ANTHROPOLOGIE • LI/3 • pp. 397–408 • 2013

LENKA VARGOVÁ, LADISLAVA HORÁČKOVÁ, KATEŘINA VYMAZALOVÁ, JOSEF SVOBODA

PALAEOPATHOLOGICAL ANALYSIS OF SKELETONS FROM THE 16th AND 17th CENTURIES (VESELÍ NAD MORAVOU, CZECH REPUBLIC)

ABSTRACT: This study includes both an anthropological analysis and a detailed description of palaeopathological cases found during rescue archaeological excavations in Veselí nad Moravou (Czech Republic). Seventy graves dating from the 16th and the first half of 17th century with the skeletal remains of 185 individuals were discovered. Out of the 98 adult skeletons, 50 skeletons were male, 40 were female and the sex could not be determined in eight cases. Articular affections occurred most frequently in the examined set, followed by traumas including trepanation, metabolic and blood diseases. Cases of bone tuberculosis and tertiary stage syphilis occurred as specific inflammations. Of all possible types of tumours only benign tumours were found. The cases described supplement the series of palaeopathological findings from the Early Modern Period in the Czech territory and provide comparative material for further osteological studies.

KEY WORDS: Palaeopathology – Bone remains – Trepanation – Trauma – Articular diseases

INTRODUCTION

Seventy graves with skeletal remains dating from the 16th and the first half of 17th century were discovered during rescue archaeological excavations uncovered as part of construction work in Sadová Street in Veselí nad Moravou in 1999.

Veselí nad Moravou is a small town on the left bank of the Moravia River by a road called "The free royal path". The name "Civitas", as an alternate for Veselí has been documented since 1396. A castle was built here that was one of the frontier fortresses along the Moravia River and protected against the raids from East. Craftsmen such as potters, coopers, wheelers, smiths, drapers, furriers, and others (Hosák, Zemek 1981) were already fully developed at the time before the Battle of White Mountain (Bílá Hora, 1620 AD). Traditional fishpond cultivation developed in the surrounding area

Received 15 July 2013; accepted 15 October 2013.

of Veselí in the middle of 16th century. During this period, the original castle was converted into a chateau and kept its strategic importance until the 18th century.

A detailed anthropological assessment of the skeletal set was carried out in the Medical Anthropology Unit, Department of Anatomy, Faculty of Medicine, Masaryk University in Brno, Czech Republic. The results of this examination are provided in the final report that has been filed in the archive of the Archaeological department of T. G. Masaryk Museum in Hodonín (Horáčková, Vargová 2000). This study completes the anthropological analysis with a detailed description of palaeopathological cases excluding inflammatory changes, which have already been published (Vargová *et al.* 2013). Palaeopathological findings provide new insight into the incidence of some diseases in the population of this part of Moravia in the Early Modern Period.

MATERIAL

Seventy graves dating from the 16th and the first half of 17th century with the skeletal remains of 185 individuals were discovered. The skeletal remains were not well preserved. The most incomplete and damaged skeletons were found in violated graves, particularly a mass-burial grave pit where as many as 11 individuals were buried. The reconstruction of individual skeletons is very problematic in such cases, as is the case in almost every skeletal set. Nor were the children's skeletal remains well-preserved, since the fragile skeletons of children are subject to natural decomposition processes more easily.

METHODS

The palaeopathological diagnostics were based on standard anthropological analysis of skeletal remains with the help of classical morphoscopic and anthropometric methods that are listed in publications of Martin, Saller (1957), Knussmann (1988) or Stloukal *et al*. (1999).

Sex determination was established (if possible) by scoring morphological sex features mainly of the skulls (Borovanský 1936, Čihák 1987, Loth, Hennenberg 1996), and postcranial skeleton – hip bones by Howells (1964), Phenice (1969), Bruzek (1991), sternum by Dokládal (1978) and long bones of extremities by Černý (1971).

Dental eruption (Komínek, Rozkovcová 1984, Ubelaker 1987), the ossification status of the axial skeleton, the length of the diaphyses of long bones and the closure status of epiphyseal fissures of long bones (Flecker 1932–33, Florkowski, Kozlowski 1994, Stloukal, Hanáková 1978) were used to estimate the age at death of immature individuals.

Skulls with ossified sphenooccipital sutures were calculated into adult individuals. The age of adults was determined on the basis of the obliteration of cranial sutures using the criteria of Vallois (1937) with Rösing's modification (1977), Linc (1971) and Lovejoy's abrasion of teeth (1985). In the postcranial skeletons of adults, the extent of changes due to ageing were analysed in the symphysial surface of pubic bone (Nemeskéri *et al.* 1960) and in the sternal end of the clavicle (Szilvássy 1980). The degree of joint degeneration – arthroses and spondyloses (Stloukal, Vyhnánek 1976) was also studied.

Individual skeletons were separated into age categories: newborns, *infans* I (1 month–6 years), *infans* II (7–14 years), *juvenis* (15–19 years), *adultus* I (20–29 years), *adultus* II (30–39 years), *maturus* I (40–49 years), *maturus* II (50–59 years) and *senilis* over 60 years.

The tables by Bach (1965) for females and Breitinger (1937) for males were used to calculate the stature of the buried individuals.

The palaeopathological findings were assessed according to Steinbock's criteria (1976), Ortner, Putschar (1985), Vyhnánek *et al*. (1998), Aufderheide, Rodríguez-Martín (1998), Ortner (2003), and Horáčková *et al.* (2004) mainly.

The basic examination methods of palaeopathological diagnostics consisted mainly of detailed macroscopic studies of pathological changes. Careful photographic documentation of all easily-visible defects was made. In the scope of the differential diagnostics, some pathological lesions were compared with similar defects in recent skeletal material from the Pathologishes-anatomisches Bundesmuseum in Vienna where the diagnosis of pathological conditions was verified using clinical methods. Standard X-ray examinations were carried out or CT images were made in the indicated cases, when it was necessary to find out the condition of both the compact bone and the spongious bone tissue or the location of macroscopically imperceptible lesions for a more precise diagnosis.

