Coll. Antropol. **37** (2013) 1: 229–237
Original scientific paper

The Cranial Analysis of Eight Skulls from Collective Grave of the Early Bronze Age Vučedol Site (East Slavonia, Croatia)

Zdravka Hincak[1], Fabio Cavalli[2] and Aleksandar Durman[1]

[1] University of Zagreb, Faculty of Humanities and Social Sciences, Department of Archaeology, Zagreb, Croatia
[2] Azienda Ospedaliero-Universitaria »Ospedali Riuniti« of Trieste, Research Unit of Paleoradiology and Allied Sciences, Trieste, Italy

A B S T R A C T

The collective grave of the Vučedol culture signed as »grave 3/1985« with skeletons of eight persons, represents the most important burial of this culture on the eponimic site in East Croatia, with several indications of human sacrifice. Anthropological and radiological analysis were performed on crania remains of the individuals, specifically on the skulls of one male and seven females. Nondestructive methods embraced craniometrical analysis, analysis of cranial non-metric traits and multivariate distance analysis, with a help of radiological methods, to detect every distinct anatomical characteristic of the skulls. All methods used in this work tried to present similarities and a possible homogeneity of the analysed individuals.

***Key words**: cranial analysis, non-metric traits, Early Bronze Age, cranial lesions, human sacrifice, Vučedol culture, Croatia*

Introduction

Vučedol is a complex, tell-type site, on the right bank of the Danube in Eastern Croatia sporadically settled from the early Neolithic to the end of the Bronze Age period. At present occasion we shall concentrate on the most impressive – Vučedol culture – layer, from the first half of the third millennium BC. Apart from numerous dwellings that can be traced in three, or sometimes even four layers, within the confinement of the settlement human and animal graves were also found, usually located in deep cylindrical pits. In spite of the fact that, along with individual graves, collective burials (of two to eight persons) have also been unearthed, their number does not correspond to the number of dwellings, time range of the Vučedol culture, and the size of the area excavated. Whether one part of this fortified settlement could have been exclusively assigned as a necropolis or the majority of the dead were buried outside of the settlement – can hardly be established at this point. The unusual positions in which all of the buried individuals were found, their mutual disposition in collective graves, as well as the unusual attention devoted to the burials, proves that they were not placed in their respective locations randomly but must have been connected with some collective ritual, and that they bear distinct features of human sacrifice[1]. It should be emphasized that the deceased were exclusively buried in a contracted (bent) position, but not on their left or right hip – typical of the earlier period – but instead, face down, the usual position for females, or face up, characteristic for males[2]. The grave 3/1985 from Vučedol (or rather grave vault) contained eight deceased individuals (Figure1). They were located at the very base and were entirely covered by one meter thick layer of charcoal. The male (3/4) was located in an extended position in the center of the grave. To the left of him was a female (3/3) in a contracted position with the chest and knees facing the soil and with two hollows in the head, while the female to the right (3/2) was also in a contracted position, but with her face upwards and her knees pressed to her chest. This is not the usual position for a woman, as men are usually buried this way. All of the others lie in contracted positions beneath this female, but with chests and knees towards the ground (Figure 1).

Received for publication January 5, 2013

Fig. 1. Situation in the collective grave 3/1985, Vučedol, Croatia.

The problem of the Vučedol culture is a very small number of graves. Archaeological campaigns, sporadically, last from 1938, but the number of graves revealed does not exceed ten with twenty six skeletons. The first anthropological findings from Vučedol site were published in 1945 by R.R. Schmidt[3] and untill today several authors have engaged in this theme[4–7]. The main aim of this research is to describe and analyse the basic cranial features of eight skulls from the Vučedol culture collective grave 3/1985, using nondestructive anthropological methods in analysing the homogeneity of the buried persons.

Material and Methods

The eight skulls analysed in this work belong to the individuals buried in the collective grave 3, revealed during the campaign on site Vučedol in 1985[2]. An earlier anthropological analysis was conducted by M. Teschler-Nicola[4] and, apart from preliminary analysis, for the first time it described lesions on the frontal and parietal bone in six individuals. Their age at death, together with sex, was determined from the cranial and postcranial parts of the completely preserved skeletons: 3/1-female – 20–25 years, 3/2-female – 20–25 years, 3/3-female – 25–30 years, 3/4-male – 40–45years, 3/5-female – 45–55 years, 3/6-female – 35–45years, 3/7-infant II–9 years, 3/8-female – 20–21years[4]. The dental analysis were limited to characteristics and anomalous forms detected by radiological analysis and represent a complement to the basic dental analysis performed by Teschler-Nicola[4].

The anthropological analysis was carried out on the Chair of Archaeometry and Methodology, Faculty of Humanities and Social Sciences, University of Zagreb, Croatia. The computerized tomography (CT) analysis was performed on the Research Unit of Paleoradiology and Allied Sciences, Azienda Ospedaliero-Universitaria »Ospedali Riuniti« of Trieste, Italy. The crania from the collective grave 3/1985 are stored in the Archaeological Museum in Zagreb, Croatia.

All cranial measurements were taken with a set of anthropological instruments GPM-Sieber Hegner. The CT scan of the eight skulls with lower jaws articulated in occlusal position (with the exception of the subject 3/1 whose lower jaw is missing) was performed (Aquilion 16© – Toshiba Inc.; 120 KVp, 300 mAs, slice thickness 0.5 mm, isotropic voxel). True cross-sections of the mandible and maxilla (Dentascan) with multiplanar reconstructions were obtained to study the dental assessment and *splanchnocranium* structures, respectively. CT datasets were also elaborated to obtain complete 3D skull reconstruction (Aquarius Intuition©, TeraRecon Inc.).

