

ASPECTS OF HARD TISSUE MODIFICATIONS

Three objects from the Gravettian at Dolní Věstonice II (Czech Republic)

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Abstract: The paper presents a case study of three animal hard tissue objects from the Gravettian site of Dolní Věstonice II (Czech Republic), a beaver incisor, a wolf canine and a raven femur, bearing unusual modifications. Detailed archeozoological, archeological and experimental methods provide complex insights into the interpretation of human and non-human taphonomic impacts affecting the morphology of selected examples. In the case of the beaver incisor human manipulation was excluded; dentine modifications were caused by short-term malocclusion. The wolf canine bears traces of intentional raw material selection, changing the mechanical properties of the tooth, along with evidence of pressure causing its longitudinal pre-depositional breakage. The raven femur was freshly defleshed using a dihedral burin or other artefact with similar morphology in its cutting-edge shape.

INTRODUCTION

Some damage and fractures produced during an animal's life, or after its death during decomposition of soft tissues and disarticulation, along with further deposition and postdeposition processes, could be easily misinterpreted as human intentional manipulation in hard tissue artefacts production, usage and abandonment. If the surface traces detected on the animal hard tissue (bone, tooth, antler, ivory) differ from the standard rank of inter-individual variability and pathological conditions, reconciling the faunal and archeological records is necessary for the most appropriate interpretation in order to avoid misinterpretations in distinguishing the human and non-human impact from those of natural origin (Vercoutère/San Juan-Foucher/Foucher 2007).

Bone surface modifications are discussed in various research papers, which focus on the interpretation of selected case studies. The conclusions, however, differ in their degree of importance and compatibility, specifically within comparative traceology of bone surface modification, where natural polishing might be mistaken for use-wear (e.g. Olsen 1989; Pankovskiy/Girya/Sablin 2015), or other functional (Jin/Shipman 2010) and production traces (e.g. D'Errico 1993; D'Errico/Villa 1997). The specific topics discussed here, such as animal canine knapping, animal tooth usage as tools, and cut marks on bird bones, have been analysed by different authors (Bello et al. 2013; Blumenshine 1988; Boschini/Crezzini 2012; Castel/Madelaine 2006; Domínguez-Rodrigo/Fernández-López/Alcalá 2011; Miller-Antonio/Schepartz/Bakken 2000; Runnings/Gustafson/Bentley 1989; Shipman 1989).

In this paper we present a case study based on three objects, namely a beaver incisor, wolf canine and raven femur, from the Mid Upper Palaeolithic site of Dolní Věstonice II. The Dolní Věstonice – Pavlov – Milovice microregion presents the area with a pattern of site complexes with different hierarchy of settlement strategies and related activities (Klíma 1959; 1963; 1981; 1995; 1997; Oliva ed. 2009; Svoboda 2016; Svoboda ed. 1991; 1994; 2005; 2011; 2016; Svoboda et al. 2016). The overall composition of animal species at these sites reflects a hunting strategy focused on middle to extra-large sized herbivores, furbearers and some bird species, such as hare (*Lepus europaeus*/*Lepus timidus*; 19% NISP), woolly mammoth (*Mammuthus primigenius*; 18% NISP), fox (*Vulpes vulpes*/*Vulpes lagopus*; 17% NISP), wolf (*Canis lupus*;