Two basic values were applied to the assessment of dental caries: caries frequency (F-CE) and caries incidence (I-CE). F-CE gives the percentage of all examined skulls having at least one tooth with caries in the jaw or an intravitally lost tooth. I-CE informs about the percentage of teeth with caries or teeth lost intravitally out of the total number of teeth (it is the sum of the percentage of teeth with caries out of the total number of

teeth and of the percentage of healed alveoli out of all preserved tooth sockets). The comparative dental and alveolar indices (CDI, CAI) were taken into consideration at the comparison of results of individual sets. They express the degree of preservation and completeness of assessed jaws to a certain extent. CDI gives the ratio of the total number of preserved teeth and empty alveoli with their ideal number. CAI gives the ratio of the total number of preserved alveoli (with teeth, as well as after intravital and postmortal losses) to their ideal number.

RESULTS AND DISCUSSION

The skeletal set from Veselí nad Moravou consisted of the remains of 185 individuals, out of which 98 skeletons belonged to adults, 5 to adolescents and 82 to children. Out of 98 skeletons of adult individuals, 50 skeletons were male, 40 were female, and the sex could not be determined in 8 cases.

Women most frequently lived until the age of 20–30 years (42.5%), 9 women (22.5%) lived till the age *adultus* II (30–40 years) and 6 women (15.0%) died in the age *maturus* (40–60 years). The biological age could not be determined in 8 cases (20.0%) due to poor preservation of the skeletons. The average body height of 159.5 cm ($n = 23$) falls below the lower limit of the category of tall women according to Martin, Saller (1957).

Men can be divided according to the age of survival almost evenly into three age categories: *adultus* I (28.0%), *adultus* II (22.0%), and *maturus* I (24.0%). Other two categories included fewer individuals:

TABLE 1. Number of studied individuals by age.

Age category	Sex	Age	*N*	%
Adults	Males	*Adultus* I	14	28.0
		Adultus II	11	22.0
		Maturus I	12	24.0
		Maturus II	4	8.0
		Senilis	3	6.0
		Age (?)	6	12.0
		Total males	50	100.0
	Females	*Adultus* I	17	42.5
		Adultus II	9	22.5
		Maturus I	2	5.0
		Maturus II	4	10.0
		Senilis	0	0.0
		Age (?)	8	20.0
		Total females	40	100.0
	Males or females		90	91.8
	Undetermined		8	8.2
	Total adults		98	100.0
Adolescents		*Juvenis*	5	100.0
		Total adolescents	5	100.0
Children		Newborns	11	13.4
		Infans I	53	64.6
		Infans II	18	22.0
		Total children	82	100.0
Total individuals			185	100.0

maturus II 8.0% and *senilis* 6.0%. The sex could not be determined in 6 cases (12.0%). The men's average body height of 169.3 cm (n = 30) falls to the upper limit of the category of above average body heights.

From 82 children's skeletons, 11 belonged to newborns (13.4%), 53 to children from 0 to 6 years of age (*infans* I; 64.6%), and 18 to children from 7 to 14 years (*infans* II; 22.0%). Five adolescents died at an age of between 15–19 years (*juvenis*) (Horáčková, Vargová 2000) (*Table 1*). Low number of assessable morphometric signs prevented the acquitting of exact statistical data.

A whole spectrum of pathological changes was diagnosed by the analysis of skeletal remains from Veselí nad Moravou. These were degenerative productive diseases (spondylosis, arthrosis), injuries, specific and non-specific inflammations (tuberculosis, syphilis, periostitis and osteomyelitis; Vargová *et al.* 2013, in press) above all. Bone symptoms of congenital and metabolic diseases, benign tumours were less common.

Joint diseases

Joint diseases were the most numerous pathological symptoms discovered by the examination of diseases in the skeletons from Veselí nad Moravou, similar to skeletal remains from various historical periods. They were noted in 13 skeletons, which is approximately 13.3% of 98 skeletons of adult individuals. Either the spine was affected by spondylosis or spondylarthrosis or in large extremity joints by arthrosis.

It was possible, however, to assess the spines only of 44 skeletons where four or more vertebrae were preserved. Symptoms of spondylosis and spondylarthrosis were noted in 9 individuals, that is in 20.5% (n = 44). The modified diagram of Stloukal and Vyhnánek (1976) was used for their classifications, based on which the findings were divided into two groups according to the nature of morphological changes. The degree of affectation was slighter in six cases of spondylosis manifesting subtle bone borders around the perimeter of terminal planes of vertebral bodies or touching surfaces of intervertebral joints. Vertebrae with bone outgrowths (osteophytes) of smaller dimensions and erosions or depressions at terminal surfaces of vertebrae – Schmorl's nodes – were also included in this group. Vertebrae with osteophytes of size greater than 3 mm (*Figure 1*) were considered as a great degree of spondylosis or vertebral blocks possibly that were created by mutual fusion of huge osteophytes of adjacent vertebrae. These blocks were noted in three skeletons with spondylosis. Lumbar and thoracic vertebrae were most frequently affected by degenerative productive changes. Men suffered from spondylosis in the bulk of cases (7 cases of all spondylosis, 77.8%, n = 9), which may be connected with typical male activities, such as hard physical labour, lifting heavy loads and the like. The different age of survival of men and women might play great role, too, as almost half of women died young, probably of pregnancy and childbearing complications, so that the degenerative productive changes did not have time to develop.

