ANTHROPOLOGIE • LXII/3 • pp. 231–248 • 2024

LENKA VARGOVÁ, ZDENĚK TVRDÝ, KATEŘINA VYMAZALOVÁ

HEALTH STATUS OF THE POPULATION FROM THE PERIOD OF THE FUNNEL BEAKER CULTURE FROM MODŘICE (BRNO-COUNTRY DISTRICT, CZECH REPUBLIC)

ABSTRACT: The presented work is focused on the palaeopathological analysis of the skeletal remains of 22 individuals (11 adults, two adolescents, nine children) from Modřice (Brno-Country District, Czech Republic) dated to the period of the FunnelBeaker Culture (4000–3700 BC). It represents a group of settled farmers. Compared to similarly dated groups, the Modřice skeletons had a very high rate of tooth decay. Of the congenital malformations, skeletal (scaphocephaly) and spinal (vertebral synostosis, spondylolysis) disabilities were found here. Most of the inflammatory changes on the bones were observed in connection with dental diseases; two cases of otitis media and inflammatory foci on the cranial vault of one of the females were also recorded. Manifestations of chronic inflammation of unknown aetiology were noted in two individuals on the long bones of the limbs. Although the presented research was limited by the small number of examined skeletons, it presents new information about the health status of the studied population group and enriches the existing knowledge about this important Eneolithic population.

KEY WORDS: Diseases – Eneolithic – Palaeopathology – Moravia

INTRODUCTION

In the Early Eneolithic period (in the 1st half of the 4th millennium BC), Funnel Beaker Culture was one of the most important groupings in Europe. It was named after the typical beakers with a wide funnel-shaped widened neck. This vast cultural complex covered a wide area of European territory from the Netherlands to western Ukraine (*Figure 1*). In the territory of Moravia (Czech Republic), a number of archaeological sites occupied by this culture are known (Šmíd 2017). But there are not many necropolises with skeletal remains and the retrieved

Received 23 January 2024; Accepted 10 August 2024. Available online 30 October 2024.

DOI: https://doi.org.10.26720/anthro.24.08.10.1

osteological collections include only a small number of individuals (e.g., Drozdová 2011, Trampota *et al.* 2021). Attention was mostly paid to standard anthropological analysis, or only interesting case studies were recorded and described (e.g. Pankowská *et al.* 2010). Detailed palaeopathological studies monitoring the general state of health of the studied population based on skeletal changes, were not carried out in most cases.

MATERIALS

The studied skeletal collection included the remains of a total of 22 individuals from the archaeological site of Modřice (Brno-Country District, Czechia) and was dated by the radiocarbon method to 3800–3640 calBC (Drtikolová Kaupová *et al.* 2023), i.e., to the period of the Funnelbeaker Culture (Neolithic – or Early Eneolithic used in the Czech and Moravian context). Of this number, there were 11 adults (six males, five females), two juvenile girls and nine children. The age structure of the buried individuals shows an even distribution. Each skeleton was placed in a separate grave. In 19 graves, mostly without grave equipment, individuals were buried in an extended position, in one of the graves in a crouched position (H 3889), and two deceased came from settlement objects (H 3881, H 3896). The graves formed two groups, which could consist of members of the same family or household.

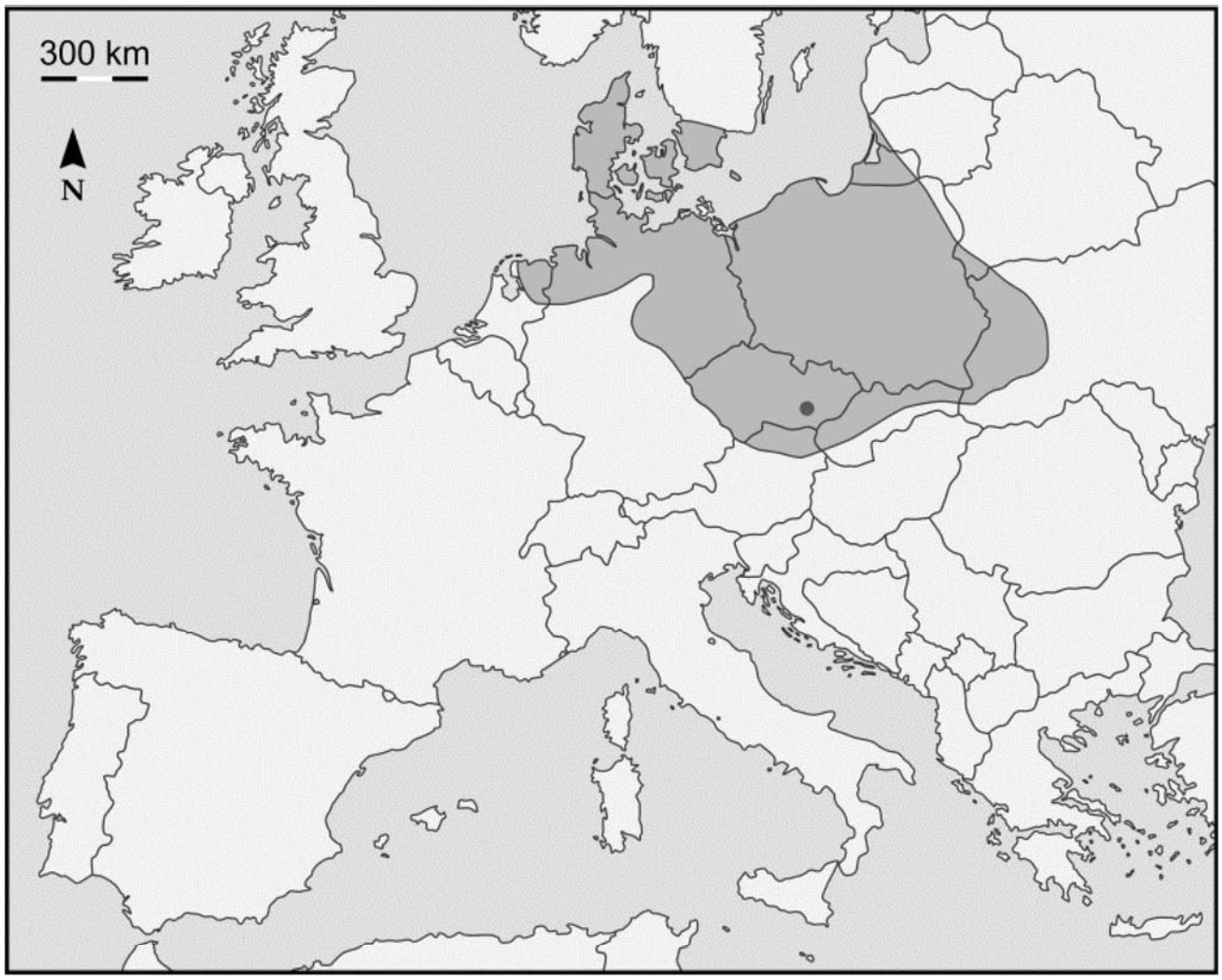

FIGURE 1: Map of Europe showing the spread of people of the Funnel-beaker Culture (graphics by Jana Vachová).

The anthropological analysis of this small osteological collection is detailed in the works of Šmíd *et al.* (2018, 2021a, b).

METHODS

Palaeopathological diagnosis was based on standard anthropological analysis described in detail in the work of Šmíd *et al.* (2021a), where the sex, age at death, stature and overall habitus have been determined. All pathological bone changes were carefully documented. The basic examination method involved primarily a detailed macroscopic examination, complemented in indicated cases by an X-ray examination.

Indicators commonly used in palaeopathology, including the caries frequency index (F-CE) and the caries intensity index (I-CE), were determined to monitor the state of the dentitions. The methodology is described in more detail, for example, in the works of Hillson (2001), Jarošová (2012). The teeth of the individuals from Modřice were examined macroscopically and only obvious carious cavities and intravital losses were counted.

As part of the palaeopathological differential diagnosis, the pathological lesions were compared with the findings mentioned in the basic specialist palaeopathological literature and with cases from current medical practice. In this context, the diagnostic criteria of Aufderheide, Rodríguez-Martín (1998), Buikstra (2019), Horáčková *et al.* (2004), Ortner, Putschar (1985), Ortner (2003), Steinbock (1976) and Waldron (2009) were used. The publication by Vyhnánek *et al.* (1998) was used to evaluate the radiological examination. The joint changes were compared with the cases described in the work of Dungl *et al.* (2005). Findings on child skeletons were evaluated according to descriptions by Lewis (2018).

RESULTS AND DISCUSSION

Developmental anomalies

Several deviations from the norm were noted in the studied collection, for which palaeopathology cannot clearly state whether they were just a variety without clinical manifestation or an anomaly. *Patella bipartita* type III (graves No. 3865 and 3866), *spina bifida* on the sacrum (graves No. 3851 and 3866) and asymmetry of cerebral fossae (grave No. 3878) were among these.