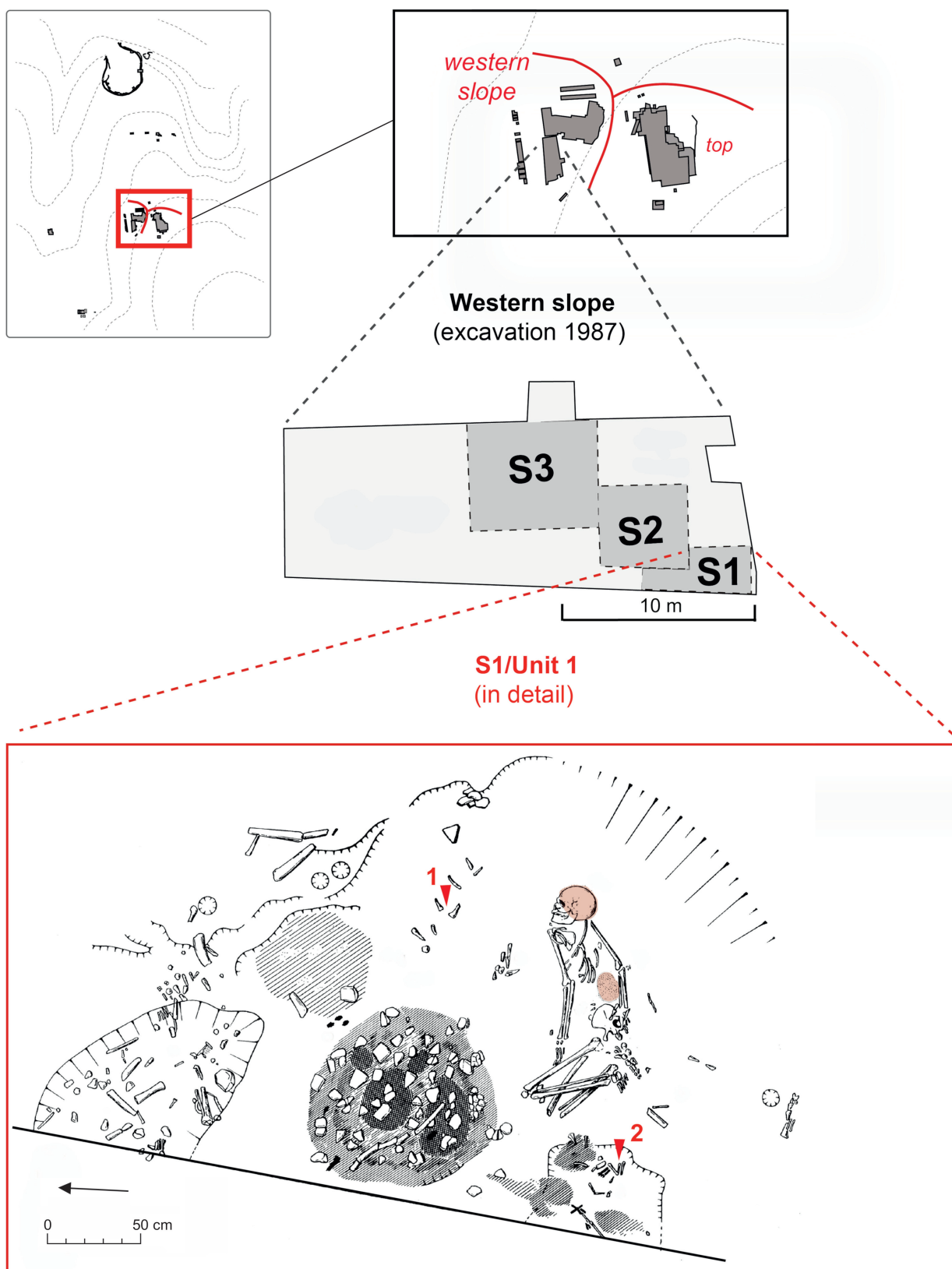


Fig. 1. The Dolní Věstonice II site plan with detail of the S1 settlement unit. 1 – the position of the wolf canine; 2 – raven femur. Vicinity of the male burial DV16 (figure M. Polanská modified after Klíma 1995; Svoboda ed. 1991; 2016).

11% NISP), reindeer (*Rangifer tarandus*; 11% NISP), horse (*Equus ferus*; 7% NISP), ptarmigan (*Lagopus* sp.; 6% NISP), raven (*Corvus corax*; 3% NISP), wolverine (*Gulo gulo*; 2% NISP), bear (*Ursus* sp.; 1% NISP) and cave lion (*Panthera leo spelaea*; 1% NISP). The remaining 3% consist of species occurring at these sites with a very low frequency, usually below 1%, such as auroch/bison (*Bos/Bison*), giant deer (*Megaloceros giganteus*), red deer (*Cervus elaphus*), lynx (*Lynx lynx*), beaver (*Castor fiber*), wild cat (*Felis sylvestris*) and others. Naturally, taxon composition differences are observed between individual site zones, especially if domestic zones are compared to mammoth bone deposits, where woolly mammoth is dominant; and between individual sites as well (e.g. Bocheński et al. 2009; Brugère/Fontanta/Oliva 2009; Musil 1994; 1997; 2005; Sázelová 2016; Svoboda et al. 2011; Wertz/Wilczyński/Tomek 2015; West 1997; Wilczyński et al. 2015; Wojtal et al. 2012; Wojtal/Wilczyński 2015). The area still lacks a comprehensive taphonomic study, although the individual biotic and abiotic depositional and postdepositional agents and processes have been discussed by various authors (e.g. Hromadová 2016; Musil 2005; Sázelová et al. 2018; Svoboda et al. 2019; Trinkaus/Sázelová/Svoboda 2019; Trinkaus/Svoboda eds. 2006; Wojtal/Wilczyński/Wertz 2016). In this study, the combination of technological and morphometric approach was applied with an emphasis to distinguish between traces left by human and non-human taphonomic agents.

