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ONTOGENY AND MORPHOLOGY OF THE CHILD'S MANDIBLE FROM ŠIPKA – MORAVIA, CZECH REPUBLIC

ABSTRACT: Ontogenetic analysis of the immature Upper Pleistocene hominid mandibular fragment from Šipka, Moravia, Czech Republic, confirms the taxonomic affinities of this child as Neanderthal. Metric comparisons of Šipka 1 with other Upper Pleistocene specimens of similar developmental age place it well within both the Neanderthal and early Homo sapiens sapiens ranges for symphyseal size and robusticity as well as dental dimensions. However, metric proportioning and the combined presence of certain non-metric features argue convincingly in favour of its Neanderthal status. Moreover, within the Neanderthal range of variation for subadults of similar developmental age, Šipka 1 possesses a morphological pattern typical of late Neanderthals as previously suggested by Jelínek (1965, 1969), Smith (1982), and Wolpoff (1980, 1999).

KEY WORDS: Neanderthal – Chin – Mandible – Growth – Modern human origins

INTRODUCTION

On August 26, 1880, while excavating the Upper Pleistocene deposits at Šipka Cave near Štramberk, in a mountainous area of the north-eastern Czech Republic, the Moravian prehistorian Karel J. Maška discovered a fragment of child's mandible imbedded in a lump of ash (Maška 1883). Despite its juvenile status and fragmentary condition, this specimen, Šipka 1, has long been of interest to students of human evolution, many of whom have noted, and questioned, the possible significance of the rudimentary chin exhibited by this child of presumed Neanderthal affinities (Coon 1962, Hrdlička 1930, Jelínek 1965, 1969, Smith 1982, Vlček 1969, Wolpoff 1980, 1999).

At the time of the Šipka discovery, few Neanderthals were known from the fossil record and their morphological variability was poorly known – a situation further complicated by the immature status of the specimen. Moreover, earlier in the 20th century, the lack of a chin

became incorporated into the morphological definitions of earlier hominid taxa, including Neanderthals (Clark 1964), making the presence of this feature in Šipka 1 of special interest to those palaeoanthropologists investigating the possible evolutionary transition from Neanderthals to modern humans in the European Upper Pleistocene hominid fossil record. Now, more than one hundred years since the Šipka discovery, weak mental eminences are known from a few adult late Neanderthals, including La Ferrassie I, Circeo III, St. Césaire 1, and Zafarraya. Nevertheless, the rarity of this feature in Neanderthals contrasts markedly with the ubiquitous presence of chins among members of H. s. sapiens.

In his 1969 morphological analysis of Šipka, Vlček mentioned the presence of a chin as identifying the child as a progressive Neanderthal; a transitional link between Homo sapiens neanderthalensis and H. s. sapiens. Jelínek (1965, 1969) also considered the presence of a chin of possible evolutionary significance, but Smith (1982)

cautioned that "it is difficult to judge what the adult morphology might have been" (Smith 1982: 677). Coon (1962) suggested that the Šipka dentition, although modern in size, was Neanderthal in form. He also mentioned that the vertical mental profile of the Šipka mandibular symphysis resembled that of La Ferrassie 1, an adult Neanderthal with a chin. Hrdlička, who had the opportunity to study the original twice, noted the presence of a slight "mental eminence" (1930: 315) but concluded that, in overall form, Šipka 1 was clearly a Neanderthal. More recently, Wolpoff (1980, 1999) has maintained that characters such as the reduced anterior dentition and presence of a chin are indicative of a late Neanderthal, possibly transitional to *H. s. sapiens*.

With continuing efforts by palaeoanthropologists to identify emergent *H. s. sapiens*, it is important that the evolutionary trends characterising the appearance of such "sapient" features as the chin be better understood. One way to approach this task is to analyse human palaeontological remains from an ontogenetic perspective. With a large body of knowledge now available concerning the growth, development, and maturation of Upper Pleistocene hominids (Vlček 1969, 1970, Skinner 1977, Trinkaus, Le May 1972, Tompkins, Trinkaus 1987, Heim 1982, Hublin, Tillier 1981, 1983a, b, 1986, 1998, Tillier *et al.* 1998, Dean *et al.* 1986, Smith, Ranyard 1980, Mallegni, Trinkaus 1997, Minugh-Purvis 1988, 1998, Coqueugniot 1998, and many others), it has become increasingly clear that juvenile morphology is not necessarily synonymous with adult morphology. The present study has attempted to clarify whether Šipka 1 is indeed a Neanderthal child with a chin by assessing the morphology of this specimen within the context of late Pleistocene *H. sapiens* mandibular ontogeny and immature morphological variation.

DATING

As with so many Upper Pleistocene fossils, attempts to investigate Šipka 1 have been hampered by problems in assessing the temporal context of the fossil. Maška (1885) reported finding the specimen near the floor along a wall of the "badger hole" ("Dachsloch" or "Jezevčí díra"), a small side extension not far inside the cave entrance where it was discovered imbedded in a lump of ash within a hearth of approximately 2 meters in diameter. Having examined profiles in several areas of the cave, Maška (1885) identified 7 different levels and left a standing column of undisturbed sediments for future reference. He attributed the hominid mandible to a green soil, which he considered to be of Würm I age. Nevertheless, this attribution is not without problems. Jelínek (1965) reported that Maška's study of the cave revealed considerable evidence of cryoturbation in the deposits, and that Maška noted the geological complexity of the site in his field diary.

Some of the sediments left at Šipka by Maška were excavated by Prošek in 1950 (Prošek, Ložek 1957) and

analyzed by Kukla (1954) who produced two chronologies for the deposits. Kukla's long chronology identified 15 layers, 9 containing cultural remains. Correlating these to Maška's stratigraphy, Kukla concluded that the hominid mandible came from the earliest cultural layer, level 9, a loess of Würm I/II (Pod hradem) provenience (Allsworth-Jones 1986). Musil (1965) and Valoch (1965) also considered the hominid-bearing level at Šipka to date to the Pod hradem or Würm I/II interstadial. However, earlier faunal analyses of Absolon, Zapletal, and Skutil (1933) and, more recently, by Gabori (1976) argue instead that several cold climate species are among the faunal remains in the hominid-bearing level at Šipka, leading them to suggest that the mandible dates somewhat earlier in the Upper Pleistocene.

Attempts to clarify the temporal position of Šipka 1 archaeologically have been similarly inconclusive. Valoch considered the Šipka Mousterian a late Eastern variant (1967, 1968, 1969) of that tradition, a characterisation which supports a Würm I/II attribution. Gabori (1976) again questioned this reasoning, arguing that the Šipka lithics may be closer to Würm I given that the assemblage appears intermediate between the Upper and lower Mousterian at Subalyuk, Hungary, an interpretation supported by Allsworth-Jones (1986).

In sum, because of the difficulties in determining the temporal provenience of Šipka 1, the specimen can only be roughly positioned in the mid-Upper Pleistocene. This is unfortunate, for an attribution to the Pod hradem interstadial would support the possibility, first noted by Jelínek (1969), and later by Wolpoff (1980, 1999), of contemporaneity between Šipka and the nearby early *H. s. sapiens* at Mladeč which are so often noted as exhibiting a fascinating blend of archaic and modern features (Jelínek 1969, Wolpoff 1980, 1999, Smith 1982, Minugh-Purvis 1988, Frayer 1992).