The methods used in this work comprise craniometrical analysis[8], determination of cranial non-metric traits (epigenetic variants) and CT analysis of the crania with special attention to the artificial lesions located on neurocranium of six individuals. In a study of ancient populations the analysis of non-metric traits is a standard. The craniometrical analysis has encompassed 24 standard measures by Martin, twelve of *neurocranium* and twelve of *splanchocranium*, with sixteen cranial indices and cranial capacity according to Pearson[8].

Paleoradiological analysis of *splanchocranium* was performed using the following parameters:

frontal bulla; agger nasi (pneumatisation immediately anterior and superior to insertion of the middle turbinate); ethmoid bulla; concha bullosa (pneumatisation of the middle turbinate), infraorbital cell – Haller's cell (pneumatisation of air cell into the bony orbital floor); depth of olfactory fossa (Keros classification: type 1, type 2, type 3)[9], ostiomeatal complex – Earwaker[10] (type 1-type 6); septal deviation; palatal tilt; frontal sinus pneumatisation (lateral extension of the frontal sinus); maxillary sinus pneumatisation (modified from Kalavagunta et al.)[11]; maxillary sinus septa; maxillary accessory ostium; sphenoid sinus pneumatisation (modified from Hamberger et al.)[12]; sphenoidal Onodi cell.

The skull sample 3/7 shows bilateral cribrosity of orbital vaults.

The cranial analysis comprised twenty six standard non-metric traits[13–15]. The analysed variants are sorted due to appearance, and are divided into: *sinus frontalis, sinus maxillaris, cava nasi,* suturas (*sutura supranasalis, sutura frontotemporalis, sutura petrosquamosa, sutura praemaxillaris*), small bones (*ossiculi*) presented on diverse cranial suturas (*ossiculum lambdoideum, ossa suturalia lambdidea*), tuberculi (*tuberculum pharyngeum, tuberculum praecondylaris*), canales (*canalis condylaris posterior, canalis hypoglossiduplex*), foramina et sulci (*foramen omis. parietale, foramen mastoideus exsuturalis, foramen mastoid* absent*, foramen ovale duplex, foramen spinosum apertum, sulcus supraorbitalis, foramen supraorbitale et sulcus supraorbitale, foramen zygomatico-faciale duplex, foramen palatinum majus, formen palatinum minus*), and other traits *(linea nuchalis su-*

prema, facies condylaris double, third molar – (M^3, M_3) maxillar or/and mandibular, processus retromastoideus).

The biological relations among the skulls have also been assessed, using the multivariate distance analysis[16].

Results

The craniometrical values are presented in the Tables 1 and 2. The cranial shapes in *norma verticalis* are *pentagonoides* (3/1, 3/2, 3/3, 3/4, 3/5, 3/6), rarely *elipsoides* (3/7) or *ovoides* (3/8), while in *norma occipitalis* have a house shape (3/1, 2/3, 3/3, 3/6, 3/7, 3/8) and only in two cases a shape of a ball (3/4, 3/5). The length of *neurocranium* define skulls as predominantly long for individuals 3/2, 3/4, 3/5, 3/6, 3/7, medium long for 3/1, 3/8 and short for 3/3. CT 3D reconstruction of cranial vaults is presented in Figure 2. Four individuals 3/1, 3/2, 3/3, 3/8 have narrow, while 3/4, 3/5, 3/6 have medium width of *neurocranium* (Table 1). All skulls are high (3/1, 3/6) to me-

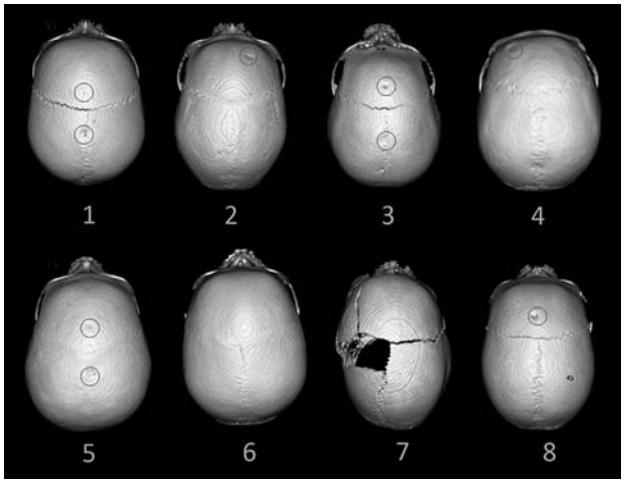

Fig. 2. CT 3D reconstruction of the cranial vaults: localization of the scars (red circle).

