.7	+3.0
dM2	lt	9.8	10.3	5.1**	9.9	1.0
	br	8.8	9.2	4.5**	8.7	+1.1
Areas						
dC		33.0	35.4	7.3*	29.5	+11.9*
dM1		54.7	57.8	5.7**	52.7	+3.8
dM2		86.2	94.4	9.5**	85.5	+0.8
Average percent differences						
Lengths and breadths				4.4		+3.5
Lengths				4.7		+3.2
Breadths				4.1		+3.8
Anteriors				4.7		+5.2
Posteriors				4.1		+0.8
Posterior areas				7.5		+5.5

TABLE 10. Mean maxillary tooth dimensions and percent differences for Krškany and Vedrovice subadults and the comparative samples (+ indicates K/V mean exceeds the comparative sample; § indicates a sample size of 1; significant difference in means between Krškany/ Vedrovice (K/V) and the comparative sample with two-tailed student's t-test: * p<0.05, ** p< 0.004).

		K/V	Mesolithic		Medieval	
		mean	mean	diff.	mean	diff.
dI1	lt	6.4	6.9	7.8*	6.1§	–
	br	5.0	5.2	4.0	4.9§	–
dI2	lt	5.3	5.5	3.8	4.8	+10.4*
	br	5.0	4.9	+2.0	4.6	+8.7
dC	lt	6.9	7.1	2.9*	6.9	0.0
	br	6.2	6.3	1.6	6.0	+3.3
dM1	lt	7.0	7.4	5.7**	6.9	+1.4
	br	8.3	8.7	4.8**	8.0	+3.8
dM2	lt	8.8	9.0	2.3*	8.6	+2.3
	br	9.8	10.2	4.1**	9.7	+1.0
Areas						
dC		42.7	45.0	5.4	41.0	+4.1
dM1		58.0	64.4	11.0**	55.3	+4.9
dM2		86.9	92.0	5.9*	86.8	0.0
Average percent differences						
Lengths and breadths				3.5		+3.9
Lengths				2.3		+3.5
Breadths				1.3		+4.2
Anteriors				1.8		+5.6
Posteriors				1.7		+2.1
Posterior areas				7.4		+3.3

1.8–5.2%, but among these only the mandibular dM2 length and breadth (along with dI2 length) reach the required Bonferroni significance level of p<0.004. Not surprisingly, canine and molar areas are also considerably larger in Mesolithic sample, ranging from 5.7–9.5% smaller in the Krškany/Vedrovice samples. Of these, only the deciduous molar areas are statistically significant. For the average percent differences, the overall reduction in lengths and breadths is 4.4% with lengths reducing slightly more than breadths and anteriors slightly more than posteriors. In contrast to the Mesolithic pattern, in the Medieval comparison teeth tend to be larger in the Krškany/Vedrovice Neolithic. With the exceptions of mandibular dM1 and dM2 lengths, all mandibular tooth dimensions (lengths, breadths and areas) are greater in Krškany and Vedrovice, however, none of these reach statistical significance using the required Boneferroni value of 0.004.

For the maxillary deciduous tooth comparisons (*Table 10*), all dental dimensions (except dI2 breadth) from Krškany and Vedrovice are smaller than those for the Mesolithic, ranging from 1.6% to 11.0% smaller. Of these only dM1 length, breadth and area and dM2 breadth reach the required Bonferroni level. The overall reduction in the length and breadths amounts to 3.5% with the lengths decreasing more than the breadths and the anteriors and posteriors reducing at the same rate. As in the mandible, differences between the Krškany/Vedrovice sample and the Medieval involve a general decrease in virtually all tooth dimensions. Again, none of these reach the required Bonferroni level (p<0.004; 0.05/13), but there is a distinct tendency for nearly every maxillary deciduous tooth dimension to decrease from the Krškany/Vedrovice to the Medieval sample.

In summary, patterns of deciduous tooth size reduction parallel the trends in the permanent teeth for the Krškany/ Vedrovice and Mesolithic comparison. For both the permanent and deciduous teeth, there is a statistically significant reduction in tooth size from the Mesolithic to the Krškany/Vedrovice sample. However, for the Krškany/ Vedrovice and Medieval comparison, the permanent teeth are larger in the Medieval sample, while the deciduous teeth tend to be larger in the Krškany and Vedrovice sample. Yet, these differences are not significant and the small sample size in the Medieval deciduous tooth sample may be the reason for these opposite trends.

Dental size: Subadult compared to adult dimensions

Using the subadult dentitions. it was possible to compare tooth size in those individuals who died in their youth to those who died as adults. These data, comparing permanent teeth from adult and subadult jaws, are presented in *Table 11*. The two data files were assembled by first distinguishing specimens who had a fully erupted dentition with no deciduous teeth (including sockets for them) from those individuals who retained at least one deciduous tooth crown or socket. The latter often included jaws with early erupting

TABLE 11. Mandibular and maxillary tooth means for Krškany/Vedrovice and Mesolithic samples for permanent teeth (µ) and permanent teeth associated only with deciduous teeth (µ'). Both samples include males, females, and unsexed individuals. Means (µ and µ') are only reported when sample size >5; significant difference in means with two-tailed student's t-test; * p<0.05 ** p<0.004.

		Mandible				Maxilla			
		Krškany/Vedrovice		Mesolithic		Krškany/Vedrovice		Mesolithic	
		µ	µ'	µ	µ'	µ	µ'	µ	µ'
I1	lt	5.0	5.2**	5.5	5.6	8.2	8.4	9.2	9.2
	br	5.8	5.7	6.2	6.0	6.9	6.9	7.4	7.3
I2	lt	5.6	5.7	6.1	6.3	6.4	6.5	7.1	7.0
	br	6.2	6.1	6.5	6.3	6.2	6.0	6.4	6.8
C	lt	6.4	6.5	6.9	7.2*	7.4	7.6	7.9	8.0
	br	7.5	7.5	7.8	8.0	8.2	8.2	8.6	8.8
P3	lt	6.5	6.6	6.9	7.0	6.6	6.5	6.9	7.2
	br	7.5	7.3	7.9	7.9	8.9	8.7	9.5	9.7
P4	lt	6.8	7.4*	7.0	7.1	6.4	6.7*	6.7	6.6
	br	8.1	–	8.4	8.5	9.1	8.9	9.6	9.4
M1	lt	10.5	10.9**	11.4	11.5	9.8	10.1*	10.4	10.6
	br	10.3	10.2	11.1	10.7	11.2	11.3	12.0	11.9
M2	lt	10.2	10.5	10.7	10.8	9.1	9.1	9.7	9.7
	br	9.9	9.6	10.2	10.5	11.0	11.5	11.8	12.0
M3	lt	9.9	–	10.5	–	8.5	–	8.7	9.1
	br	9.6	–	10.2	–	10.4	–	11.2	11.2
Areas									
C		48.3	49.1	53.6	58.3*	60.4	62.3	67.9	70.4
P3		49.5	48.5	54.9	56.3	59.3	56.7	65.8	69.1
P4		54.5	–	58.6	61.0	57.9	60.1	63.9	62.3
M1		107.9	110.6	124.2	122.0	110.5	113.5	124.6	125.4
M2		100.2	101.7	112.6	110.4	100.2	104.1	114.3	115.7
M3		95.5	–	107.2	–	88.7	–	97.4	102.7

permanent teeth (such as a six year old with permanent M1s in occlusion along with deciduous molars). In other cases, it was possible to take dimensions of permanent crowns which were unerupted, but measurable since they were loose or had fallen from the broken tooth crypts. Thus, two samples were constructed which were differentiated by age. One included individuals older than about 12 years in which all deciduous teeth had been shed and ranged up to old adults. The other sample was comprised of individuals who had all died before reaching 12 years of age judged from the retention of deciduous teeth and/or the uneruption of permanent ones. Data for the Mesolithic sample were collected in a similar manner. These samples were compiled to determine if those individuals who died at an early age had dissimilar dental dimensions to those who lived into late adolescence and adulthood.

For the Krškany and Vedrovice, the younger sample tends to have slightly larger teeth (*Table 11*). For the mandibular and maxillary lengths and breadths, just over half of these dimensions are greater in the younger sample and for areas all but the upper and lower P3s are larger in these younger individuals. A similar pattern occurs in the Mesolithic sample, where about 60% of the younger sample has larger length and breadth dimensions and most (73%) of the areas are also larger. However, very few of these differences in either the Krškany/Vedrovice or Mesolithic samples reach even a p<0.05 level of statistical significance and only mandibular I1 and M1 length in the Krškany/Vedrovice sample satisfy the Bonferroni requirement. Thus, there is no evidence at Krškany and Vedrovice (or for the Mesolithic) that individuals who died before reaching adulthood had significantly larger permanent teeth. Moreover, given that interproximal wear acts to reduce tooth length and heavy occlusal wear can sometimes reduce tooth breadth, the observation that overall tooth size is not different between these "young" and "old" samples indicates that the specimens making up the Krškany and Vedrovice (and Mesolithic) samples do not have significantly reduced dimensions due to pronounced tooth wear. The main reason for this is that individuals with heavily worn teeth were excluded (especially for length dimensions) from the samples presented in *Tables 1–7*.

In summary, there appears to be no relationship in these limited samples for individuals who died young to have larger permanent tooth dimensions than those who died later in life.

Dental sexual dimorphism

Percentage differences for males and females are given in *Tables 12* and *13*. These are calculated by dividing the male mean by the female mean (*100) and are based on the mean dimensions given in *Tables 4–7*. Significant differences in the means as measured by two-tailed student's t-test are given in the tables. As in the previous section,

TABLE 12. Comparison of caries incidence in anterior and posterior teeth based on the total number of teeth (* p<0.05; ** p <0.001 with student's t-test).

	I1–C			P3–M3		
	Number of teeth	**Number of caries**	**Percent carious**	**Number of teeth**	**Number of caries**	**Percent carious**
Mandible Males						
Krškany	92	0	0.0%	150	9	6.0%
Vedrovice	110	0	0.0%	180	8	4.4%
K & V	202	0	0.0%	330	17	5.2%
Mesolithic	408	1	0.2%	880	24	2.7%
Females						
Krškany	105	2	1.9%	181	17	9.4%
Vedrovice	163	2	1.2%	259	23	8.9%
K & V	268	4	1.5%	440	40	9.0%
Mesolithic	380	2	0.5%	707	42	5.9%
Males, females, and unsexed						
Krškany	209	2	1.0%	347	27	7.8%
Vedrovice	300	2	0.7%	477	32	6.7%
K & V	509	4	0.8%	824	59	6.9%
Mesolithic	807	5	0.6%	1637	67	4.1%**
Maxilla Males						
Krškany	65	3	4.6%	126	14	11.1%
Vedrovice	101	1	0.9%	173	25	14.5%
K & V	166	4	2.4%	299	39	13.0%
Mesolithic	372	2	0.5%	822	17	2.1%**
Females						
Krškany	96	3	3.1%	178	7	3.9%
Vedrovice	172	3	1.7%	261	39	14.9%**
K & V	268	7	2.6%	439	46	10.5%
Mesolithic	307	1	0.3%	594	28	3.2%**
Males, females, and unsexed						
Krškany	174	6	3.4%	326	22	6.7%
Vedrovice	296	4	1.4%	468	64	13.7%**
K & V	470	10	2.1%	794	86	10.8%
Mesolithic	709	3	0.4%**	1511	48	3.2%**
Mandible & maxilla Males, females, and unsexed						
Krškany	383	8	2.0%	673	49	7.3%
Vedrovice	596	6	1.0%	945	96	10.2%
K & V	979	14	1.4%	1618	143	8.8%
Mesolithic	1516	8	0.5%*	3148	115	3.7%**

the Bonferroni protection value of p<0.002 represents a statistically significant difference. In the mandible, for nearly every length, breadth and area dimension, the Krškany/Vedrovice sample exhibits the greatest dimorphism when compared to any of the other samples. Males and females from Krškany/Vedrovice show the highest level of dental dimorphism for any mandibular length or breadth (12.5% in the canine breadth) and for canine area the Krškany/Vedrovice sample displays a percent dimorphism of nearly 20%. Compared to the Mesolithic, the degree of sexual dimorphism at Krškany/Vedrovice is higher in 14 of the 16 length/breadth dimensions and for all areas except M2. It is apparent that this is not a consequence of sampling, since the values for sexual dimorphism of the other LnP Neolithic specimens also exceed the Mesolithic values in the majority of the length and breadth dimensions and for all the areas. Summary statistics for the lengths and breadths, lengths only, breadths only, anterior teeth only and posterior teeth only (*Table 12* bottom) illustrate that the Early Neolithic samples (for either the Krškany/Vedrovice or the LnP Neolithic) are consistently greater in sexual dimorphism than the Mesolithic. From the Early to the Later Neolithic there appears to be some evidence for a reduction in sexual dimorphism, since virtually all tooth dimensions from the Later Neolithic sample show reduced levels of dimorphism. Yet, sexual dimorphism increases again in the Medieval sample. Clearly, based on these mandibular dental data, there is no consistent trend over time (or across economic types) for sexual dimorphism.