MATERIALS AND METHODS

Comparisons were made between Šipka 1 and other immature Upper Pleistocene hominid mandibles from Europe and western Asia. Except where noted, all measurements were taken from the original fossils by the author. An unfortunate exception to this is Šipka 1 itself. The fossil was destroyed in the fire at Mikulov Castle, Mikulov, Czech Republic, in May 1945 (Vlček 1971) making it necessary for the observations presented here to rely on: 1. published descriptions taken from the original prior to its destruction, and 2. on the author's study of primary casts of Šipka 1 housed at the Moravské zemské muzeum – Anthropos Institute, Brno, Czech Republic. In addition, dental comparisons were made using metric data published by Frayer (1978) and radiographic assessments of Šipka 1 relied upon radiographs of the original published by Vlček (1969). All data on modern human children were collected by the author from the Libben Amerind

Collection, courtesy of the Dept. of Sociology and Anthropology, Kent State University, Kent, Ohio, and the Tepe Hissar Iranian Collection housed at the University Museum of Archaeology and Anthropology, University of Pennsylvania, Philadelphia. Further details on both the Upper Pleistocene and modern comparative remains are available in Minugh-Purvis (1988).

For comparative purposes, Upper Pleistocene specimens were divided into two groups: Neanderthals and early *H. s. sapiens* based on 1. the presence of traits typically found in adults of these groups, and/or 2. unequivocal direct association with adult members of a group. For further details regarding the composition of the comparative collection, the reader is referred to Minugh-Purvis (1988).

DESCRIPTION OF THE REMAINS

Preservation

Because Šipka 1 has been the subject of detailed descriptions by a number of authors, particularly Jelínek (1965) and Vlček (1969), only a brief summary of its preservation and morphology will be provided here. The original fossil consisted of an eroded and broken fragment of mandibular symphysis, containing the LI_2, RI_1, and unerupted C, RP_3, and P_4 germs *(Figure 1)*. Most of the thin alveolar bone which covered the developing permanent dental germs had broken away from the labial surface of the mandible, although a small amount remained at the RI_2 level so that the external symphyseal contour was preserved at this location. Inferiorly, the basal portion of the left side of the mental trigone remained visible as well. The basal aspect of the mandible was essentially intact from the RP_4 to LI_2. Lingually, the bone was essentially complete from the I_1–P_4 on the right, but only the basal area survived to the left of the midline.

Age and sex

A number of developmental ages at death have been proposed for Šipka 1 – indeed Virchow (1882) even challenged its immature designation, arguing that it represented the pathological mandible of a modern adult human with numerous impacted, unerupted teeth. Dental ages more consistent with its obviously juvenile status have been proposed by a number of investigators since the time of its discovery. In reviewing the various age determinations for Šipka 1 as of his writing, Vlček (1969) reported estimates ranging from as young as 8–9 (Radkovec 1939, Schaafhausen 1881, Wankel 1880, Weidenreich 1937) to as old as 11–13 (Matiegka 1933). More recently, estimates of 10 (Jelínek 1969), 8.3–10.9 (Skinner 1977), 9–10 (Vlček 1986) and 10–10.5 (Minugh-Purvis 1988) have been published.

Assessment of the developmental ages of *each individual tooth* in the Šipka 1 mandible *(Table 1)*, with modern human stages of development, reveals a considerable spread of possible age estimates, which might,
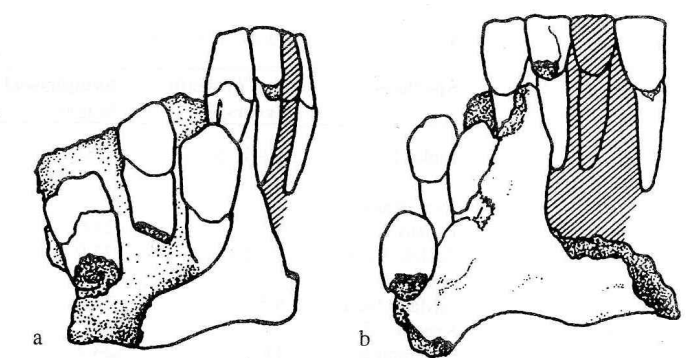

FIGURE 1. a) Lateral (right) and b) anterior views of Šipka 1 (drawn from a cast and photographs by Melissa Bell-Sabatino).

TABLE 1. Dental age estimates for Šipka 1.

Method I: Dental calcification scoring[1]

Teet	Calcification score[2]	Tooth age (in years)[2]
RI_1	8.0	>9.5
I_2	8.0	>10.0
C	6.0	9.0
P_3	5.5	9.25
P_4	5.0	9.5
	Quadrant age:	>9.45 years
LI_2	8.0	>10.0 years
	Quadrant age:	>10.0 years

Method II: Dental formation assessment[2]

Teet	Formation/Eruption status[2]	Tooth age (in years)[2]
RI_1	root complete	>9.0
I_2	root complete	>10
C	root 1/2; unerupted	<11
P_3	root 1/4; erupting	10–12
P_4	crown complete; root formation beginning	>7
LI_2	root complete	>10.0

[1] Read from published radiographs in Vlček (1969).
[2] From Minugh-Purvis (1988).

in part, explain the unusually great variation in age attributions reached by different investigators. In addition, however, Šipka 1's dental calcification scores reveal a pattern in which maturation of the permanent mandibular canine is delayed relative to the other teeth. This delay was first noted by Vlček (1969), who observed a greater than usual discrepancy between the expected stages of canine and incisor development in the specimen.

Two possible explanations for a developmental discrepancy between the canine and other teeth are either that it represents normal individual variation, or, more probably, sexual dimorphism indicative of a male. According to Demirjian and Levesque (1980), the rate of permanent canine calcification in modern *H. s. sapiens* is

TABLE 2. Comparative symphyseal metrics.

Specimen	Age at death (years)	Symphyseal height	Symphyseal thickness	Height/Thickness robusticity index
Šipka 1	10–10.5	(28)	(14)	(50)
Neanderthals[1]				
Hortus 2	9	23.6	13.8	58.4
Teshik-Tash	10–10.5	27.0	13.7	50.7
Krapina 52 (Mandible B)	9.5	26.0	(12)	(46.1)
Krapina 53 (Mandible C)	11	23.7	13.6	57.3
Ehringsdorf 7/8	12	28.3	15.3	54.0
Montgaudier 1[2]	12.5–14.5	22.0	11.8	53.6
Krapina 55 (Mandible E)	15–17	31.4	14.1	44.9
Le Moustier 1	15.5–16.0	(30)	(15)	(50.0)
Neanderthal Mean		27.1	13.9	51.8
Range		(23.6–31.4)	(12–15.3)	(46.1–58.4)
Early *Homo sapiens sapiens*[1]				
Mießlingtal 1	9–10	22.1	(13)	58.8
Kostenki 4	10	25.8	15.4	59.6
Předmostí 25[3]	10	25.5[1]	15.0[1]	58.8
Les Rois 1	10–11	26.8	13.6	50.7
Sungir' 3	10–11	27.0	13.5	50.0
Sungir' 2	11–12	31.5	14.0	44.4
Early *H. s. sapiens* Mean		26.9	13.9	53.7
Range		(22.1–31.5)	(13–15.4)	(44.1–59.6)
Homo sapiens, subsp. indet.[1]				
Irhoud 3	7.5–8	26.2	13.5	51.5
Qafzeh 11	12	29.9	13.2	44.1
Rabat 1	14–15	32.2	–	–
Malarnaud 1	14–15	25.3	12.8	50.5
Modern *Homo sapiens sapiens*				
Ages 6.1–8.0		(N=11)	(N=12)	(N=11)
Mean ± 2sd		22.7 ± 1.86	13.65 ± 3.38	60.4 ± 13.2
Ages 8.1–11.0		(N=6)	(N=6)	(N=6)
Mean ± 2sd		25.0 ± 2.21	12.75 ± 1.04	51.2 ± 5.01
Ages 11.1–12.0		(N=8)	(N=7)	(N=7)
Mean ± 2sd		26.7 ± 3.07	14.4 ± 1.79	55.9 ± 13.9
Ages 12.1–18.0		(N=11)	(N=12)	(N=11)
Mean ± 2sd		28.6 ± 2.8	13.2 ± 1.55	46.9 ± 5.33

[1] Unless otherwise noted, all measurements are from Minugh-Purvis (1988).
[2] From Mann and Vandermeersch 1997.
[3] From Matiegka 1934.