Pathological changes on the skeleton of a 20–30-year-old female (grave No. 3889) can be considered a true developmental defect of the spine. A vertebral block from L3–L5 was created here (*Figure 2a*). The vertebrae were fused in the area of the left articular processes, without osteophytes. The vertebral bodies had a regular shape, and the slits at the place of the intervertebral discs were preserved. On the radiograph, the vertebrae had a standard structure, typical for congenital vertebral block (Vyhnánek *et al.* 1998). The main cause of congenital synostosis is a segmentation disorder of the mesenchymal blastema of the sclerotomes during the development of the axial skeleton. This type of developmental anomaly (type II) is one of the most common anomalies of the spine (Barnes 1994). Interarticular spondylolysis (*Figure 2b*) could also be another manifestation of a congenital developmental defect of the spine, although a traumatic origin cannot be ruled out unequivocally on this skeleton. It was a bilateral interruption of the L5 vertebral arch between the upper and lower articular processes (known as interarticular spondylolysis). The repair process manifested as rounded margins of the central fragment of the arch, the dorsal part was not preserved. Due to the changed biomechanics of the lumbar spine, pronounced osteophytes (up to 6.8 mm in size) were formed around the margin of the *facies terminalis inferior* of the 5th lumbar vertebra. The 1st sacral vertebra also has visible osteophytes around the upper terminal surface. In addition, this sacral vertebra did not grow with the sacrum and was displaced, relative to the lumbar section of the spine, about 7 mm dorsally. This formation of the lumbosacral segment was most probably the result of spondylolisthesis, when the body of the affected vertebra (and the entire column of vertebrae located above it) is displaced in the ventral direction and the lower section of the spine is therefore located dorsally (*Figure 2c*). This condition is usually associated with neurological problems such as symptoms from chronic stretching of the nerve roots of the *cauda equina* ("plank sign"), leg flexor contractures, acral paresis, sphincter disorders, etc. (Dungl *et al.* 2005, Vyhnánek *et al.* 1998).

In the examined osteological collection, spondylolysis was also observed on the skeletal remains of two males (male 20–30 years old – grave No. 3865; male 30–40 years old – grave No. 4811) and an older female (50–60 years old – grave No. 4809). The findings were of completely identical character. The interruption of the vertebral arch was also found on the 5th lumbar vertebra and was located between the articular processes. The repair process manifested in rounded edges of the defect. In these cases, no other pathological

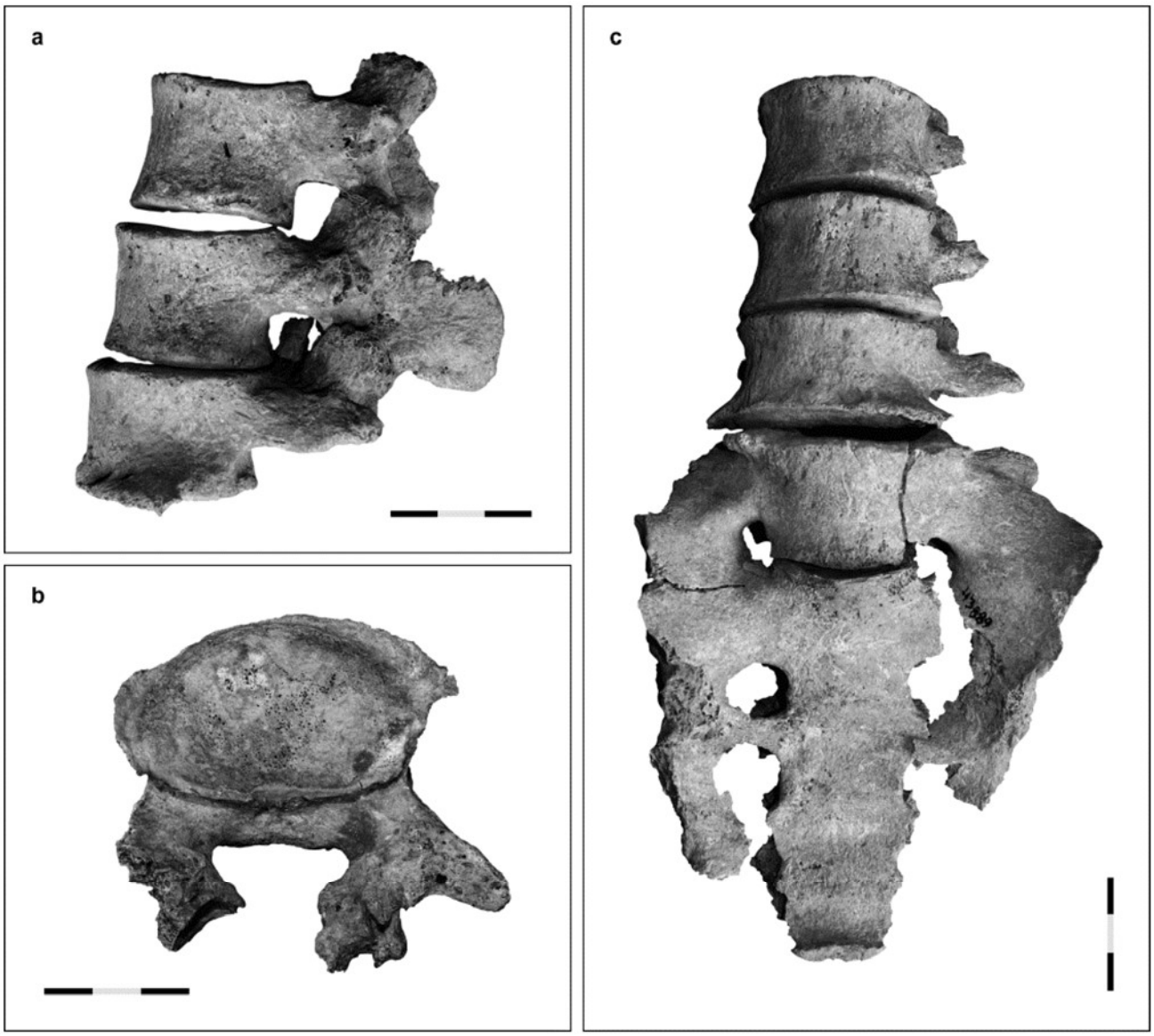

FIGURE 2: Pathological changes are visible on the young female's spine showing congenital fusion of three lumbar vertebrae – congenital L3–L5 synostosis (a), interruption of the vertebral arch of the 5th lumbar vertebra – intraarticular spondylolysis (b), which caused a shift of the sacrum in the dorsal direction – spondylolisthesis (c). (Grave No. 3889; photo by Zdeněk Tvrdý).

changes that could be considered developmental malformations were observed on the spine of the affected individuals. For this reason, a traumatic origin was assumed for the aetiology of the finding. In most cases, acquired spondylolysis is regarded as a fatigue fracture due to repeated overloading of the spine (pseudoarthrosis), which would logically correspond to its occurrence in a functionally heavily stressed part of the spine. More rarely, it may be a direct single trauma (Wiltse *et al.* 1975). However, the congenital predisposition to spondylolysis under the influence of external factors must also be taken into account. This is evidenced by the gradually increasing incidence of this defect from childhood until adolescence (Fredrickson *et al.* 1984, Tsirikos, Garrido 2010). Furthermore, an increase in this defect with increasing

age was also recorded in adults, where the main cause was osteoporosis and degenerative changes (Kalichman *et al.* 2009). In historical populations, the incidence of spondylolysis is estimated at 4–8 % (Aufderheide, Rodríguez-Martín 1998). In the Czech Lands, spondylolysis was studied in detail in Slavic burial grounds (9th–10th centuries), an overview of which is given, for example, by Vyhnánek and Stloukal (1977). They found spondylolisis in 8.8 %. In agreement with recent studies, its incidence in European populations varies between 5–6 % (Vyhnánek, Stloukal 1977, Žižka 1994). Czech skeletal collections from the period of the Funnel-Beaker Culture are currently few, and therefore the occurrence of spondylolysis in these populations cannot be evaluated objectively. To date, spondylolysis has been recorded on the 5th lumbar vertebra of a 24–30-year-old male from Prostějov-Čechůvky (Drozdová 2011) and also on the 5th lumbar vertebra of an 18–25-year-old female from Dambořice (Šmíd *et al.* 2021b). It was a case similar to the one from the studied osteological collection.

Asymmetric fusion of the sacrum in a young female (grave No. 3851) can also be considered a possible developmental defect, which probably caused a slight dextroscoliosis in the area of the lumbosacral transition (the L5 body is 3 mm lower on the left side).

After the partial reconstruction of the fragments of the cranial vault of the skull of a 12–14-year-old child (grave No. 3871), it was evident that the cranium was noticeably long and narrow (dolichocranial). However, the metric assessment must be considered only as an indicative value (cranial index = 66.5) due to the incomplete state. However, during a detailed study of the cranial sutures, it became clear that there was a partial intracranial obliteration of the *sutura sagittalis* near the lambda point in sections S3 and S4, according to Olivier (1960). The other sutures of the cranial vault had a very ragged course, in places with *ossa suturarum*.

The formation of cranial sutures and their obliteration have been addressed by a number of authors since the time of Hippocrates (e.g., Acsádi, Nemeskéri 1970, Hajniš, Novák 1984, Linc 1971, Meindl, Lovejoy 1985, Olivier 1960). The results of their research are evidence of quite considerable individual variability in the area of sagittal suture. However, all authors seem to agree that, under normal circumstances, the sagittal suture does not fuse until adulthood. In the case of the child's skeleton (grave No. 3871) from Modřice, this is a partial premature obliteration of this sagittal suture (known as "craniosynostosis"). As early as the end of the 19th century, Virchow (1851) found that premature fusion of one of the cranial sutures halts the growth of the skull in the plane perpendicular to this suture (Delashaw *et al.* 1991). Deformities of the neurocranium are then created by compensatory growth in the place of free sutures. Due to premature obliteration of the *sutura sagittalis*, the cranial vault was long and narrow (dolichocephalic) and resembled a boat in shape – also known as "scaphocephaly". In more severe cases, the affected individual may suffer intracranial pressure accompanied by neurological dysfunctions due to oppression of the central nervous system (Kajdic *et al.* 2018). The aetiology of craniosynostosis is currently unclear, as suture fusion is regulated at the cellular level from the dura mater in integration with the surrounding tissues. Growth regulators are affected by many factors, for example, fibroblast factor, transforming factor beta, migration factors, mechanical factors, etc. This complex signalling cascade can be disrupted by a whole range of genetic mutations, several dozen of which are currently known (Johnson, Wilkie 2011, Kajdic *et al.* 2018). Scaphocephaly occurs more often in boys than in girls. Changes on the skull may be an isolated finding, or craniosynostosis may be a part of congenital syndromes, such as Crouzon, Apert, Muenke or Pfeiffer syndrome (Kubátová *et al.* 2019). No other skeletal development disorders were found on the skeletal remains of the Modřice child with partial obliteration of the *sutura sagittalis*. For this reason, it was probably only an isolated defect, either hereditary or acquired during embryonic development. Since the fusion of the *sutura sagittalis* was only partial and clearly visible only on the intracranial surface of the cranial vault, the deformity of the neurocranium was not too large (more details in Williams *et al.* 2023).