In the maxilla, as in the mandible, the Krškany/Vedrovice sample shows elevated levels of sexual dimorphism

TABLE 13. Sex differences in caries prevalence for the posterior teeth based on the total number of teeth (* p<0.05; ** p<0.001 with student's t-test).

	Males			Females		
	Number of teeth	Number of caries	Percent carious	Number of teeth	Number of caries	Percent carious
Krškany & Vedrovice						
mandible P3–M3	330	17	5.2%	440	40	9.1%
maxilla P3–M3	299	39	13.0%	439	46	10.5%
totals P3–M3	629	56	8.9%	879	86	9.8%
Mesolithic						
mandible P3–M3	880	25	2.8%	707	42	5.9%*
maxilla P3–M3	822	17	2.1%	594	28	4.7%
totals P3–M3	1702	43	2.5%	1301	70	5.4%**

compared to all other samples (*Table 13*). Thirteen of sixteen length and breadth dimensions are greater in the Krškany/Vedrovice samples (compared to the Mesolithic) and all of the values for sexual dimorphism in the canine and posterior tooth areas are larger. Moreover, the percent dimorphism for the every summed tooth grouping reaches its maximum in the Krškany/Vedrovice sample. As in the mandible, the Later Neolithic shows considerable reduction in the level of sexual dimorphism from the Krškany/Vedrovice base, but unlike the mandible, the other LnP Neolithic sample shows an overall smaller degree of male/female differences than Krškany/Vedrovice. For both the mandible and maxilla, the Hungarian Medieval sample shows levels of dimorphism slightly higher than the Later Neolithic, but clearly less than the Krškany/Vedrovice sample.

In summary, levels of sexual dimorphism in tooth size consistently reach their maximum in the Krškany/Vedrovice sample when considering only these five groups. It is perhaps relevant that few of these differences reach statistical significance in the inter-group test proposed by Relethford and Hodges (1985), although this test is very conservative. If there is a trend, it seems to be that sexual dimorphism from the Mesolithic to the Medieval periods fluctuated markedly over time. In both jaws, low levels characterize the Mesolithic, followed by much higher levels in the earliest Neolithic samples, followed by a decrease in dimorphism in the Later Neolithic and then an increase in the Medieval period. Clearly, the earlier model of Frayer (1980) and updated by Frayer and Wolpoff (1985) is in need of revision now that larger Neolithic samples are available.

DENTAL CARIES

Caries rates (total number of teeth)

Caries rates based on the total number of teeth for adult males, females and the total sample (which includes both sexes and all unsexed adult individuals) are given for Krškany, Vedrovice and a combined category of the two sites in *Tables 14* and *15*. Data for the European Mesolithic sample are also given. These derive from Frayer (1989), but are modified to reflect the redating, inclusion and removal of several specimens. Unfortunately, similar pathological data were not collected for the other LnP, the Later Neolithic material or, in some cases, the Hungarian Medieval sample. Consequently, unlike the metric analyses, the only comparisons in tables documenting oral pathologies are between the Mesolithic and Krškany/Vedrovice samples. Overall the following tables show that caries rates are high at Krškany and Vedrovice compared to the hunter-gatherer groups who preceded them.

It is important to note here that oral pathologies are only reported for adult individuals, defined by a combination of factors such as eruption of the third molar, degree of dental wear, or non-dental skeletal evidence. Caries were also recorded for the deciduous teeth, but these tend to be rare, occurring only in the deciduous first molars. For instance, carious teeth occur in only two individuals Krškany 68/65 and Vedrovice 3/66, aged seven and nine years, respectively. Krškany 68/65 has two large caries on its upper and lower dM1, while Vedrovice 3/66 is afflicted with a well-developed carious lesion occupying the distal surface of the lower left dM1. Based on the total number of deciduous upper and lower first molars, this represents a rate of 4.2% for the lower dM1s and 2.2% for the upper dM1s. While these rates are not particularly high compared to those for the permanent teeth described below, they do indicate that children suffered from caries involvement, likely for the same reasons which afflicted the adults. Finally, there were no cases of abscesses in any of the children's jaws.

With respect to the Krškany and Vedrovice permanent teeth, there are individual differences on a tooth-by-tooth basis, but with one exception, males (or females) from the two sites show similar caries rates in both jaws. For example, in the mandibular teeth Krškany males have overall rates of 3.7%, while Vedrovice males are slightly lower at 2.8% (*Table 14*). In the maxilla (*Table 15*), the male rates are 8.9% and 9.5% respectively at Krškany and Vedrovice. Females from the two sites exhibit a similar pattern of percentage differences in the specific teeth affected by caries and overall there is a general similarity between the two sites. In the mandible Krškany females

TABLE 14. Caries rates based on total number of teeth (mandible) (n = sample size; % = frequency of caries; significant difference with Chi-square * p<0.05; ** p<0.001).

	I1		I2		C		P3		P4		M1		M2		M3		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Males																		
Krškany	24	0.0%	32	0.0%	36	0.0%	36	0.0%	35	9.0%	31	13.0%	25	0.0%	23	9.0%	242	3.7%
Vedrovice	37	0.0%	37	0.0%	36	0.0%	39	0.0%	39	5.0%	36	3.0%	37	8.0%	29	7.0%	290	2.8%
K & V	61	0.0%	69	0.0%	72	0.0%	75	0.0%	74	6.8%	67	7.5%	62	4.8%	52	7.7%	532	3.2%
Mesolithic	115	0.0%	139	0.0%	154	0.6%	173	0.0%	174	1.1%	178	3.4%	179	3.4%	176	5.1%	1288	1.9%
Females																		
Krškany	28	0.0%	35	3.0%	42	2.0%	42	2.0%	40	8.0%	38	16.0%	42	10.0%	19	16.0%	286	6.6%
Vedrovice	44	5.0%	57	0.0%	62	0.0%	59	3.0%	56	4.0%	55	13.0%	51	14.0%	38	13.0%	422	6.0%
K & V	72	2.8%	92	1.0%	104	1.0%	101	3.0%	96	5.2%	93	14.0%	93	11.8%	57	14.0%	708	6.2%
Mesolithic	106	1.9%	127	0.0%	147	0.0%	147	1.4%	143	4.9%	148	6.8%	148	6.8%	121	10.7%	1087	4.0%
Males, females, and unsexed																		
Krškany	58	0.0%	69	1.4%	82	1.2%	81	1.2%	79	7.6%	72	13.9%	71	5.6%	44	11.4%	556	5.4%
Vedrovice	88	2.3%	104	0.0%	108	0.0%	106	1.9%	102	3.9%	103	7.8%	97	10.3%	69	10.1%	777	4.2%
K & V	146	1.4%	173	0.6%	190	0.5%	187	1.6%	181	5.5%	175	10.3%	168	8.3%	113	10.6%	1333	4.7%
Mesolithic	225	0.9%	273	0.0%	309	1.0%	330	0.9%	326	3.1%	338	4.7%	340	4.7%	303	7.3%	2444	2.9%*

TABLE 15. Caries rates based on total number of teeth (maxilla) and summary (n = sample size; % = frequency of caries; significant difference with Chi-square * p<0.05; ** p<0.001).

	I1		I2		C		P3		P4		M1		M2		M3		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Males																		
Krškany	20	0.0%	19	5.0%	26	8.0%	28	0.0%	25	12.0%	29	21.0%	24	13.0%	20	10.0%	191	8.9%
Vedrovice	35	0.0%	33	0.0%	33	3.0%	38	13.0%	39	10.0%	34	18.0%	34	21.0%	28	11.0%	274	9.5%
K & V	55	0.0%	52	1.9%	59	5.1%	66	7.6%	64	10.9%	63	19.0%	58	17.2%	48	10.4%	465	9.2%
Mesolithic	106	0.0%	112	0.0%	154	1.3%	157	1.3%	169	1.8%	179	2.8%	173	2.3%	144	2.8%	1194	1.7%**
Females																		
Krškany	30	7.0%	30	3.0%	36	0.0%	41	0.0%	41	5.0%	36	6.0%	37	3.0%	23	9.0%	274	3.6%
Vedrovice	53	0.0%	59	0.0%	60	5.0%	60	13.0%	57	19.0%	54	20.0%	50	12.0%	40	8.0%	433	9.7%*
K & V	83	2.4%	89	1.1%	96	3.1%	101	7.9%	98	13.3%	90	14.4%	87	8.0%	63	7.9%	707	7.4%
Mesolithic	95	0.0%	95	0.0%	117	0.9%	119	0.8%	121	3.3%	133	6.8%	129	1.6%	92	10.9%	901	3.0%**
Males, females, and unsexed																		
Krškany	113	1.8%	122	2.5%	148	2.0%	155	0.6%	150	7.3%	143	12.6%	136	6.6%	89	10.1%	1056	5.3%
Vedrovice	185	1.1%	202	0.0%	209	1.9%	215	7.0%	206	9.2%	198	12.6%	189	12.2%	137	9.5%	1541	6.6%
K & V	298	1.3%	324	0.9%	357	2.0%	370	4.0%	356	8.4%	341	12.6%	325	9.8%	226	9.7%	2597	6.0%
Mesolithic	438	0.5%	487	0.0%	591	1.0%	621	1.0%	631	2.9%	674	4.7%	666	3.3%	556	6.7%	4664	2.6%**

TABLE 16. Comparison of caries incidence in anterior and posterior teeth based on the total number of teeth (* p<0.05; ** p<0.001 with Chi-square).

	I1–C			P3–M3		
	Number of teeth	**Number of caries**	**Percent carious**	**Number of teeth**	**Number of caries**	**Percent carious**
Mandible						
Males						
Krškany	92	0	0.0%	150	9	6.0%
Vedrovice	110	0	0.0%	180	8	4.4%
K & V	202	0	0.0%	330	17	5.2%
Mesolithic	408	1	0.2%	880	24	2.7%
Females						
Krškany	105	2	1.9%	181	17	9.4%
Vedrovice	163	2	1.2%	259	23	8.9%
K & v	268	4	1.5%	440	40	9.0%
Mesolithic	380	2	0.5%	707	42	5.9%
Males, females, and unsexed						
Krškany	209	2	1.0%	347	27	7.8%
Vedrovice	300	2	0.7%	477	32	6.7%
K & V	509	4	0.8%	824	59	6.9%
Mesolithic	807	5	0.6%	1637	67	4.1%**
Maxilla						
Males						
Krškany	65	3	4.6%	126	14	11.1%
Vedrovice	101	1	0.9%	173	25	14.5%
K & V	166	4	2.4%	299	39	13.0%
Mesolithic	372	2	0.5%	822	17	2.1%**
Females						
Krškany	96	3	3.1%	178	7	3.9%
Vedrovice	172	3	1.7%	261	39	14.9%**
K & V	268	7	2.6%	439	46	10.5%
Mesolithic	307	1	0.3%	594	28	3.2%**
Males, females, and unsexed						
Krškany	174	6	3.4%	326	22	6.7%
Vedrovice	296	4	1.4%	468	64	13.7%**
K & V	470	10	2.1%	794	86	10.8%
Mesolithic	709	3	0.4%**	1511	48	3.2%**
Mandible & maxilla						
Males, females, and unsexed						
Krškany	383	8	2.0%	673	49	7.3%
Vedrovice	596	6	1.0%	945	96	10.2%
K & V	979	14	1.4%	1618	143	8.8%
Mesolithic	1516	8	0.5%*	3148	115	3.7%**

show a caries rate of 6.6%, while Vedrovice females have a 6.0% of the teeth affected by caries (*Table 14*). The female maxillary rates (*Table 15*) provide an exception to the pattern with rates more than twice the frequency at Vedrovice (Krškany 3.6%; Vedrovice 9.7%) and these reach statistical significance with Chi-square (p<0.01). Thus, with this one exception, the caries rates based on the total number of teeth are comparable for males or females from Krškany and Vedrovice. Consequently, for diachronic comparisons, the rates are calculated for the two sites combined.