TABLE 3. Šipka 1 – comparative dental metrics.

Tooth		Šipka	Krapina Mean[1]	Würm I Neanderthal Mean[2]	Würm II Neanderthal Mean[2]	EUP[2] Mean[2]
(Vlček 1969) (primary cast)						
LI1	(L) 5.5	5.4				
	(B) 7.0	7.23				
RI1	(L) 6.0	5.44				
	(B) 7.0	7.14				
I1(L) (R and L combined)			5.9	5.8	6.0	5.8
			sd 0.42	0.75	0.40	0.52
I1(B) (R and L combined)			7.6	7.5	7.2	6.4
			sd 0.50	0.29	0.19	0.34
RI2 (L) 7.0		5.94	6.8	6.6	6.8	6.5
		sd	0.48	0.59	0.86	0.55
(B) 7.0		7.38	8.0	7.9	7.7	7.0
		sd	0.54	0.09	0.38	0.46
C (M-D) 7.4		7.6	8.2	8.0	7.8	7.6
		sd	0.36	0.48	0.51	0.55
(B-L) –		–	9.4	9.7	8.3	9.0
		sd	0.56	0.38	0.97	0.51
P3 (M-D) 8.0		7.52	8.3	7.6	8.2	7.3
		sd	0.40	0.47	0.78	0.41
(B-L) 8.0		–	9.4	9.3	9.3	8.5
		sd	0.50	0.79	1.10	0.48
P4 (M-D) 7.5		7.24	8.1	7.2	8.0	7.4
		sd	0.62	0.75	1.11	0.24
(B-L) 8.0		–	9.6	9.2	9.2	8.7
		sd	0.48	0.50	1.14	0.37

[1] From Wolpoff 1979.
[2] From Frayer 1978.
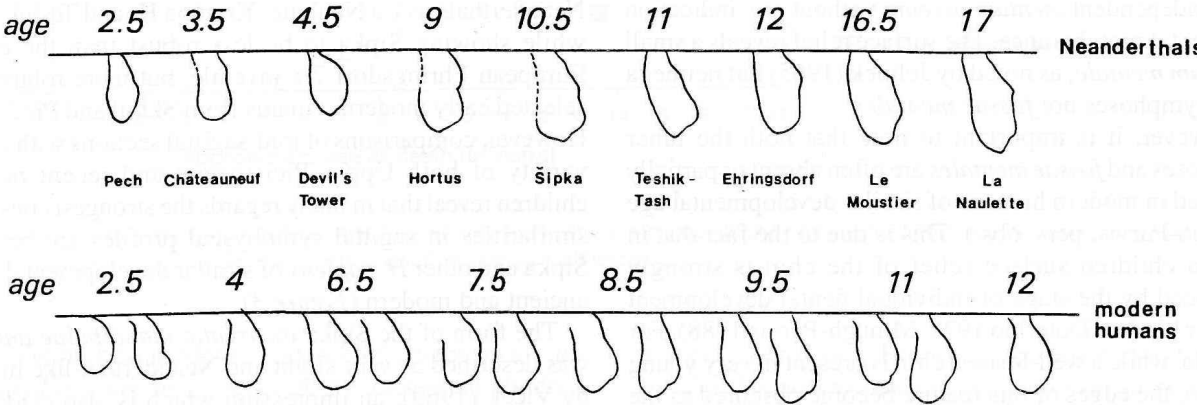
FIGURE 2. Symphyseal profiles – immature individuals.

sexually dimorphic, with male permanent mandibular canine apical closure lagging behind females by as much as 1.2 to 1.4 years (Demirjian, Levesque 1980). While these numbers represent chronological years in living human children, so that they should be used with some caution in interpreting an Upper Pleistocene juvenile, it seems reasonable to suggest that despite its relatively small teeth (*Table 3*), Šipka 1 was probably a male child. If indeed a male, the Šipka anterior dentition is quite small for a Neanderthal as Wolpoff has repeatedly asserted (1980, 1999) and which he notes would be consistent with the dental dimensions of late Neanderthals.

Table 1 presents dental ages arrived at for Šipka using 1. scoring of dental calcification stages from radiographs, and 2. dental formation assessment based on observations taken directly from a primary cast, following the methodology outlined in Minugh-Purvis (1988). This ageing method, which utilizes modern human dental maturation standards, is considered appropriate for ageing an Upper Pleistocene specimen such as Šipka in view of Tompkins (1996) findings of extremely similar dental calcification schedules between Neanderthals and modern humans. Examination of the various dental ages presented in *Table 1* reveals the strong concordance between the

calcification and formation methods, which yield a maximum possible age range of approximately 7–12 years at death for Šipka 1 when the findings of the two methods are combined. A narrower age range, arrived at using the mean of the individual tooth ages, is 9.45–10.5 years of age at death. However, if the delayed canine is eliminated

from consideration on grounds that it represents a sexually dimorphic feature of a male individual, an even narrower adjusted estimated range of 10–10.5 years at death is obtained.

DEVELOPMENTAL MANDIBULAR MORPHOLOGY

Metric comparisons

Metrically, compared to other 9–11-year-old Upper Pleistocene mandibular remains, Šipka 1 clearly falls within the ranges of both Neanderthals and early *H. s. sapiens* for symphyseal height, thickness, and robusticity (*Table 2, Figure 2a* and *b*) so that it cannot be differentiated from either Neanderthals or early *H. s. sapiens* on the basis of symphyseal metrics. It is clear, however, that Šipka 1 was rather robust in bony dimensions for its age regardless of its subspecific designation within *H. sapiens*. Examination of metric data shows that in both the Neanderthals and early *H. s. sapiens* specimens examined here, a rather marked increase in symphyseal height appears to have occurred starting at 11 or 12 years of life, continuing through adolescence – as is characteristic of modern humans (Minugh-Purvis 1988, van der Linden, Duterloo 1976). This very large size of Šipka 1 would be more consistent with the slightly older age determination of 10–10.5 years arrived at here and it is difficult to have confidence in younger age estimates such as 8 or 9 years at death when examining the symphyseal metrics of other immature Upper Pleistocene juveniles since among this younger age group, Šipka 1 would fall far above the ranges of both immature Neanderthals as well as early *H. s. sapiens*.