Currently, the incidence of craniosynostosis in the Czech Republic is relatively low, up to 0.1 % (in newborns), and approximately one-half of them are scaphocephalies. In the palaeopathological literature, a rare finding of scaphocephaly only on skeletal remains of a female from the cemetery in Náměšť na Hané has been documented to date at Czech archaeological sites from the period of the people of the Funnel-Beaker Culture. Due to the pronounced *foveolae granulares* and pathological changes on the bones of the lower limbs (Harris lines on X-ray of the tibiae), it cannot be ruled out that this was part of one of the genetically determined syndromes. The burial position of the body was also unusual in this case, which differed from the usual burial rite. The skeleton was not properly buried, it was thrown in a settlement pit (Pankowská *et al.* 2010). Other finds of scaphocephaly from the Czech Lands

are dated to the modern era and were recorded in more extensive osteological collections from the ossuary in Křtiny and Broumov. Four cases of craniosynostoses were found in the Křtiny ossuary (13th–18th centuries), representing 0.6 % of the total number of evaluable skulls (N= 583). From these cases, the *sutura sagittalis* was obliterated in two skulls (Vargová, Horáčková 1996). In the Broumov ossuary (13th–18th centuries), craniosynostosis was recorded in 4.8 % of skulls (N= 743), which is an incidence many times higher than in the recent population (Pospíšilová *et al.* 2003, Pospíšilová, Procházková 2006). The stated values are higher than the prevalence of this malformation observed by Kubátová *et al.* (2019) in the current Czech population (around 0.1 %). The main cause of these differences can be ascribed to the fact that partial premature obliteration of the sutures, which does not cause noticeable shape deformations of the head and does not cause any functional disorders, is considered in common clinical practice as a variation. However, osteological studies can capture these cases, especially on children's skulls.

Metabolic diseases

In palaeopathology, porotic changes on the roof of the orbits called *cribra orbitalia* are often referred to as non-specific manifestations of metabolic diseases (e.g. Hengen 1971, Møller-Christensen, Sandison 1963, Steinbock 1976). Many authors consider anaemia to be the main cause of these lesions (e.g. Aufderheide, Rodríguez-Martín 1998, Moseley 1963). However, it may only be one of the symptoms of another disease, for example, kidney disease, digestive tract disease, vitamin deficiency (C, K, B6, B12) or haematogenous diseases. For this reason, it is always necessary to search for other causes of these changes (Brickley 2018, Brickley *et al.* 2020, Wapler *et al.* 2004).

In the studied skeletal group, *cribra orbitalia* were found on the roof of the orbits of 4 children (graves no. 3854, 3869, 3871, 3896) out of 13 evaluable individuals (i.e. 30.7 %). In most cases, these were several small openings (*cribra orbitalia* – grade I); only in the case of a single skeleton (grave No. 3854) were the changes more pronounced (*cribra orbitalia* – grade II*).* The recorded occurrence of *cribra orbitalia* at the investigated burial site falls within the range of values found during similar Central European archaeological investigations dating to the Neolithic (Ash *et al.* 2016, Bickle, Whittle 2013, Smrčka, Tvrdý 2009).

When searching for the aetiology of *cribra orbitalia* in individual cases, in only one child's skeleton (grave No. 3869; age at death 7–8 years) was it possible to suspect that scurvy could have been the cause. Other findings can only be classified as non-specific stress manifestations. The reason for suspecting scurvy in the individual from grave No. 3869 was the significantly increased porosity at both ends of the bodies of the long bones of the limbs near the epiphyseal cartilages and the simultaneous occurrence of tooth enamel hypoplasia. However, other typical diagnostic criteria for scurvy on the skull (as formation of periostosis or porosity of greater wings of the sphenoid bone and maxilla, established, for example, in the work of Ortner and Ericksen (1997), or on the long bones of the limbs (Brickley, Ives 2006, Dewitte, Bekvalac 2011), were not present. For this reason, it was not possible to unequivocally confirm avitaminosis C in this case.

Several possible symptoms of scurvy were noted on the skeletal remains of a 3-year-old child (grave No. 3850). Due to the damage, it was not possible to evaluate the occurrence of *cribra orbitalia* and possible enamel hypoplasia on the damaged enamel in this individual, but there was a newly formed bone tissue around the infraorbital foramen on the right upper jaw. A similar periosteal lodgement was also noted on the *tuber maxillae*, along the entire length of the arms on the inner side of the mandible (mostly in the area of the *canalis mandibulae*).

Periosteal new bone formation was also observed on the postcranial skeleton – on the inner and outer sides and in the *sulcus costae* of most of the preserved rib fragments, in the sternal end of the right clavicle, on the bodies of both humeri (*Figure 3*), in the entire range of the bodies of both forearm bones (left, to a lesser extent). The skeleton of the lower limbs was equally affected. Newly formed bone tissue was noted on both hip bones, on the ventral surface of the distal third of

FIGURE 3: Depositions of newly formed bone tissue on the surface of the left humerus of a 3- to 4-year-old child. The lesion is most probably one of the manifestations of scurvy – an ossified subperiosteal haematoma (Grave No. 3850; photo by Jana Vachová).

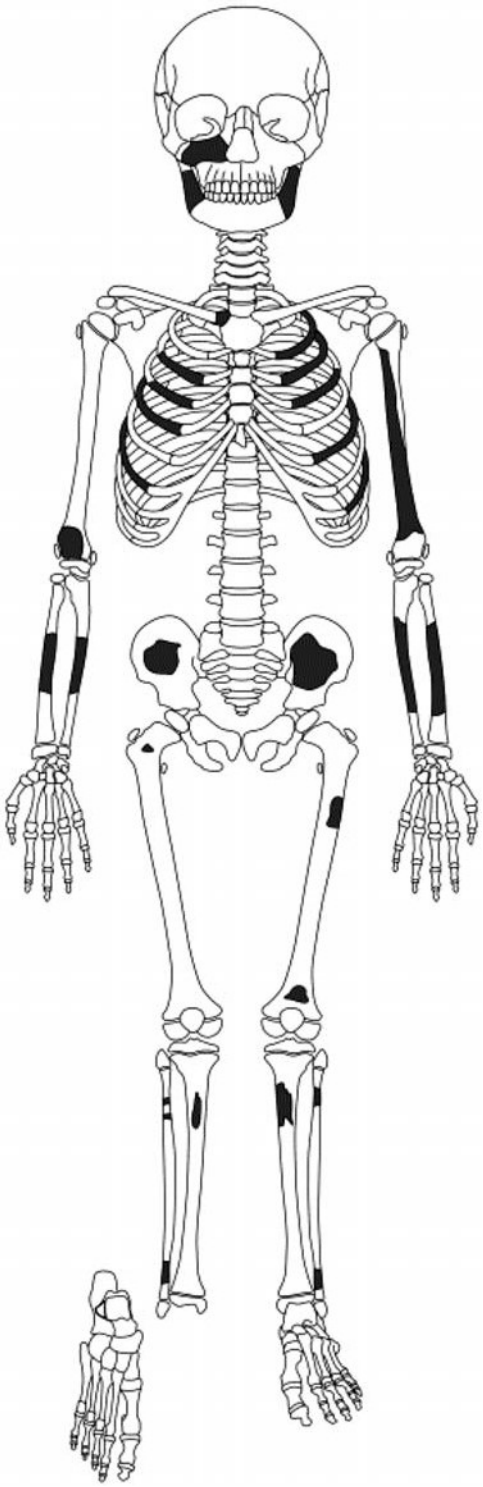

FIGURE 4: Location of the foci of newly formed bone tissue on the skeleton of a 3–4-year-old child, ossified subperiosteal haematomas, possible manifestations of scurvy. (Grave No. 3850; scheme by Jana Vachová).

the body of the right femur, on the bodies of both tibiae (mostly around the *foramina nutricia*) and fibulae (*Figure 4*).

All the described changes on this child's skeleton (grave No. 3850) corresponded to the diagnostic criteria of scurvy (Ortner, Ericksen 1997, Pimentel 2003, Snoddy *et al.* 2018, Stark 2014). In the differential diagnosis, leprosy was considered, although it causes enlargement of the openings on the skull for the penetration of branches of the trigeminal nerve and pitting on the bones of the facial skeleton. However, the palatonasal destruction and resorption of the bones of the hands and feet, typical for this disease, were absent (Buikstra 2019, Møller-Christensen 1961).

Syphilis congenita was also excluded because, in addition to periosteal lodgements on the long bones of the limbs, there were no dental stigmata, palatonasal destruction or other deformities (e.g. Buikstra 2019, Hackett 1976, Ortner, Putschar 1985, Suzuki 1984). Furthermore, given the dating of the skeleton, a diagnosis of syphilis seems highly unlikely.