Tables 14 and *15* also provide evidence for caries prevalence according to tooth category. In the mandible, using the combined category (males, females and unsexed), the third and first molars have the highest rates (10.6%, 10.3% respectively) and the second incisor and canine the lowest (0.6%, 0.5% respectively). Expressed as decreasing caries incidence, for mandibular teeth the sequence is M3>M1>M2>P4>P3>I1>I2>C. In the maxilla the highest caries rates are found in the first molar and fourth premolar (15.1% and 11.4%, respectively and the lowest involve the lateral (1.0%) and central (1.3%) incisors. In decreasing caries incidence the sequence in the maxilla is M1>P4>M2>M3>P3>C>I1>I2. Typical of other studies from around the world and discussed in greater detail below, the premolars and molars consistently show higher caries rates than the incisors and canines.

Considered in an evolutionary context, Krškany and Vedrovice have a markedly elevated incidence of caries compared to the Mesolithic sample. In the mandible caries rates range between 0.0–7.3% for the Mesolithic (*Table 14*).

TABLE 17. Sex differences in caries prevalence for the posterior teeth based on the total number of teeth (* p<0.05; ** p<0.001 with Chi-square).

	Males			Females		
	Number of teeth	Number of caries	Percent carious	Number of teeth	Number of caries	Percent carious
Krškany & Vedrovice						
Mandible P3–M3	330	17	5.2%	440	40	9.1%
Maxilla P3–M3	299	39	13.0%	439	46	10.5%
Totals P3–M3	629	56	8.9%	879	86	9.8%
Mesolithic						
Mandible P3–M3	880	25	2.8%	707	42	5.9%*
Maxilla P3–M3	822	17	2.1%	594	28	4.7%
Totals P3–M3	1702	43	2.5%	1301	70	5.4%**

In contrast, at Krškany and Vedrovice no teeth are caries-free so that the range of caries prevalence is from 0.5% to 10.6%. Overall, the mandibular caries rate increases from the Mesolithic (2.9%) to the combined Krškany/Vedrovice average (4.7%). This difference in caries rate for the combined Krškany/Vedrovice – Mesolithic sample comparison reaches statistical significance (*Table 14*). For the maxilla (*Table 15*) a similar pattern is seen with the Mesolithic showing a frequency of 2.3%. Caries rates for Krškany and Vedrovice, however, are more than three times higher (7.5%) and, as in the mandibular teeth, no tooth classes are caries-free. From *Table 15* it is also apparent that maxillary caries rates tend to be higher in the combined Krškany and Vedrovice sample (compared to the mandible), so that all of the comparisons between the Krškany/Vedrovice and Mesolithic samples reach statistical significance measured by Chi-square. As shown in subsequent analyses, the maxillary teeth (especially the premolars and molars) are fairly consistent in having higher caries rates which generally represent statistically significant differences. Finally, when all teeth are considered (*Table 15*), the overall caries rate for Krškany and Vedrovice (6.0%) is more than double the rate for the Mesolithic (2.6%) and this higher rate at Krškany and Vedrovice is highly significant at p<0.001 with Chi-square.

While it is difficult to make direct comparisons to other studies (since methods and criteria for identification vary among investigators), it is perhaps relevant that Mieklejohn *et al.* (1984: 86) found a similarly high rate of caries in a collection of Neolithic sites from Belgium, France and Portugal. For example, depending on the way the caries rates per total number of teeth were calculated, these western European Neolithic sites showed a caries incidence between 4.2–6.3%. In another series of Late Neolithic teeth from Hungary (different from the ones used here), Molnar and Molnar (1985) found a caries rate of 11.7% in a relatively small sample of 392 teeth. Outside Europe, Powell (1985) and Larsen (1983) among others have demonstrated an increased incidence of caries in agricultural groups compared to hunter-gatherers. Thus, the high rates of caries at Krškany and Vedrovice, compared to the Mesolithic, fit patterns for caries increase in other agricultural samples from sites in Europe or North America.

Finally, Frayer (1984) has collected data on caries rates for Hungarian Medieval samples from two large cemeteries at Zalavár. These populations show even higher rates of caries, averaging 8.0% of the total number of teeth found at the two sites, indicating that caries susceptibility was even higher in this later sample.

Besides the trend for increase in the caries rates over time, it is clear that the posterior teeth are much more common sites for dental decay than the anterior teeth. Caries occur at a low incidence in the anterior teeth, affecting less than 1.5% of all the upper and lower incisors and canines (*Table 16*). The rate is higher in the maxilla (2.1%) than the mandible (0.8%), but in either case, very few anterior teeth are afflicted with caries. A similar pattern occurs in the Mesolithic sample, which essentially has caries-free incisors and canines. (*Figure 1b* shows one of the few cases of caries in an anterior tooth.) These stand in contrast to the posterior dentition which is especially caries prone. Overall, in the combined Krškany and Vedrovice sample 8.8% of the posterior teeth show at least one caries, with slightly higher (but not statistically significant) rates for Vedrovice (10.2%) than Krškany (7.3%) and generally higher rates in the maxilla (10.8%) than the mandible (7.2%). The contrasts between the Neolithic and Mesolithic samples are even more marked (and most reach statistical significance) when caries rates in only the posterior teeth are considered. This reflects the substantial increase of caries in agriculturalists and is consistent with many other studies of dental pathology comparing hunter-gatherers and agriculturalists.

Finally, *Tables 14–16* show some variance in the susceptibility to caries between males and females. For example, from *Tables 14* and *15* it is apparent that females have higher incidence of caries in the mandibular teeth (females 6.2%; males 3.2%), while the opposite is the case in the maxilla where the male rate is 9.2% and the female rate 7.4%. Moreover, differences exist between males and females in rates between the anterior and posterior teeth (*Table 16*) in the mandible and maxilla. These differences are summarized for the posterior teeth in *Table 17* and it is clear that at Krškany and Vedrovice there are no statistically significant differences in caries rates. Moreover, the overall caries for males (8.9%) and females (9.8%) do not differ significantly. These results are in contrast to the Mesolithic, where females have significantly higher caries rates (than males) in the mandible (2.8% for males, 5.9% for females) and for the total sample (2.5% for males, 5.4% for females). It is difficult to construct an adaptive reason why this sex difference exists in the Mesolithic, but not in the subsequent Neolithic sample with overall higher rates. But, based on the total number of teeth, there is no sexual difference in the susceptibility to caries in the Krškany and Vedrovice samples.

Caries rates (per individual)

When considering caries, it is important not only to show incidence of caries in individual teeth, but to present the number of affected individuals represented in the samples (Hillson 1986, Powell 1985). *Table 18* shows the percentage of males, females and total adults (which includes some unsexed individuals) at Krškany, Vedrovice and the comparative samples with at least one carious tooth. Using the "total" category, 56.8% of the individuals at Krškany and 45.3% at Vedrovice possess at least one caries, but these differences are not statistically significant. In fact, none of the differences between males (or the females) from Krškany and Vedrovice reach statistically significant levels. With respect to differences between males and females, as in the previous analyses, females appear to have higher caries rates than males (55.0%, 43.9%, respectively), but these differences do not reach even the minimal $p<0.05$ statistical significance with Chi-square.

The high rates of dental disease at Krškany and Vedrovice are very evident when comparing caries rate per individual across time. For example, the number of males with at least one caries in the Mesolithic is 15.4%. But, at Krškany and Vedrovice nearly three times this number (43.9%) are afflicted (*Table 18*). A similar pattern occurs in females, who increase caries rates from the Mesolithic incidence of 26.5% to the Krškany/Vedrovice value of 55.0%. For males, females and unsexed (Totals), the high caries rates based on the number of afflicted individuals at Krškany and Vedrovice are statistically significant compared to rates in the Mesolithic. Here the Mesolithic incidence of caries is only 19.1%, but half of all adults from Krškany and Vedrovice have at least one carious lesion. Finally, the high caries prevalence at Krškany and Vedrovice generally mirrors the caries incidence in the Hungarian Late Neolithic (Molnar, Molnar 1985) or the Italian Middle Neolithic (Formicola 1986). As in other European Neolithic series and agricultural groups in general, caries was an important health factor in these two Early Neolithic sites whether measured by the total number of teeth, only the posterior teeth, or the number of afflicted individuals.

Severity of caries

Besides position, caries were also scored as occlusal (involving just the enamel), penetrant (extending into the dentin or pulp chamber) and root (cemental) caries. Definitions for scoring these degrees of caries severity were similar to those used by Molnar and Molnar (1985). The only difference was that root caries was not differentiated from cemental caries, as done by Molnar and Molnar (1985). Rather, all caries which were limited to the root [always in interproximal or buccal (labial) positions] were classified as root caries. Compared to small, surface caries, penetrant and root (cemental) caries are obviously more extensive and damaging to the crown/root surfaces. These were grouped together in *Table 19* as "penetrant" caries. This category is consistent with the comparative data for the Mesolithic (Frayer 1989) which did not distinguish between penetrant and root (cemental) caries.

TABLE 18. Oral pathologies based on the total number of adults (n = sample size; np = number of individuals with at least one pathology; "Totals" includes males, females and unsexed; * $p<0.05$; ** $p<0.001$ – Chi-square significant difference with combined Krškany and Vedrovice sample).

	Males			Females			Totals		
	n	np	%	n	np	%	n	np	%
Caries									
Krškany	20	10	50.0%	22	13	56.5%	44	255	6.8%
Vedrovice	21	8	38.1%	38	21	55.3%	64	294	5.3%
Krškany/Vedrovice	41	18	43.9%	60	33	55.0%	108	54	50.0%
Mesolithic	123	19	15.4%*	98	26	26.5%*	246	47	19.1%**
Abscesses									
Krškany	20	7	35.0%	22	5	22.7%	43	122	7.9%
Vedrovice	21	6	28.6%	38	12	31.6%	64	182	8.1%
Krškany/Vedrovice	41	13	31.7%	60	17	28.3%	107	302	8.0%
Mesolithic	124	24	19.4%	9	32	32.7%	247	602	4.7%
Premortem tooth loss									
Krškany	20	10	50.0%	22	7	31.8%	43	173	9.5%
Vedrovice	21	5	23.8%	38	13	34.2%	64	182	8.1%
Krškany/Vedrovice	41	15	36.6%	60	20	33.3%	107	353	2.7%
Mesolithic	124	27	21.8%	98	24	24.5%	47	532	1.5%

TABLE 19. Percentages of penetrant (pen) and non-penetrant (nonpen) caries at Krškany/Vedrovice and the Mesolithic sample ("Totals" includes males, females and unsexed; * p<0.05; ** p<0.001 – Chi-square with combined Krškany and Vedrovice).