Non-metric aspects of mandibular morphology

Unequivocally, the labial symphysis in Šipka reveals the presence of a slight mental eminence. Vlček (1969:86) characterised this as a typical example of the development of an independent *mentum osseum* without any indication of a mental protuberance. The surface relief reveals a small *trigonum mentale*, as noted by Jelínek (1965) but neither a tuber symphoses nor *fossae mentales*.

However, it is important to note that both the tuber symphoses and *fossae mentales* are often absent or partially obscured in modern humans of similar developmental age (Minugh-Purvis, pers. obs.). This is due to the fact that in modern children surface relief of the chin is strongly influenced by the stage of individual dental development (van der Linden, Duterloo 1976, Minugh-Purvis 1988). For example, while a well-formed chin is present in very young children, the edges of this feature become obscured as the permanent anterior mandibular teeth reach their maximum point of intra-alveolar growth. When examining the fossil record, this makes it extremely difficult, if not impossible, to distinguish between chin morphology in Neanderthals and early *H. s. sapiens* at certain developmental intervals during growth and development, particularly just prior the eruption of the permanent incisors and canines (Minugh-Purvis 1988). During this time, the swollen anterior dental germs push the surface compacta on either side of the mental eminence forward, so that the developing chin no longer protrudes beyond the rest of the symphyseal bone.

Upon eruption of the permanent anterior teeth this swelling recedes, so that mental surface relief reappears. In Šipka 1, although the permanent incisors have already erupted, the permanent canines are indeed near or at their maximum point of intra-alveolar growth. Because these teeth are situated immediately lateral to the mental region, their expansion results in a bulging of the contiguous labial surface on either side. Consequently, it is nearly impossible to assess the degree of development of the Šipka mental protuberance, and to predict what its adult morphology would have been. Mallegni and Trinkaus (1997) report the clear presence of the tuber symphoses on 45.5% of the Neanderthal children examined, while 45.5% completely lack this feature. In support of the above observations all four of the specimens examined by Mallegni and Trinkaus, of the same developmental age as Šipka 1 (Le Fate 2, Hortus 2, Teshik-Tash 1, and Zaskalnaya) lack this feature.

The information available from examination of the Šipka symphysis (*Figure 3*) in cross section is somewhat limited due to the anterior exfoliation of compact bone from its labial surface. However, the lingual surface is intact, and a number of observations regarding its morphology are possible. Vlček (1969) noted an inner surface with a moderately dorsally arching *planum alveolare* ending at a superior transverse torus – a feature which, he mentions, aligns the child with Neanderthals. As Smith (1982) mentions, the superior transverse torus of Šipka 1 is fairly weak; but this is a common situation in Neanderthals, both immature and adult. Inferior to the superior transverse torus, the basilar portion of the symphysis runs nearly vertically until ending at a weak inferior torus. Vlček used comparisons of mandibular mid-sagittal sections (1969) to demonstrate close similarities between Šipka and such Neanderthals as La Naulette, Krapina H, and Teshik-Tash, while showing Šipka to be less robust than the earlier European Ehringsdorf 7/8 juvenile, but more robust than selected early modern remains from Skhul and Předmostí. However, comparisons of mid-sagittal sections with a wide variety of both Upper Pleistocene and recent modern children reveal that in many regards the strongest consistent similarities in sagittal symphyseal profiles are between Šipka and other *H. sapiens* of similar developmental age – ancient and modern (*Figure 3*).

The form of the Šipka *incurvatio mandibulae anterior* was described as very slight and Neanderthal-like in form by Vlček (1969); an impression which is also evident in primary casts of the fossil (Minugh-Purvis, pers. obs.). This area of slightly depressed relief on either side of the labial midline, between the *alveoli* of the canine *juga*, essentially gives relief to the mental eminence or *trigonum mentale*. As noted previously, in discussing the mental eminence, bulging of permanent dental germs often obscures topographic features of this region, and Minugh-Purvis (1988) found this feature also largely obscured in many modern children of similar dental ages.

In her excellent study of non-metric variability of the *H. sapiens* craniofacial skeleton, Coqueugniot (1998: 84)
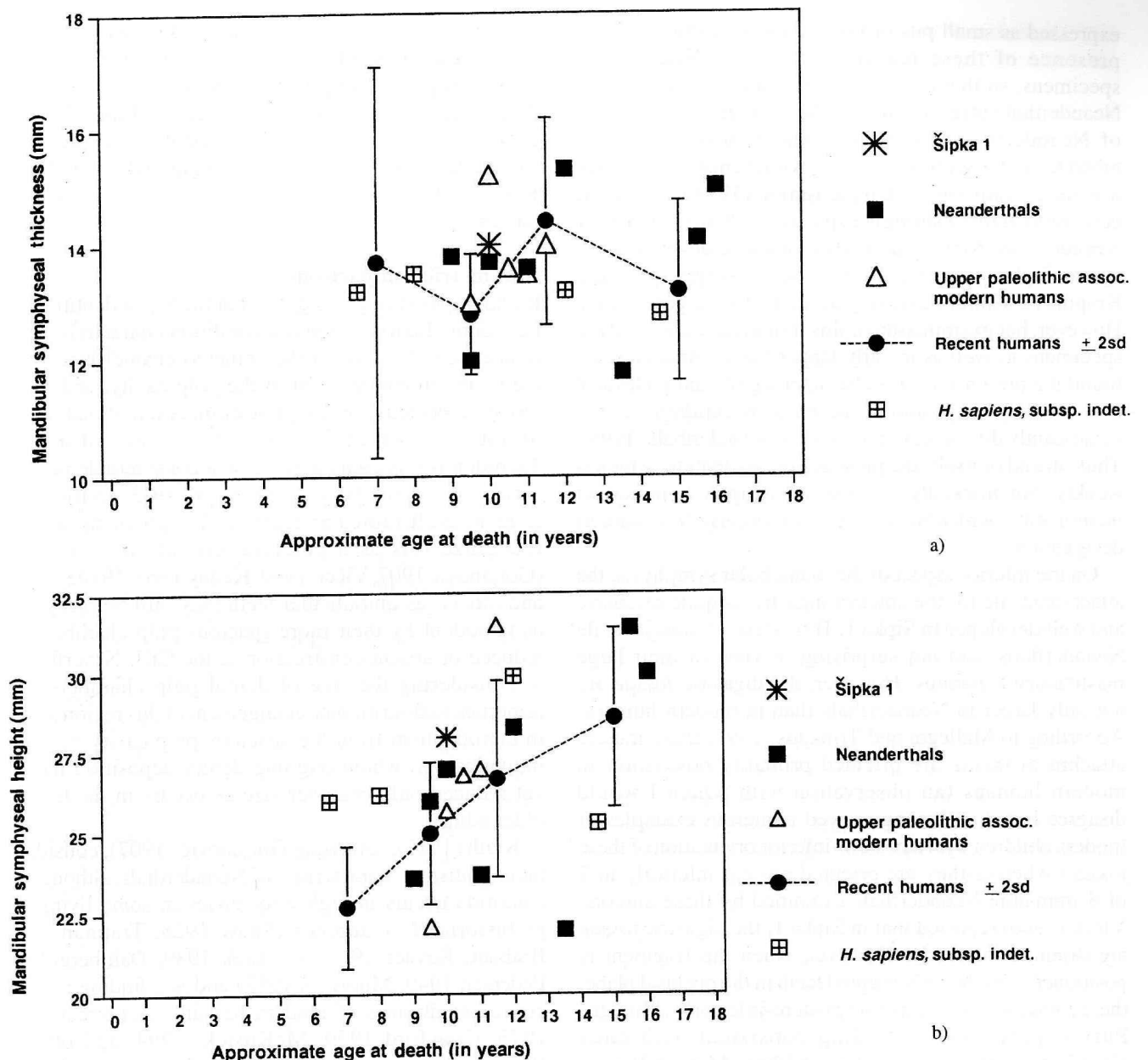