The diagnostics of spondylosis was not difficult in above-mentioned cases. However, in case of vertebral blocks, it was necessary to differentiate the rheumatoid spine affection (Bechterew's disease), congenital vertebrae accretions, and Pott's disease of the spine in addition to this. The presence of mutually fused beaky osteophytes protruding above the spine surface was the

FIGURE 1. Large rostral osteophytes are visible on the anterolateral side of the three caudal lumbar vertebrae. The largest of them is situated at the fourth lumbar vertebra (35 mm wide and 14 mm high). It is a typical finding of an advanced stage of spondylosis. Veselí nad Moravou grave No. 60, male, *adultus* II. Photo by S. Bártová.

main diagnostic criterion of spondylosis vertebral blocks. Osteophytes are not present at Bechterew's disease, where vertebrae are connected by ossified long spine ligaments and by rings of fibrocartilage of intervertebral discs (the so-called "bamboo stick" picture). Osteophytes and osteophytic margins are also absent in the case of congenital vertebral blocks where the vertebrae keep a normal shape and a smooth surface. The absence of classical osteophytes is typical also of Pott's disease, at which disintegration (a caseation) and collapse of vertebral body and its consequent accretion with an adjacent vertebra occurs due to tubercular inflammation of one or two vertebrae (Vargová, Horáčková 2005).

Extremity joints were also affected by degenerative productive changes concurrently with the spine in case of four individuals. Symptoms of arthrosis were found at large extremity joints in only four other adult individuals. Arthrosis was diagnosed in 8 male skeletons, which is 8.2% (n = 98) adults. This frequency of arthrosis incidence seems to be rather low compared to other palaeopathological studies. The comparability of results obtained with similar analyses is very problematic, however, since the method of assessment of arthritic changes is not standard and uniform. The interpretation of results may be influenced by many factors, but mainly by the extent of deterioration of the osteological set. The borderline between the normal and diseased condition tends to differ, too. When arthritic changes do not correspond to the respective age category, such condition can be labelled a real disease (Rejholec 1982). From this point of view, real joint diseases were found in three individuals from Veselí nad Moravou with the arthrosis developed demonstrably before the 40th year.

Trauma

Beside degenerative changes of joints, post-traumatic conditions belong to the most frequent palaeopathological findings in skeletons. Of the various types of trauma discovered, fractures in various stages of healing commonly occur. Only four healed fractures were found in the set of skeletons from Veselí nad Moravou. The first case was a fragment of the medial part of one left-side rib from 30–40 years old man from grave No. 60, where symptoms of a healed oblique fracture were found. The rib is rather shortened, because the fracture was slightly dislocated *ad longitudinem*. The union of both fragments was not complete, a space in the form of a canal in craniocaudal direction remained between them in the medial part. Rib fractures may arise owing to either a direct or an indirect force. The fracture is located almost in the medioclavicular line in this case; therefore its origin remains unsolved.

The absence of the distal part of the medial epicondyle of the left humerus of the same man can be also regarded as a trauma. It is necessary to consider not only the possibility of a fracture in the differential diagnostics, but also its separation (abruption) at the time, when the cartilaginous connection between the *trochlea humeri* and the apophysis of medial epicondyle still existed. The nature of the surrounding bone tissue shows evidence of a traumatic origin (of a fracture or abruption) in particular. The surface is rugged and coarsened in the dorsal part of medial surface of the *trochlea humeri*; there is a distinctive roughness proximally from it given by the origin of flexor tendons of the forearm and of the hand. The defect is on the left side, where the rib fracture was found as well. It is possible, consequently, that both injuries happened at the same time. Such polytrauma might come into existence as a result of a direct force.

Another fracture was found on a left fibula of an adult 30–35 year old man from the grave 34. The rupture line is oblique and is located in the distal third of the bone body. The fracture is well-healed, it is only slightly dislocated *ad axim*; an arch with a medially directed convexity developed in the union place. The left tibia remained undisturbed, that is why no dislocation *ad longitudinem* and no shortening of the total length of the affected fibula occurred. It is known from today's clinical practice that isolated fractures of fibulas are relatively rare and are caused always by an impact of direct force on the bone.

The diagnosis of the above-mentioned fractures was obvious during a simple macroscopic examination, while the fracture of right tibia of an adult individual from the grave 59 was only found by an X-ray examination. Almost the whole body of the affected bone is thickened and covered by newly formed bone tissue with rugged surface on the lateral plane in particular. Very subtle perforations typical of chronic inflammatory processes are mostly visible in the distal part. Other bones of the shin are not preserved and therefore it was not possible to assess either the bone shortening or the extent of the damage by a mere visual examination. Only the X-ray examination showed a long oblique rupture line on the body of the affected tibia. The peripheral fragment was slightly rotated in the lateral direction and dislocated *ad longitudinem* proximally (*Figure 2*).

Artificially made holes in a cranial vault of various sizes – trepanations – are also among traumatic changes in the palaeopathology. There are impressive openings

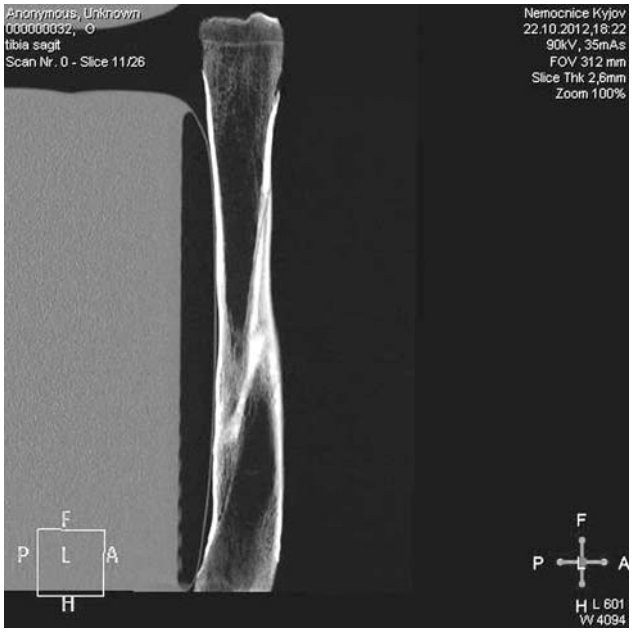

FIGURE 2. A CT scan of the right tibia of an adult individual in a sagittal projection. A long oblique rupture line and a deep shadow of a new formed bone tissue are well visible at the body bone. The peripheral fragment is rotated slightly in the lateral direction and dislocated *ad longitudinem* proximally. Veselí nad Moravou grave No. 59, adult individual. CT by J. Svoboda.