Traumas

Traces of trauma are common findings. They were also documented on the skeletal remains of the Funnel-Beaker Culture before (Horn 2021). Pathological changes, which could have been caused by injuries, were also recorded on the studied skeletons. This group usually includes the separation of a part of the articular cartilage (*osteochondritis dissecans*) which manifests on dry bones as a minor pitted depression on the joint surfaces. The repair process is indicated by smooth edges of these defects, the bottom is usually smooth and porous as well (Aufderheide, Rodríguez-Martín 1998, Ortner 2003, Waldron 2009). The round lesion on the sternal joint surface of the left clavicle with the size of about 6×4.8 mm in one of the female skeletons from Modřice (grave No. 3862) was of the same character. Current research shows that more aetiological factors may be involved in local damage to articular cartilage. According to Bruns *et al.* (2018), not only repeated long-term microtrauma or direct injury but also metabolic disease, avascular necrosis due to insufficient nutrition of the articular cartilage, genetic predisposition, infectious disease or local morphological deviations from the norm can contribute to the development. However, several factors can contribute to the development of *osteochondritis* simultaneously. The high incidence of *osteochondritis dissecans* in osteological collections of historical populations can also be considered as one of the indicators of increased

physical load on a given population group (Vikatou *et al.* 2017, Wells 1974).

Repeated microtrauma to the muscles (e.g., during long-term excessive strain) may lead to their partial ossification (*myositis ossificans posttraumatica*). This manifests as a bony outgrowth at the site of the origin of the muscle or its attachment (Aufderheide, Rodríguez-Martín 1998). An example of this condition may be the growth on the lateral edge of the right scapula at the site of the origin of the teres minor on a male skeleton (grave No. 3866). However, it should be noted that the pathophysiology of the processes leading to the development of *myositis ossificans* has not yet been fully clarified (Walczak *et al.* 2015).

Changes on the left 5th metacarpal bone on the skeleton of a young male's hand (grave No. 3872) are probably of traumatic origin as well. This bone was shorter, thicker, and its base had a thick and deformed articular surface. On the radiograph, periosteal reaction was evident as well; it was hence most probably a soft tissue injury with a subperiosteal haematoma, which gradually ossified.

A soft tissue injury with subsequent damage to the bones of the cranial vault could not be ruled out in the case of the skeleton of a 50–60-year-old male (grave No. 3866) either. Two shallow depressions were observed in the front section of the left parietal bone. One of them was located approximately 15.2 mm from the *sutura coronalis;* it had a round shape with a diameter of about 17.5 mm. A second, smaller depression (with a diameter of about 11.8 mm) was found more dorsally. The surface of both pits is smooth; the edges are rounded and they pass into the surroundings without a clear boundary. The depressions were probably caused by trauma or pressure, for example, by benign tumours (lipomas) or cysts (atheromas).

A small healed fracture was also found on one of the proximal hand phalanges of a female individual (grave No. 4809). In this case, it was most probably an accidental injury during a daily activity.

Among the most significant traumatic changes from the Modřice osteological collection was a find on the skeleton of a 3–4-year-old child (grave No. 3881). In the lower part of the left parietal bone, there is an extensive fracture in the shape of an inverted letter U, with a convexity directed dorsally with a radius of about 5 cm (*Figure 5*). The fracture lines have sharp edges, are slightly bevelled and show no signs of healing. The fragments correspond to each other. Five radial cracks spread around the defect. The first goes to the squamous part of the frontal bone, the second to the parietal bone towards the *sutura sagittalis*, the third runs to the lambda, the fourth goes to the squamous part of the occipital bone, the fifth then reaches almost to the mastoid process.The differential diagnosis between perimortem and postmortem injuries was the most challenging in this case. However, the finding suggested that the bone was still flexible at the time of the injury. This is evidenced by the sharp edges of the broken parts of the defect, evident cracks around the defect, and the individual bone fragments matched in shape and size and enabled the reconstruction of the cranial vault (Aufderheide, Rodríguez-Martín 1985, Horáčková *et al.* 2004, Lovell 1997). It is, therefore, obvious that the described comminuted fracture of the left part of the cranial vault most probably occurred perimortally, apparently by a blow to the head with a blunt object. Such an extensive injury with no signs of repair most probably damaged the brain and was the cause of the child's death. Due to the considerable extent and localisation on the left side of the cranial vault, the anthropogenic origin of the trauma (wound inflicted by a right-handed person) cannot be ruled out. It is also necessary to speculate about the possible fall of a small child from a great height. The method of burial of this child is also unusual and is different from the others.

FIGURE 5: Extensive fracture in the shape of the letter U, with a convexity directed dorsally (arrows) on the left parietal bone of a 3–4-year-old child. Five radial cracks radiating from the defect can be seen. The injury with no signs of reparation was probably caused by a blow to the head with a blunt object and could have been the cause of the child's death. (Grave No 3881; photo by Zdeněk Tvrdý).

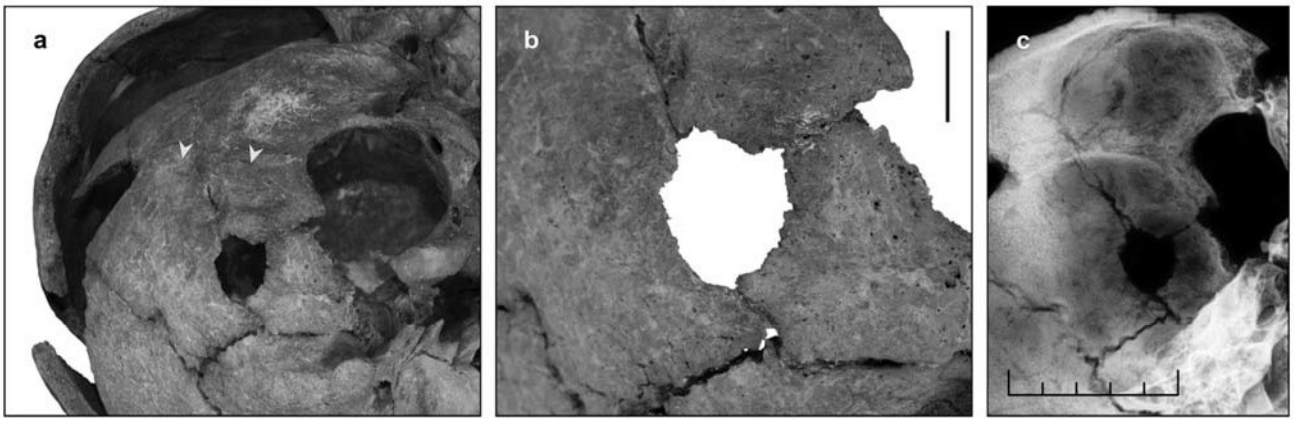

FIGURE 6: Several shallow depressions with pitting observed on the occipital bone of an elderly female, probably caused by chronic soft tissue inflammation (a), with a nearby oval-shaped opening (a, b). The edges of the defect are gently indented and rounded by the healing process (b). X-ray image (c) showsthat the bone is thinned around the perimeter of the lesion without a sclerotic rimwith evident clearing at the depressions. The indentation of the edges could thus have been caused by an effort to clean the wound. (Grave 4809; photo by Zdeněk Tvrdý and Jana Vachová; X-ray by Jan Holub).

The child was one of two individuals buried in the settlement pits. Perhaps someone harmed the child and buried it secretly outside the proper burial ground.

Inflammations

Traces of inflammatory processes in the skeletal remains from Modřice were not frequent, except for the lesions in the oral cavity at the roots of the teeth and inflammation of the attachment apparatus of the teeth – periodontal disease. In two cases, fine lodgements of newly formed bone tissue around the external auditory canal were observed on two children skeletons (graves No. 3850 and 3854). In these places, the surface was finely perforated, slightly bumpy, but rounded by the repair process. It can be assumed that these were signs of *otitis media* (Krenz-Niedballa, Lukasik 2016).

Several shallow depressions on the skull of a 50–60-year-old female (grave No. 4809) in the area of the *linea nuchae inferior* were rare findings. The surface of these pits was bumpy, with a few very fine pores and signs of healing. Apparently, this was a chronic inflammation of the soft tissues in the occipital region, which partially spread to the bone. Near the depressions, on the left side of the squamous part of the occipital bone (about 18 mm from the *crista occipitalis externa*), there was an opening of an approximately oval shape (transversely measuring 18×14.3 mm). From the outside, the edges of the defect are scalloped, but smoothed by the repair process. From the inside, the opening in the ventral part is wider and its edge is bevelled (*Figure 6*). It is possible that the perforation of the skull occurred as a result of an osteolytic inflammatory process. However, it could also have been skull trauma, complicated by chronic inflammation of the surrounding tissues. In this case, the indentation of the edges of the opening could also have been caused artificially, with a trepanation tool, when trying to clean the defect. However, the area around the lesion is partially damaged, so it could not be examined in more detail.

Traces of local chronic inflammation in the form of a rough surface with numerous small perforations on both fibulas above the lateral ankles (grave No. 3859) represent another unusual find. In this case, the aetiology is unknown (e.g. wearing inappropriate shoes, overloading the feet at work, etc.). A local focus of chronic periostitis was noted on the medial surface of the right tibia above the *incisura fibularis* (grave No. 4805). It was probably an ossified subperiosteal hematoma or the beginning of ossification of the *ligamentum tibiofibulare* as a result of age-related wear and tear of the musculoskeletal system.