FIGURE 3. a) Comparisons of growth in mandibular symphysis thickness from mid-childhood through adolescence, b) comparisons of mandibular symphyseal growth in vertical height from mid-childhood through adolescence.

found the highest modern incidence of absent *incurvatio mandibulae anterior* to occur in pre-adolescent children. In her large sample of 110 modern European children of this developmental age, 69% lacked this feature. She found the major difference between the expression of this feature in Neanderthals and modern humans to appear in adolescence – when the feature is strongly and consistently present in modern children but absent in Neanderthals. Mallegni and Trinkaus (1997) found the *incurvatio mandibulae anterior* weakly expressed in 30.7%; very weakly expressed in 7.7% and absent from 61.5% of their juvenile Neanderthal sample. However, among the four Neanderthal juveniles of comparable developmental age

as Šipka 1, only one, Hortus 2, possessed even a weakly developed *incurvatio mandibulae anterior* while the other three lacked the feature entirely.

Lingually, Jelínek (1965) and Vlček (1969) noted the presence of weak impressions for the genial musculature, although both note the presence of weak genial – what they term "mental" spines, as well as a *genioglossal fossa*, in Šipka 1. The presence of these features is of considerable interest as it has, for some time, been recognized that in modern humans, the attachment of *mm. genioglossus* and *geniohyoid* are expressed as small prongs, the genial tubercles or spines, while in most earlier hominids the symphyseal attachment sites for these muscles are

expressed as small pits or *fossae*. Vlček (1969) notes the presence of these features in several Neanderthal specimens, so that they should be considered part of the Neanderthal range of variation. Nevertheless, the majority of Neanderthals that Vlček examined lacked genial tubercles and, significantly, those with them also possessed a *genioglossal fossa*. Coqueugniot (1998) found the *genioglossal fossa* strongly expressed in 9 of 15 immature Neanderthals. Among those of comparable developmental age as Šipka 1, she reports that only a single specimen, Krapina 52, exhibited weakly developed *fossa genioglossi*. However, her examination of this trait in the Skhul/Qafzeh specimens as well as in early Upper Palaeolithic children found the presence of this character significantly elevated over its frequency among the modern children but not significantly different from immature Neanderthals (1998). Thus, in and of itself, the presence of this feature, which is weakly, not markedly, expressed in Šipka 1, is neither incompatible with a Neanderthal nor an early *H. s. sapiens* designation.

On the inferior aspect of the mandibular symphysis, the attachment site for the anterior digastric is quite extensive and well-developed in Šipka 1. This is true of most juvenile Neanderthals, and not surprising in view of their large masticatory apparatus. However, the digastric *fossae* are not only larger in Neanderthals than in modern humans. According to Mallegni and Trinkaus (1997) these muscle attachment *fossae* are oriented primarily posteriorly in modern humans (an observation with which I would disagree based on having viewed numerous examples of modern children with a postero-inferior orientation of these *fossae*) whereas they are oriented postero-inferiorly in 7 of 8 immature Neanderthals examined by these authors. Vlček (1969) reported that in Šipka 1, the digastric *fossae* are oriented inferiorly. However, when the fragment is positioned with the fully erupted teeth in the occlusal plane, these *fossae* are oriented more postero-inferiorly (Minugh-Purvis, pers. obs.) a finding consistent with most Neanderthals and many modern children (Minugh-Purvis, pers. obs.) of similar developmental age.

Also in the region of the basal symphysis, Vlček (1969) noted the presence of a well-developed, anteriorly projecting basal tubercle between the digastric *fossae* responsible for a "cupid's bow" configuration of the basal anterior mandibular margin. This feature, most likely created by the strongly sculpted digastric *fossae* situated bilateral to it, is consistent with the overall robusticity of the Šipka specimen.

DENTITION

Metric comparisons

A consideration of the Šipka dentition also requires attention in attempting to better clarify the taxonomic status of this specimen. Smith (1982) and Wolpoff (1980) have noted that metrically, the Šipka dentition falls at the lower

end of the Neanderthal range but also falls well within the range of early Upper Palaeolithic associated human remains from Europe. A comparison of Šipka with other Upper Pleistocene dentitions is presented in *Table 3*. These comparisons reveal that the Šipka dental metrics are closest to the later Neanderthal means although falling within the Krapina, Würm I, Würm II, and early Upper Palaeolithic ranges.

Non-metric comparisons

Radiographs strongly suggest that the Šipka dentition was taurodont. Taurodontism is a condition characterised by a reduced construction at the cemento-enamel junction of the tooth; an enlargement of the pulp cavity; and, in the molars, a decrease or complete elimination of that portion of the root which is normally bi- or trifurcated. Taurodontism is characterised by a considerable range of variation from mild to marked. Keith (1913) restricted the term to multiradicular teeth, although many authors recognize this as a potential condition of all teeth (Gorjanović 1907, Vlček 1969, Kallay 1963, 1970a, 1970b, and others) as uniradicular teeth may still be recognised as taurodont by their more spacious pulp chambers and reduced or absent construction at the CEJ. Nevertheless, in considering the size of dental pulp chambers, it is important to discriminate enlargement of this region as seen in taurodontism from the spacious pulp cavity of young individuals in whom ongoing dentin deposition has not yet reduced pulp chamber size as occurs in the teeth of older adults.

Keith (1913), following Gorjanović (1907), considered taurodontism a characteristic of Neanderthals, although the condition occurs in high frequencies in some living and prehistoric *H. s. sapiens* (Shaw 1928, Tratman 1950, Brabant, Kovacs 1961, Senyürek 1939, Dahlberg 1960, Pedersen 1949, Moorrees 1957) and is a finding in some genetic syndromes of modern humans (Ackerman *et al.* 1973, Crawford 1970, McKusick, 1994, and others). Because of its consistent inclusion in genetic syndromes, the presence of taurodontism is clearly under some degree of genetic control, a finding of interest considering its higher frequencies and stronger expression in Neanderthals compared with living and other fossil members of *Homo*.

Radiographic examination of the Šipka dentition reveals that the developing permanent teeth did, in fact, have rather large pulp chambers. This finding led Vlček (1969: 128) to speculate that the cheek teeth of this individual may have exhibited the marked degree of taurodontism so characteristic of Neanderthals. There are two problems with this assertion, however: First, examination of Upper Palaeolithic associated *H. s. sapiens* reveals that the presence of spacious dental pulp chambers is not uncommon among early Upper Palaeolithic associated specimens including individuals from Rocheril, Roc de Sers, and Mladeč (Minugh-Purvis, pers. obs.). Thus, taurodontism cannot be considered an exclusively Neanderthal trait among European Upper Pleistocene

people and, as such, cannot by itself be considered as a definitive indicator of a Šipka 1's affinities with that group. Moreover, because the relative size of the developing Šipka pulp chambers are similar to those of comparably aged recent *H. s. sapiens*, there is no evidence to suggest that they would have been unusually voluminous later in life (Minugh-Purvis, pers. obs.).