	Males		Females		Totals	
	Pen	**Nonpen**	**Pen**	**Nonpen**	**Pen**	**Nonpen**
Krškany	96.8%	3.2%	92.9%	7.1%	95.1%	4.9%
Vedrovice	97.1%	2.9%	90.0%	10.0%	92.4%	7.6%
Krškany/Vedrovice	97.0%	3.0%	91.8%	8.2%	93.4%	6.6%
Mesolithic	47.6%	52.4%*	38.2%	61.8%*	42.5%	57.8%**

It is evident from *Table 19* that the majority of caries in the Krškany and Vedrovice series were of the severe, penetrant type. Overall, 93.4% of the total sample showed caries which were deeply etched into the crowns or cemento-enamel junction, often leading to extensive crown destruction. There are no significant differences between the severity of caries at Krškany and Vedrovice and, while males and females differ slightly in their caries severity within and between sites, these differences do not reach statistical significance. What is striking about these data is the increase in caries severity compared to the Mesolithic sample. In the Mesolithic less than half of the caries (42.5%) penetrate the enamel, using the totals category. Compared to this, the two Early Neolithic samples from Krškany and Vedrovice show greatly elevated frequencies where more than 90% of the caries deeply penetrate the enamel and extend into the dentin or pulp chamber. These variations in severity of caries are significantly different between Krškany/Vedrovice and the Mesolithic sample, indicating that caries rates were not only substantially higher in these two Neolithic cemeteries, but when they occur they were also more severe. Here, it is important to note that these sample differences are not related to different demographic profiles between the Neolithic and Mesolithic samples which, as discussed above, have similar numbers of young, mature and old adults.

Other differences not shown in *Table 19* concern the incidence of root (cemental) caries and the severity of caries, measured by the number of lesions per jaw. There is the great increase in root (cemental) caries at Krškany and Vedrovice compared to the Mesolithic. In the "penetrant" category, root (cemental) caries make up between 31.4–48.4% of the cases in the two Neolithic sites. This is a very marked change from the Mesolithic which has only a few known cases of root (cemental) caries and these derive primarily from one region, the Portuguese Late Mesolithic sites at Muge (Frayer 1987). If root (cemental) caries are a consequence of periodontal disease, their high incidence in the two Early Neolithic samples signals a decline in alveolar as well as dental health.

Finally, caries severity at Krškany and Vedrovice is high, measured by the average number of caries per afflicted individual. Overall, for the two Neolithic sites the average number of caries for all individuals afflicted with at least one carious lesion is 3.2 caries per individual. This compares to an incidence of about 2.4 caries per individual in the Mesolithic (Frayer 1989). At Krškany and Vedrovice males have higher average caries incidence per individual than females (males 3.7; females 2.9) and average rates are higher at Vedrovice (3.6 per individual) than Krškany (2.7 per individual), but as in the previous analyses, these differences do not reach statistical significance. Coupled with the other evidence for caries surveyed above, it is apparent that caries involvement in the Krškany and Vedrovice adults was common and when caries did develop they were extensive, involving large portions of the tooth surfaces. There can be no doubt that caries was a significant detriment to the health in the early agricultural groups.

ABSCESSES AND PRE-MORTEM TOOTH LOSS

Table 18 reviews the incidence of abscesses and pre-mortem tooth loss based on the number of individuals. In comparison to the degree of dental caries, fewer individuals from Krškany and Vedrovice are affected by abscesses and pre-mortem tooth loss which results in lower rates for these non-dental pathologies. For example, while 43.9% of the males at Krškany and Vedrovice possessed at least one caries, fewer than a third (31.7%) had one (or more) abscess(es) and just more than a third (36.6%) had lost a tooth (teeth) before death. Females from both sites have caries rates slightly above 50%, but many fewer females had abscesses (28.3%) or had lost teeth before death (33.3%). Clearly for male and females at both Krškany and Vedrovice caries was the oral pathology with the highest incidence. Also, while there is some variation in abscesses and teeth lost before death between sites and sexes, the overall rates are similar and not significantly different between Krškany and Vedrovice. So, like caries, individuals from the two sites were affected equally by abscesses and pre-mortem tooth loss. However, when the average number of abscesses per jaw is considered, males have considerably higher frequencies at both Krškany and Vedrovice compared to females (*Table 20*). At both sites the male incidence (2.7 per jaw; range 1–6) is nearly double that females (1.5 per jaw; range 1–4), suggesting that males were more susceptible to alveolar disease leading to apical abscesses. However, this apparently did not result in a greater incidence of teeth lost prior to death, since males lost an average of 5.9 teeth in both jaws, while females average a slightly higher mean rate of 6.7 teeth (*Table 20*).

It is somewhat unexpected to find that the much higher caries rates at Krškany and Vedrovice do not result in

TABLE 20. Average number of abscesses and premortem lost teeth in afflicted individuals.

		Abscesses			Premortem tooth loss		
		mean	(n)	range	mean	(n)	range
Krškany	males	2.4	7	1–5	6.9	10	1–18
	females	1.2	5	1–2	4.3	7	1–13
Vedrovice	males	3.0	6	1–6	4.0	5	2–10
	females	1.6	12	1–4	8.0	13	1–23
Combined	males	2.7	13	1–6	5.9	15	1–18
	females	1.5	17	1–4	6.7	20	1–23
Totals		2.0	30	1–6	6.4	35	1–23

similarly high rates of abscesses and pre-mortem lost teeth. It is also a bit surprising to find that frequencies of abscesses and pre-mortem lost teeth do not show trends through time which mirror the caries rates. Thus, compared to the Mesolithic sample (*Table 18*), there are minimal differences to the Krškany and Vedrovice samples for frequencies of periapical abscesses. Using the "total" category, all samples are within a few percentage points of each other (24.7–28.1%) and none represent statistically significant differences. For teeth lost before death, there appears to be a general increase in the frequency through time, so that Krškany and Vedrovice have about a third more individuals who lost at least one tooth prior to death in the Mesolithic, but like the frequencies for abscesses these differences through time do not constitute statistically significant differences. For the average number of abscesses and teeth lost before death (*Table 20*), there are no comparative data for the Mesolithic samples. Yet, compared to the limited Neolithic sample described by Molnar and Molnar (1985), the frequencies of abscesses and pre-mortem tooth loss are considerably higher in the Krškany and Vedrovice samples. Moreover, compared to frequencies for these two pathological conditions in the Hungarian Middle Ages (Frayer 1984), abscesses and teeth lost before death are substantially higher at Krškany and Vedrovice despite an overall higher caries incidence in the Hungarian Middle Ages.

In summary, caries are common, reaching high frequencies at Krškany and Vedrovice. These rates greatly exceed the incidence and severity found in the Mesolithic. When comparable data are available, these rates broadly resemble caries incidence for the Hungarian Late Neolithic (Molnar and Molnar 1985) and the Italian Middle Neolithic samples (Formicola 1986). Given the common finding that caries, in particular, increases between hunter-gatherers and agriculturalists (Hillson 1986, Larsen 1983, Mieklejohn *et al.* 1984, Powell 1985) and with the intensification of agriculture (Beckett, Lovell 1994), it is not surprising that dental caries increase in frequency and severity from the Mesolithic or from the Neolithic into the Middle Ages. However, changes in the frequency of abscesses and teeth lost prior to death are not matched with the increase in caries frequencies, suggesting that these indicators of oral health were precipitated by factors other than dental caries, at least in the hunter-gatherer groups.

THIRD MOLAR AGENESIS AND IMPACTION

The criteria for determining agenesis were (1) absence of the third molar or its socket, (2) absence of occlusal wear on the opposing third molar, (3) absence of a distal interproximal wear facet on the second molar and/or (4) lack of space for the third molar crown in the existing alveolus. In addition, breaks in the alveolar region of the third molar were inspected for presence (or absence) of a molar crown. Finally, third molars were never scored as congenitally absent when individuals were too young for the third molar to have erupted, measured by little or no occlusal wear or skeletal age markers. Despite this conservative approach, because radiographs were not consulted, it is probable that some impacted molars were included in the following agenesis counts making these slightly elevated and lowering the incidence of impacted teeth.

For the 103 adult mandibles and maxillas from Krškany and Vedrovice which preserve some part of the third molar region, the overall rate for third molar agenesis is nearly 30% (30/103). This frequency is nearly twice the average reported by Cadien (1972: 205) for modern Europeans and Euro-Americans, but near the average for modern Asians, American Indians and Africans. Clearly, the level of third molar agenesis at Krškany and Vedrovice is within modern ranges, but it is well above the frequencies in the Mesolithic which has an incidence of third molar agenesis below 10% (Frayer, unpublished). Thus, the frequency of third molar agenesis at Krškany and Vedrovice is high compared to both earlier and later European samples. For either sex, more than half of individuals (53%; 16/30) show agenesis co-occurring in the mandible and maxilla. At Vedrovice 59% (10/17) of the cases of agenesis involve both jaws, with 12% (2/17) affecting the maxilla only and 29% (5/17) affecting the mandible only. At Krškany, the frequencies are 46% (6/13) involving both jaws, 23% (3/13) the maxilla only and 31% (4/13) the mandible only. There is some sexual dimorphism in third molar agenesis since at both sites 20% (9/45) of the males show agenesis of at least one third molar, while females exhibit higher rates with nearly 40% (21/54) of the individuals affected by agenesis (Krškany 12/36; Vedrovice 9/18).

There appears to be no relationship between agenesis and reduced posterior tooth size. For example, for males with at least one case of agenesis in the mandible, the summed mandibular P3–M2 areas total 303 mm^2, while those cases with no evidence of third molar agenesis average 296 mm^2. Similarly, in females summed mandibular P3–M2 areas average 337 mm^2 and 330 mm^2 respectively for lower jaws with and without third molar agenesis. An identical pattern occurs in the maxilla where, like the mandible, there are no statistically significant differences between tooth size in arches with and without third molar agenesis. Likewise, no pattern of tooth size differences emerges when only lengths or summed lengths are considered. Unlike other studies where tooth size reduction appears to coincide with third molar agenesis at the individual level (Garn *et al.* 1963), no such pattern exists in these two Neolithic samples. It seems possible that sample size may account for this discrepancy for individual correlations of tooth size reduction and third molar agenesis. Unfortunately, data on the congenital absence of third molars was not collected for the comparative Neolithic samples. Such data would be useful here in testing the relationship with additional specimens.

For impactions, without radiographs of any of the suspected cases, it was difficult to confirm their existence. However, for several dentitions an impaction could be identified from breaks in the alveolar bone. In five of six cases these involved specimens from Vedrovice. Three of these were impacted maxillary third molars, while two other involved an impacted upper or lower canine. The sole case of an impacted tooth from Krškany concerned an impacted lower right canine. Clearly, third molar agenesis was much more common than impaction which was relatively rare and included a variety of different teeth.

MORPHOLOGICAL TRAITS

Given the frequent destruction of the full crown by caries, the high frequency of pre-mortem tooth loss and heavy occlusal wear (discussed below) most details of crown morphology were obliterated or were unable to be scored, resulting in extremely small sample sizes. Consequently, the only occlusal details recorded were the expression of Carabelli's cusp and incisor shovelling. For the former, of the adults 40 individuals who possess a maxillary molar preserving the mesial-lingual region, none show any expression of Carabelli's cusp. Given the generally high incidence for a strong expression of Carabelli's cusp in recent European populations (Scott 1980), the absence of its expression in these two Neolithic cemeteries is somewhat unexpected. The reason for this may be the generally extensive occlusal wear, since a few cases of Carabelli's cusp occur in juveniles with newly erupted first molars. However, even when these are present, they are seldom strongly marked. For incisor shovelling, heavy tooth wear or pre-mortem loss precluded the inclusion of but a few specimens with central incisors. Consequently, only frequencies for lateral incisors are considered here. Of 42 individuals possessing at least a maxillary lateral incisor, 14 showed a trace expression of shovelling, with a single specimen showing marked shovelling on a lateral incisor. Translated into frequencies, absence of shovelling characterizes 64% of the sample, trace 33%, semi 0% and full 3%. These percentages are within the range reported by Cadien (1972) for modern Europeans, who typically lack the degree of shovelling found in the Asian/ Amerindian groups.