TABLE 1
NEUROCRANIUM – MEASURES (mm), COLLECTIVE GRAVE 3/1985, VUČEDOL, CROATIA

Martin No.	1	2	7	8	9	10	11	12	13	16	17	20
Individual												
3/1 F	174	164	36	133	99	120	112	106	94	28	135	113
3/2 F	176	175	–	128	99	112	109	101	97	–	–	111
3/3 F	164	156	36	130	86	101	113	108	100	31	127	104
3/4 M	183	173	37	143	93	123	126	105	113	31	132	109
3/5 F	182	166	32	144	98	119	112	107	92	28	128	113
3/6 F	184	176	33	141	97	128	120	106	101	28	137	117
3/7	182	177	–	–	–	117	–	–	–	–	–	113
3/8 F	174	170	36	128	97	115	114	100	93	–	130	112

Legend: 1. maximim cranial length (go–op), 2. glabella-inion length (g–i) 7. Foramen magnum length (ba–o) 8. maximum breadth (eu–eu), 9. minimum frontal breadth (ft–ft), 10. maximum frontal breadth (co–co) 11. biauricular breath (au–au), 12. biasterionic breadth (ast–ast) 13. mastoideal breadth (ms–ms) 16. width foramen magnum 17. basion-bregma height (ba–b) 20. ear-bregma height (po–b).

TABLE 2
SPLANCHOCRANIUM – MEASURES (mm), COLLECTIVE GRAVE 3/1985, VUČEDOL, CROATIA

Martin No.	45	47	48	50	51	52	54	55	65	66	69	70
Individual												
3/1 F	121	–	69	21	L37R36	L33R34	21	50	–	–	32	–
3/2 F	123	113	66	23	L38R38	L28R29	21	48	106	91	35	49
3/3 F	118	108	63	16	L38R37	L35L35	20	46	108	83	27	50
3/4 M	136	–	63	21	L38R38	L37R37	24	51	117	102	27	42
3/5 F	118	111	66	22	L39R39	L33R34	21	66	103	82	28	42
3/6 F	–	113	66	20	L36R36	L32R31	21	51	117	97	35	49
3/7	–	95	57	–	R36	R34	21	41	93	81	25	37
3/8 F	–	103	60	20	L36R36	L31R30	21	47	110	95	30	46

Legend: 45. bizygomatic breadth (zy–zy), 47. face height (n–gn), 48. upper facial height (n–pr), 50. interorbital breadth (mf–mf), 51. orbital breadth (mf–ec), 52. orbital height, 54. width of *apertura piriformis*, 55. nasal height (n–ns), 65. bicondylar breadth (cdl–cdl), 66. bigonial width (go–go), 69. chin height (gn–id), 70. condylar height.

TABLE 3
CRANIAL INDICES, COLLECTIVE GRAVE 3/1985, VUČEDOL, CROATIA

Martin No.	8/1	17/1	17/8	20/1	20/8	9/10	9/8	16/7	47/45	48/45	66/45	52/51	54/55	66/65	9/45	CRV
Individual																
3/1 F	76.4	77.6	101.5	65.0	85.0	82.5	74.4	78.5	–	56.6	–	L89.1R94.4	41.6	–	81.8	1277
3/2 F	72.8	–	–	63.0	86.7	88.0	77.0	–	91.6	53.9	74.0	L73.9R75.7	43.7	85.8	80.5	1234
3/3 F	79.3	77.4	98.5	63.4	80.0	85.0	66.0	85.0	91.5	53.7	70.7	L93.9R94.4	43.0	77.0	72.88	1127
3/4 M	78.0	72.0	92.3	59.6	76.2	75.6	65.0	83.3	–	46.0	75.0	L96.8R96.9	46.0	86.9	68.4	1400
3/5 F	79.0	70.3	88.8	62.0	78.5	82.3	68.0	86.5	94.2	55.6	69.5	L85 R87.2	32.6	79.7	83.0	1407
3/6 F	76.6	74.5	97.0	63.6	82.9	75.8	68.8	84.8	–	–	–	L88.8R86.1	40.4	82.9	–	1435
3/7 Ind.	–	–	–	62	–	–	–	–	–	–	–	R89.3	50.4	86.9	–	–
3/8 F	73.6	74.7	101.5	64.4	87.5	84.3	75.8	–	–	–	–	L86.1R83.3	44.9	86.4	–	1232

Legend: 8/1 – length-breadth index, 17/1 – length-height index,17/8 – breadth-height index, 20/1 – auricular height-length index 20/8 – auricular height-width index, 9/10 – transversal frontal index, 9/8 – fronto parietal index, 16/7 – *foramen magnum* index, 47/45 – total facial index, 48/45 – upper face index, 66/45 – jugo-mandibular index, 52/51 – orbital index, 54/55 – nasal index, 66/65 – breadth index of lower jaw, 9/45 – jugo-frontal index, CRV – cranium capacity.

dium height (3/2, 3/4, 3/5, 3/7, 3/8). The measures of *splanchocranium* are given in the Table 2. The face width is predominantly of medium value (3/1, 3/2, 3/3, 3/5) and just in one case very wide (4). The face height is short for the individuals 3/5, 3/6, 3/7, 3/8, while medium height values of the face was detected for individuals 3/2 and 3/3.