THE DOLNÍ VĚSTONICE II CONTEXT OF THE OBJECTS

According to recent archeozoological works done by P. Wojtal, J. Wilczyński and K. Wertz (2016) on material from excavations in 1985–1989 the occurrence of the three species at site do not exceed a MNI of 11.4% for wolves, 5.3% for ravens and 0.6% for beaver. There is a striking taxon difference between settlement area and the mammoth bone deposit (Svoboda et al. 2019). The beaver tooth was found during the excavation led by Bohuslav Klíma in 1986 and might be located to the settlement unit K7 at Site top, which is dated 31.0–30.6 ky cal BP (Klíma 1995; Svoboda 2016). The wolf canine and raven femur was detected a year later in excavations led by Jiří Svoboda in the Western Slope (Fig. 1; Svoboda 2016; Svoboda et al. 1991). Both finds laid in the settlement unit S1 within close vicinity (up to 100 cm) from male burial DV16. The settlement unit possesses radiocarbon dates between 31.0–29.3 ky cal BP (Fewlass et al. 2019; Svoboda 1987; Trinkaus/Svoboda eds. 2006). The wolf canine was found in a northward direction before the human skull and the raven femur laid in western direction under human lower limbs (Fig. 1).

The depositional color changes observed on the bone and tooth surface can be interpreted by soil character, which according to L. Smolíková (1991, 68) is described as weakly humous flocculated tinted grey to brown matrix with clodded rounded forms and angular fragments of humous and non-humous brown soil material. The matrix contains the dark brown braunlehm nodules too (some of them mechanically damaged) and the primary components are well sorted with prevalence of unweathered silt. The soil groundmass includes carbonate microskeletons accompanied by numerous epithelia with supply channels of amorphous CaCO₃. Additionally, charcoal fragments in various stages of preservation and sizes occur in large numbers and traces of biogenic activity (earthworms and mites) were observed. The sediment character around the beaver tooth is similar, however the density of anthropogenic remains is lower. Furthermore, we have observed tiny red and black colored microparticles on the studied bone and tooth surfaces (cf. Hromadová 2016). These traces reflect the wet depositional and postdepositional environment of the surrounding sediments (caused by water reservoirs stored in depressions, ice wedges or gullies), which have been observed at different parts of the Dolní Věstonice II site (Svoboda et al. 2019).

MATERIAL AND METHODS

This paper focuses on three objects from the Dolní Věstonice II site, displaying specific traces after the surface modifications. Namely, a permanent right lower canine of a wolf (*dens caninus inferior dx.*), the right femur of an adult raven (*femur dx.*) and a permanent upper right beaver incisor (*dens incisivus superior dx.*).

Anatomical and taphonomical methods

Taxonomic and anatomic descriptions follow osteological atlases (France 2009; Hillson 1992; 2005; Schmid 1972; Tomek/Bocheński 2000), taphonomic studies (Binford 1981; Fernández-Jalvo/Andrews 2016; Hall/Byrd 2012; Tibbett/Carter 2008) and works with virtual comparative collections VZAP.org (Virtual Zooarcheology of the Arctic project) and ARCHEOZOO.org (Portal of archeozoological information). Due to strong surface modifications the wolf canine and beaver incisor were measured in their greatest length axis and greatest breadth axis. The raven femoral measurements were taken based on recommendations by A. von den Driesch (1976), where the greatest length (GL) was taken between the major tuber and lateral distal condyle. A Spi digital caliper 6"/.001" was used for all measurements. The * indicates the estimated diameter. Biotic and abiotic taphonomic traces were analysed using a NIKON SMZ 1500 stereomicroscope (Amstelveen, Netherlands) at 7.5–110.0 x magnification.

Archeological methods

The methodological scheme for hard organic tissue artefacts analysis was described in several papers concerning technological analysis (macro-striation analysis) and taphonomical and paleozoological studies of accompanying osteological material (e.g. Averbouh/Provenzano 1998; Dauvois 1977; D'Errico 1991; Fernández-Jalvo/Andrews 2016; Filippov 1983; Rigaud 2007; Semenov 1957). The procedure followed in this study might be summed up in the four subsequent points.

1. raw material identification (classification by the anatomical position, description of structure, identification of the surface with alteration);
2. distribution of the traces and its analysis (location, orientation, organization, quantity, size) and the trace morphology (profile, bords, section, shape) according to the macro- and microscopic criteria;
3. distinction between the human impact and nonhuman taphonomic agents, alterations and/or processes;
4. identification of the possible origin of trace.

The objects were documented photographically under the stereomicroscope and the figures were calibrated and analysed by the NIS-element software (Amstelveen, Netherlands). For the macro level photo documentation, a Canon EOS 60 camera with EFS 60 mm and Helicon Focus 5.2 software (Kharkiv, Ukraine) was used.

Bird bone experiment

In order to collect more reference data and to reconstruct the traces of origin on the raven femur, it was necessary to build own experimental material. As raven bones were not available, the experiment was based on six chicken (*Gallus gallus* f. *domesticus*) femurs of similar size and morphology. Each bone was cleaned from soft tissues by different experimental lithic tools (unretouched), present in the Dolní Věstonice II collections, namely a non-retouched blade (8 and 12 cm, *idem silex du Bergeracois*), an endscraper (*idem silex du Bergeracois*), a diherdal burin (*idem silex du Bergeracois*) and a bec (*idem silex du Bergeracois*).