HYPOPLASIA

Hypoplasia was scored as present or absent based on observations of all permanent teeth. Originally, the technique described by Goodman and Rose (1991) was followed, but the general faintness of the hypoplastic lines, along with heavy occlusal wear and pre-mortem tooth loss of anterior teeth, limited the detailed accuracy of the technique or the recording ability. When hypoplasia did occur, it was the linear type and the characteristic lines were found in mainly the anterior teeth, although premolars and molars were sometimes affected. In the Krškany/ Vedrovice sample, 18.2% of the individuals showed at least some evidence of hypoplasia. This compares to about 28% of the individuals in the Mesolithic and 75% in the Hungarian Medieval site of Zalavár (Frayer, unpublished). Deciduous teeth were also scored for hypoplasia, but none of the children showed any indications of enamel hypoplasia. If hypoplasias in the adults are general indicators of nutritional/disease stress (Goodman, Rose 1991), it is apparent that the available dental evidence at least for Krškany and Vedrovice provides no indication that these Early Neolithic people were heavily stressed by childhood nutrition deficiencies or diseases which interfered with enamel formation.

OCCLUSAL WEAR

Figures 4 and *5* summarize the averages for occlusal wear for males, females and unsexed adults in the Krškany/ Vedrovice sample compared the Mesolithic and Medieval. The two graphs are based on individuals evaluated as being 18 or older. Age in these cases was generally determined by the fact that the third molars were in occlusion as well as other skeletal markers indicating adult status. The wear codes represent the left, right, or the average of the two when both antimeres were present. In the mandible (*Figure 4*) not unexpectedly the first molar shows the most wear and the third molar the least. The average wear on the anterior teeth slightly exceeds the average wear for M2 and is also higher than the average wear on either of the premolars. It is apparent that the degree of wear between Krškany/Vedrovice and the Mesolithic is remarkably similar. The average wear of the anterior teeth slightly exceeds the Mesolithic means as does the average wear on the M2 and M3. Only P4 and M1 show a greater average

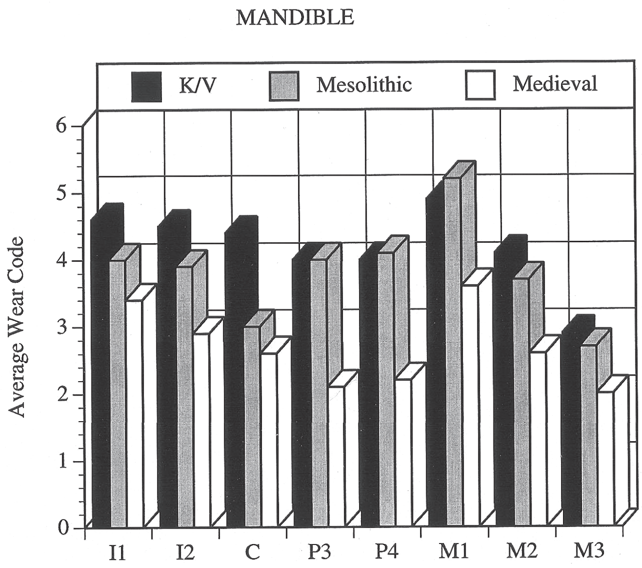

FIGURE 4. Wear profiles of mandibular teeth of Krškany/Vedrovice, Mesolithic and Medieval samples. The samples include adult male, female and unsexed individuals. Although not indicated, all differences between the Krškany/Vedrovice and Medieval samples are significantly different (p<0.006), while no statistically significant differences occur between Krškany/Vedrovice and the Mesolithic.

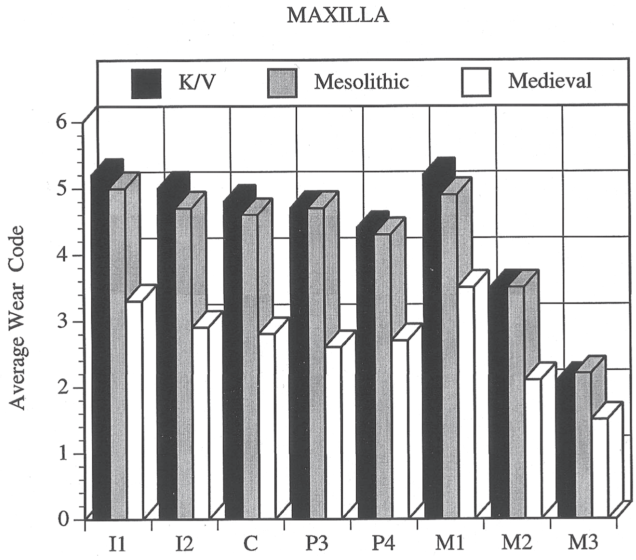

FIGURE 5. Wear profiles of maxillary teeth of Krškany/Vedrovice, Mesolithic and Medieval samples. The samples include adult male, female and unsexed individuals. Although not indicated, all differences between the Krškany/Vedrovice and Medieval samples are significantly different (p<0.006), while no statistically significant differences occur between Krškany/Vedrovice and the Mesolithic.

wear in the Mesolithic. Despite these variances, none comes close to reaching a statistically significant difference measured by Mann-Whitney U test. Thus, the wear is not different between Krškany/Vedrovice and the Mesolithic for the mandibular teeth. While these two samples are not different from each other, both are very different in degree of wear from the Hungarian Medieval sample. For each tooth in the Medieval sample, the wear code is significantly smaller. The same general pattern occurs in the maxilla (*Figure 5*) with (1) the first and third molars, respectively, exhibiting the most and least average occlusal wear, (2) the incisors and canines displaying more wear than the second molar, (3) the Krškany/Vedrovice and Mesolithic sample showing only minor and no statistically significant differences in wear codes for any maxillary tooth. In addition (4) both the Krškany/Vedrovice and Mesolithic samples strongly vary from the average wear in the Medieval sample. As in the mandible, each tooth shows statistically significant (Mann-Whitney U test) less wear in the Medieval sample.

TABLE 21. Average mandibular tooth wear for Krškany/Vedrovice (K/V), Mesolithic, and Medieval males and females (n = sample size, significant differences between K/V and comparative samples with Mann-Whitney U test * p<0.05; ** p<0.006).

		K/V		Mesolithic		Medieval	
		mean	n	mean	n	mean	n
I1	males	5.0	34	4.2*	72	3.6**	34
	females	4.4	41	4.3	64	3.1**	25
I2	males	4.7	37	3.9*	84	3.0**	51
	females	4.4	53	4.1	80	2.9**	39
C	males	4.6	37	4.1	96	2.7**	72
	females	4.3	59	4.1	90	2.5**	56
P3	males	4.3	37	3.9	87	2.1**	64
	females	4.0	52	4.4	74	2.1**	45
P4	males	4.1	38	4.0	106	2.3**	82
	females	3.8	54	4.4	87	2.0**	58
M1	males	5.1	35	5.1	106	3.7**	80
	females	4.9	53	5.6*	88	3.3**	54
M2	males	3.8	33	4.2	101	2.8**	82
	females	3.7	54	4.2	85	2.3**	61
M3	males	3.1	28	2.8	96	2.2*	68
	females	2.6	35	2.5	71	1.5**	43

TABLE 22. Average maxillary tooth wear for Krškany/Vedrovice (K/V), Mesolithic, and Medieval males and females (n = sample size, significant differences between K/V and comparative samples with Mann-Whitney U test * p<0.05; ** p<0.006).

		K/V		Mesolithic		Medieval	
		mean	n	mean	n	mean	n
I1	males	5.7	32	4.9*	68	3.5**	29
	females	5.1	45	5.3	66	2.9**	21
I2	males	5.2	29	4.6	77	2.9**	48
	females	5.1	46	5.0	66	2.8**	35
C	males	4.9	33	4.5	94	2.9**	66
	females	4.9	52	4.8	77	2.7**	48
P3	males	4.8	36	4.7	94	2.7**	78
	females	4.9	53	4.9	74	2.5**	54
P4	males	4.4	33	4.5	97	2.9**	80
	females	4.6	54	4.4	74	2.5**	58
M1	males	5.2	34	5.1	105	3.7**	83
	females	5.3	48	5.0	77	3.2**	63
M2	males	3.5	33	3.6	97	2.4**	76
	females	3.5	49	3.3	76	1.8**	54
M3	males	2.2	28	2.3	86	1.6*	52
	females	1.8	41	2.0	55	1.2*	26

Table 21 reviews data for mean mandibular tooth wear according to sex for Krškany/Vedrovice and the Mesolithic and Medieval comparative samples. While males appear to have greater wear than females for each tooth at Krškany and Vedrovice, none of these differences reach even the p<0.05 level of statistical significance, indicating that sex differences in the degree of wear for the mandibular teeth do not exist. When comparing males or females between Krškany/Vedrovice and the Mesolithic, the two Neolithic samples exhibit greater mean wear for many of the anterior teeth, but only two reach the p<0.05 level for significant differences (mandibular I1 and I2 in males only). However, neither of these satisfies the Bonferroni requirement of p<0.006. In the posterior teeth the M1 of females shows a significant difference using p<0.05, but again this does not satisfy the Bonferroni value. Consequently, there are no statistically significant differences between the average wear of the Krškany/Vedrovice and the Mesolithic samples by sex and no evidence for differential wear rates between these two groups. The same is not true, however, for the Krškany/Vedrovice and Medieval comparison which shows means for tooth wear to be significantly different at p<0.006 for all mandibular teeth in males and females, except for the value for M3 in males. Given that the Zalavár sample is composed of individuals estimated to be older than the Krškany/Vedrovice sample (as discussed above), this indicates that the speed and impact of wear in the two Neolithic samples was much greater than in Hungarian Middle Ages.

This identical pattern of tooth wear is duplicated in the maxillary teeth (*Table 22*) where no significant differences occur between males and females in the Krškany/Vedrovice sample and no significant differences exist between the Krškany/Vedrovice sample and the Mesolithic in the mean tooth wear. But, just as in the maxilla, the Krškany/ Vedrovice sample shows statistically significant greater

TABLE 23. Differential wear for Krškany/Vedrovice (K/V), Mesolithic, and Medieval males, females, and unsexed (n = sample size, significant differences between K/V and comparative samples with Mann-Whitney U test * p<0.05; ** p<0.008).

		K/V		Mesolithic		Medieval	
		mean	n	mean	n	mean	n
I1/M1	mandible	0.95	67	0.80**	117	0.95	34
	maxilla	1.08	64	1.11	114	0.92**	37
I2/M1	mandible	0.88	81	0.75**	145	0.83	53
	maxilla	0.98	64	0.98	123	0.91	59
C/M1	mandible	0.84	84	0.74**	163	0.70**	74
	maxilla	0.91	72	0.94	151	0.82	81
I1/M2	mandible	1.41	73	1.17**	134	1.67*	51
	maxilla	1.74	70	1.71	122	2.05	43
I2/M2	mandible	1.31	82	1.11**	160	1.43	73
	maxilla	1.55	73	1.46	130	1.72	69
C/M2	mandible	1.20	87	1.02**	172	1.21	102
	maxilla	1.38	79	1.38	158	1.58	94

wear for all teeth (in both sexes) with respect to the Medieval sample. Given the absence of significant differences between Krškany/Vedrovice and the Mesolithic samples, it is apparent, for at least these samples, that a significant reduction in occlusal wear does not occur until the Middle Ages.

Finally, *Table 23* reviews indices of differential wear for the anterior and posterior teeth in Krškany/Vedrovice and the two comparative samples. These indices for differential wear were calculated by dividing the wear code of the specific anterior tooth by the code for either the M1 or the M2. Each calculation was made unilaterally, for either the left side or right. For example, a left I1 wear code was always expressed relative to the left M1, never as a percentage of a right M1 in cases where the left M1 was missing. In this table, the higher the ratio, the greater the wear on the specific anterior tooth compared to either the first or second molar. For Krškany/Vedrovice the indices generally show that the degree of attrition on M1 generally exceeds the wear on I1, I2, or C. For the M2 comparisons, each anterior tooth exhibits greater wear. Sex differences are not reported in *Table 23*, but there are no statistically significant differences between males and females in the relative wear. Thus, despite the incisor manipulative wear pattern discussed below (which is much more common in females), there is no indication that this translates into a sex difference when the entire Krškany/Vedrovice sample is considered.