The cranial indices are shown in the Table 3. For the majority of specimens the cranial length-breadth index is detected as *mesocrania* (3/1, 3/3, 3/4, 3/5, 3/6) or rarely as narrow *dolichocrania* type (3/2, 3/8). The length-height indices determine the skulls of the individuals as *hypsicrania* (3/1, 3/3, 3/4, 3/5, 3/6) or *orthocrania* type (3/2, 3/8). The breadth-height indices show different types, from skulls of high vault, *acrocrania* (3/1, 3/2, 3/8), to medium *metriorania* (3/3, 3/6), and finally *tapeinocrania* type (3/5). The transversal frontal indices for all samples are in normal range. The values of the fronto-parietal index show much more incoherency, from *eurymetopia* type of low (3/1, 3/2, 3/8), medium *metriometopia* (3/3, 3/5, 3/6), to *stenometopia* type of high front (3/4). The foramen magnum indices are in range from narrow (3/1, 3/5) to medium width (3/3, 3/4, 3/6). The face indices are calculated for only three samples (3/2, 3/3, 3/5) and they all show *leptoproscopic* type. The upper facial index is defined for five samples as *euryene,* characterized by low front (3/4, 3/5), medium *mesene* (3/2, 3/3), and *leptene* (3/1). Among the orbital indices are predominantly high *hypsikonch* (3/1, 3/3, 3/4, 3/5, 3/6, 3/7, 3/8) and in just one case low *chamaeconch* (3/2). The nasal indices for this group describe narrow type of nose or *leptorrhinia* and only in one sample medium width type or *mesorrhinia* (3/2). The majority of the skulls are of medium cranial capacity, *euencephalia* (3/1, 3/2, 3/4, 3/8), only two have bigger capacity and are classified as *aristencephalia* (3/5, 3/6). The smallest cranial capacity, *oligeucephalia*, belongs to the skull of the individual 3/3.

The biological distance among the skulls has also been assessed, using the multivariate distance analysis. Only three basic *neurocranium* measurements were used: length (1), breadth (8) and height (20). The assessment included six skulls that belonged to female individuals from the collective grave (3/1, 3/2, 3/3, 3/5, 3/6, 3/8). The general distance coefficients (C^2r) are shown in the Table 4. The skull 3/2 has its best match in the skull 3/8, since the distance coefficient is only 0.06. The skulls 3/1 – 3/8 have also very low distance coefficient (0.25). Relatively low distance coefficients can also be noticed between skulls 3/5 – 3/6 (0.36) and 3/1 – 3/2 (0.37), while the distances between skulls 3/2–3/5 (2.44) and 3/5–3/8 (2.64) are significant. Of the six skulls included in the distance analysis, that of the individual 3/3 shows the biggest deviation. Other calculated distances between the skulls are in values from 1.13 to 1.87.

TABLE 4
PENROSE ANALYSIS OF BIOLOGICAL DISTANCE: COEFFICIENTS OF GENERAL DISTANCE (C^2r), COLLECTIVE GRAVE 3/1985, VUČEDOL, CROATIA

	3/2	3/3	3/5	3/6	3/8
3/1	0.37	1.27	1.52	1.13	0.25
3/2		1.87	2.44	1.68	0.06
3/3			3.62	4.13	1.57
3/5				0.36	2.64
3/6					1.87

The shape distance coefficients (C^2p) are shown in the Table 5. We can see that 3/2 corresponds best in shape to 3/8 (0.07). The low distance coefficients can also be noted between the skulls 3/1–3/2 (0.44), 3/5–3/6 (0.39) and 3/1–3/8 (0.35). Other skull distances do not show similarities, and distance values vary mostly from 2.24 to 3.92. The biggest deviation shows again the skull 3/3, with distance 8.01 in comparison with the skull 3/5 and 9.20 in comparison with the 3/6.

TABLE 5
PENROSE ANALYSIS OF BIOLOGICAL DISTANCE: COEFFICIENTS OF SHAPE DISTANCE (C^2p), COLLECTIVE GRAVE 3/1985, VUČEDOL, CROATIA

	3/2	3/3	3/5	3/6	3/8
3/1	0.44	2.53	2.57	2.40	0.35
3/2		2.63	3.95	3.59	0.07
3/3			8.01	9.20	2.24
3/5				0.39	4.28
3/6					3.92

The data presented in the Table 6 encompass 26 epigenetic traits detected on the skulls. The computed tomography of the frontal sinuses presents a fan shape on the skulls of individuals 3/2 and 3/4, while a pyramid shape is detected for the individuals 3/5 and 3/3 (Figure 3). The data are rather inhomogeneous. Despite that, as shown in the Table 7, the individuals 3/2, 3/3 and 3/5 present the same type of frontal sinus pneumatization (type II) as the individuals 3/1 and 3/8 (type 0, i.e agenesia) (Figure 3.). The individuals 3/2 and 3/3 show presence of *bulla frontalis*, whereas concha bullosa (on the left side) is present in the individuals 3/1, 3/5 and 3/6 (Figure 4). The depht of olfactory fossa is similar in all studied subjects. The ethmoid morphology is similar in all skull specimens but 3/5. The maxillary sinuses are small in all individuals but 3/2. A rare variant of maxillary sinus morphology, *ostium mascellaris*, is present only in the individual 3/8.

The suturas most frequently found at the samples are *sutura supranasalis* with a zigzag shape, *sutura frontotemporalis* with an H-shape (3/1, 3/2, 3/3, 3/4, 3/5, 3/6, 3/8), *sutura petrosquamosa* with shapes type c (left 3/3, left 3/8), d (left and right 3/2, 3/4, right 3/6), g (right 3/6) and h (left 3/1), and present *sutura praemaxillaris* (3/4, 3/6, 3/8). The most frequent *ossiculi* are distributed at

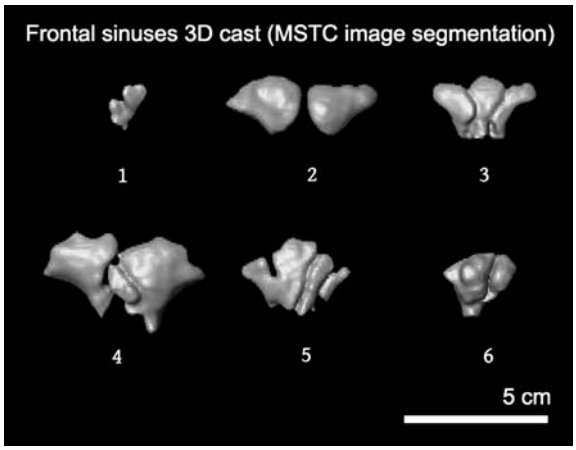

Fig. 3. The shape of frontal sinuses. CT 3D reconstruction with segmentation of the frontal sinus aerial space.