Joint diseases

Even in small osteological collections, mainly degenerative productive changes are always found. The skeletal remains from Modřice were no exception. These changes were noted mainly on the spine, affecting the vertebral bodies (spondylosis) or the intervertebral joints (spondylarthrosis). It was possible to assess the condition of the spine of 12 individuals (five males, five

females and two juvenile girls). In total, 234 vertebrae (64 cervical, 116 thoracic and 54 lumbar, i.e., an average of 19–20 vertebrae per individual) and eight sacral bones or their parts were studied. Degenerative changes were noted in one-half of them. They had the character of small erosions on the terminal surfaces of the vertebral bodies, osteophytes of varying size around their perimeter, or there were various deep Schmorl´s nodes, which are caused by the protrusion of the nucleus of the intervertebral disc (*nucleus pulposus*) towards the vertebral body (Kahl, Ostendorf Smith, 2000, Mattei, Rehman 2014). The most affected part of the spine was the lumbar section, then the cervical, and the least changes were in the thoracic vertebrae. However, the interpretation of the findings is difficult. Degenerative changes of a smaller scale in individuals older than 40 years can be considered as a manifestation of the natural wear and tear of the locomotor system with age. For that reason, it is possible to consider degenerative changes in individuals younger than 40 years, or in older people with advanced stage manifestations, as a real disease (Dobisíková 1999). These include osteophytes bigger than 3 mm, eburnation and significant destruction of joint surfaces, and geodes of large dimensions. In this context, the actual diseases of spondylosis and spondyloarthrosis would only be in four individuals, namely in two males (grave No. 3853; grave No. 3866) and two females (graves No. 4805 and 4809). A special case is represented by secondary spondylosis in the area of the lumbosacral segment in a young female (grave No. 3889), which originated as a complication of spondylolysis with subsequent spondylolisthesis. Schmorl's nodes on fragments of the bodies of four lumbar vertebrae of a 16–19-year-old subadult girl (grave No. 3860) are also an unusual find. In the differential diagnosis, in this case, the cause of Schmorl's nodes was considered not as spondylosis, but juvenile kyphosis, also called "Scheuermann's disease". This occurs in 0.5–8 % of the Czech population. This disease is typical for adolescent individuals in the period of growth acceleration. This is a structural defect of the vertebrae, which take on a wedge shape and cause, usually at the transition of the thoracic and lumbar sections, a kyphotic curvature of the spine. The aetiology is still unclear; factors such as osteopenia, hormonal imbalance, ischaemic necrosis, genetic influences, etc. are considered (Chaloupka *et al.* 2009, Lewis 2018, Mattei, Rehman 2014). The vertebrae of the affected girl were preserved only in fragments, so their shape could not be determined with absolute certainty. The diagnosis therefore remains only suspect in this case. In the palaeopathological literature, possible cases of juvenile kyphosis from the Late Iron Age were described by Anderson, Cartner (1994), from the Roman period by López-Lázaro *et al.* (2012) and from the 13th–14th centuries by Ustündağ, Deveci (2011). Juvenile kyphosis cannot be confirmed but not excluded either in the skeletal collection from Modřice.

Degenerative changes in the form of arthrosis were noted in three adults (graves No. 3866; 4805 and 4809). Damage to the left temporomandibular joint was observed in the skeleton of a 50–60-year-old male (grave No. 3866), who had erosion of the joint surface on the left head of the mandible. No pathological changes were evident on the right side. Inflammatory lesions at the roots of the teeth could have been the cause of the asymmetric involvement of the temporomandibular joints. During chewing, both temporomandibular joints were therefore unevenly loaded due to pain. In a 40–50-year-old female (grave No. 4805), arthrotic changes were observed in the similarly fine bony rim on the ventral part of the *facies lunata* and around the facies *symphysialis* of both pelvic bones. It is therefore clear that this was a case of incipient arthrosis of both hip joints, which can be considered age-related wear and tear of the joints. Similarly, a sign of ossification of the *ligamentum tibiofibulare anterius* in the form of a light periostotic reaction in the distal part of the right tibia (proximal to the *incisura fibularis*) can be considered as a natural manifestation of the aging of the locomotor system. The same interpretation of the finding of degenerative changes in the sternoclavicular and shoulder joints was also found in the skeleton of a 50–60-year-old female (grave No. 4809).

The diagnosis of this type of joint change is not difficult, but the comparability of findings between individual population samples is problematic. The reason is a different perspective on the assessment of degenerative changes of individual palaeopathologists (e.g. Crubézy *et al.* 2002, Nikita *et al.* 2013, Woo, Sciulli 2013).

Dental diseases

The main indicator of dental health assessment in historical populations is primarily the study of dental caries. In the studied skeletal remains from Modřice, a total of 381 teeth were examined (224 teeth from 9 adults and 85 permanent and 72 deciduous teeth from children), as well as 287 dental alveoli.

To quantify the occurrence of dental caries, the total caries frequency index (F-CE) in the studied sample of the adult population was determined to be 77.7 % and

the caries intensity index (I-CE) to be 13.3 %, while in males I-CE was slightly lower (10.0 %) than in females (15.8 %). Not a single tooth caries was recorded on the evaluable skeletons of juvenile individuals, therefore they are not included in the overall results.

It should be noted that the values found are only indicative, due to the small number of individuals examined (N=9). Extreme findings in individuals could therefore significantly influence the result, e.g., 40–50-year-old a male (grave No. 3853) had five caries, a 50–60-year-old female (grave No. 4809) lost 14 teeth intravitally, while two young males (20–30-year-old male from grave No. 3872 and 30–40-year-old male from grave No. 4811) had dentition without caries and intravital losses.

Comparing the results with other collections from the period of the people of the Funnel-beaker Culture is problematic because mostly only isolated finds or only a few skeletal collections are available. Based on the study of Jarošová *et al.* (2022) of several similarly dated skeletal collections, including the presented skeletal collection from Modřice, the average I-CE in this period in the Czech Lands was 6.1 %.

Using the I-CE index, Caselitz (1998) attempted a worldwide diachronic capture of decay development. Based on his research, the I-CE is around 4.0–5.3 % in the Paleolithic, Mesolithic and Early Neolithic (up to about 4500 BC). With the development of agriculture, in the Neolithic, there is a sudden rise to 7.0 %, reflecting the increased amount of sugars in the diet. From the Middle Bronze Age (about 2350 BC), a gradual rise begins (e.g. around 500 BC it is 13.0 %), and around 750 it reaches 17.0 %. Throughout the Middle Ages, I-CE values are relatively stable (15.0–16.0 %). Only at the beginning of the modern age does a very sharp rise begin, which is associated with the importation of new foods into Europe from America (mainly potatoes).

A similar study for Central Europe was compiled by Strouhal (2004). According to his results, tooth decay in Europeans was also very minimal in the oldest periods (2–5 %), but its increase occurred only in the Early Bronze Age (8.0 %). From the 1st century, however, significant differences were noted in individual population samples (from 3.5 % to 14 %), probably in connection with the stratification of society. Differences were also recorded between Germanic tribes during the Migration Period, with low I-CE values (2–5 %) and Slavic tribes (10–30 %).

In the Czech Lands, Stránská (2013) focused on monitoring caries from prehistoric times to modern times, noting its gradual rise from the Neolithic (7.8 %) through the Middle Ages (9.6 %) to the modern times (13.2 %). Even in this work, however, large differences between individual social groups of the population were

FIGURE 7: Supernumerary tooth – mesiodens – located between the incisors of the maxilla of a 30–40-year-old male, extending into the nasal cavity and causing asymmetry of the *apertura piriformis* (a). The X-ray shows its pin-like shape (b). (Grave No 4811; photo by Zdeněk Tvrdý; X-ray by Jan Holub).

noted. In summary, it can therefore be stated that, in the past, tooth decay in the Czech Lands was generally higher than in the global and Central European comparisons. Considering the above-mentioned data, the frequency and intensity of decay in the collection from Modřice are very high even by Czech standards. The state of preservation of the dentition, necessary for comparing the results with similar locations, was assessed on the basis of commonly used comparative indices. The comparative alveolar index (CAI) had a value of 99.7 %, which meant that the damage to the dental alveoli was minimal in the examined individuals. The comparative dental index (CDI) reached a value of 84.7 % (males 81.3 %; females 87.5 %). Almost 100 % preservation of alveoli and 85 % preservation of teeth are unusually high, considering the age of the collection. A detailed comparison of the dental caries of residents from Modřice with similar studies from the Neolithic period is given in their work by Jarošová *et al.* (2022). Based on their research, along with dietary research, the inhabitants of Modřice consumed mainly plant food, such as wheat, which was rich in carbohydrates (Drtikolová Kaupová *et al.* 2023).

Of the genetically determined dental defects, there was a finding of a supernumerary tooth – mesiodens– on the maxilla of a 30–40-year-old male (grave No. 4811). The tooth was located between the first incisors and protruded into the nasal cavity in close proximity to the *spina nasalis anterior* on the left side (*Figure 7a*). The radiograph showed that it was pin-shaped (*Figure 7b*). As a result, there was an asymmetry in the lower part of the *apertura piriformis*. Similar, even more pronounced deformation of the nasal landscape due to the presence of a mesiodens was described, for example, by Wood and Mackenzie (1987). Mesiodens is the most common type of supernumerary tooth (hyperodontia); its prevalence rates in individual populations range from 0.09 to 2.05 %. Its typical location is in the upper dental arch in the middle plane, between the first incisors (in 82 %). Rarely, it can also occur in the lower jaw. There is usually only one mesiodens, but more can be found. It can be conical, pin-shaped, tube-shaped, or resemble a normal tooth. Its occurrence has been observed mainly in the permanent dentition, it is a rare finding in the deciduous dentition (Meighani, Pakdaman 2010).

Mesiodens may be a separate dental anomaly, or be part of the symptoms in several congenital syndromes, such as Gardner's syndrome, dysostosis cleidocranialis, palatognathoschisis, etc. (Subasioglu *et al.* 2015). No bone changes which would indicate a genetically determined syndrome were observed on the male skeleton from Modřice. In this case, the mesiodens was probably only an isolated finding.

Congenital dental deviations can also include orthodontic anomalies, such as dental crowding. This condition was recorded in the left maxilla of the 30–40-year-old female from grave No. 3851, where the canine was significantly rotated.