Other qualitative traits which have been noted in the Šipka dentition include the lack of shovelling, a feature commonly found in Neanderthals (Jelínek 1965, Crummett 1994). Other resemblances to Neanderthals include the particularly strongly developed basal tubercle on the lingual aspect of the I_2 and the strongly molarised crowns of both the P_3 and P_4 (Jelínek 1965).

DISCUSSION AND CONCLUSIONS

Jelínek (1965) has observed that Šipka Cave is situated in a remote, mountainous area of Moravia. In making this observation, he suggested that the cave might have been a refuge for Late Neanderthal populations living at the most northern fringe of their geographical range and that, furthermore, the Šipka people may have been contemporaries of the robust early modern *H. s. sapiens* inhabiting the Aurignacian levels at nearby Mladeč Cave.

Other remains displaying a mixture of Neanderthal and more modern features are found in this area of Central Europe. The Late Neanderthal Kůlna adolescent maxilla has been regarded as having some transitional features (Smith 1982), while the later Gravettian associated *H. s. sapiens* from Předmostí exhibit a number of archaic characters in their morphology as well. Understanding this mosaic of morphology in the rich central European fossil record is critical for interpreting the pattern of Upper Pleistocene hominid evolution, particularly with new controversial evidence for the mixture of modern and archaic features in the western European Late Pleistocene (Hublin *et al.* 1995, Duarte *et al.* 1999, Tattersall, Schwartz 1999).

Gradual frequency changes in a number of so-called Neanderthal traits across the European Neanderthal to modern transition have been well-documented (Brose, Wolpoff 1971, Smith 1982, Smith, Ranyard 1980, Smith 1994, Frayer 1984, 1992, Frayer *et al.* 1993, Wolpoff 1980, 1999, Coqueugniot 1998, and others). Conversely, the gradual appearance and acquisition of modern features, including chins, further demonstrate the morphological overlap between Neanderthals and the earliest *H. s. sapiens* in Europe. For example, the Late Neanderthals from Vindija, Croatia, dated to between 28,000–29,000 BP (Smith *et al.*, in print) exhibit symphyseal profiles ranging from fairly vertical to the slight expression of a mental eminence (Wolpoff 1989, Malez *et al.* 1980). In addition Wolpoff (1989) notes that in these specimens, more modern symphyseal morphology is accompanied by anterior teeth which are smaller in size – particularly in breadth – than

those typically found in earlier-in-time Neanderthals. This is the pattern of reduced anterior tooth breadth seen in the Šipka 1 pre-adolescent.

In her excellent study of non-metric craniofacial variation through ontogeny in *H. sapiens*, Coqueugniot (1998) identified a fascinating evolutionary cascade in the ontogeny of the mental region in Late Pleistocene and modern children. This cascade involves three complexes: the anterior mandibular depressions, number of mental foramina, and the presence of a *fossa* as opposed to a spine for the attachment of *m. genioglossus*. Although Šipka 1 does not preserve the region of the mental foramina, the development of these other two complexes in the fossil deserves some discussion.

Among Neanderthals, Coqueugniot found an increased incidence of *fossae genioglossi* through ontogeny, with 100% of her oldest subadult sample exhibiting this trait. Interestingly, the Upper Palaeolithic children lack this feature in childhood although by adolescence, 75% of them exhibited it. It is also interesting that none of the Upper Palaeolithic infants had yet developed a *genioglossal fossa*, although it was present in 40% of similarly aged Neanderthals. Between 97% and 100% of the modern children studied by Coqueugniot, from the earliest ages to adulthood, exhibited an absence of the *genioglossal fossa* (1998). Thus, although this feature does appear in modern humans, it is extremely rare. In the Upper Palaeolithic children of the same developmental age at death as Šipka 1, only 1 specimen was available for examination and Coqueugniot reports it lacked the feature although she found the *genioglossal fossa* well expressed in the Skhul/ Qafzeh sample, with 100% of those of the same approximate developmental age as Šipka possessing the trait. Thus, the fact that Šipka 1 possessed a *genioglossal fossa* more strongly aligns it with Neanderthals, although the fact that the specimen also possessed rudimentary spines within its *genioglossal fossa* suggests that this complex might have additional intermediate evolutionary and developmental stages of expression. Among the adult Neanderthals possessing mental spines, Vlček (1969) found these particularly well-developed in La Ferrassie 1. Whether Šipka 1's possession of a *genioglossal fossa* in combination with a rudimentary development of the mental spines, is indicative of a later Neanderthal pattern or is simply a morphological variation found in Neanderthals from the earliest to later populations, is not clear given the available data.

Another trait for which Coqueugniot noticed a change in frequency from Neanderthals to Upper Palaeolithic associated to modern children was the anterior mandibular *fossae*. These features were first described in some detail by Arensburg *et al.* (1989) who linked them to the acquisition of a pronounced chin. In Upper Palaeolithic associated children these are always in evidence to some extent, according to Coqueugniot (1998). However, she found the incidence of anterior mandibular *fossae* in Neanderthals dropped to its lowest around mid- to late

childhood when none of the specimens exhibited marked anterior depressions although one possessed weakly developed *fossae*. As the Šipka child died in mid- to late childhood, its lack of these features is consistent with a juvenile Neanderthal rather than an Upper Palaeolithic or recent modern child.

SUMMARY

The mandibular symphyseal fragment from Šipka comprises the remains of a 10–10.5-year-old Neanderthal male. Regardless of its precise dating, which may never be resolved, Šipka adheres to the morphological pattern seen in many Neanderthal children of similar developmental age, while also showing hints of features known from a number of late Neanderthal specimens. Thus, this review of the morphology of Šipka 1 agrees with previous designations (Jelínek 1965, 1969, Smith 1982, Wolpoff 1980, 1999) of this child as a late Neanderthal. Additionally, this study provides further evidence of the remarkable similarity between Neanderthals and the earliest modern Europeans who followed them in time – yet more support that significant genetic continuity characterised the Upper Pleistocene hominid populations of Europe.

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REFERENCES

ABSOLON K., ZAPATEL K., SKUTIL J., 1933: O pravé podstatě paleolitických industrií ze Šipky a Čertovy Díry na Moravě. *Anthropologie* (Prague) 11: 253–272.

ACKERMAN J. L., ACKERMAN A., LEON A., BERNARD A., 1973: Taurodont, pyramidal and fused molar roots associated with other anomalies in a kindred. *Amer. J. of Phys. Anthrop.* 38: 681–694.

ARENSBURG B., KAFFE I., LITTNER M., 1989: The anterior buccal mandibular depressions: Ontogeny and phylogeny. *Amer. J. of Phys. Anthrop.* 78: 431–437.

ALLSWORTH-JONES P., 1986: *The Szeletian.* Clarendon, Oxford.

BAUME R., 1883: Die Kieferfragmente von La Naulette und aus der Schipkahöhle als Merkmale für die Existenz inferioren Menschenresten in der Diluvialzeit. Leipzig (cited in Vlček, 1969).

BRABANT H., KOVACS I., 1961: Contribution to the persistance of taurodontism in modern races and its possible relationship to the pyramidal root of molars. *Bull. Group Reich. Scient. Stomat.* 4: 232–286.

BROSE D. S., WOLPOFF M. H., 1971: Early Upper Palaeolithic man and late Middle Palaeolithic tools. *Amer. Anthrop.* 73: 1156–1194.