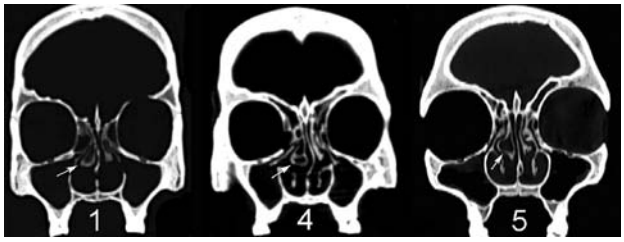

Fig. 4. Concha bullosa (arrow). The subject 3/4 shows a sepimented bulla.

sutura lambdoidea (3/1, 3/2, 3/5-left, 3/6-left, 3/7, 3/8). It is rarely possible to determine *ossiculum lambdoidea* (3/7, 3/8) and *ossiculum epiptericum* (3/2-left). A slightly expressed *tuberculum pharyngeum* is detected at the skull bases of several individuals (3/3, 3/4, 3/5, 3/6 and 3/8), while *tuber praecondylaris* is present in the case of the individual 3/4 on both left and right side. *Canalis condylaris posterior* is present in the individuals 3/1

TABLE 6
NON METRIC TRAITS, COLLECTIVE GRAVE 3/1985, VUČEDOL, CROATIA

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
3/1	+	H	Lh		+					L+		+							+		L+	+	+	+	M^3+	
3/2	+	H	LdRd		+		L+					+							L+	L+	+	+	+	+	+	
3/3	+	H	Lc					+		+	R+								R+		R+	+	+	+	+	
3/4	+	H	LdRd	+				+	+		R+	R+	L+						+		+	+	+	+		+
3/5	+	H			L+			+		R+				+	R+	+	R+	R+				+	+	+	+	
3/6	+	H	Rg	+	L+			+		+		L+		+								+	+	+	+	
3/7					+	+								+									+			
3/8	+	H	Lc	+	+	+		+			R+	+							+		+	+	R+		M_3+	

Legend: 1. *sutura supranasalis,* 2. *sutura frontotemporalis,* 3. *sutura petrosquamosa,* 4. *sutura praemaxillaris,* 5. *ossiculi et sutura lambdoidea*, 6. *ossiculum lambdoidea*, 7. *ossiculum epiptericum,* 8. *tuberculum pharyngeum,* 9. *tuberculum praecondylaris,* 10. *canalis condylaris posterior,* 11. *canallis hypoglossi duplex,* 12. *foramen emissarium parietale,* 13. *foramen mastoideus exsuturalis,* 14. *foramen mastoideus absent,* 15. *foramen ovale duplex,* 16. *foramen spinosum apertum,* 17. *foramen zygomatico-facialis,* 18. *foramen supraorbitale,* 19. *sulcus supraorbitalis,* 20. *foramen et sulcus supraorbitalis,* 21. *foramen zygomatico-facialis duplex,* 22. *foramen palatinum maius,* 23. *foramen palatinum minus,* 24. *linea nuchalis suprema,* 25. *dentes molares* 26. *processus retromastoideus.*

TABLE 7
NASAL/PARANASAL CAVITIES MORPHOLOGY. COMPARISON BETWEEN THE SUBJECTS, COLLECTIVE GRAVE 3/1985, VUČEDOL, CROATIA

	Type	S1		S2		S3		S4		S5		S6		S8	
		dx	sn	dx	sn	dx	sn	dx	sn	dx	sn	dx	sn	dx	sn
Frontal sinus pneum.	0	x	x						x					x	x
	I			x	x	x	x	x		x	x				
	II											x	x		
Frontal cell	I			x	x	nv	nv	x				x	x		
	IV									x					
Frontal bulla				x	x										
Agger nasi cell		x	x	x	x	nv	nv	x	x	x	x	x	x		
Concha bullosa		x								x		x			
Laminar pneumatization of middle turbinate			x	x	x	nv	nv								
Haller cell		x	x	x	x	nv	nv			x	x				
Depht olfattory fossa	II	x	x	nv	x	x	x					x			
Ethmoid morphology	I	x	x	nv	x		x					x			
	II					x									
Ethmoid bulla	hypoplasia								x						
	agenesia													x	
Septal deviation					x		x	x							
Palatal tilt							x								
Septal spur						x									
Ostiomeatal complex	I					nv	nv	x	x	x	x				
	II	x	x												
	III													x	x
	IV			x	x							x	x		
Sphenoid sinus pneum.	II	x	x	x	x	nv	nv	x	x	x	x	x	x	nv	nv
Onodi cell								x	x						
Maxillary sinus pn.	0	x	x			x	x	x	x		x	x	x	x	x
	1			x	x					x					
Maxillary ostium														x	x

