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The interdisciplinary cooperation of forensic medicine, clinical medicene and palaeozoology: a case of cave bear *(Ursus spelaeus)* bones

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SUMMARY
Three pathologically modified bones (cranium, left mandible, iliac bone) of a cave bears (*Ursus spelaeus*) were found in the Last Glacial deposits (OIS 3) in the caves of the Veľká Fatra carst, Slovak republic. Despite of thorough paleontological examination, the bear bones were examined by experts in forensic medicine, traumatology and stomatology, too. The pathological changes were found in the tooth bed on the right side of the maxilla at the place of M1, being interpreted as a result of odontogenic purulent inflammation of soft tissues of tooth bed and surrounding bone. The iliac bone has an abnormally formed acetabulum with damaged and deformed osseous upper border, which could be a result of immoderate pressure of the head of femur, following with the mineral dysbalance (decalcification) or fracture of *limbus acetabuli* caused by injury. The mutual cooperation of all the abovementioned experts was declared as a very fruitful.

Key words: palaeozoology - cave bear - *Ursus spelaeus* – forensic osteology

Interdisciplinárna spolupráca súdneho lekárstva, klinickej medicíny a paleozoológie: Prípad kostí jaskynného medveďa *(Ursus spelaeus)*

SÚHRN
Počas paleontologického výskumu krasovej oblasti v pohorí Veľká Fatra (severné Slovensko) bolo nájdených niekoľko patologicky zmenených kostí medveďov jaskynných (*Ursus spelaeus*), datovaných do obdobia posledného zaľadnenia, pravdepodobne do kyslíkového izotopového štádia OIS 3. Po dôslednom paleontologickom preskúmaní boli medvedie kosti skúmané ďalej expertmi zo súdneho lekárstva, traumatológie a stomatológie. Patologické zmeny zubného lôžka, vyskytujúce sa na pravej strane hornej čeľuste lebky medveďa jaskynného v mieste M1 boli interpretované ako výsledok odontogénnej purulentnej inflamácie mäkkých tkanív zubného lôžka a okolitej kosti. Skúmaná bedrová kosť mala patologické acetabulum s poškodeným a deformovaným horným kosteným okrajom, čo pravdepodobne vzniklo nadmerným tlakom hlavice stehnovej kosti v súčinnosti so stratou minerálnej rovnováhy v kosti (dekalcifikácie) alebo so zlomeninou *limbus acetabuli*, spôsobenou zranením. Vzájomná spolupráca expertov z vyššie uvedených odborov sa ukázala ako veľmi prínosná.

Kľúčové slová: paleozoológia – jaskynný medveď – *Ursus spelaeus* - forenzná osteológia

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In the course of the palaeontological research of the carst area within the Veľká Fatra Mts. (Northern Slovakia), several bones of cave bears (*Ursus spelaeus*) were found. The signs of some pathological changes were supposed on the bones; thus the experts of forensic and clinical medicine were asked to join the exploratory team. The fossil record was dated to the Last Glacial, probably to the period of OIS 3 (2, 7). Most of fossils under the study came from the Cave of Izabela Textorisová (named as HJ-number) and the Biela Cave (named as JB-number), both caves being situated in Gaderská Valley (National Natural Reservation) near the village of Blatnica in the region nearby Martin, Slovak republic (1).

DESCRIPTIVE MORPHOLOGY OF THE BONES

While some pathological changes were found on the bear bones, the working group of experts from palaeozoology, forensic medicine, traumatology, and forensic stomatology was established. The aim was to precisely describe the

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bones themselves, with particular focusing on eventual pathological changes, by use of x-ray analysis as well.

In the aspect of morphological changes, the cranium (HJ-548), left hemimandible (JB-21), left humerus (HJ-834) and the iliac bone (HJ-626) were among the most interesting parts of the ancient cave bears skeleton. Since the left bear humerus (HJ-834) has been already described elsewhere (4), the pathological changes of the other bones of the mentioned animal are described here.

1. The cranium (HJ-548) was of an adult cave bear, well preserved and almost complete. Any visible degenerative or growth abnormalities on the skull were found. There was, however, an evident morphological difference between teeth of the right and left side of the maxilla, being caused by natural, non-symmetric mechanical abrasion. The profound mechanical abrasion together with a deep caries up to dentine of dark brown colour was found on right side teeth. Left side teeth with still present enamel were less mechanically worn out, perhaps due of former pathological process of the tooth bed in the site of the M1 (Fig. 1). The surrounding osseous alveolar process was reduced with tooth bed distension and reduction of the mass of alveolar bone of the M2. A visible *canaliculus*, connecting the maxillary sinus with openings in the maxilla was also found. The opening and the minute bone erosions (depurations) were found on the external area of maxillar bone.
2. The signs of the healing process were found also on the processus alveolares of the left side of the mandible after falling out of the teeth during the life of the animal, together with the bed of the canine tooth, and healing remnants belonging to premolar tooth (JB-21). The cavity at the posterior part of the mandible was interpreted as a residuum after the tooth fallen out passively after the animal´s death. At the back border of a bone fragment, a smooth mandibular nerve canal was clearly seen. One big and one smaller openings were situated at the frontal external area of the bone. In a deeper part of the bigger opening the small orifices for branches of the nerve were seen; borders of the opening were smooth, round-shaped.
3. The specimen HJ-626 represented a fragment of the bear´s hipbone with abnormally formed acetabulum (Fig. 2), together with the parts of bones arising from the acetabular area towards the wing of iliac bone and the pubic bone. The bone specimen belonged to an adult animal since all three parts forming the acetabulum were firmly fixed together by the grown process. Well-developed tuberosities for tendon attachments were also visible.