RESULTS

Beaver incisor

The upper right beaver incisor with a greatest length 28.2 mm and breadth 8.6 mm is postdepositionally broken (Fig. 2: 1). Its lingual side is heavily affected by a series of impacts causing the removal of dentine and enamel revealed in its uppermost part, extended on 4.0 mm from its occlusal direction. The observed pattern is more irregular in comparison to natural tooth wear, where a shallow, smooth relief is expected. The tooth surface is changed by several clearly separated deep, transverse grooves, which at first glance seem to represent a possible intentional manipulation. The tooth is slightly etched by roots and the dark dot-like pattern is most probably caused by manganese oxides.

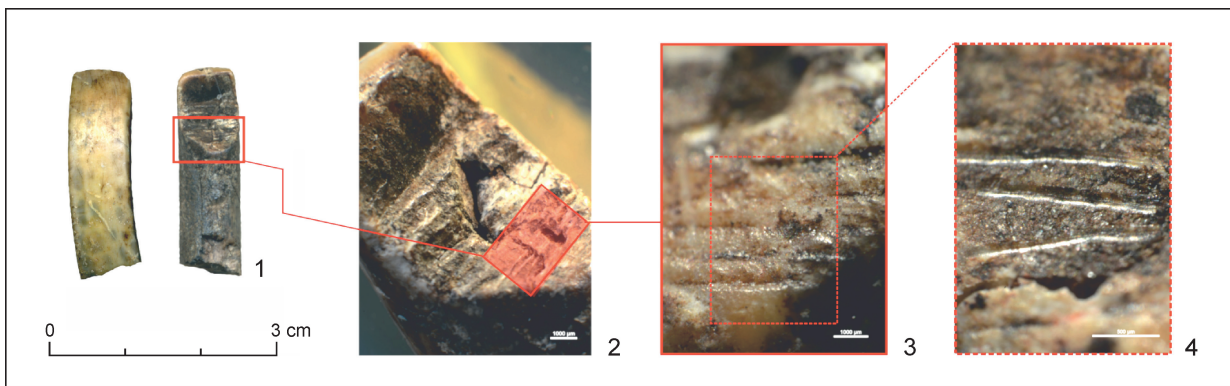


Fig. 2. The Dolní Věstonice II site. Beaver incisor. 1 – buccal (left) and lingual (right) side of the tooth; 2 – a micro-view of the longitudinal microstriation on the bottom of grooves (tooth rotate on +45°); 3, 4 – which create fine parallel lines with a different depth without overlapping. Scales: macro bar = 3cm, micro bar = 1000 microns (photo by S. Sázelová, B. Hromadová).

The grooves have a parallel orientation to the enamel and do not overlap each other (Fig. 2: 2). The relatively smooth surface complicated the microscopic analysis, so we were not able to closely estimate the specific number of grooves. In three instances the beginning and ending of grooves finish within the enamel. Thus, we can suggest here, that the grooves originated earlier than they might be deformed by natural process of enamel abrasion and smoothing. The edges in between grooves create a natural tooth surface disturbed with numerous deformations and gloss. In section, the side and bottom of them bear a U-shape; the edge of individual groove is slightly rounded and often does not create any distinct passage from the natural tooth surface (Fig. 2: 3). A longitudinal microstriation was observed on the bottom of grooves, creating fine lines with same orientation, different depth and without any overlapping. The side surface of grooves is uniform and slightly waved in its orientation (Fig. 2: 4). However, we did not observe any microbarriers within these waved parts left behind the even spreading of groove and the other expectable irregularities or deformations caused by the working artefact were not detected either. According to all these characteristics of microrelief we cannot confirm with at least low degree of certainty a relationship between such deformations and human activities.

Wolf canine

The right lower permanent wolf canine has a total length 42.2 mm and breadth 14.2 mm. Only the distal half of the tooth is preserved (Fig. 3: 1). The enamel was almost fully removed from the crown and the impacts running in the apical direction have affected the neck and root shape too. The dental cavity remained intact in the occlusal plane. The preserved parts reach approximately one half of the length in natural state, which depends on age and abrasion stage. The root size suggests a mature individual, with fully mineralized and closed root apex. The root surface is heavily etched by plants, which means that the tooth was in its taphonomic history in a direct contact with the root system.

Most of the enamel was removed from the crown with the exception of several millimeters remaining on the bucco-dorsal and lingual side. The residual coronal part represents the pointed dentine projection, approx. 13.0 mm in length, which is affected by a longitudinal fissure extending from the occlusal plane down to the pointed part and causing the absence of the mesial half. The crack development remains thus unclear, although the edges are straight, oriented, without shredding and progressively meets in the occlusal direction. The fissure's ending stops in the tongue fracture with a shallow undulation. Based on the fissure's color it is obvious that it could be taphonomically dated back to prehistory and we can correlate it with the latest, discarding phase of the object.