FIGURE 3. A healed opening of oval shape is situated at the right half of frontal bone squama. A subtle radial grooving is visible around the lesion perimeter, which is typical of a trepanation performed with a chisel. Round edges of the defect due to a reparation process bear evidence of a long time survival of the affected individual. It is highly probable that the trepanation was carried out as therapeutic intervention, i.e. at the wound toilet after an impressive fracture of cranial vault. Veselí nad Moravou grave No. 65, male, *maturus* I. Photo by S. Bártová.

in the cranial vault as part of therapeutic intervention, possibly wound management, as we assume in the case of a 40–50 year-old man from the grave 65 (*Figures 3, 4*). There is a very low probability that the trepanation performed was part of a religious or magic ritual given the dating of the skeletal remains (16th or 17th centuries). A healed oval-shaped opening with a transversally oriented long axis is visible on the right half of the frontal bone squama (33 mm from pterium point and 28 mm above the orbit centre). The opening edges are slanted so the external dimension of the defect is larger (36×24 mm) than the internal one (21×17 mm). A fine radial grooving (left by a trepanation tool most probably) is visible at the lesion perimeter, which is typical of a trepanation performed with a chisel. The trepanation was carried out intravitally and the affected individual survived the intervention, because the lesion edges are rounded by advanced reparation process.

Non-traumatic conditions (such as the therapy of obstinate headaches, mental disorders, epilepsy, inflammations of paranasal sinuses, middle ear, dentoalveolar processes and the like) must also be considered as possible causes for the interventions on the skull in the differential diagnostics. However, three subtle almost healed fissures extend from the defect edges in the mentioned case. Similar cracks occur at skull fractures usually after a hard impact to the head. Therefore, the described trepanation is likely to have been performed as part of wound management following an injury, at which bone fragments were removed and the edges of the perforation smoothed, so that they did not irritate surrounding tissues during the healing.

Fifty cases of trepanations from 38 locations have been documented in the Czech lands up to now according to Malyková (2002), from those nine date back to the Eneolith, 15 to the Late Bronze Age, two to the La Tène Period, 12 to the Middle Ages, two to the Early Modern Period, and the dating could not be unambiguously determined in ten cases. Most trepanations were described on male skulls. It can be assumed with regard to more risky activities of young men in particular that they were performed as post-traumatic treatments of fractures (Aufderheide, Rodríguez-Martín 1998, Malyková 2002).

FIGURE 4. A CT scan of cranium in *norma verticalis* with a trepanation opening in squamous part of frontal bone. Edges of the defect are slant towards the internal lamina and rounded due to a reparation process. Veselí nad Moravou grave No. 65, male, *maturus* I. CT by J. Svoboda.

The frequent occurrence of spondylosis may be also included in the group of traumatic conditions. This is a state caused by the detachment of the vertebral arch in isthmus, most frequently at L4–5. Either as a congenital state (usually accompanied by other spine affection) or post-traumatic spondylosis with the nature of pseudoarthrosis can be considered in the differential diagnostics.

Interarticular spondylosis was found in the typical location – at the fifth lumbar vertebra – in individuals from graves 10 and 70 (60–70 years old man and 50–60 years old woman). No other changes were found on the spines of the affected individuals, so a traumatic cause for these lesions is more likely. The determination of spondylosis aetiology was more difficult in the third case (20–25 years old woman), since the defect is located in a relatively stable area of spine that tends to be affected by injuries less frequently. The arch of the fourth thoracic vertebra on the left side was disrupted in this case. A narrow crevice is located under the *processus articularis superior sinister* whose edges are rounded by the healing process. However, the other preserved vertebrae do not show any pathological changes that would bear evidence of a congenital origin of the lesion.

An *osteochondritis dissecans* at a lateral condyle of right femur of an adult man from the grave 17 (*Figure 5*) may be classified among suspect cases of traumas from the examined osteological collection. A degenerative affection of the knee joint was considered in the differential diagnostics as well. However, no arthritic changes were noticed in other articular surfaces of this joint. Moreover, the defect of articular surface was relatively large (20×20 mm) and relatively well delimited, so that this case was classified as a trauma.

Metabolic diseases, anaemias

From typical blood diseases, anaemia symptoms were demonstrated in bones from Veselí nad Moravou, at which abnormalities in the number, the structure or the life-time of erythrocytes are compensated by excessive haematopoiesis that is manifested by hyperplasia of red bone marrow and thus also by a proliferation of the spongious bone tissue. Some palaeopathologists (for

FIGURE 5. A large well delimited defect of subchondral bone layer was noticed on the articular plane of lateral condyle of the right femur. Lesion edges as well as its bottom are rounded due to a reparation process – a finding typical of osteochondritis dissecans. No degenerative productive changes were found on either of the preserved bones, so that the damage of cartilage and bone was of traumatic origin obviously. Veselí nad Moravou grave No. 17, male *maturus* ?. Photo by S. Bártová.

example Moseley 1963) incline to the opinion today that porotic changes at the orbital roof, called *cribra orbitalia*, possibly also *usura orbitae* (Møller-Christensen, Sandison 1963) or *hyperostosis spongiosa orbitae* (Hengen 1971) are anaemia symptoms. Following bone destruction new bone tissue forms in the frontal part of the orbital roof in the form of small patches with porous or spongious structure. Namely, the hypertrophied diploe presses the thin cortical layer of the orbital roof towards the orbit and the excess spongious bone enters into it. The lesions at orbital roofs can be ranked to three basic types representing their different development degrees according to the morphological appearance: the porotic, cribrotic and trabecular type (Horáčková *et al.* 2004).