The inflammatory changes that occur in the oral cavity are primarily periapical granulomas or cysts. They most often originate as a complication of deep caries extending into the medullary cavity. The infection can thus penetrate from the oral cavity through the root canal to the bone. In palaeopathology, only traces of a periapical granuloma or a radicular cyst can be observed in the form of cystic formations of various sizes near the tooth roots. They can open with a channel (fistula) or one of their sides to the surface of the bone. Periapical granuloma is usually small in size (up to 10 mm), while a radicular cyst is larger. Both formations can only be distinguished histologically (a granuloma is filled with granulation tissue with fibroblasts; a cyst is a bag formed by an epithelial lining and a fibrous capsule). In the studied collection, traces of periradicular inflammation were recorded in two males (50–60-year-old male form grave No. 3866; 40–50-year-old male from Grave no. 3853) and three females (20–30-year-old female from grave No. 3851; 40–50-year-old female from grave No. 4805; 50–60-year-old female from grave No. 4809).

Other inflammatory changes in the oral cavity can be attributed to periodontal disease, an inflammation of the attachment apparatus of the teeth and surrounding soft tissues. Its causes are various. Most often, the disease is caused by bacteria from dental plaque, which is considered the main cause of marginal gingivitis. In chronic forms of periodontal disease, calculus, which is formed by the ossification of dental plaque, is mainly involved in the development of aseptic inflammation. This then mechanically irritates the surrounding soft structures. Gingivitis is one of the typical symptoms of some general diseases, especially scurvy (Ortner, Eriksen 1997; Snoddy *et al.* 2018), *diabetes mellitus*, endocrine imbalance (puberty, pregnancy, menopause), or when the body's defences are reduced by some serious disease (for example, in leukemia). However, the cause can also be genetically conditioned disposition (Dřízhal 2003).

On the skeletal remains, periodontal disease is most often manifested by porosity or indentation of the edges of the alveoli. There may be horizontal destruction of the alveolus, resembling physiological atrophy of the

alveolus with age or, conversely, bone neoplasia. Dental alveoli are then lined with ridges that resemble an abnormally large torus maxillaris or mandibularis (Brothwell 1972, Strouhal 2004).

In the studied osteological collection, it was possible to assess the condition of the jaws in a total of 19 individuals (11 adults and eight children), of which signs of periodontal disease were observed in 6 cases (i.e. 31.5 %; see *Table 1*). Comparison with the remains from other archaeological sites is quite problematic, as a standardised evaluation system has not been universally adopted. StrohmAlt (1998) tried to determine criteria for the evaluation of periodontal disease in palaeopathology, according to the distance between the enamel and cementum border to the alveolar edge (up to 2 mm - standard; between 2-4 mm - 1st degree; between 4-6 mm - 2nd degree and above 6 mm - 3rd degree). However, the natural loss of bone tissue of the dental alveolus with age can significantly distort the result of this method. In addition, gingivitis often results in bone neoplasia as well, which this classification does not account for. Nevertheless, it is known that this disease already occurred in the Paleolithic, and its frequency began to increase from the Neolithic (Brothwell 1972, Strohm, Alt 1998, Strouhal 2004). The results of the presented study correspond to this.

CONCLUSIONS

An extensive cultural complex of Funnel-beaker Culture occupied a dominant position in Northern Europe during the Eneolithic period. The studied osteological collection from Modřice near Brno (3800-3640 calBC) is dated to this prehistorical era. The presented paper focuses on monitoring disease changes on skeletal remains. In the palaeopathological analysis, the usual spectrum of diseases was noted, similar to other historical population samples.

In the studied population, dental diseases occurred most often. During the Funnel-Beaker period, tooth decay, in particular, was relatively high. This was also related to the high incidence of inflammatory periapical foci at the roots of the teeth. Traces of periodontal disease were also common. Of the genetically determined dental defects, an interesting finding was a supernumerary tooth - mesiodens. Among the congenital dental deviations, orthodontic anomalies, such as dental crowding of the teeth with the subsequent rotation of some of them, were documented.

Of joint diseases, even in small osteological collections, especially degenerative changes are usually found. In the population from Modřice, these changes were noted mainly on the spine, in roughly one-half of the evaluable individuals. The most affected part of the spine was the lumbar section. An interesting case was represented by a secondary spondylosis in a young female, occuring in the area of the lumbosacral segment, which arose as a complication of spondylolysis with subsequent spondylolisthesis. Schmorl's nodes were noted on the lumbar vertebrae of a 16-19-year-old girl, probably as a result of juvenile kyphosis (Scheuerman's disease). Degenerative changes in the form of arthrosis were recorded in only 3 adults (50-60-year-old male from grave No. 3866; 40-50-year-old female from grave No. 4805; 50-60-year-old female from grave No. 4809).

Of developmental anomalies, partial obliteration of the sagittal suture with an indication of scaphocephaly was observed on the skull of a 12-14-year-old child. A congenital block of lumbar vertebrae (L3-L5) was created on the spine of one of the females, and interarticular spondylolysis was found in the 5th lumbar vertebra (grave No. 3889).

In palaeopathology, porotic changes on the roof of the orbits called *cribra orbitalia* are classified as non-specific manifestations of, especially, metabolic diseases. In Modřice skeletons, the occurrence of *cribra orbitalia* fell within the range of values recorded on similar Central European Neolithic and Eneolithic skeletal collections. It is not excluded that *cribra orbitalia* on 2 children's skeletons were the symptoms of C-avitaminosis- scurvy. Especially on the skeletal remains of a 3-4-year-old child, the diagnosis is very possible, as multiple periostotic foci, probably ossified subperiosteal haematomas, were visible on the skeleton.

Traces of injuries are a common finding in skeletal remains of historical populations. In Modřice, these were mostly the consequences of caused by repeated physical stress, or small healed fractures caused by accidental injuries. Anthropogenic origin is highly probable in the case of a very extensive fracture on the left parietal bone with numerous cracks on the skull of a 3-4-year-old child. The child probably received a strong blow to the head with a blunt object. This was a very serious, fatal injury, most probably associated with intracranial bleeding.

Traces of inflammatory processes were not frequent in the examined population, with the exception of the already mentioned dental diseases. Signs of *otitis media* were observed on two children's skulls.

TABLE 1: Summary of paleopathological findings recorded on the skeletal remains of the Funnel-beaker Culture from Modřice (Brno-Country District). Legend: Sex: M – male (*masculinum*); F – female (*femininum*); N/A – unknown. Age cathegories: I – infans I (0–6 yrs), infans II (7–14 yrs); J – juvenis (15–20 yrs); A – adultus I (20–30 yrs), adultus II (30–40 yrs); M – maturus I (40–50 yrs), maturus II (50–60 yrs); S – senilis (60 yrs and over)
Abbreviations: yrs – years.

Grave No.	Sex	Age	Finding
	N/A	Infans I (3–4 yrs)	3850
3851	F	A I (20–30 yrs)	dental caries
			dental crowding
			periapical inflammation
			periodontal disease
			dextroscoliosis
			spina bifida ossis sacri
3853	M	M I (40–50 yrs)	dental caries
			periapical inflammation
			periodontal disease
			spondylosis
			periostosis on both fibulae
3854	N/A	Infans II (7 yrs)	*cribra orbitalia* (II)
			otitis media
3857	M	A	without pathological findings
3858	F	J (15–19 yrs)	without pathological findings
3859	N/A	Infans I (3–4 yrs)	without pathological findings
3860	F	J (16–19 yrs)	discopathy of the lumbar spine
3862	F	A II (30–40 yrs)	dental caries
			osteochondritis dissecans
3863	N/A	Infans II (11–12 yrs)	without pathological findings
3865	M	A I (20–30 yrs)	intraarticular spondylolysis L5
			patella bipartita (III)
3866	M	M II (50–60 yrs)	occipital bone depressions
			dental caries
			periapical inflammation
			periodontal disease
			spondylosis ad spondylarthrosis
			arthrosis
			myositis ossificans
			patella bipartita (III)
			spina bifida ossis sacri
3869	N/A	Infans II (7–8 yrs)	*cribra orbitalia*
			enamel hypoplasia
			porosity on ends of long bones
3871	N/A	Infans II (12–14 yrs)	*cribra orbitalia* (I)
			craniosynostosis
3872	M	A I (20–30 yrs)	periodontal disease
			5th metacarpal bone trauma
3878	N/A	Infans I (3 yrs)	asymmetry of cerebral fossae

3881	N/A	Infans I (3–4 yrs)	perimortal fracture of cranial vault
3889	F	A I (20–30 yrs)	dental caries
			enamel hypoplasia
			synostosis of L3–L5
			intraarticular spondylolysis of L5
			spondylosis of lumbar-sacral segment
3896	N/A	Infans I (2.5–3 yrs)	without pathological findings
4805	F	M I (40–50 yrs)	periodontal disease
			dental caries
			periapical inflammation
			spondylosis of L4, L5, S
			arthrosis of *facies lunata*, *facies symphysialis*
			periostosis on right tibia
4809	F	M II (50–60 yrs)	dental caries
			periapical inflammation
			traces after inflammation on occipital bone
			trauma – skull perforation
			spondylolysis
			spondylarthrosis
			phalanx fracture
			arthrosis of sternoclavicular joints omarthrosis
4811	M	A II (30–40 yrs)	mesiodens (supernumerary tooth)
			periodontal disease
			spondylolysis
			spondylarthrosis
			osteochondritis dissecans
			myositis ossificans

One of unusual findings, several shallow depressions on the occipital bone of a 50–60-year-old female, were apparently caused by the transfer of infection from the surrounding soft tissues to the surface of the occipital bone. Near the depressions, there was an oval opening with a slightly indented edge showing traces of the healing process. The perforation of the skull could have occurred as a result of an osteolytic inflammatory process, but it could also represent a trauma complicated by chronic inflammation of the surrounding tissues.