(right), 3/3, 3/5 (right), 3/6, and *canallis hypoglossi duplex* in the individuals 3/8 (right), 3/3 (right), 3/4 (right) and 3/8 (right). Openings are widely presented. *Foramen emissarium parietale* is present on the skulls 3/8, 3/6 (left), 3/4 (right), 3/2, 3/1. *Foramen mastoideus exsuturalis* is a rare trait which is detected on the skull 3/4 on the left side. Three skulls show absence of *foramen mastoid* (3/7, 3/5 and 3/6). *Foramen ovale duplex* is a rare non-metric trait and it is present only on the skull 3/5 on the right side, together with *foramen spinosum apertum*. The skull 3/5 has also absent *foramen zygomaticofacialis* on the right position, where it has *foramen supraorbitale* as well. *Sulcus supraorbitalis* are more frequent, and are detected on six skulls: 3/1, 3/2 (left), 3/3 (right), 3/4 and 3/8. On only one skull (3/2) *foramen et sulcus supraorbitalis* is detected on the left side. *Foramen zygomaticofacialis duplex* is present on the skulls 3/1 (left), 3/2, 3/3 (right), 3/4, 3/8 (right). Finally, *foramen palatinum magius* is one of the most common non-metric traits and it is detected on the skulls 3/1, 3/2, 3/3, 3/4, 3/5, 3/6, 3/8. *Foramen palatinum minus* is presented on all skull samples: 3/1, 3/2, 3/3, 3/4, 3/5, 3/6, 3/7 right and 3/8. *Linea nuchalis suprema* is very frequent and is present in the skulls of the individuals 3/1, 3/2, 3/3, 3/5, 3/4, 3/6. Dental non-metric traits were analysed just in case of the third molars, which are present in mandibular and maxillar positions of the skulls 3/2, 3/3, 3/5, 3/7 and 3/8. *Processus retromastoideus* is a very rare trait in this group and it is developed only in the case of the individual 3/4.

Cranial vault lesions are present on six of the eight skulls (3/1, 3/2, 3/3, 3/4, 3/5, 3/8). All subjects, with the exception of 3/6 and 3/7, present a scar on the frontal bone; the subjects 3/1, 3/3 and 3/5 have also a similar scar on the vertex (Figure 2). The scars are radiologically rather monotone, characterized by an erosion of outer Table of the *diploë* with weak signs of secondary bone

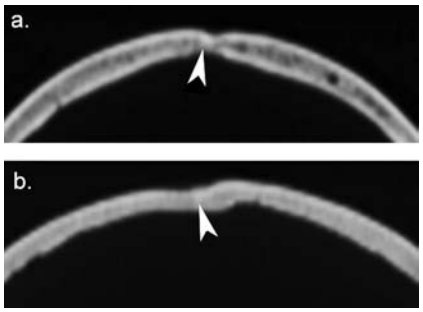

Fig. 5. Comparison between the subjects 3/3 and 3/5: frontal scars (coronal section). Weak reactive bone sclerosis on the margin of the lesion (white arrows).

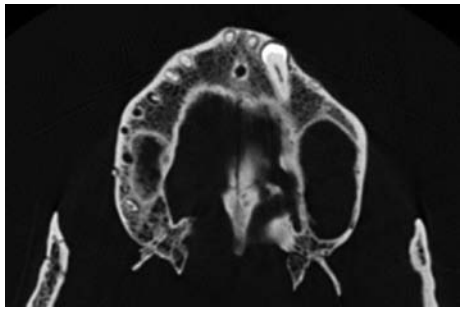

Fig. 6. Subject 3/6 (axial section): impacted left tooth (22).

sclerosis (Figure 5). Radiology analysis has also detected other cranial and dental characteristics of the samples. The subject 3/6 has in the position 22 an impacted left tooth (Figure 6) and congenital absence of the third molars. Dental eruption pattern of the individual 3/7 shows the age at death of 9 and 1/2 years. Neither of the teeth examined (197) has caries. Intravitam lost of teeth are detected in six positions (2.5%) (Table 8) while in the subjects 3/4 and 3/5 there are residual distal parts of the roots in the positions 13 and 44, respectively.

More interesting is the situation of alveolar bones. The subject 3/2 presents a radiolucent round lesion (9 mm in diameter) with sharp margins, which contains the root of the tooth 22, without any signs of dental decay or apex alterations (Figure 7). The subject 3/4 presents a similar radiolucent lesion of 5 mm in diameter, at the apex of alveolar residue in the position 21 (Figure 8). The subject 3/3 presents bone focal sclerosis that corresponds to the roots in the positions 31, 32, 41 and 42 (Figure 9).

TABLE 8
DENTAL STATUS, COLLECTIVE GRAVE 3/1985, VUČEDOL, CROATIA

	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8
PSML	7	7	3	4		9	1	4
PRML				1	2	3		
ABP		y	y	y		y		

PSML: Post-mortem teeth loss; PRML: Pre-mortem teeth loss; ABP: Alveolar bone pathology

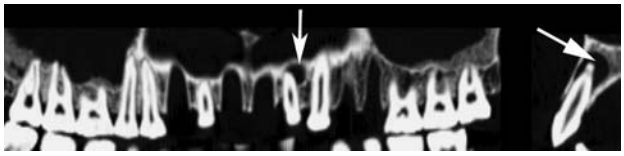

Fig. 7. Subject 3/2 (Dentascan). Sharp margin radiolucent round lesion of the maxillary bone that contains the root 22 without signs of dental decay or alterations of the apex. On the right the middle sagittal section of the tooth.