The *cribra orbitalia* was found in orbits of 12 individuals, that is in 19.0% of assessable skulls ($n = 63$) of the examined osteological set. It occurred in children in nine cases, the vast majority of them, with the exception of two, died as toddlers (age category *infans* I). The *cribra orbitalia* was noted in cases of three individuals at adult skeletons only – of one man and two women. It was located in both orbits at the same time and had the form of small perforations (porotic type) as a rule. Larger and more numerous small openings (cribrotic type) were found in one case only (child about 3 years, grave 61).

The frequency of *cribra orbitalia* varies in different osteological sets; it varies similarly within the relatively large range of skulls from the Czech territory as well. For example, the incidence of 10.8% was noted at skeletons from 18th–19th century from the cemetery in Malá Nová Street in Brno (Vargová, Horáčková 2006), 9.6% from 10th–13th century in Bílina (Vyhnánek 1971), 19.1% in the burial-ground from 11th–12th century in Dolní Věstonice- Vysoké Zahrady (Jarošová 2007), 12.5% in the burial-ground from 9th–11th century in Libice nad Cidlinou (Stloukal, Vyhnánek 1976), 14.5% in the locality from the first half of 9th century in Dolní Věstonice-Na Pískách (Jarošová 2007). The results of the analysis of *cribra orbitalia* in skeletons from Veselí nad Moravou (19.0%) do not differ therefore in any aspect from the data obtained by examination of other historical populations. However, it is quite possible that the real number of findings was somewhat higher, since many of the skeletons were damaged or the skulls were missing and it was not possible to assess them.

Tumours

Of tumour diseases, only benign bone tumours (osteomas) were found in the palaeopathological analysis of skeletal remains from Veselí nad Moravou. They were located on skulls of three men (3.4%, $n = 88$) from graves 41, 42 and 45. The osteoma could be diagnosed macroscopically in all the cases based on the characteristic appearance. The osteomas have the form of a small lentil shaped formation with a smooth surface of thin layer of compact bone. The osteomas were located at the external laminae of the bones of cranial vault, in two cases at the parietal bone, in one case at the frontal bone. This type of benign tumour tends to be a common finding even in smaller osteological collections according to many authors (such as Aufderheide, Rodríquez-Martín 1998, Horáčková *et al.* 2004, Ortner 2003).

Congenital diseases

The symptoms of certain congenital defects may be classified as rarer palaeopathological findings. The premature obliteration of cranial sutures and a developmental defect of dentition in the skull of a 16–20 year old woman (grave 7) is one such case in the examined set. The left half of the lambdoidal suture was fully obliterated intracranially as well as extracranially, the fusion continued as far as the parietomastoideal sutura of the left side. Other sutures, including the right half of the lambdoid suture remained open in full range. It is evident from many publications that great individual differences exist in the time sequence of cranial suture obliteration (for example Hajniš, Novák 1984, Linc 1971, Meindl, Lovejoy 1985, Olivier 1960, Vargová, Horáčková 1996). However, the majority of authors mentioned agree with the opinion that lambdoidal suture obliteration occurs after 40th year of age and that side differences of obliteration are minimum. The permanent teeth of the examined individual were abraded only slightly, however, and crowns of both third molars were deep embedded still in the upper jaw (abrasion category B1, age 16–20 years according to Lovejoy 1985). The low age determined relatively accurately based on the dentition condition indicates an atypical premature fusing of a part of the lambdoid suture (craniosynostosis). The cause of craniosynostoses cannot be fully explained even in the current clinical practice. The premature fusion of cranial sutures may be only one of the symptoms of rare genetically influenced syndromes (such as Apert's, Pfeiffer's, Crouzon's, Carpenter's syndromes). The craniosynostoses might be also subject to external influences according to Cohen (1976), however, their cause remains unclear in many cases.

The congenital aetiology is mainly attributed to such conditions in palaeopathology in cases of unilateral

incidence and if the defect is accompanied by other congenital deviations of the skeleton at the same time.

At the same skull, a palato-radicular groove is located on the second right incisor that begins on the distal surface of the tooth cervix and continues askew to the lingual plane, where it ends in the lingual fossa (*Figure 6*). A hypoplastic fossa is located on the labial surface of the dental crown near to the tooth neck. Generally, it is considered to be a developmental disorder of Hertwig's epithelial root sheath or an attempt to create another root of the lateral incisor (Lee *et al.* 1968, Peikoff, Trot 1977). It is a typical developmental defect in any case (Ash, Nelson 2003).

FIGURE 6. A developmental defect at the crown of the right second upper incisor in the form of a marked palato-radicular groove. Veselí nad Moravou grave No. 7, female, 16–20 years. Photo by S. Bártová.

Diseases of teeth

Assessment of other dental pathologies was also an integral part of the palaeopathological analysis of the skeletal set from Veselí nad Moravou. It was necessary to determine basic indicators of preservation of facial skeletons first of all. The value of the comparative dental index (CDI) 51.6% and of the comparative alveolar index (CAI) 88.46% is indicative of the partial damage of examined jaws. That is why all acquired data is distorted by this fact to a certain extent. It was possible to assess teeth in 34 adult individuals (24 men and 10 women) only after the isolated teeth as well as jaw fragments with incomplete substantially damaged empty alveoli have been excluded. The dependence of the incidence of caries on the age of the deceased was not assessed with respect to the small number of skeletons in the particular age categories. The statistical assessment of children's dentition was not carried out on the same ground, since only small jaw fragments of fragile children's skulls were preserved in the majority of cases.