CLARK W.E, Le GROS 1964: *The fossil evidence for human evolution.* U. of Chicago Press, Chicago.

COQUEUGNIOT H., 1998: Varibilité morphologique de la tête osseuse au cours de l'ontogénèse. L'exemple des enfants de l'espèce *Homo sapiens.* Thèse de Doctorat (unpublished), Université Bordeaux 1.

COON C. S., 1962: *The Origin of Races.* Knopf, N. Y.

CRAWFORD J. L., 1970: Concomitant taurodontism and amelogenesis imperfecta in the American Caucasian. *J. of Dentistry for Children* 23: 41–49.

DAHLBERG A. A., 1960: The dentition of the first agriculturalists (Jarmo, Iraq). *Amer. J. of Phys. Anthrop.* 18: 243.

DEAN M. C., STRINGER C. B., BROMAGE T. G., 1986: Age at death of the Neanderthal child from Devil's Tower, Gibraltar, and the implications for studies of general growth and development in Neanderthals. *Amer. J. of Phys. Anthrop.* 70: 301–309.

DEMIRJIAN A., LEVESQUE G.-Y., 1980: Sexual differences in dental development and prediction of emergence. *J. of Dental Research* 59: 1110–1122.

DUARTE C., MAURÍCIO J., PETTITT P. B., SOUTO P., TRINKAUS E., VAND PLICHT H., ZILHÃO J., 1999: The early Upper Palaeolithic human skeleton from the Abrigo do Lagar Velho (Portugal) and modern human emergence in Iberia. *Proceedings of the National Academy of Sciences* 96: 7604–7609.

FRAYER D. W., 1978: Evolution of the dentition in Upper Palaeolithic and Mesolithic Europe. *University of Kansas Publications in Anthropology,* 10. Lawrence, University of Kansas, KS.

FRAYER D. W., 1984: Biological and cultural change in the European late Pleistocene and early Holocene. In: F. H. Smith, F. Spencer (Eds.): *The origins of modern humans: a world survey of the fossil evidence,* pp. 211–250. New York: Alan R. Liss.

FRAYER D. W., 1992: The persistence of Neanderthal features in post-Neanderthal Europeans. In: F. G. Bräuer and F. Smith (Eds.): *Continuity or replacement.* Pp. 179–188. Balkema, Rotterdam.

FRAYER D. W., WOLPOFF M. H., THORNE A. G., SMITH F. H., POPE G. G., 1993: Theories of modern human origins: The paleontological test. *Amer. Anthrop.* 95: 14–50.

GABORI M., 1976: *Les civilisations du Paléolithique moyen entre les Alpes et l'Oural.* Akademiai Kiadó. Budapest.

GORJANOVIĆ D., 1907: Die Kronen und Wurzeln der Mahlzahne des *Homo primigenius* und ihre genetische Bedeutung. *Anatomischer Anzeiger* 31: 97–134.

HEIM J.-L., 1976: *Les hommes fossiles de La Ferrassie I.* Arch. Inst. Pal. Hum. 35: 1–331.

HEIM J.-L., 1982: *Les Enfants Néanderthaliens de La Ferrassie.* Paris: Masson.

HRDLIČKA A., 1930: The skeletal remains of early man. *Smith. Misc. Coll.,* 83. Washington: The Smithsonian Institution.

HUBLIN J. J., TILLIER A.-M., 1981: The Mousterian juvenile mandible from Irhoud (Morocco): A phylogenetic interpretation. In: C. B. Stringer (Ed.): Aspects of human evolution. *Symposia of the society for the study of human biology,* Vol 21. London: Taylor and Prancis, pp. 167–185.

HUBLIN J. J., BARROSO RUIZ C., LARA P. M., FONTUGNE M., REYSS J. L., 1995: *Comptes Rendus Academie Sci. Ser. II,* 321: 931–937.

JELÍNEK J., 1965: Der Kiefer aus der Šipkahöhle. *Anthropos* 17: 165–179.

JELÍNEK J., 1969: Neanderthal man and *Homo sapiens* in central and eastern Europe. *Curr. Anthrop.* 10: 475–503.

KALLAY J., 1963: A radiographic study of the neanderthal teeth from Krapina, Croatia. In: D. R. Brothwell (Ed.): *Dental Anthropology,* pp. 75–86. New York: MacMillan.

KALLAY J., 1970: Pecularities of Krapina Neanderthal teeth. In: M. Malez (Ed.): *Krapina: 1899–1969,* Zagreb: Izdavacki zavod Jugoslavenske akademije znanosti i umjetnosti, pp. 207–228.

KEITH A., 1913: Problems relating to the teeth of the earlier forms of prehistoric man. *Proceedings of the Royal Society, Odontological Section VI.* Pp. 103–119.

KUKLA G., 1954: Složení pleistocenních sedimentů v kontrolním profilu v Šipce z roku 1950. *Příroda ostravského kraje* 15: 105–124.

LINDEN F. P. G. M.,van der, DUTERLOO H. S., 1976: *Development of the human dentition. An Atlas.* Hagerstown, MD: Harper and Row.

MALEZ M., SMITH F. H., RADOVČIĆ J., RUKAVINA D., 1980: Upper Pleistocene hominids from Vindija, Croatia, Yugoslavia. *Curr. Anthrop.* 21: 365–367.

MALLEGNI F., TRINKAUS E., 1997: A reconsideration of the Archi 1. Neanderthal mandible. *J. of Hum. Evol.* 33: 651–668.

MANN A. E., VANDERMEERSCH B., 1997: An adolescent female Neanderthal mandible from Montgaudier Cave, Charente, France. *Amer. J. of Phys. Anthrop.* 103: 507–527.

MAŠKA K. J., 1883: Čelist předpotopního člověka nalezená v Šipce u Štramberka. *Čas. vlast. muz. Spolku Olomouck.* 2: 27–35.

MATIEGKA J., 1933: Pravěká anthropologie Československa. *Československá vlastivěda II (Člověk),* pp. 144–145.

MATIEGKA J., 1934: Homo Předmostensis: Fosilní člověk z Předmostí na Moravě. II. Prague: Nákladem České akademie věd a umění.

McKUSICK V. A., 1994: *Mendelian inheritance in Man: A Catalog of human genes and genetic disorders.* (11th ed.) Baltimore: Johns Hopkins University Press.

MINUGH-PURVIS N., 1988: *Patterns of craniofacial growth and development in Upper Pleistocene hominids.* Ph.D. Dissertation in anthropology. University of Pennsylvania, Philadelphia. Ann Arbor, MI: University Microfilms.

MINUGH-PURVIS N., 1989: A comparison of ontogenetic patterning and morphological variation in the mandibular symphysis of *Homo sapiens neanderthalensis* and *Homo sapiens sapiens.* Paper presented at the 17th Annual Meeting of the Canadian Association for Physical Anthropology. Vancouver, B.C., November 4, 1989.

MINUGH-PURVIS N., 1998: The search for the earliest modern Europeans: A comparison of the Krapina 1 and es-Skhul 1 juveniles. In: T. Akazawa, K. Aoki and O. Bar-Yosef (Eds.): *Neanderthals and modern humans in west Asia,* pp. 339–352. New York: Plenum.

MOORREES C., 1957: *The Aleut Dentition.* Cambridge: Harvard University Press.