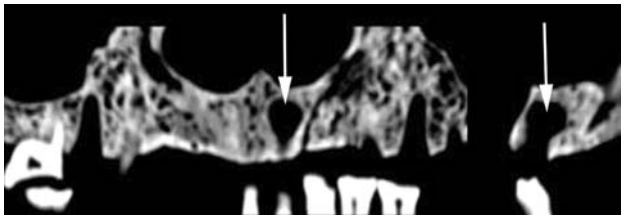

Fig. 8. Subject 3/4 (Dentascan). Sharp margin radiolucent lesion of 5mm in diameter at the apex of alveolar residue of 21. On the right the middle sagittal section of the lesion.

Fig. 9. Subject 3/3 (Dentascan): Focal bone sclerosis in correspondence to the roots 31, 32, 41 and 42. The lesion in correspondence to the 32 root shows a radiolucent center (arrow).

The lesion that corresponds to the 32 root position shows a radiolucent center. The teeth have no signs of dental decay or alterations of the root apex. All these lesions may be connected to distinct phases of the periapical cement-osseous dysplasia (PCOD).

Discussion and Conclusion

The craniometrical data of the analysed skulls (»Results«) were compared with two cranial data from Ig[17] and with five cranial data from earlier analysis of the Vučedol material[6,7]. The length-breadth indices show a range of values in two types, medium width *mesocrania* and narrow *dolichocrania* type of neurocranium, with the exception of the Vučedol skull sample from the grave 2, pit 10 (female), which represents a very narrow type, *hyperdolichocrania* (Figure 10). The length-height indices (17/1) show, in majority, belonging to medium *orthocrania* type, while in two skull samples the calculated values detect *hypsicrania* type and in one *chamaecrania* type (Ig, grave 1a) (Figure 11).

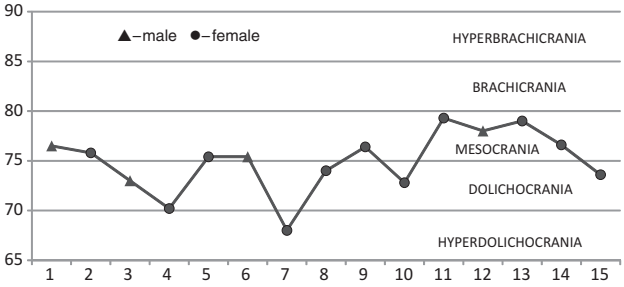

Fig. 10. The distribution of length-breadth indices (8/1). Legend: 1. Ig gr. 1a, 2. Ig gr. 2, 3. Vučedol gr. 3, 4. Vučedol gr. 4, 5. Vučedol gr. 6, 6. Vučedol gr. 7, 7. Vučedol gr. 2 pit 10, 8. Vinkovci »Hotel« gr. 2, 9. Vučedol coll gr. 3/1, 10. Vučedol coll gr. 3/2, 11. Vučedol coll gr. 3/3, 12. Vučedol coll gr. 3/4, 13. Vučedol coll gr. 3/5, 14. Vučedol coll gr. 3/6, 15. Vučedol coll gr. 3/8.

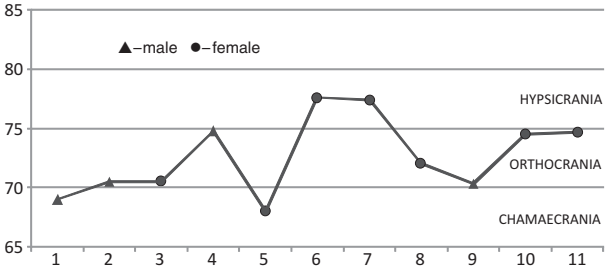

Fig. 11. The distribution of length-height indices (17/1). Legend: 1. Ig gr. 1a, 2. Vučedol gr. 3, 3. Vučedol gr. 6, 4. Vučedol gr. 7, 5. Vučedol gr. 2 pit 10, 6. Vinkovci »Hotel« gr. 2, 7. Vučedol coll. gr. 3/1, 8.Vučedol coll. gr. 3/3, 9. Vučedol coll. gr. 3/4, 10. Vučedol coll. gr. 3/5, 11. Vučedol coll. gr. 3/6, 12. Vučedol coll. gr. 3/8.

Since the metric and non-metric aspects of skeletal and dental forms, together with structure (i.e., morphology) have a genetic basis, these categories of variation provide valuable information about past genetic relationships[18]. Groups that share more metric and non-metric traits are considered to be more closely related than groups which do not share these features[19]. The biggest problem here is the lack of sufficient number of comparative skeletons from the Vučedol culture to establish basic parameters for the population. Therefore, the results of non-metric traits analysis could be discussed as an effort to identify possible homogeneity among cranial remains of the individuals from the collective grave 3/1985, but also as an analysis of the cranial characteristics of Vučedol culture individuals from its eponimic site.