It was possible to assess 430 teeth and to examine 784 tooth alveoli in detail altogether. It was established based on the total amount of permanent teeth that incidence of caries was 25.8% and the frequency of caries F-CE was 82.5%. Comparing the incidence of caries in male and female teeth, we found a higher incidence as well as frequency in men (I-CE men 30.7%, I-CE women 13.8%). Regarding individual types of teeth, caries were most frequently found in molars, then in premolars, followed by canines and the least affected teeth were incisors (*Table 2*).

Our results correspond fully to the work of Caselitz (1998), who attempted to record diachronically the worldwide development of caries incidence by means of I-CE indexes of 518 examined sets and of Strouhal (1961) and Horáčková *et al.* (2004), who focused on Central European populations. The intensity of caries incidence is relatively low (around 2.0–5.0%) in Palaeolithic and Mesolithic periods. A double increase is noted at the end of the Neolithic era, at the time of hunters and gatherers were proceeding to a settled agricultural way of life (around 7–8%). Slight fluctuations of values in individual groups of population conform to the initial blending of both populations. The intensity of caries incidence remained at the same, almost constant level in following periods. The gradual growth of values began after 1500–1100 BC being slight at first and steeper and steeper later on, which means that

TABLE 2. Incidence of caries in individual types of teeth.

	Medial incisor	Lateral incisor	Canine	First premolar	Second premolar	First molar	Second molar	Third molar
C	1	6	7	2	5	8	6	6
CA	16	7	13	14	15	45	43	41
TT	62	65	66	67	54	46	45	25
TA	102	102	103	102	101	100	99	75
I-CE (%)	17.2	16.0	23.2	16.6	24.0	62.3	56.7	78.6

C, number of caries; CA, number of closed alveoles; TT, total number of all studied teeth; TA, total number of all studied alveoles; I-CE, caries incidence.

the intensity of caries incidence increased directly in proportion to rising standards of living (consuming softer food rich in carbohydrates instead of harder food with fibres that remove the dental plaque by their abrasive influence). A sharp rise in the incidence of caries incidence (around 30%) culminates in the youngest sets from the Early Modern Period.

It is possible to say with respect to the above-mentioned facts that the I-CE value of the set from Veselí nad Moravou matches the values of other sets from the Early Modern Period, generally. However, there is a great difference when comparing the results between the group of men and the group of women because of the small number of assessable individuals. Namely, the incidence of caries in women is ordinarily higher than that of men, which is related to the lack of calcium in food and changes in the components of saliva (which plays very important role as a defence mechanism against caries) in the periods of pregnancy and lactation (Urban 1976: 69–85).

Besides dental caries, signs of inflammatory processes of tooth alveoli were also found in the teeth, of 5 adult individuals (i.e. at 14.7%, $n = 34$). They were small cystic formations on the tooth roots with sizes up to 10 mm. There was a larger cavity (approximately 30 mm) in one case only, at the canine root of the right maxilla of a 50–60 year-old man. The dimensions of periapical lesions are the only diagnostic criteria for differentiating a periapical granuloma (with the size up to 10 mm) from a radicular cyst (with the size over 10 mm) in palaeopathological examinations due to the absence of soft tissues.

Retention of the upper right canine of a 20–30 year-old woman from violated grave R d-2 may be included among the pathological findings of teeth, too. An oval perforation (8×2 mm) with a denuded part of the palatal surface of a crown of the retained tooth is visible in the palate process of the right maxilla in the incisive bone area. The slanted position of the canine with the dental crown pointing ventromedially can be seen by X-ray imaging. The root is fully developed and reaches almost to the front surface of the maxillar body in the place of canine fossa (*Figure 7*). The majority of teeth were lost post mortem. The dental alveolus of the milk canine is not fully closed yet. Retention of upper canine teeth represents 54% of all retained teeth according to the specialised literature. Many etiological factors exist that may contribute to the retention origin: heredity, abnormal placing of tooth buds, mechanical obstacles at teeth eruptions (supernumerary teeth, odontomas, cysts, etc.), inflammatory processes in the proximity of unerupted teeth (because of coalescence with adjacent bone tissue) and lack of room in the dental arch are secondary causes (Adam 1976).

CONCLUSIONS

The skeletal remains examined are a group of Early Modern Period inhabitants of Veselí nad Moravou, a small town located on a strategic trade route from the Mediterranean Sea to the Baltic Sea. The town's inhabitants were small tradesmen and peasants predominantly. The average values of morphoscopic and metric criteria of these skeletons do not differ significantly from data acquired at examinations of similar Early Modern Period skeletal sets in the Czech lands.

The palaeopathological part of the study confirmed the existence of a majority of diseases that were common in this historical period.

Degenerative productive changes are the most frequent pathological events in the bones from Veselí nad Moravou. However, the frequency of their incidence was lower in comparison with other skeletal sets. It can be assumed thus that the group of individuals examined was not exposed to excessive physical stress.

Most injuries were accidental incidents occurring during daily routine activities. The evidence is provided not only by the nature of traumatic lesions but also by their low number. There were no signs after cutting, stabbing or gunshot wounds in the bones examined that are typical of war periods. Nor was there an increase in

FIGURE 7. Retention of the upper right canine. The tooth is in a slant position, the crown points ventromedially. The root is fully developed and reaches almost to the front surface of the maxilla body. (Veselí nad Moravou grave No. R d-2, female *adultus* I). Photo by S. Bártová.

the total number of indicators of metabolic diseases (of *cribra orbitalia* in particular) that usually accompany the famines connected with war events.

The assessment of indicators of therapeutic interventions tends to be a part of palaeopathological studies. One such indicator was the finding of a trepanation on the skull of a 40–50 year-old man, where a healed oval-shaped opening was identified on the right half of the frontal bone squama. A subtle radial grooving was visible around its perimeter that is typical of trepanation carried out by means of a chisel. In the majority of cases, such interventions were carried out during the wound management of serious calva fractures. The trepanation was performed intravitally in this case and the individual survived.