The remaining crown part is shaped by a series of three inclined and sequent removals. Their surfaces and mutual arrangement are similar to a sharpened pencil tip (Fig. 3: 2). These negatives overlap each other (Fig. 3: 3), however the smoothness on their surfaces and edges preclude any specification of a knapping manner. Since the radical part is absent, an area of a possible percussion is

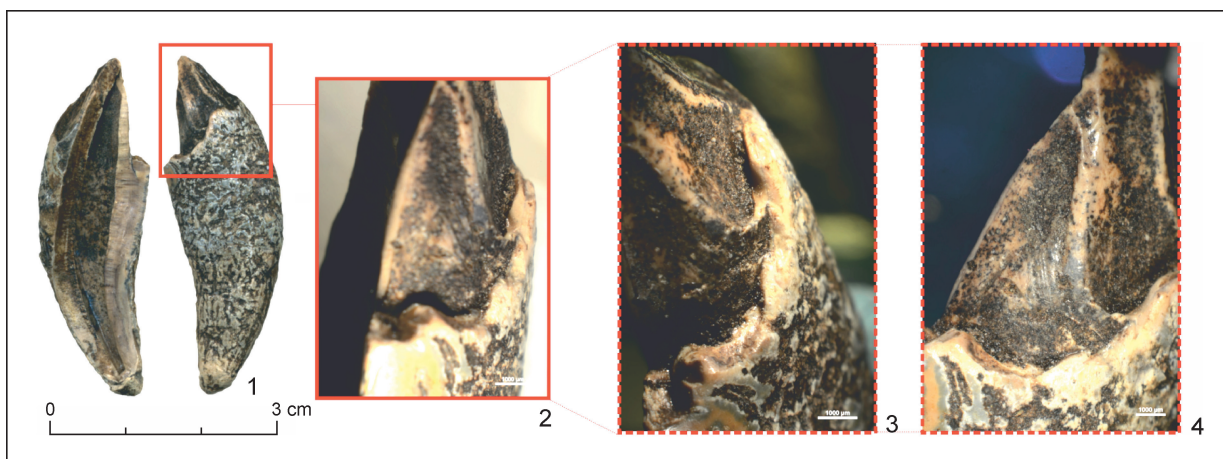


Fig. 3. The Dolní Věstonice II site. Wolf canine. 1 – mesial (left) and distal (right) sides of the tooth; 2 – a micro-view of the pointed tip (tooth rotate on $+90^\circ$) with two types of intentional alterations; 3 – regular oblique alterations/removals (tooth rotate on -30°); 4 – longitudinal fracture formation, which might be related to the morphology of the point. Scales: macro bar = 3 cm, micro bar = 1000 microns (photo by S. Sázelová, B. Hromadová).

not preserved. The surface of chopping ends at the root border, where it creates a plunging fracture. It seems that the fissure's spreading was stopped here too. The occlusal part of crown creates a partially preserved and pointed apex, which displays a series of smoothing and tiny negatives of microremovals (Fig. 3: 4). The tooth conservation precludes detection of functional traces under the microscope.

Raven femur

The right femur with both fused epiphyses belongs to an adult bird (GL = 66.8* mm). The bone is nearly complete, except the broken distal condyle on the medial side (Fig. 4: 1). The impacts are located on the dorsal side of the femoral body and extend from the medial to lateral side, most frequently on the proximal part of the diaphysis. Other traces are located on the ventral side above the distal extremity (*extremitas inferior femoris*) and run directly between both condyles on the *facies patellaris femoris*. The bone surface is slightly etched by roots and there is an obvious secondary change of color into the light brown shade with precipitated microparticles of manganese dioxide and iron oxides; the original color of bone surface (beige to light yellow) still occurs at several places.

The raven bone possesses several traces of anthropogenic origin, such as cut marks, depressions and remains after bone modification with a specific microrelief (Fig. 4: 2, 3). The femoral patination helps us to determine the origin and sequence of human intervention (cuts/grooves). Although, we cannot determine the complete taphonomic history step by step, the patination was influenced by the cultural layer with several charcoal lenses. The brown patination with manganese oxides covers the whole bone surface and some of the modification traces, from which we can suggest that the majority of these traces occurred before the bone deposition within the cultural layer.

Firstly, the alterations concentrate on the distal epiphysis and creates the transversal, mostly shallow cuts (Fig. 4: 4). Their breadth is mostly constant across the bone, where some of them are overlapping each other and alternatively display the typical frayed ending, which is connected to the repeated back and forward motion during the cutting. The depth of the incisions varies in the middle and endings and indicates the gradual penetration of artefact into the material with a relatively flat working edge moving on the rounded surface. The accurate cut-profile cannot be closely characterized due the infilling with dark sediment. The overall localization, orientation and character of cuts suggest decarnization, the removing of muscle mass from the bone base with a lower occurrence of meat (Laroulandie 2001; 2009).