MUSIL R., 1965: Wertung der Früheren Palaontologischen Funde aus der Šipka-Höhle. *Anthropos* 17: 132–134.

PARMA C., 1944: Stomatologické vyšetření prehistorických čelistí v Čechách a na Moravě. *Česká stomatologie* 44: 191–200.

PEDERSEN P. O., 1949: *The East Greenland Eskimo dentition, numerical variations and anatomy.* Copenhagen: CA Reitzels Forlag.

PROŠEK F., LOŽEK V., 1957: Stratigrafische übersicht des tschechoslovakischen *Quartärs. Eiszeitalter Gegnw.* 8: 37–90.

RADKOVEC F., 1939: Fragment dolní čelisti z jeskyně Šipky u Štramberka. *Česká stomatologie* 39: 117–125.

SENYÜREK M. S., 1939: Pulp cavities of molars in primates. *Amer. J. of Phys. Anthrop.* 25: 119–131.

SCHAAFHAUSEN H., 1881: Ein pithecoider menschlicher Unterkiefer. *Correspondenzblatt der deutschen Gesellschaft für Anthropologie* XII: 2–4.

SHAW J. M., 1928: Taurodont teeth in South African races. *J. of Anatomy* (London) 62: 476–498.

SKINNER M. F., 1977: *Dental maturation, dental attrition and growth of the skull in fossil hominidae.* Unpublished Ph.D. Dissertation. Oxford University.

SMITH F. H., 1982: Upper Pleistocene hominid evolution in south-central Europe: A review of the evidence and analysis of trends. *Curr. Anthrop.* 23: 667–703.

SMITH F. H., 1994: Samples, species, and speculations in the study of modern human origins. In: M. H. Nitecki, D. V. Nitecki (Eds.): *Origins of anatomically modern humans,* pp. 227–249. New York: Plenum.

SMITH F. H., RANYARD G. C., 1980: Evolution of the supra-orbital region in Upper Pleistocene fossil hominids from south-central Europe. *Amer. J. of Phys. Anthrop.* 53: 589–610.

TATTERSALL I., SCHWARTZ J., 1999: Hominids and hybrids: The place of Neanderthals in human evolution. *Proceedings of the National Academy of Sciences,* 96: 13: 7117–7119.

TILLIER A.-M., 1981: Evolution de la région symphysaire chez les *Homo sapiens* juvéniles du Paléolithique moyen: Pech de l'Azé, Roc de Marsal et La Chaise 13. *C. R. Acad. Sci. Paris Série II,* 293: 725–727.

TILLIER A.-M., 1983a: Le crâne de l'enfant d'Engis 2: Un exemple de distribution de caractères juvéniles, promitifs et néanderthaliens. *Bull. Soc. Roy. Belge Anthrop. Préhist.* 94: 51–75.

TILLIER A.-M., 1983b: L'enfant néanderthalien du Roc de Marsal, Campagne du Buge, Dordogne: Le squelette facial. *Ann. Paléont. (Vértebrés)* 69: 137–149.

TILLIER A.-M., 1986: Ordre d'apparition des caractères Néanderthaliens sur le squelette crânien au cours de la croissance. Problèmes d'analyse phylogénétique. In: M. Sakka (Ed.): *Définition et origines de l'homme,* pp. 263–271. Paris: Editions du CNRS.

TILLIER A.-M., 1998: Ontogenetic variation in Late Pleistocene *Homo sapiens* from the Near East. In: T. Akazawa, K. Aoki, and O. Bar-Yosef (Eds.): *Neanderthals and modern humans in Western Asia*. Pp. 381–389. New York: Plenum.

TILLIER A.-M., KAFFE I., ARENSBURG B., CHECH M., 1998: Hypodontia of permanent teeth among Middle Palaeolithic hominids: an early case dated to ca. 92000 + 5000 years BP at the Qafzeh site. *Internat. J. of Osteoarchaeology* 8: 1–6.

TOMPKINS R., TRINKAUS E., 1987: La Ferrassie 6 and the development of Neanderthal pubic morphology. *Amer. J. of Phys. Anthrop.* 73: 333–239.

TOMPKINS R., 1996: Relative dental development in Upper Pleistocene hominids compared to human population variation. *Amer. J. of Phys. Anthrop.* 99: 103–118.

TRATMAN E. K., 1950: A comparison of the teeth of people; Indo-European racial stock with the Mongoloid racial stock. *The Dental Record* 70: 31–53; 63–88.

TRINKAUS E., LE MAY M., 1982: Occipital bunning among the Pleistocene hominids. *Amer. J. of Phys. Anthrop.* 57: 27–35.

VALOCH K., 1965: Höhlen Šipka und Čertova Díra bei Štramberk. *Anthropos* 17: 80–125.

VALOCH K., 1967: Die Steinindustrie von der Fundstelle des menschlichen Skelettrestes I aus der Höhle Kůlna bei Sloup (Mähren). *Anthropologie* (Brno) 5: 21–32.

VALOCH K., 1968: Evolution of the Palaeolithic in Central and Eastern Europe. *Curr. Anthrop.* 9: 351–390.

VALOCH K., 1969: Das Paläolithikum in der Tschechoslowakei. In: K. Žebera (Ed.): *Quaternary in Czechoslovakia*, pp. 69–149. Prague.

VALOCH K., MUSIL R., JELÍNEK J., 1965: Jeskyně Šipka a Čertova Díra u Štramberku (Die Höhlen Šipka und Čertova Díra bei Štramberk). *Anthropos* 17(NS 9).

VIRCHOW R., 1882: Der Kiefer aus der Schipka-Höhle und der Kiefer von La Naulette. *Zeitschrift für Ethnologie* 14: 277–310.

VLČEK E., 1969: *Neanderthaler der Tschoslowakei*. Prag: Böhlau.

VLČEK E., 1970: Étude comparative onto-phylogénétique de l'enfant du Pech-de-L'Azé par rapport aux autres enfants Néanderthaliens. In: D. Ferembach (Ed.): L'Enfant du Pech-de-l'Azé. *Arch. Inst. Paléont. Humaine* 33: 149–178.

VLČEK E., 1971: Czechoslovakia. In: K. P. Oakley, B. G. Campbell, T. I. Molleson (Eds.): *Catalogue of fossil hominids. Part II: Europe*. London: British Museum (Natural History).

VLČEK E., 1986: Die ontophylogenetische Entwicklung des Gebisses des Neanderthalers. *Verh. Anat. Gesellschaft* 80: 295–296.

VLČEK E., 1991: L'homme fossile en Europe Centrale. *L'Anthropologie* 95: 409–472.

WANKEL J., 1880: *Nachricht. Östr. ärztliche Vereinszeitung* 4: 194.

WEIDENREICH F., 1937: The dentition of *Sinanthropus pekinensis*. A comparative odontography of the hominids. *Palaeontologica Sinica*. New Series 10, Peking.

WOLPOFF M. H., 1979: The Krapina dental remains. *Amer. J. of Phys. Anthrop.* 50: 67–113.

WOLPOFF M. H., 1980: *Palaeoanthropology*. NY: Knopf.

WOLPOFF M. H., 1989: The place of Neanderthals in human evolution. In: E. Trinkaus (Ed.): *The Emergence of modern humans*, pp. 97–141. Cambridge: University Press.

WOLPOFF M. H., 1999: *Palaeoanthropology*. 2nd ed. New York: McGraw Hill.

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