Contrary to expectations, when relative wear is compared between Krškany/Vedrovice and the Mesolithic sample, the latter generally shows a pattern of less differential wear. Thus, when statistically significant differences occur (all in the mandible), in each case the Krškany/Vedrovice sample exhibits greater relative incisor and canine wear than found in the Mesolithic. For example, in the I1/M1 ratio, the Krškany/Vedrovice sample average is 0.95 (indicating about equal wear between the two teeth), while in the Mesolithic the same ratio is 0.80 (indicating considerably more wear on the M1 relative to I1). This pattern is consistent whether M1 or M2 is used and suggests that the Mesolithic hunter-gatherer groups wear their first and second molars at rates equal to or higher than their incisors and canines. For all these ratios, the Krškany/Vedrovice sample much more closely resembles the differential wear found in the Hungarian Medieval sample, but when statistically significant differences occur (at the Bonferroni value of $p<0.008$), the Krškany/Vedrovice sample always shows more relative wear on the anterior tooth (e.g., I1/M1 and I1/M2). Thus, while differential wear at Krškany/Vedrovice shows no male/female differences, there are significant differences compared to the Mesolithic sample and in each case the Krškany/Vedrovice anterior teeth show more wear. This suggests that there is not a simple, straightforward relationship where hunter-gatherers consistently show more loading and wear on the anterior teeth.

In summary, it is apparent that the degree and pattern of wear is roughly similar between the Krškany/Vedrovice early farming populations and the postglacial hunters and gatherers from the Mesolithic. It is only in the much more technologically (and culinary?) advanced Medieval populations when occlusal wear substantially reduces.

BITE

By occluding the upper and lower jaws it was possible to estimate the incidence of anterior crossbite, edge to edge contact and overjet (Hillson 1986: 279). Due to the incompleteness of some specimens (especially the loss of the mandibular condyles or missing parts of the mandibles or maxillas) and major tooth loss in some specimens, it was not always easy to determine the occlusal type. Only 42 adults were preserved sufficiently. Of these none showed an anterior crossbite (underbite), 14 (33%) an edge to edge occlusion and 28 (67%) an overjet. No differences were detected between the sites nor between the sexes. In several of the cases of severe overjet, the individual had marked malocclusion with the upper incisors more than a centimeter labial to the lower incisors. In these cases (such as Vedrovice 100/81) the lingual surfaces of the upper incisors exposed large areas of dentine from malocclusion with the labial surfaces of the lower incisors. While there are no comparative data for the European Mesolithic, this degree of overjet is not found in the Mesolithic specimens I have analysed in western and central Europe.

MANIPULATIVE INCISOR WEAR

A number of the juveniles and adults from both sites possess a peculiar wear pattern (Frayer, Minozzi 2002) mainly affecting the maxillary incisors (*Table 24*). The wear typically consists of a notch in the distal occlusal corner of both upper lateral incisors. In older individuals the wear progresses to deep channels running in a mesial-distal direction across the central incisors (*Figures 6* and *7*). The notches on the maxillary lateral incisors nearly always occur bilaterally and are generally etched deeper into the enamel on one side than the other. While one side may be favoured over the other in an individual, for the entire sample there is no evidence that the preferred side was consistently the right or the left since notches are deeper in the right lateral incisors in seven cases and the left in nine cases. There is one case where a central incisor shows a notch on its distal edge (Krškany 41/65), but this is an exception to the typical pattern. These notches seldom extend onto the adjacent, mesial canine surface, but open labially. Absence of wear on the mesial canine surface suggests that these teeth were not involved in the object manipulation which produced the lateral incisor notches. Moreover, the mandibular teeth were also not generally involved since only two individuals from Vedrovice (6/88 and 80/79) show grooving on the lower incisors and canines (see below).

TABLE 24. Individuals from Vedrovice and Krškany with grooved anterior teeth (mx = maxilla; mn = mandible).

Vedrovice							
1/85	old adult	female	mx	80/79	26	female	mx & mn
6/88	old adult	female	mn	81/79	22	female	mx
22/75	35-39	female	mx & mn	86/80	27	female	mx & mn
62/78	adult	female	mx	91/80	20	female	mx
68/78	old adult	female	mx	93/80	26	female	mx
72/79	26	female	mx	100/82	26	female	mx
75/79	adult	female	mx	107/82	y. adult	female	mx
Krškany							
24/65	adult	female	mx	45/65	adult	?	mx
32/65	18	female	mx	53/65	21	female	mx & mn
33/65	y. adult	male	mx	68/65	?	?	mx
35/65	adult	female	mx & mn	70/65	y. adult	female	mx
41/65	13	female?	mx	77/65	adult	male	mx
44/65	old adult	female	mx				

This distinctive wear does not occur on any of the deciduous teeth, but makes its first appearance on newly erupted permanent lateral incisors which have just reached full occlusion. The youngest specimen with lateral incisor notches is an unsexed nine-year-old from Krškany (68/65). All teeth are isolated in this fragmentary specimen, but it possible to re-assemble the arcade and the distal surface of the right lateral maxillary incisor shows the beginning of a notch. The left maxillary lateral incisor preserves no evidence of manipulative wear. The next youngest individual is a 13-year-old, probably female individual from Krškany (41/65) with a slight groove in a left central incisor, followed by six young adults (18–21) where age was determined from epiphyseal closure, pubic symphysis morphology and slight tooth wear. The most common cases involve twelve adults, aged by the state of the pubic symphysis, the medial clavicle epiphysis, or the presence of moderate tooth wear. The oldest are four individuals with extremely heavy tooth wear. Only in these individuals does the occlusal channelling on the central incisors become apparent (*Figure 8*).

Using these age-graded specimens it is possible to reconstruct a sequence for the appearance and procession of the upper incisor wear. In the youngest individuals the notches in the distal edges of the lateral incisors are small. There is little or no involvement of the upper central incisors, with at most only some polishing on their lingual faces. Even when this polishing occurs, it is often the result of extreme overjet and consequent lower incisor malocclusion in some of the specimens as discussed above. In most individuals, polishing is absent indicating that whatever produced the notches in the maxillary lateral incisors did not produce macroscopic effects on the upper centrals. Even at the earliest stage, side differences appear (see *Figure 6*), indicating that one side was preferred over the other early in the onset of the manipulative activity. In older individuals the notches in the lateral incisors increase in size, but never expand to more than half of the total crown height (*Figure 7*). Eventually the lateral incisors lose their notched form as occlusal attrition erodes the crown height. In the youngest (adolescent) specimens, maximum height of the maxillary lateral incisor crown averages 9.2 mm and the notches in their distal edges represent a small proportion of total crown height. In older individuals lateral incisor crown height is reduced (young adults 7.7 mm, middle-age to old adults 6.0 mm) and the notches increase in size proportional to the height until crown height is so reduced that no notch is present.

In older individuals, distinct channels appear on the lingual (or occlusal) surface of the two central incisors, sometimes extending onto the mesial lateral incisor (*Figure 8*). These channels range in width between 3 mm and 6 mm, presumably reflecting the dimensions of the object which was pulled across the upper teeth. This type of wear on the upper central incisors occurs in only the oldest individuals. Eventually, as wear proceeds, the notches on the lateral incisors probably disappear as the teeth are worn to the cervix. For example, *Figure 1b* shows the dentition of an old female who may have had the distinctive maxillary tooth wear judged from the unmistakable differential wear. However, the excessive anterior tooth wear has progressed to the cemento-enamel junction and erased all traces of the occlusal surface. From this sequence it is clear that the notches never extend to the superior-most distal surface of the lateral incisors, to the cemento-enamel junction, or to the root, so that their expression is always limited to the occlusal-most portion of the crown. Finally, the lateral incisor notches or grooves in the occlusal faces of the central incisors are never associated with dental caries or other dental pathologies which are rare in the maxillary incisors anyway.

These notches and grooves occur more commonly at Krškany where 11/31 or 36% of individuals who possess at least one maxillary incisor have a notched corner or a central with an occlusal groove. At Vedrovice 13/58 or 22% of the individuals show notched upper laterals or grooved upper centrals. Overall, 27% of the sample from both sites show this distinctive wear. Of these 19 (79%) are females,

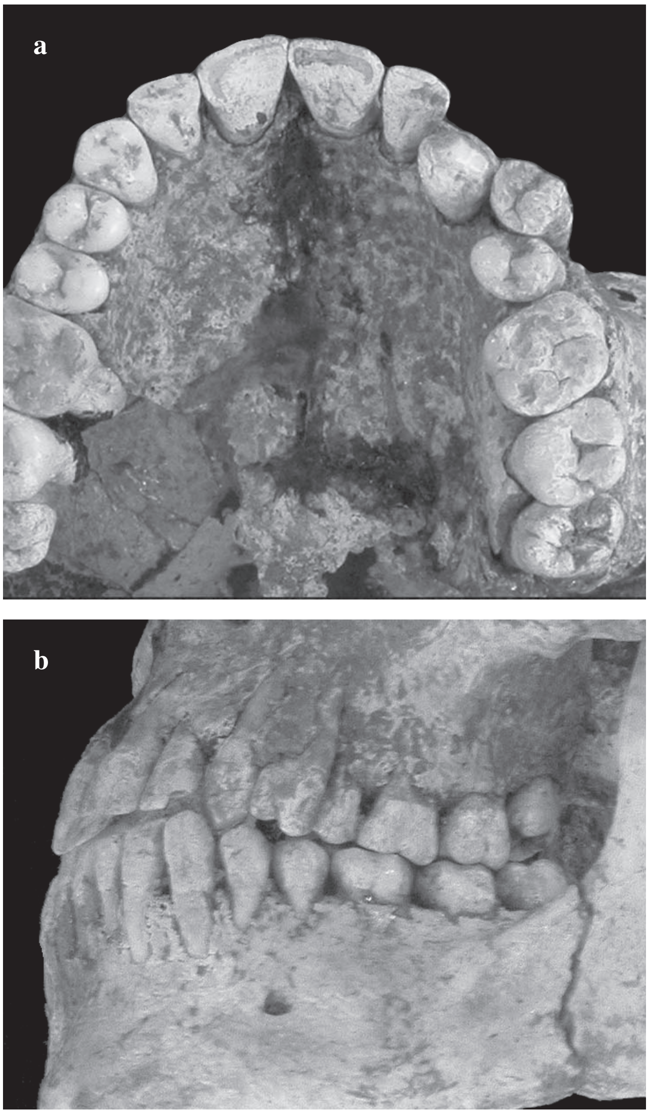

FIGURE 6a. Occlusal view of Vedrovice 91, a 20-year-old female. The left lateral incisor shows a deep notch in its distal, occlusal margin and some wear on the left canine. The right lateral incisor is much less affected. The young female also shows some malocclusion and rotated teeth on the left side and the maxillary left third molar seems to be impacted. The lower third molars (not shown) are in occlusion, but the left maxillary M3 is slightly twisted and "erupting" into the cervical aspect of the left M2. 6b. A labial view of the same specimen showing the marked notch in the left lateral I2. No similar notching is located on the adjacent canine or the lower incisors or canines.