Secondly, the other type of alteration is located on the dorsal surface of the femoral body and presents tiny linear striations in the form of parallel incisions or linear depressions covering most of the proximal bone. They create miniature shallow lines with a sharp bottom no longer than 3–4 mm; the length is regular across the bone and becomes longer 4–5 mm below the intertrochanteric crest of the proximal

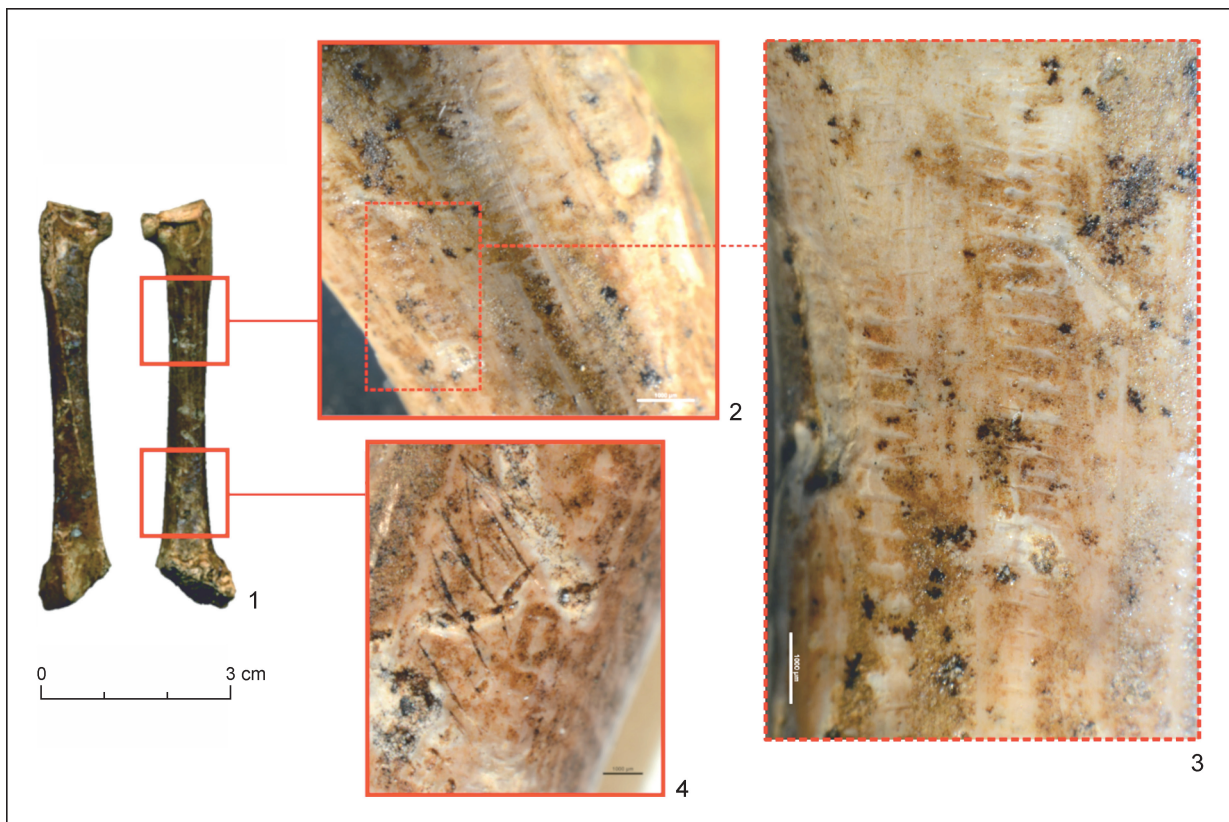


Fig. 4. The Dolní Věstonice II site. Raven femur. 1 – ventral (left) and dorsal (right) sides of the bone; 2 – micro-view (bone rotate on $+30^\circ$) of linear alterations covering most of the proximal part; 3 – micro-view (bone rotate on 0°) of linear alterations covering most of the proximal part; 4 – micro-view (bone rotate on -30°) of stigmata (incisions) after decarnization. Scales: macro bar – 3 cm; micro bar – 1000 microns (photo by S. Sázelová, B. Hromadová).

part. Morphologically, they comprise of tiny grooves followed by another series of longitudinal striations, running with a regular spacing between each of them. The individual grooves are without any patination, which might suggest that these cuts were caused postdepositionally while the bone was excavated. However, close examination of the bone surface shows that some part of the striations is still covered by this patination (the flat surface of compact bone too), sometimes followed by manganese oxide infilling. The original bone surface seems to be well preserved with a slight weathering. So, we suggest here, that the covering and uncovering of these shallow stigmata was likely caused by infilling them with fine sediment and patine crystallization, which both were subsequently removed when the bone was washed after the rescue excavations (pers. comm. J. Svoboda). Unfortunately, due to the strong patination it was not possible to understand the relation between the longitudinal striations and transversal lines on the diaphysis. However, a direct link between these two main types of alterations confirm their association at the epiphyseal surface. Considering the fact, the part of the striation remains uncovered and filled by the sediment. Moreover we lack any direct evidence supporting post-excavational origin of the traces (e.g. postexcavational cleaning of the bone with metal edge).