The non-metric traits described in »Results« are also partly presented in the Table 6. Statistically significant sexual dimorphism is detected only for *foramen parietale* and *foramen mastoideus exsuturalis*[20], but the analysis performed include only one male person (3/4). The most frequent traits in the skull specimens from the grave 3/1985 are *sutura supranasalis*, *sutura frontotemporalis*, *foramen palatinum majus, foramen palatinum minus, linea nuchais suprema*, and the existence of third molars, together with other relatively common variants, like *sutura praemaxillare, tuberculum pharyngeum, foramen emmisarium parietale* and *sulcus supraorbitalis*. This traits has a hereditary component, they do not change with age, and they also belong to the group of frequent traits[14]. Some of them could predict a development of a certain anatomical element, like *sutura supranasals*, the prominence of which brings to a stronger expression of arcus supraciliaris or to the pronounced *processus retromastoideus* that serves as the origin of trapezius muscle, but all of them show a certain aspect of embriological development[20].

Although an epigenetic correlation has been hypothesized about paranasal and nasal cavities morphology[21,22], more recent studies in twins[23] and in kin groups[24] clearly demonstrate that environmental factors are more important than genetic ones for the development of anatomical variants of paranasal sinuses. It has also been reported that old age may account for the bony resorption, thereby leading to alteration in the size of the frontal sinus[25]. In our sample, however, we can highlight how three of the six studied individuals (3/1, 3/5, 3/6) showed evidence of right middleturbinate concha bullosa, two of them (3/1, 3/5) even with the same morphology. Of the many other parameters considered, according to the literature, none has proved useful to assume or exclude certain kinship. Better utility presents, instead, pathological evidence (which also confirms particular usefulness of CT in palaeopathological studies) where evidence of PCOD in the specimens 3/2, 3/3 and 3/4 would seem to provide the most useful indications about kinship. Cement-osseous dysplasia (and PCOD, which represents one of its three variants)[26,27] progresses through three stages of maturation, each with its unique radiographic characteristics. In the early stage, a normal bone is resorbed and replaced with fibrous tissue and is represented radiographically by a well-defined radiolucent lesion, which may be round, oval, or irregularly shaped, sometimes surrounded by a band of sclerotic bone with varying width. In PCOD a lesion is centered over the apex of a tooth. The second stage of maturation denotes the appearance of radiopaque tissue within the radiolucent structure. In the mature stage, the internal aspects of the lesions may be totally radiopaque without any obvious pattern, and there is usually a thin radiolucent margin at the periphery. All three stages are present in our specimens. Very interesting for our scope is the evidence that cement-osseous dysplasia is an autosomal dominant familiar disease[28,29].

The multivariate distance analysis has given biological distance values for the skull specimens. The obtained results show a strong match for the skulls of two individuals (3/2 and 3/8), with very low coefficients, the distances between them being only 0.06 (C^2r) and 0.07 (C^2p). The skull sample 3/3 shows the highest deviation, while others from the group do not show significant deviation, but neither a strong homogeneity.

Artificial lesions detected on the six skulls of collective grave 3/1985 were radiologically examined but will be a subject of further detailed research (Figure 2, Figure 3).

In view of extremely small number of specimens, the skeletons which belong to the Vučedol culture, and a cer-

tain inhomogeneity of the data they provide, the potential of nondestructive anthropological analysis is limited. However, it is possible to reach a conclusion from the presented analysis that five skull samples stand out from the analysed group. Craniometrical analysis together with multivariate distance analysis point out that the skull samples 3/2 and 3/8 show a high level of similarity, while radiological analysis of certain non-metric traits and the presence of familiar displastic bone disease determine the skull samples 3/1, 3/4 and 3/5 as very similar. Due to the lack of sufficient number of skeletons from the Vučedol culture, and the basic characteristics of its population, it is not possible to interpret these results as a close kinship. According to all analysed parameters, the skull of the subject 3/3, due to all analyzed parameters stands out in its entirety with a great deviation. It is possible to conclude that the nondestructive anthropological and radiological methods have given valuble results for the collective grave 3/1985 by detecting a wide homogeneity of the presented samples.

Acknowledgements

The research was supported by the project »The Vučedol culture on the Croatian ground«, the main researcher Professor Dr. Aleksandar Durman). Special thanks to Dr. Jacqueline Balen and the Archaeological Museum in Zagreb, as well as to Dr. Ruža Marić and the City Museum of Vukovar, for ceded material for the analysis and technical support.

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Z. Hincak

University of Zagreb, Faculty of Humanities and Social Sciences, Department of Archaeology, Ivana Lučića 3, 10 000 Zagreb, Croatia
e-mail: zhincak@ffzg.hr

ANALIZA LUBANJA ŠEST OSOBA IZ ZAJEDNIČKOG GROBA RANOG BRONČANOG DOBA S LOKALITETA VUČEDOL (ISTOČNA SLAVONIJA, HRVATSKA)

SAŽETAK

Zajednički grob osam osoba vučedolske kulture s oznakom »Grob 3/1985« predstavlja najvažniji ukop ove kulture na eponimskom nalazištu istočne Slavonije. Okolnosti nalaza upućuju na ljudsku žrtvu. Antropološke i radiološke analize izvedene su na lubanjama osoba čiji ostaci potječu iz kolektivnog groba, točnije, na lubanji muške i na sedam lubanja ženskih osoba. Nedestruktivne metode obuhvatile su multivarijantnu analizu distance, morfometrijsku analizu lubanja, kao i analizu nemetričkih ili nedimenzioniranih znakova na lubanji uz pomoć radioloških metoda kako bi se precizno istražile njihove anatomske značajke. Sve upotrijebljene metode pokušale su istaknuti razlike između individua iz zajedničkog groba, ali i prikazati sličnosti i moguću homogenost analiziranih individua.