The palaeopathological analysis of skeletal remains from the Early Modern Period burial-ground in Veselí nad Moravou will undoubtedly extend the spectrum of findings from the Czech lands and the results of this study will provide comparative material for the verification of interpretation of cases of pathological changes in already described bones as well as new ones.

REFERENCES

ADAM M., 1976: *Ortodoncie*. Avicenum, Zdravotnické nakladatelství, Praha.

ASH M. M. JR., NELSON S. J., 2003: *Wheeler's dental anatomy, physiology, and occlusion.* 8th Edition. Saunders, Philadelphia, PA.

AUFDERHEIDE A. C., RODRÍGUEZ-MARTÍN R. C., 1998: *The Cambridge encyclopedia of human paleopathology.* Cambridge University Press, Cambridge.

BACH H., 1965: Zur Berechnung der Körperhoheaus den Langen Gliedmassenknochen weiblicher Skelete. *Anthropologischer Anzeiger* 29: 12–21.

BOROVANSKÝ L., 1936: *Pohlavní rozdíly na lebce člověka*. Česká akademie věd a umění, Praha.

BREITINGER E., 1937: Zur Berechnung der Körperhöhe aus den langen Gliedmassenknochen. *Anthropologischer Anzeiger* 14: 249–274.

BRUZEK J., 1991: *Fiabilité des procédes de détermination du sexe á partir de l'os coxal. Implification á l'étude du dimorphisme sexuel de l'Homme fossile*. Thése de Doctorat. Museum National d'Histoire Naturelle, Institut de Paléontologie Humaine, Paris.

CASELITZ P., 1998: Caries – ancient plaque of humankind. In: K. V. Alt, F. W. Rösing, M. Teschler-Nicola (Eds.): *Dental anthropology. Fundamentals, limits, prospects*. Pp. 203–226. Springer Verlag, Wien and New York.

COHEN M., 1976: The cloverleaf skull malformation. In: J. Bosma (Ed.): *Symposium on development of the basicranium*. Pp. 372–382. Dept. of Health, Education, and Welfare, Public Health Service, National Institutes of Health, Bethesda, MD.

ČERNÝ M., 1971: Určování pohlaví podle postkraniálního skeletu. In: E. Vlček (Ed.): *Symposium o určování stáří a pohlaví jedince na základě studia kostry.* Pp. 46–62. Národní muzeum, Praha.

ČIHÁK R., 1987: *Anatomie 1*. Avicenum, Praha.

DOKLÁDAL M., 1978: Pohlavní rozdíly na hrudní kosti u člověka a jejich praktický význam při stanovení pohlaví na kostře. *Scripta Medica* 51, 8: 451–468.

FLECKER H., 1932–33: Roentgenographic observations of the times of appearance of the epiphyses and their fusion with the diaphyses. *Journal of Anatomy* 67: 118–164.

FLORKOWSKI A., KOZLOWSKI T., 1994: Ocena wieku szkieletowego dziecina na podstawie wielkosci kosci. *Przeglad Antropologiczny* 57, 1–2: 71–78.

HAJNIŠ K., NOVÁK J. T., 1984: *Srůst švů lebeční klenby*. Babákova sbírka č. 70. Avicenum, zdravotnické nakladatelství, Praha.

HENGEN O. P., 1971: Cribra orbitalia. Pathogenesis and probable aetiology. *Homo* 22, 2: 57–76.

HORÁČKOVÁ L., STROUHAL E., VARGOVÁ L., 2004: Základy paleopatologie. In: J. Malina (Ed.): *Panoráma biologické a sociokulturní antropologie*. Pp. 1–263. Nadace Universitas Masarykiana, Brno.

HORÁČKOVÁ L., VARGOVÁ L., 2000: *Antropologické hodnocení kosterních pozůstatků z Veselí nad Moravou*. Závěrečná zpráva. Archiv Muzea T. G. Masaryka, Hodonín.

HOSÁK L., ZEMEK M., 1981: *Hrady, zámky a tvrze v Čechách, na Moravě a ve Slezsku I, Jižní Morava.* Nakladatelství Svoboda, Praha.

HOWELLS W. W., 1964: Détermination du sexe du bassin par fonction discriminante. *Bulletin et mémoires de la Société d'anthropologie* 7: 95–105.

JAROŠOVÁ I., 2007: Cribra orbitalia ve středověké populaci z Dolních Věstonic. *Ve službách archeologie* 2: 68–83.

KNUSSMANN R., 1988: *Anthropologie. Handbuch der vergleichenden Biologie des Menschen. Band I: Wesen und Methoden der Anthropologie.* Gustav Fischer Verlag, Stuttgart, New York.

KOMÍNEK J., ROZKOVCOVÁ E., 1984: Metoda určování zubního věku a její význam pro praxi. In: F. Urban (Ed.): *Pokroky ve stomatologii 2*. Pp. 175–208. Avicenum, Praha.

LEE K. W., LEE E. C., POON K. Y., 1968: Palato-gingival grooves in maxillary incisors. *British Dental Journal* 124: 14–18.

LINC R., 1971: *Kapitoly z růstové a funkční morfologie*. Pp. 112–117. Univerzita Karlova v Praze FTVS, SPN, Praha.

LOTH S. R., HENNENBERG M., 1996: Mandibular ramus flexure: a new morphologic indicator of sexual dimorphism in the human skeleton. *American Journal of Physical Anthropology* 99, 3: 473–485.

LOVEJOY C. O., 1985: Dental wear in the Libben population: its pattern and role in the determination of adult skeletal age at death. *American Journal of Physical Anthropology* 68, 1: 47–56.

MALYKOVÁ D., 2002: Trepanace lebky v archeologických nálezech z území Čech. *Archeologie ve středních Čechách* 6: 293–314.