Another interesting detail is the overall character of these linear traces, when their breadth and length is stable in size, varying just in depth and orientation to the bone surface. They are much wider on the diaphysis when compared to the proximal end with different side angles and sharp bases. The transversal orientation of these alterations respects the main longitudinal bone axis and their inclination slightly changes in the proximal epiphyseal direction where starts to be oblique in its character. Such difference in overall direction and orientation is likely caused by the changing trajectory of used lithic artefact, which mirrored the general bone shape on its diaphysis – proximal epiphysis transition. However, we did not observe any specific changes in the microrelief of the trace edges. Furthermore, the series of transversal parallel lines are arranged in several rows (Fig. 4: 3). The bone surface with depressions is slightly undulate. Rows are approximately parallel and somewhat overlapping each

other or they are in superposition. The bone surface displays flattening along those rows, the linear striations provide a very fine linear pattern that at some degree can be mistaken with ornamentation. Such alterations, if accompanied by other diagnostic features, result from the activity performed by the straight edged tool, when the linear and progressive motion is applied with increasing force towards the epiphysis.

Around the metaphysis the striations display a deeper character, while lines and row length vary in their trajectory. Change of the depth and orientation of striations can be caused by a different morphology of bone surface, in the transition between diaphysis and distal epiphysis. The diagnostic features have the most pronounced morphology in this part of the bone. The transversal striations have an irregular V-shaped bottom edge and triangular cross-section. The walls form a blunt angle, still differs in angle of inclination to the bone surface. These irregularities define the position of stone tool working edge, change of the applied force and contact pressure. On the other hand, the regularity observed in the microdeformations, the similar length and terminations, and repeating elements of diagnostic features, suggest that the same intentional origin is observed in these linear striations. We propose that the alterations do not result from cutting or sawing (back and forward motion as in the first case), and the whole complex of traces is necessary to be analysed. Together with the longitudinal striations, organization of traces in rows, trajectory and character of the surface we consider their origin resulting in scraping/planning, when the force and contact pressure of the sharp cutting edge on the bone surface is applied. Regularity of marks and straight bottom edge corresponds to the narrow cutting edge. V-shaped and triangular cross-section shows the angle at which the tool was held, as well as the width of the cutting edge. Apparently, the tools went to the bone surface under a constant angle, almost perpendicular to the trajectory of tool. The main question on the final form of the tool, which created the traces, remains unanswered.

DISCUSSION

Beaver incisor

The atypical traces on the beaver incisor (*Hillson 2005*) shift our attention to the pathological conditions during the individual's end of life. The most possible interpretation seems to be the gnawing of heavy objects, when its jaws misfit each other up to 2–3 mm, which caused a temporary malocclusion before the animal's death (perhaps when trying to escape from a human or natural trap; pers. comm. I. Horáček).

Wolf canine

The analysis of this object is based on the description of traces, analysis of their development, and interaction between them and a causality of following actions. The very specific shape of the tooth crown excludes other non-intentional and taphonomic agents and processes as being the potential producers of such traces. The oldest trace generation belongs to the negatives of the deeper and oblique removal, extending into the dentine. Regular oblique alterations, organized side by side and inclined on the surface in almost a vertical line from the crown to root, refers to the intentional origin of the traces. All these traces form together the pointed tip, in order to create an appropriate pointed active part or to utilize the primary fracture of the tooth, which appeared to be a result of another accident. Unfortunately, due to the inappropriate preservation of the surface, it is impossible to identify the technique used. In addition, such pointed morphology can be a result of intentional object modification too. Generally, we lack comparative material. There is a low number of published objects with the similar shape or traces, such as recently described modified and used *Cercopithecoid* canines from the Late Pleistocene cave site Fa-Hien Lenain Sri Lanka (*Langley et al. 2020*).