Fig. 1: Deep caries chages on right side teeth of the maxilla. Left side teeth with still present enamel, being less mechanically worn out.

Fig. 2: Pathologically formed acetabulum of the hipbone.

POSSIBLE PATHOGENESIS OF BONE CHANGES

The specimen for microscopic investigation weren´t taken from the afflicted bone tissue, as far as all the bones were covered by serious protection as a precious paleontologic artifacts. The X-ray analysis of skull wasn´t of a great relevancy for more detailed investigation, due to the age of the bones and gross decalcification. After the gross and thorough examination it was stated, that the opening on the left maxillar side was developed by pathological process, most probably an odontogenic purulent inflammation of soft tissues of tooth bed and surrounding bone. Such pathological process might cause to the the animal a deep tactile pain while biting food, which might be a reason why the affected animal tried to protect the left side teeth and used the right side teeth for biting. Curiously, the condylar processes of both hemimandibles and their articular surfaces in the skull display no asymmetrical morphology. While there weren´t found any pathological changes on enamel and dentine of the molar tooth adjacent to pathologically changed tooth bed (no deep-seated caries), it seems probable that pathological changes could develop as a result of an inflammation of periodontal apparatus of the tooth (paradentosis). Paradentosis could be caused also due of injury (e.g. by sharp infected fragment of animal bone, pricked into the periosteum, etc.). Based on the X-ray analysis of the bone fragment of mandible and its comparison to the mandible of other individual of the same biological species, the following can be stated:

a) The opening was conjoined only with canal of nervus mandibularis. It was not conjoined with opening (tooth bed) right above it. No markers of inflammatory chan-

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ges and/or bone remodelling were present in the surrounding bone structures;
b) The opening was probably formed by natural process, perhaps by connecting of two smaller openings together;
c) The opening was not a result of pathological cystic process in the bone mass;
d) Postmortal changes of the bone and the reaction of surrounding bone tissue after death could contribute to enlargement of the opening; and
e) The complete healing of the alveolar process and supposed way of falling out of the molar tooth (with subsequent healing) suggest the higher age of specimen.

The pathological changes of the hip acetabulum were represented by damaged and deformed osseous upper border of acetabulum (*limbus acetabuli*). Such a pathomorphology grown during the life of the animal as a result of probably two possible causes:

a) Moderate pressure of the head of femur, in coincidence with the mineral dysbalance (resulting in bone decalcification), or
b) Possible fracture of *limbus acetabuli* caused by injury.

Regardless of primary cause of the warping of acetabulum, the hip joint was subsequently biomechanically deformed – the head of femur was displaced out of the acetabulum slightly outwards and upwards. Reduced articulation area for the head of femur can be seen on damaged acetabulum. On the other hand, just above this area in the site of original acetabular margin, an evident smoothering out of the iliac bone could be seen, which had been evidently caused by direct contact and pressure of the head of femur while moving the affected limb. Right above this smoothered area, the osteophytes were present. They were developed by chronic inflammatory process and by degenerative inflammatory changes of the cartilage and the bone. The head of femur could be also damaged and/or underwent later morphological changes, so-called "double bubble" shape. The respective femoral bone, however, has not been found. The animal with such a pathological changes in hip joint must have suffered from long-term pain both in rest and motion. Similar anatomical deformations can occur in people with imperfect development of hip joint leading to its luxation (*luxatio coxae congenita*), in some posttraumatic conditions, or chronic degenerative processes (coxarthrosis, chronic degenerative damage resulting from hormonal and mineral dysbalance – osteoporosis).

CONCLUSIONS

The cave bears were widely distributed in Central Europe in upper Pleistocene, where skeletal remains and teeth can be found it carst cavities, which the animals used to occupy during hibernation (5, 6, 7). During palaeontological research of the carst area within the Veľká Fatra Mts. (Northern Slovakia), several pathologically affected bones of cave bears have been found in the Last Glacial deposits of the 2 caves in the described locality. The most interesting pathological record has been disclosed on the cranium (HJ-548), the left mandible (JB-21), and the iliac bone (HJ-626). According the group of experts, the pathological change of the tooth bed, found in the right side of the cranium at the place of M1 was the result of odontogenic purulent inflammation of soft tissues of tooth bed and surrounding bone. The X-ray analysis of left mandible disclosed no pathological cystic process and the bone opening was probably developed by natural process, connecting of two smaller openings together (bone vascularization). The iliac bone had the pathological acetabulum with damaged and deformed osseous upper border, which could be interpreted as a result of moderate pressure of the head of femur, coinciding with the mineral dysbalance (resulting in bone decalcification), or fracture of *limbus acetabuli* caused by injury. All the above mentioned pathological phenomena, found on jaws and teeth of the deceased animals broaden the knowledge in palaeozoology, concerning the cave bear populations and its extinction in the Slovak territory of the Western Carpathians Mts. (3, 4, 8).

The „think-tank" of experts in palaeozoology, forensic medicine, traumatology, and forensic stomatology proved itself as very effective in investigation, morphological description and interpretation of the pathomorphological changes on the abovementioned precious palaeozoological specimen.

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