MARTIN R., SALLER K., 1957: *Lehrbuch der Anthropologie in systematischer Darstellung.* 3. Aufl., Band I. Gustav Fischer Verlag, Stuttgart.

MEINDL R. S., LOVEJOY C. O., 1985: Ectocranial suture closure: a revised method for the determination of skeletal age at death based on the lateral-anterior sutures. *American Journal of Physical Anthropology* 68, 1: 57–66.

MØLLER-CHRISTENSEN V., SANDISON A. T., 1963: Usura orbitae (cribra orbitalia) in the collection of crania in the Anatomy Department of the University of Glasgow. *Pathologia et Microbiologia (Basel)* 26: 175–183.

MOSELEY J. E., 1963: Bone changes in hematologic disorders: implications for paleopathology. In: S. Jarcho (Ed.): *Human palaeopathology*. Pp. 121–130. Yale University Press, New Haven, London.

NEMESKÉRI J., HARSANYI L., ACSÁDI G., 1960: Metoden zur Diagnose des Lebensalters von Skelettfunden. *Anthropologischer Anzeiger* 24: 70–95.

OLIVIER G., 1960: *Practique Anthropologique*. Paris.

ORTNER D. J., 2003: *Identification of pathological conditions in human skeletal remains*. 2nd Edition. Academic Press, London.

ORTNER D. J., PUTSCHAR W. G. J., 1985: *Identification of pathological conditions in human skeletal remains.* Reprint edition. Smithsonian Institution Press, Washington.

PEIKOFF M. D., TROT J. R., 1977: An endodontic failure caused by an unusual anatomical anomaly. *Journal of Endodontics* 3, 9: 356–359.

PHENICE T. W., 1969: A newly developed visual method of sexing the os pubis. *American Journal of Physical Anthropology* 30: 297–302.

REJHOLEC V., 1982: Osteoartrosa. Artrosa. Osteoartritis. Degenerativní kloubní nemoc (715). In: A. Štork (Ed.): *Lékařské repetitorium. Svazek II*. Pp. 1246–1250. Avicenum, zdravotnické nakladatelství, Praha.

RÖSING F. W., 1977: Methoden und Aussagemöglichkeiten der antropologischen Leichenbrandbearbeitung. *Archäologie und Naturwissenschaften* 1: 53–80.

STEINBOCK R. T., 1976: *Paleopathological diagnosis and interpretation*. Charles C. Thomas, Springfield, IL.

STLOUKAL M., DOBISÍKOVÁ M., KUŽELKA V., STRÁNSKÁ P., VELEMÍNSKÝ P., VYHNÁNEK L., ZVÁRA K., 1999: *Antropologie. Příručka pro studium kostry*. Národní muzeum, Praha.

STLOUKAL M., HANÁKOVÁ H., 1978: Die Länge der Längsknochen altslawischer Bevölkerungen unter besonderer Berücksichtigung von Waschstumsfragen. *Homo* 29, 1: 53–69.

STLOUKAL M., VYHNÁNEK L., 1976: *Slované z velkomoravských Mikulčic.* Academia, Praha.

STROUHAL E., 1961: K prehistorii zubního kazu. *Praktický lékař* 41, 12: 567–569.

SZILVÁSSY J., 1980: Age determination on the sternal articular facets of the clavicula. *Journal of Human Evolution* 9, 8: 609–610.

UBELAKER D. H., 1987: Estimating age at death from immature human skeleton: an overview. *Journal of Forensic Sciences* 32, 5: 1254–1263.

URBAN F., 1976: *Stomatologie.* Avicenum, zdravotnické nakladatelství, Praha.

VALLOIS, H. V., 1937: La durée de la vie chez l'homme fossile. *L'Anthropologie* 47: 449–532.

VARGOVÁ L., HORÁČKOVÁ L., 1996: Interesting cases of craniosynostoses in osteological material from Křtiny ossarium. *Scripta medica* 69, 6: 313–323.

VARGOVÁ L., HORÁČKOVÁ L., 2005: Degenerative joint changes found on skeletal remains from a modern period cemetery in Antonínská Street in Brno (Czech Republic). *Slovenská antropológia* 8, 2: 142–147.

VARGOVÁ L., HORÁČKOVÁ L., 2006: Projevy krevních, metabolických a endokrinních onemocnění na skeletech z novověkého hřbitova na Malé Nové v Brně, Česká republika. In: Š. Polák, V. Pospíšilová, I. Varga (Eds.): *Morfológia v súčasnosti*. Pp. 431–438. Univerzita Komenského, Bratislava.

VARGOVÁ L., HORÁČKOVÁ L., VYMAZALOVÁ K., SVOBODA J., 2013: Inflammatory changes on the skeletons from the 16th–17 th century (Veselí nad Moravou, Czech Republic). *Journal of Paleopathology*, in press.

VYHNÁNEK L., 1971: Analyse der pathologischen Knochenbefunde aus der Slawischen Begräbnisstätte von Bílina. *Anthropologie* 9, 2: 129–135.

VYHNÁNEK L., BOHUTOVÁ J., BELŠÁN T., DANEŠ J., FENDRYCH P., HOŘÁK J., HOŘEJŠ J., CHMEL J., KŘIVÁNEK J., ORT J., TŮMA S., 1998: *Radiodiagnostika. Kapitoly z klinické praxe.* Grada Publishing, Praha.

Lenka Vargová
Ladislava Horáčková
Kateřina Vymazalová
Department of Anatomy
Faculty of Medicine
Masaryk University
Kamenice 3
625 00 Brno
Czech Republic
E-mail: vargova@med.muni.cz
E-mail: lhorac@med.muni.cz
E-mail: 184368@mail.muni.cz

Josef Svoboda
Radiodiagnostické oddělení
Nemocnice Kyjov
Strážovská 1247
697 01 Kyjov
Czech Republic
E-mail: primrad@nemkyj.cz