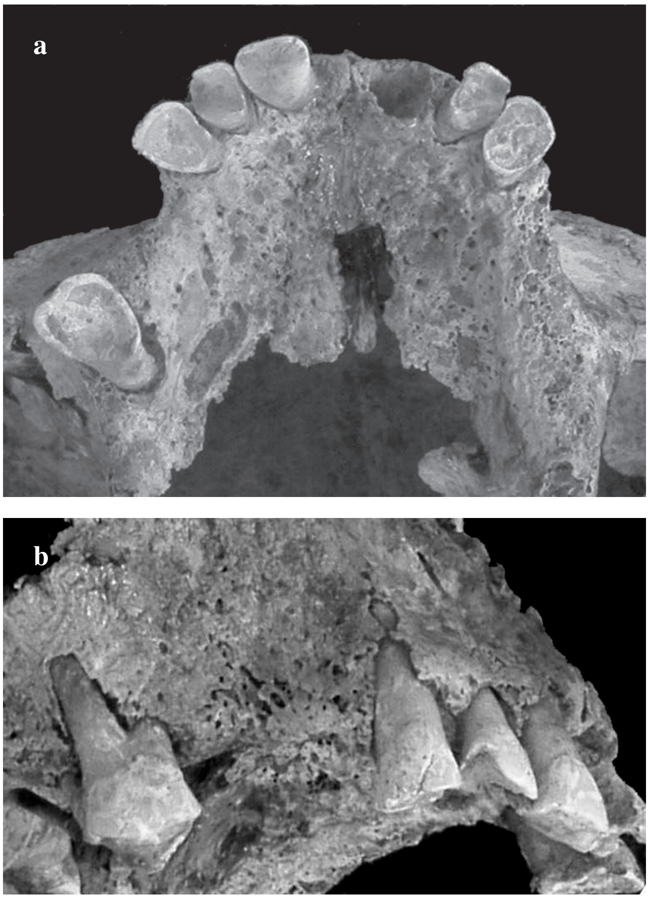

FIGURE 7a. Occlusal view of Vedrovice 68, an old adult female missing many teeth with considerable alveolar resorption. The right lateral incisor shows a deep channel with no involvement of the canine. A less deep groove occurs on the left side. 7b. The second right incisor from a labial aspect.

three (13%) are males and two (8%) are unsexed individuals. Thus, at both sites females are primarily affected, representing 86% (19/24) of the sexed cases, indicating that this wear (and whatever the task which produced it) was fairly sex-specific.

In addition to the cases where only the maxillary incisors are involved, there are two individuals where macroscopic changes can be observed on the mandibular anterior teeth. On Vedrovice 6/88 a small notch is located at the distal edge of the lower left canine. This occurs on one side only and is associated with a heavily worn upper I2 which shows some surface scratches. Given the advanced state of the wear on this female, the "typical" maxillary activity may have shifted to the mandible. The second specimen involves a young adult female (Vedrovice 80/79). Here, the upper incisors show moderate to heavy wear and the centrals show narrow, shallow grooves running in the mesial-distal direction across their occlusal faces. However, there is no evidence for notching of the distal edges of the lateral maxillary incisors. In the mandible, there is a slight notch formed on the distal margin of the left lateral incisor and a very weak notch on the right. Shallow grooves run across the occlusal faces of the lateral incisors in the mesial-distal direction. Except for these two cases the mandibular teeth show no special involvement when the maxillary incisors show large notches or heavy grooves. For example, in Krškany 44/65 from the flat wear on the mandibular incisors one would never predict that the associated maxillary incisors would show deep grooves on their occlusal faces (*Figure 7*). Also, with only a couple of exceptions, the upper canines are not involved in the

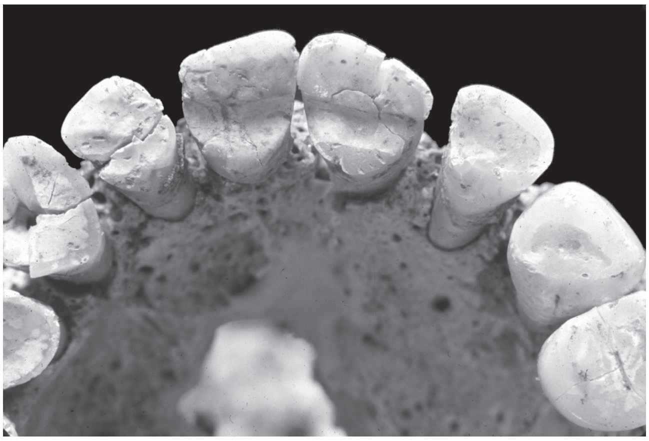

FIGURE 8. Krškany 44, an old female showing deep channels in the occlusal surfaces of the maxillary central incisors. This type of occlusal grooving only appears in older individuals and seems to relate to the loss of the notch in the lateral incisors as shown in *Figure 6b*. Note that the special wear does not extend on to the left canine. Unfortunately the right canine is broken post-mortem, but from what remains shows more wear than the left.

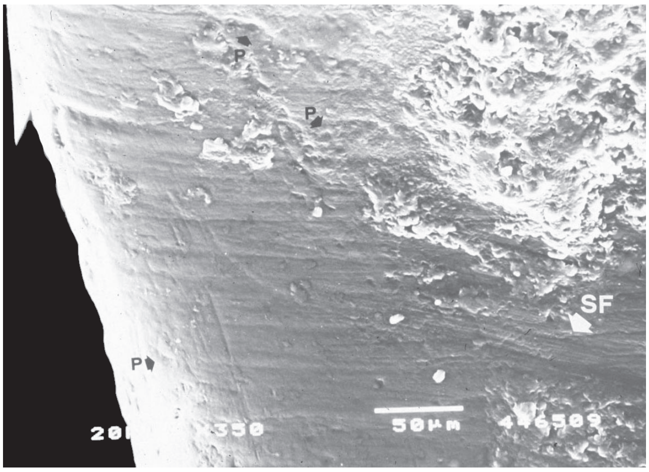

FIGURE 9. Scanning electron microscope image of the lingual surface of the right central maxillary incisor of Krškany 44. Note the bands of parallel striations (SF) and the perpendicular striations (P) at the distal/lingual margin only.

activity which produced the maxillary incisor wear since canines almost never show wear on the mesial, distal, or occlusal faces.

This type of wear is undoubtedly a remnant of some special type of dental manipulation, as reviewed by Molnar (1972). It is similar in some ways to what Larsen (1985) and Schulz (1977) have described as fibre processing, especially in the way the occlusal incisor surfaces are deeply etched in older individuals. However, the cases reported by Larsen were all males and both upper and lower teeth were affected. At Krškany and Vedrovice females exhibit the wear much more frequently and the lower incisors are seldom part of the activity. Moreover, the distinctive wear at Krškany and Vedrovice is primarily on the distal, not the occlusal surface. In Schulz's sample, the grooves were primarily on the mandibular teeth and sometimes their interproximal surfaces. Macchiarelli and Salvadei (1985) have described maxillary anterior teeth from the Italian Iron Age with distinctive wear which they suggest might be due to leather processing. This wear is also dissimilar to Krškany/Vedrovice in that it extends onto the upper canines, does not involve notching of the lateral incisors and no asymmetry or sex differences were found. Similar grooves on the upper incisors have been documented by Ravy *et al.* (1996) for some Chalcolithic specimens from France which they attribute to sinew or fiber processing. Cruwys *et al.* (1992) have also reviewed anterior tooth notches in a small percentage of British specimens, but none of the cases match the pattern at the central European sites. Microscopic analysis (currently in progress) is needed to establish the directionality of the object manipulation, but from macroscopic observations it appears that some kind of fibre (or tissue) was pulled across the distal and lingual faces of the upper incisors. Since the lower anteriors are not commonly involved, it appears that the jaws were not clenched when the task was performed. Otherwise, there should be more instances of mandibular incisor involvement. During the activity, the material raked across the teeth must have made a sharp anterior angle, so that the hands were pulling the material perpendicular to the labial face of the incisors. This must have been at a fairly sharp angle since notching (or even surface polish) is rare on the adjacent maxillary canines. Eventually, as occlusal wear proceeded, the material was dragged more across the lingual face of the central incisors, leaving the distinct tracks shown in *Figure 8*. This must indicate that there was also an upward component (at least in the later stages of wear) to the pulling motions. Ultimately, as the incisor crowns were worn to the cervix, the distinctive features typical of the early stages of this manipulative wear were lost in the lateral incisors as shown in *Figure 8*. In some specimens (such as shown in *Figure 1b*), the wear on the anterior teeth was so great that no remnant of the channels remains (assuming the specimen actually possessed them at a earlier age). For those few which retain the deeply channelled upper incisors (*Figure 8*), apparently, the action of movement was changed, since the wear never migrated to the cemento-enamel junction or root of the incisors as described by Brown and Molnar (1990) in some Australian cases of sinew stripping.

With Simona Minozzi (University of Pisa) some experimental work was done in an attempt to reproduce these grooves. As part of her dissertation, Minozzi (1994) used a machine to repetitively abrade teeth over a 200 hour period. She used different types of fibres (sinew, a leather string and hemp), then observed the consequences of prolonged friction on tooth enamel. SEM work on these grooves showed that the striations and wear pattern most closely corresponded with sinew processing. Unfortunately, most of the Vedrovice/Krškany teeth are heavily coated with preservative, so SEM work on them could not be done and direct comparison between the LnP sample and the experimental work was impossible. However, the right maxillary incisor of Krškany 44 preserves a portion of the original tooth surface along its distal border. The SEM of this region (*Figure 9*) shows parallel bands of striations running along the mesial/distal axis of the lingual surface. At the distal border a few perpendicular striations occur where the fibres were twisted in an upper movement.

Consequently, based on this comparative work, the grooves seem most likely the result of repetitive sinew processing. Finally, based on the highly skewed sex distribution, whatever activity produced the wear, it was a task performed more routinely by females.

CONCLUSIONS

The following points summarize this research on the dentitions from Krškany and Vedrovice.

1. Dental size does not differ between Krškany and Vedrovice, whether the total sample, or only males or only females are compared between the sites. Consequently, the sites were grouped together for all tooth size comparisons.

2. Tooth size is relatively small in males and females in the Krškany/Vedrovice sample. Compared to the Mesolithic, males and females both show substantial and statistically significant reduction for all dental dimensions, with females generally showing more reduction than males. For other LnP and Later Neolithic samples there are few differences. If any trends occur, tooth size increases slightly to the Later Neolithic and to the Medieval samples (especially in females). Certainly, these samples do not show trends for further reduction of tooth size.

3. For deciduous teeth, when statistically significant reductions occur, they always involve decreases in tooth size between the Mesolithic and Krškany/Vedrovice. Overall, the degree of reduction in deciduous teeth does not equal that compared to the size decrease in the permanent teeth. There appears to be no change in deciduous tooth size between Krškany/Vedrovice and the Medieval sample.

4. Based on an analysis of the permanent tooth size in specimens retaining deciduous teeth or other subadult, there is no evidence to suggest that individuals who died as infants, children or early adolescents had larger (or smaller) tooth size.

5. The differential reduction between males and females between Krškany/Vedrovice and the Mesolithic samples results in high values for sexual dimorphism in tooth size at Krškany and Vedrovice. Since virtually all the specimens were sexed by one person using consistent procedures, it is unlikely that different sexing criteria account for the differences. Rather, it appears that there are real trends for increased sexual dimorphism in the Early Neolithic cemeteries at Krškany and Vedrovice. Such an observation in the Early Neolithic samples reinforces the argument that there is no simple, straightforward explanation for the occurrence (and changes in) sexual dimorphism (Frayer, Wolpoff 1985).

6. Coupled with small tooth size, caries is high in the Krškany/Vedrovice sample whether measured by the total number of teeth or the number of individuals with at least one caries. No significant differences occur between the mandible and maxilla, although the latter typically has a higher caries rate. Posterior teeth are much more affected by caries than the anteriors. The Krškany/Vedrovice sample shows markedly high caries rates compared to the Mesolithic.

7. Caries severity is striking in the Krškany/Vedrovice sample with most lesions represented by those which penetrated the enamel/pulp chamber and led to extensive crown destruction. More than 90% of all caries in the Krškany/Vedrovice sample penetrated the enamel, while comparative figures for penetrating caries in the Mesolithic fall below 50%. Root (cemental) caries are also high at Krškany/Vedrovice as are the number of caries per afflicted individual. Using the Mesolithic as a base for late European hunters and gatherers, caries number and severity unequivocally increased markedly in the earliest agriculturalists from Krškany and Vedrovice. Judged by modern standards of dental discomfort from caries, many of the inhabitants from the Krškany and Vedrovice must have suffered sustained periods of painful dental misery.

8. Rates for abscesses and teeth lost before death are consistently lower than rates for caries. No sex differences exist in the overall rates for abscesses and pre-mortem tooth loss. Counts for only those afflicted with abscesses or pre-mortem lost teeth, also, show no sex differences.