In summary, it can be concluded that the population from Modřice (Brno-Country District), from the period of the Funnel-beaker Culture, represents a small group of the rural population engaged in agricultural activity. There are clear signs of physical activity on the skeletons. On the two children skeletons, scurvy has been indicated, probably being caused by a low intake of vitamin C during the transition from breastfeeding to solid food. Compared to similar Neolithic and Eneolithic groups, the population from Modřice had a very high rate of tooth decay, which could be related not only to the composition of the food, but also to an innate predisposition to its occurrence. Skulls and spines were those most affected by congenital malformations. Most of the inflammatory changes on the bones were observed in connection with dental diseases; two cases of *otitis media* were also recorded, and the most unusual finding were the lesions on the cranial vault of one of the females (depressions on the occipital bone with signs of chronic inflammation), the origin of which can only be speculated. The number of non-specific manifestations of stress, mostly caused by various common infectious diseases, did not exceed the data described in other populations. The presented research was limited by the small number of skeletons excavated during the archaeological research. Even so, it presents new information about the health status of the Funnel Beaker population and deepens the existing knowledge about the Eneolithic population living in Moravia.

ACKNOWLEDGEMENTS

We thank Dr. František Trampota for refining the radiocarbon dating of the burial site.

We thank Jana Vachová, Pearl Harris and Jan Holub for their skilful technical assistance.

The presented work appears through the institutional support of long-term conceptual development of research institutions provided by the Ministry of Culture (ref. MK000094862).

REFERENCES

ACSÁDI G., NEMESKÉRI J., 1970: *History of human life span and mortality*. Akadémiai Kiadó, Budapest.

ANDERSON T., CARTNER A. R., 1994: A possible example of Scheuermann's Disease from Iron Age, Deal, Kent. *Journal of Palepathology* 6: 57–62.

ASH A., FRANCKEN M., PAP I., TVRDÝ, Z., WAHL J., PINHASI R., 2016: Regional differences in health, diet and weaning patterns amongst the first Neolithic farmers of central Europe. *Scientific Report*s 6, 29458. doi: 10.1038/srep29458

AUFDERHEIDE A. C., RODRÍGUEZ-MARTÍN R. C., 1998: *The Cambridge Encyclopedia of Human Paleopathology*. Cambridge University Press, Cambridge.

BARNES E. 1994: *Developmental Defects of the Axial Skeleton in Palaeopathology*. University Press of Colorado.

BICKLE P., WHITTLE A., 2013: *The first farmers of central Europe*. Oxbow Books.

BRICKLEY M., 2018: Cribra orbitalia and porotic hyperostosis: A biological approach to diagnosis. *American Journal of Physical Anthropology* 167: 896–902. DOI: 10.1002/ajpa.23701

BRICKLEY M., IVES R., 2006: Skeletal manifestations of infantile scurvy. *American Journal of Physical Anthropology* 129: 163–172.

BRICKLEY M., IVES R., MAYS S., 2020: *Bioarchaeology of Metabolic Bone Disease*. Elsevier.

BROTHWELL D. R., 1972: *Digging up Bones*. British Museum of Natural History, London.

BUIKSTRA J., 2019: *Ortner's Identification of Pathological Conditions in Human Skeletal Remains*. Academic Press, London.

BRUNS J., WERNER M., HABERMANN CH., 2018: Osteochondritis Dissecans: Etiology, Pathology, and Imaging with a Special Focus on the Knee Joint. *Cartilage* 9: 346–362. DOI: 10.1177/1947603517715736

CASELITZ P., 1998: Caries – Ancient Plaque of Humankind. In: K. V. Alt, F. W. Rösing, M. Teschler-Nikola (Eds.): *Dental Anthropology*. Pp. 203–226. Fundamentals, Limits, Prospects, Springer, Wien, New York.

CHALOUPKA R., REPKO M., RYBA L., NEUBAUER J., 2009: Dětská páteř. In: J. Poul et al. (Eds.): *Dětská ortopedie*. Pp. 57–77. Galén.

CRUBÉZY E., GOULET J., BRŮŽEK J., JELÍNEK, J., ROUGÉ R., LUDES B., 2002: Epidemiology of osteoarthritis and enthesopathies in a European population dating back 7700 years. *Joint Bone Spine* 69, 580–588.

DELASHAW J. B., PERSING J. A., JANE J. A., 1991: Cranial deformation in craniosynostosis. A new explanation. *Neurosurgery Clinics of North America* 2: 611–620.

DEWITTE S. N., BEKVALAC J., 2011: The Association Between Periodontal Disease and Periosteal Lesions in the St. Mary Graces Cemetery, London, England A.D. 1350–1538. *American Journal of Physical Anthropology* 146: 609–618. DOI: 10.1002/ajpa.21622

DOBISÍKOVÁ M., 1999: Určování věku. In: M. Stloukal, M. Dobisíková, V. Kuželka et al. (Eds.): *Antropologie. Příručka pro studium kostry*. Pp. 235–339. Národní muzeum, Praha.

DROZDOVÁ E., 2011: *Antropologický rozbor kosterních pozůstatků z Prostějova-Čechůvek a Olomouce-Hejčína*. Sborník prací Filozofické fakulty brněnské univerzity M16, 29–41.

DRTIKOLOVÁ KAUPOVÁ S., JAROŠOVÁ I., BÍŠKOVÁ J., HRNČÍŘ V., KVĚTINA P., NEUGEBAUER-MARESCH CH., POKUTTA D. A., ŘÍDKÝ J., TVRDÝ Z., VYTLAČIL Z., TRAMPOTA F., 2023: The diet of settled Neolithic farmers of east-central Europe: isotopic and dental microwear evidence. *Archaeological and Anthropological Sciences* 15, 21. doi: 10.1007/s12520-023-01720-9

DŘÍZHAL I., 2003: Parodontologie. In: J. Mazánek, F. Urban et al. (Eds.): *Stomatologické repetitorium.* Pp. 81–84. Grada Publishing a.s, Praha.

DUNGL P., CHROMIAK J., KOFRÁNEK I., et al. 2005: *Ortopedie*. Grada Publishing, Praha.

FREDRICKSON B. E., BAKER D., MCHOLICK W. J., YUAN H. P., LUBICKY J. P., 1984: The natural history of spondylolysis and spondylolisthesis. *The Journal of Bone and Joint Surgery* 66: 699–707.

HACKETT C. J., 1976: *Diagnostic Criteria of Syphilis, Yaws and Treponematoses and Some Other Diseases in Dry Bones*. Sber Heidel Akad Wiss, Math-Nat Ki Abhdlg 4. Springer, Berlin, Heidelberg.

HAJNIŠ K., NOVÁK L., 1984: *Srůst švů lebeční klenby*. Avicenum, Praha.

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

HILLSON S., 2001: Recording Dental Caries in Archeological Human Remains. *International Journal of Osteoarcheology* 11: 249–289.

HORÁČKOVÁ L., STROUHAL E., VARGOVÁ L., 2004: *Základy paleopatologie. Panoráma biologické a sociokulturní antropologie*. Nadace Universitas Masarykiana, Edice Scientia, Brno.

HORN CH., 2021: Trouble in paradise? – Violent conflict in Funnel-Beaker societies. *Oxford Journal of Archeology* 40: 43–64. https://doi.org/10.1111/ojoa.12212

JAROŠOVÁ I., 2012: Kazivost zubů dolnověstonické populace Na Pískách. Komparační studie vybraných historických populací. In: I. Jarošová, M. Fojtová, Z. Tvrdý (Eds.): *Antropologická analýza raně středověké populace z Dolních Věstonic-Na Pískách*. Pp. 80–95. Anthropos 34, Brno.

JAROŠOVÁ I., FOJTOVÁ M., TVRDÝ Z., KALA J, BERAN-CIMBŮRKOVÁ P, BRZOBOHATÁ H, TRAMPOTA F., 2022: Dental health and diet in the Middle and Late Neolithic (4900–3400 BC): A study of selected microregions in the Czech Republic. *Anthropologie* 60: 351–378. https://doi.org/10.26720/anthro.22.09.19.1

JOHNSON D., WILKIE A. O. M., 2011: Craniosynostosis. *European Journal of Human Genetics* 19: 369–376.

KAHL K. E., OSTENDORF SMITH M., 2000: The Pattern of Spodylosis Deformans in Praehistoric Samples from West-Central New Mexico. *International Journal of Osteoarchaelogy* 10: 432–446.

KAJDIC N., SPAZZAPAN P., VELNAR T., 2018: Craniosynostosis – Recognition, clinical characteristics, and treatment. *Bosnian Journal of Basic Medical Sciences* 18: 110–116. DOI: 10.17305/bjbms.2017.2083

KALICHMAN L., KIM D. H., LI L., GUERMAZI A., BERKIN V., HUNTER D. J., 2009: Spondylolysis and spondylolisthesis: prevalence and association with low back pain in the adult community-based population. *Spine* 34: 199–205. DOI: 10.1097/BRS.0b013e31818edcfd

KRENZ-NIEDBALLA M., LUKASIK S., 2016: Skeletal Evidence for Otitis Media in Mediaeval and Post-Mediaeval Children from Poland, Central Europe. *International Journal of Osteoarchaeology* 27: 375–386. https://doi.org/10.1002/oa.2545

KUBÁTOVÁ A., MELICHAR J., LIBÝ P., *et al.* 2019: Kraniosynostóza – časná správná diagnóza, časné endoskopické řešení. *Pediatrie pro praxi* 20: 229–233.

LINC R., 1971: *Kapitoly z růstové a funkční morfologie*. Univerzita Karlova, Praha.

LEWIS M., 2018: *Paleopathology of Children.* Academic Press, Elsevier, London, San Diego, Cambridge, Oxford.

LÓPÉZ-LÁZARO S., VICIANO J., AMORES A., JIMÉNEZ-TRIGURO J. M., 2012: A probable case of scheuermann's disease in a juvenile male from the Late Roman necropolis of Torrenueva (III – IV AD, Granada, Spain). *Journal of Biological Research - Bollettino della Societa Biologia Sperimentale* 85: 239–240. https://doi.org/10.4081/jbr.2012.4124

LOVELL N. C., 1997: Trauma analysis in paleopathology. *Yearbook of Physical Anthropology* 40: 139–170.