9. Despite the substantial difference in caries rates between the Krškany/Vedrovice and Mesolithic samples, these do not translate to elevated rates for abscesses or pre-mortem lost teeth. Thus, there are no statistically significant differences between the Krškany/Vedrovice agriculturalists and the Mesolithic hunter-gatherers for non-carious oral pathologies.

10. Third molar agenesis at Krškany/Vedrovice is high, occurring in about 30% of the individuals who preserve at least some portion of the posterior tooth row. Third molar agenesis does not appear to be correlated with overall smaller tooth size.

11. Carabelli's cusp is rare, occurring in a few newly erupted upper molars, but seldom in its most marked category. It is not observed in adults, presumably due to their heavy occlusal wear. Shovelling is present as determined from maxillary lateral incisors only, since the centrals tend to be too worn to score. The expression of shovelling is primarily the trace category (33%), while one specimen shows a full expression (3%). The majority of maxillary lateral incisors (64%) exhibit no indication of shovelling.

12. Linear hypoplasia is present at low frequencies in the Krškany/Vedrovice sample. The Mesolithic shows

slightly higher rates, but the Hungarian Medieval (Zalavár) sample shows a significantly higher rate of these lines presumably related to health/nutrition stress.

13. Dental wear shows only minor differences between Krškany and Vedrovice, none of which reach statistical significance. There are also no differences between Krškany/Vedrovice and the Mesolithic sample, indicating that a change in the degree of tooth wear does not characterize these economically different groups. However, Krškany and Vedrovice show substantially and significantly more wear than the Medieval Hungarians.

14. Differential wear between the anterior and posterior teeth is marked in the mandibular incisors and canines of Krškany and Vedrovice, but not for the maxillary teeth. The Krškany/Vedrovice sample shows significantly greater anterior/posterior wear differentials (indicating heavier anterior tooth wear) than typical of the Mesolithic.

15. For occlusion, two-thirds of the sample have an overjet, one-third an edge to edge occlusion and none an anterior crossbite (underbite). For these bite types there were no significant differences between sites or between sexes. Some cases of overjet were severe, resulting in exposure of dentin patches on the lingual surfaces of the maxillary incisors.

16. At Krškany and Vedrovice, 24 of 90 specimens show evidence of manipulative wear, generally limited to the upper lateral incisors. This wear occurs only in the permanent teeth of juveniles and adults, is overwhelmingly found in females, progresses in its depth of etching into the incisor crowns with age (eventually involving the central incisor occlusal surfaces) and appears to relate to a special task activity involving the processing of fibrous materials, most likely sinew.

Some of these observations are relevant to models for dental size change across time and between different economic types. Based on the Krškany and Vedrovice sample, it is apparent that they have much smaller teeth than the hunter-gatherers of the Mesolithic who preceded them. However, tooth size did not undergo further reduction in later groups, but, if anything, shows an increase in the Hungarian Middle Ages. Thus, the argument that tooth size (especially great reduction in dental dimensions) is a marker for the length of time agriculture has been practiced is not supported by the data from Krškany and Vedrovice. Other sites outside of Europe, such as Ra's al-Hamra (Macchiarelli 1989), have previously demonstrated that this generalization is false.

There are also some problems with accepting reduced tooth size as some kind of protection against or adaptation to rampant caries. The substantially reduced teeth of the Krškany/Vedrovice individuals (compared to those from Mesolithic) do not appear to have had much of an effect on lowering their caries rates. Moreover, caries rates increase in the Medieval populations, as does tooth size. Also, similar dental attrition rates between the early agriculturalists and the Mesolithic groups indicate that wear alone has little effect on caries rates or severity, at least in these extensive samples. Rather, the factor which appears to be most critical (at least with the samples considered here) is dietary change and the presumed incorporation of more carbohydrates and sugars in the diet on the Early Neolithic groups.

In conclusion, it is apparent that the adult dental remains from Krškany and Vedrovice add important information to our understanding of the course of dental evolution in the earliest agricultural populations and the people who proceeded and followed them in central Europe.

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APPENDIX 1. Sites and male/female/unknown breakdown for the Mesolithic sample.

Site	Males	Females	Unknown	Country
Obříství	0	0	3	Czech Republic
Staré Město	0	1	0	Czech Republic
Bergmandsdal	0	0	1	Denmark
Dragsholm	0	1	0	Denmark
Henriksholm Bøgebakken	6	4	2	Denmark
Holmegaard-Sjaeland	0	0	1	Denmark
Holmegard-Jutland	1	0	0	Denmark
Kams	1	0	0	Denmark
Koed	2	0	0	Denmark
Koelbjerg	0	1	0	Denmark
Korsør Glasvaerk	1	0	0	Denmark
Korsør Nor	1	0	0	Denmark
Korsør Nor 2	0	1	0	Denmark
Melby	1	0	0	Denmark
Mullerup	0	0	1	Denmark
Nivaa	0	0	1	Denmark
Sejrø	1	0	0	Denmark
Sølager	1	0	0	Denmark
Tybrind Vig I	0	2	0	Denmark
Vaengesø	1	0	0	Denmark
Vedbaek	1	0	0	Denmark
Arudy	1	0	0	France
Bonafacio	0	1	0	France
Cheix	0	1	0	France
Culoz	1	0	0	France
Gramat	2	0	1	France
Hoëdic	5	4	3	France
Le Peyrat	1	0	3	France
Le Rastel	1	0	0	France
Montclus	0	1	0	France
St. Rabier	0	0	1	France
Téviec	7	5	0	France
Bottendorf	1	0	0	Germany
Falkensteinhöhle	0	0	1	Germany
Felsdach Inzigkofen	0	0	1	Germany
Hohlenstein	1	1	0	Germany
Hohler Fels/Happurg	3	1	1	Germany
Kaufertsberg	0	0	1	Germany
Ofnet	5	10	18	Germany
Rhunda	1	0	0	Germany
Schellnecker Wand	0	1	0	Germany
Molara	1	0	1	Italy
Mondeval de Sora	1	0	0	Italy
Parabita	1	0	0	Italy
Uzzo	4	2	0	Italy
Vatte di Zambana	0	1	0	Italy
Loschbour	1	0	0	Luxembourg
Muge (General)	0	0	3	Portugal

APPENDIX 1. Sites and male/female/unknown breakdown for the Mesolithic sample (continued).

Site	Males	Females	Unknown	Country
Vlasac (Ia + Ib)	2	2	3	Serbia
Vlasac (Ia + Ib?)	8	5	2	Serbia
Vlasac II	1	1	0	Serbia
Vlasac II?	4	0	0	Serbia
Vlasac III	1	3	0	Serbia
Vlasac III?	6	3	1	Serbia
Cuatamentero	0	0	1	Spain
El Cingle Vermell	0	0	6	Spain
Bäckaskog	0	1	0	Sweden
Skateholm1	12	11	14	Sweden
Skateholm2	9	7	5	Sweden
Stora Bjers	1	0	0	Sweden
Birsematten-Basisgrotte	0	1	0	Switzerland
Aveline's Hole	0	0	52	United Kingdom
Badger Hole	0	0	1	United Kingdom
Gough's Cave	1	0	0	United Kingdom
McArthur Cave	1	1	0	United Kingdom
McKay Cave	0	0	2	United Kingdom
Ogof-yr-Ychen	2	0	0	United Kingdom
Oronsay	0	0	3	United Kingdom
Pontnewydd	0	0	2	United Kingdom

APPENDIX 2. Sites and male/female/unknown breakdown for the Neolithic sample. Sites with (LnP) represent the comparative Linear Pottery sample.

Site	Males	Females	Unknown	Country
Dojringe	0	0	1	Denmark
Dragsholm	1	1	0	Denmark
Ondlese Mose	0	1	0	Denmark
Sigersdal Mose	0	1	0	Denmark
Stasevang	0	0	3	Denmark
Stose Lyng	0	0	3	Denmark
Tysmose	0	0	2	Denmark
Bispebjerg	0	0	1	Denmark
Bonderup	1	0	0	Denmark
Bronoj	0	1	0	Denmark
Ejby	0	1	0	Denmark
Eskebergaard	0	1	0	Denmark
Falshoj	2	1	0	Denmark
Flong	1	0	0	Denmark
Fuldby	0	1	0	Denmark
Gerdrup	1	1	3	Denmark
Gerlev	0	1	0	Denmark
Graese	0	1	0	Denmark
Grimdstrup	1	1	0	Denmark
Hasmark	1	0	0	Denmark
Lille Havelse	1	1	0	Denmark
Hellested	3	1	0	Denmark
Holbaek Lodegaard	2	1	0	Denmark
Holmslry	1	0	0	Denmark
Juelsberg	7	0	9	Denmark
Karlsberg	0	1	3	Denmark
Kjoerby	0	1	0	Denmark
Kyndelose	1	2	0	Denmark
Landsgrav	1	0	0	Denmark
Marbjerg	7	2	1	Denmark
Nyrup	1	0	3	Denmark
Overvindinge	4	2	0	Denmark
St. Rorback	0	1	0	Denmark
Serdrup	0	0	1	Denmark
Smidstrup	0	1	0	Denmark
Skodsborg	1	0	0	Denmark
Sonderup	0	1	1	Denmark
Store Tuborg	0	0	1	Denmark
Studo	1	0	1	Denmark
Thinghoj	0	1	0	Denmark
Vejleby	1	0	0	Denmark
Hammer Nar	1	0	0	Denmark
Reuland	2	0	1	Denmark
Mendingen	0	1	0	Denmark
Schled	1	0	0	Denmark
Manzenbach	0	1	0	Denmark
Flinterupgaard	1	0	0	Denmark
Frejlev	4	4	0	Denmark
Hovbolle	4	0	1	Denmark
Klememsker	0	0	1	Denmark

APPENDIX 2. Sites and male/female/unknown breakdown for the Neolithic sample. Sites with (LnP) represent the comparative Linear Pottery sample (continued).

Site	Males	Females	Unknown	Country
Krejbjerg	0	0	1	Denmark
Kyndelose	6	7	1	Denmark
Lundehoj	0	0	2	Denmark
Mandemarke	0	0	1	Denmark
Martofte	1	0	0	Denmark
Paeregaard	0	0	15	Denmark
Svino	0	2	0	Denmark
Udby	1	4	1	Denmark
Altendorf	0	2	0	Denmark
Bidstrup	3	3	0	Denmark
Borre	2	0	1	Denmark
Borreby	12	8	2	Denmark
Bregninge	1	0	0	Denmark
Bronhoj	2	1	0	Denmark
Forsinge	1	0	0	Denmark
Gandelose	0	0	1	Denmark
Grydelhoj	1	0	0	Denmark
Korsaus	0	0	1	Denmark
Kirkehelsinge	1	0	0	Denmark
Noes	1	0	0	Denmark
Raevehoj	1	5	2	Denmark
Skovgaard	1	1	0	Denmark
Stege	1	2	0	Denmark
Stenstrup	1	0	0	Denmark
Tjaereby	1	1	1	Denmark
Troldhoj	0	1	0	Denmark
Uggerslev	1	1	0	Denmark
Vittingshoj	0	2	0	Denmark
Fiegneux	2	0	16	France
Daulnay-aux-Planches	4	5	1	France
Caverne de l'Homme	1	2	0	France
Muhlhausen	23	14	5	Germany
Altendorf	1	0	1	Germany
Meilen-Feldmeilen (LnP)	3	1	0	Germany
Schweizerbild	0	3	1	Germany
Klein Hadersdorf	3	5	0	Germany
Niedertiefenbach	4	0	2	Germany
Szegvar – Tuzkoves (LnP)	10	5	0	Hungary
Krskore – Gat (LnP)	3	5	3	Hungary
Herpaly (LnP)	1	2	0	Hungary
Arene Candide	1	1	0	Italy
Oost Flaviland	1	0	6	Netherlands
Swifterbant	0	0	1	Netherlands
Grottas de Melides	0	3	0	Portugal
Vesterbiers	5	5	1	Sweden
Visby	4	3	3	Sweden
Ire Hangervar	5	2	2	Sweden
Chamblandes	6	5	3	Switzerland
Barmaz I & II	10	9	8	Switzerland