MATTEI T. A., REHMAN A. A., 2014: Schmorl's nodes: current pathophysiological, diagnostic, and therapeutic paradigms. *Neurosurgical Review* 37: 39–46. DOI: 10.1007/s10143-013-0488-4

MEIGHANI G., PAKDAMAN A., 2010: Diagnosis and Management of Supernumerary (Mesiodens). *Journal of Dental Medicine - Tehran* 7: 41–49.

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: 57–66.

MØLLER-CHRISTENSEN V., 1961: *Bone Changes in Leprosy*. Munksgaard, Copenhagen.

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 and London.

NIKITA E., MATTINGLYM D., LAHR M. M., 2013: Methodological considerations in the statistical analysis of degenerative joint and disc disease. *International Journal of Paleopathology* 3: 105–112. https://doi.org/10.1016/j.ijpp.2013.03.002

OLIVIER G., 1960: *Pratique Anthropologique*. Vigot Fréres, Paris.

ORTNER D. J., 2003: *Identification of Pathological Conditions in Human Skeletal Remains*. Academic Press, London.

ORTNER D. J., ERICKSEN M. F., 1997: Bone Changes in the Human Skull Probably Resulting from Scurvy in Infancy and Childhood. *International Journal of Osteoarchaeology* 7: 212–220.

ORTNER D. J., PUTSCHAR G. J., 1985: *Identification of Pathological Conditions in Human Skeletal Remains*. Smithsonian Institution Press, Washington.

PANKOWSKÁ A., PEŠKA J., VRÁNA J., 2010: Congenital Cranial Defect in a Female from a Funnel Beaker Culture Settlement in Náměšť na Hané (Czech Republic) – a Case Report. *Interdisciplinaria Archaeologica* 1: 35–47.

PIMENTEL L., 2003: Scurvy: Historical Review and Current Diagnostic Approach. *The American Journal of Emergency Medicine* 21: 328–332.

POSPÍŠILOVÁ B., PROCHÁZKOVÁ O., SERBOUTI K., 2003: Paleopatologické nálezy předčasné obliterace věnčitého švu. *Acta Medica supplementum* 46: 13–21.

POSPÍŠILOVÁ B., PROCHÁZKOVÁ O., 2006: Paleopathological Findings of Dry Skulls with Plagiocephaly. *Acta Medica* 49: 219–226.

SMRČKA V., TVRDÝ Z., 2009: Skeletal Evidence for Diseases in the Neolithic of Moravia. *Anthropologie* 47: 295–303.

SNODDY A. M. E., BUCKLEY H. R., ELLIOTT G. E., STANDEN V. G, ARRIAZA B. T., HALCROW S. E., 2018: Macroscopic features of scurvy in human skeletal remains: A literature synthesis and diagnostic guide. *American Journal of Physical Anthropology* 167: 876–895. doi: 10.1002/ajpa.23699

STARK J. R., 2014: A proposed Framework for the study of paleopathological cases of subadult scurvy. *International Journal of Paleopathology* 5: 18–26. DOI: 10.1016/j.ijpp.2014.01.005

STEINBOCK R. T., 1976: *Paleopathological Diagnosis and Interpretation*. Charles C. Thomas, Publischer, Springfield, Illinois.

STRÁNSKÁ P., 2013: Možnosti hodnocení dentální patologie na kostrovém materiálu: prevalence zubního kazu od pravěku po novověk. *Časopis lékařů českých* 152: 196–204.

STROHM T. F., ALT K. W., 1998: Periodontal Disease – Etiology, Classification and Diagnosis. In: K. Alt, F. W. Rösing, M. Teschler-Nicola (Eds.): *Dental Anthropology Fundamentals, Limits, Prospects*. Pp. 227–244. Springer, Wien–New York.

STROUHAL E., 2004: Choroby zubů a alveolů. In: L. Horáčková, E. Strouhal, L. Vargová: *Základy paleopatologie. Panoráma biologické a sociokulturní antropologie*. Pp. 177–191. Nadace Universitas Masarykiana, Edice Scientia, Brno.

SUBASIOGLU A., SAVAS S., KUCUKYILMAZ E., Kesim S., YAGCI A., DUNDAR M., 2015: Genetic background of supernumerary teeth. *European Journal of Dentistry* 9: 153–158. doi: 10.4103/1305-7456.149670

SUZUKI T., 1984: *Palaeopathological and Palaeoepidemiological Study of Osseous Syphilis in Skulls of the Edo Period*. The University of Tokyo Press, Tokyo.

ŠMÍD M., 2017: *Nálevkovité poháry na Moravě*. Pravěk Supplementum 33. Ústav archeologické památkové péče Brno, v.v.i., Brno.

ŠMÍD M., TVRDÝ Z., PARMA D., KOS P., 2018: *Pohřebiště kultury nálevkovitých pohárů s pohřby v natažené poloze z Modřic, okr. Brno-venkov*. Acta Mus Moraviae, Sci soc CIII: 101–140.

ŠMÍD M., KOS P., PARMA D., *et al.* 2021a: *Eneolitické osídlení lokality Modřice-Rybníky (okr. Brno-venkov).* Pravěk Supplementum 36. Ústav archeologické památkové péče Brno, v.v.i, Brno.

ŠMÍD M., LEČBYCH M., ŠMERDA J., KALA, J., LIMBURSKÝ P., 2021b: Sídliště a pohřebiště kultury nálevkovitých pohárů v Dambořicích, okr. Hodonín. Příspěvek k poznání pohřebišť s pohřby v natažené poloze. *Archeologické rozhledy* LXXIII: 3–47.

TRAMPOTA F., BÍŠKOVÁ J., ČEREVKOVÁ A., ČIŽMÁŘ I., DROZDOVÁ E., KALA J., KOS P., KVĚTINA P., PARMA D., PŘICHYSTAL M., SVĚTLÍK I., ŠÍN L., TVRDÝ Z., VRÁNA J., 2021: Eneolitický kostrový pohřební ritus na Moravě ve světle radiokarbonového datování. *Archeologické rozhledy* LXXIII: 315–358.

TSIRIKOS A. I., GARRIDO E. G., 2010: Spondylolysis and spondylolisthesis in children and adolescents. *Journal of Bone and Joint Surgery (Br)* 92: 751–759.

USTÜNDAĞ H., DEVECI A., 2011: A Possible Case of Scheuermann's Disease from Akarçay Hoyük, Birecik (Sanlıurfa, Turkey). *International Journal of Osteoarchaeology* 21: 187–196.

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

VIKATOU I., HOOGLAND M. L. P., WATER-RIST A. L., 2017: Osteochondritis Dissecans of skeletal elements of the foot in a 19th century rural farming community from The Netherlands. *International Journal of Paleopathology* 19: 53–63. DOI: 10.1016/j.ijpp.2017.09.005

VIRCHOW R., 1851: Über den Cretinismus, namentlich in Franken, und über pathologische Schädelformen. *Verh Phys Med Ges Wurz* 2: 230–270.

VYHNÁNEK L., STLOUKAL M., 1977: *Spondylolyse. Problematik und Vorkommen im altslawischen Knochenmaterial*. Academia, Praha.

VYHNÁNEK L., BOHUTOVÁ J., BELŠÁN T., *et al.* 1998: *Radiodiagnostika. Kapitoly z klinické praxe*. Grada Publishing, Praha.

WALCZAK B. E., JOHNSON CH. N., HOWE B. M., 2015: Myositis Ossificans. *Journal of the American Academy of Orthopaedics Surggery* 23: 612–622. DOI: 10.5435/JAAOS-D-14-00269

WALDRON T. 2009: *Palaeopathology*. Cambridge University Press, Cambridge.

WAPLER U., CRUBÉZY E., SCHULTZ M., 2004: Is Cribra Orbitalia Synonymous With Anemia? Analysis and Interpretation of Cranial Pathology in Sudan. *American Journal of Physical Anthropology* 123: 333–339.

WELLS C. 1974: Osteochondritis dissecans in ancient British skeletal material. *Medical History* 18: 365–369.

WILTSE L. L., WIDELL E. H., JACKSON D. W., 1975: Fatigue fracture. The basic lesion in isthmic spondylolisthesis. *Journal of Bone and Joint Surgery (Am)* 57: 280–288.

WILLIAMS F. L., TVRDÝ Z., PARMA D., 2023: Craniofacial pathologies in a Funnel Beaker Neolithic early adolescent from Modřice, Czechia. *Anthropological Review* 86: 1–15. DOI: https://doi.org/10.18778/1898-6773.86.1.01

WOO J. E., SCIULLI P. W., 2013: Degenerative Joint Disease and Social Status in the Terminal Late Archaic Period (1000–500 B.C.) of Ohio. *International Journal of Osteoarchaeology* 23: 529–544. DOI:10.1002/oa.1264

WOOD G. D., MACKENZIE I., 1987: A dentonasal deformity. *Oral Surgery, Oral Medicine, Oral Pathology* 63: 656–657.

ŽIŽKA J., 1994: *Diagnostika syndromů a malformací.* Galén, Praha.

Lenka Vargová
Kateřina Vymazalová*
Research Group of Medical Anthropology and Clinical Anatomy, Department of Anatomy, Faculty of Medicine, Masaryk University, Kamenice 3, 625 00 Brno, Czech Republic,
e-mail: vargova@med.muni.cz,
e-mail: vymazalova@med.muni.cz

Zdeněk Tvrdý
Anthropos Institute, Moravian Museum, Zelný trh 6, 659 37, Brno, Czech Republic,
e-mail: ztvrdy@mzm.cz

*Corresponding author.