Based on the position and organization of all surface alterations, we suggest that the longitudinal fracture occurred as the latest trace. The pointed tooth morphology has determined the longitudinal spreading of the fracture along the major axis. We can conclude that the general morphology of the point and fracture formation are related. The very deep and slightly bent longitudinal fracture with an orientation to the occlusal part might be a result of contact with another hard surface in pressure. The fracture

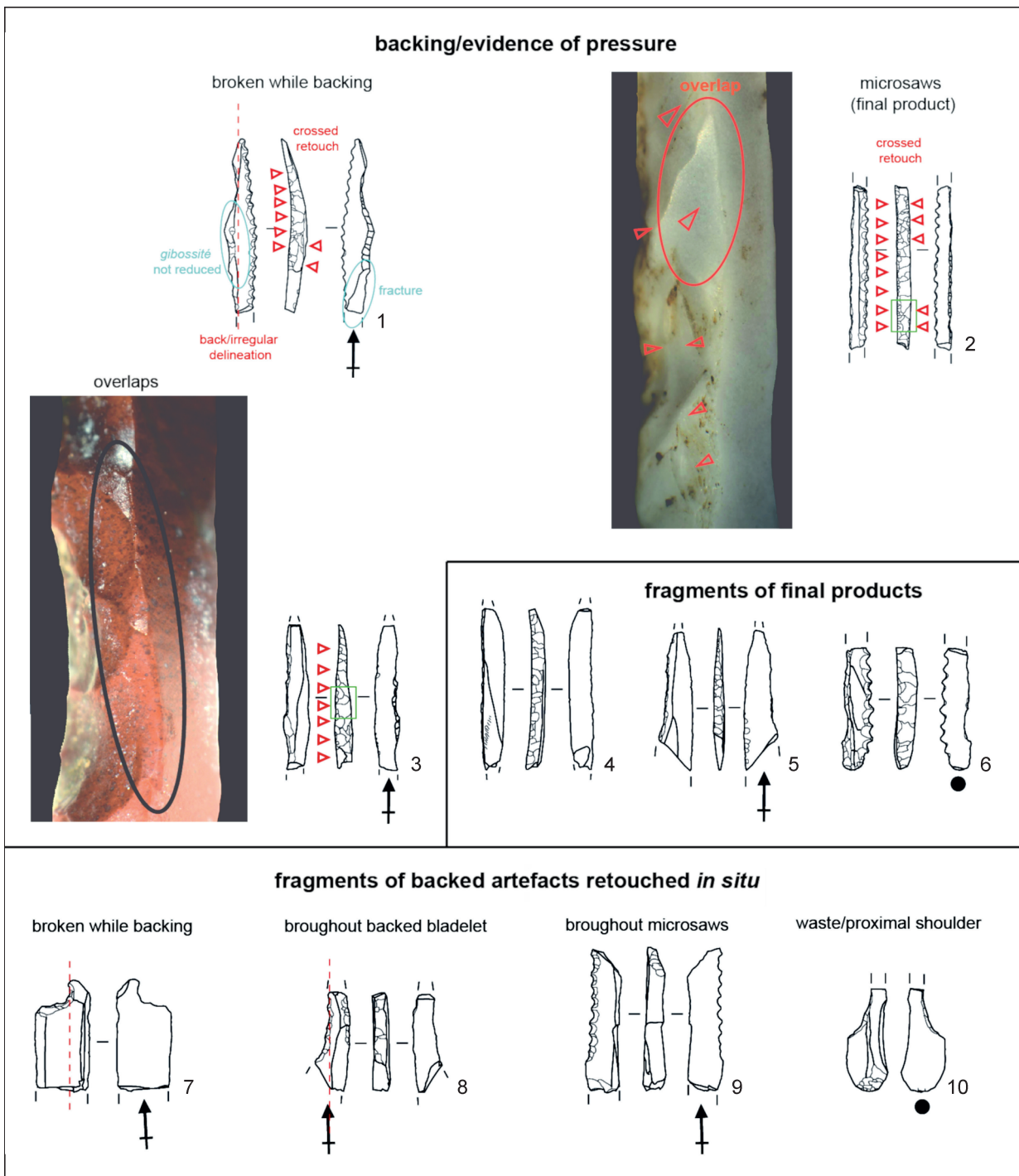


Fig. 5. Selected lithic artefacts from the S1 settlement unit at Dolní Věstonice II (figure M. Polanská).

stopped in the crown tuberculum at the border of histologically different tissues of enamel and dentine. The longitudinal fracture thus most likely occurred as a result of an intentional activity with the pointed part. In order to summarize the previous observations, we can identify two types of alterations: a) short removal scars and b) destructive longitudinal fracture, related to the single and common operation. According to the above-described characteristics both types might occur during intense contact with hard materials.

Such a pointed object, that displays possible contact with a hard surface at the tip can have an interesting contextual explanation. Within its closest vicinity were found several unfinished backed

tools, namely backed microsaws (Fig. 5: 2, 6), backed bladelets (Fig. 5: 3–5) or microgravettes of Dolní Věstonice subtype (Polanská 2020; Svoboda ed. 1991) and waste after their production. All these lithics were produced *in situ*, as demonstrated by broken pieces abandoned in various stages of backing (Fig. 5: 1, 7–9) and again their waste (Fig. 5: 10). The final backing was made by an organic casually rounded tip which pressed on the edge of an organic raw material. The microoverlaps on the retouches present then the characteristic markers after such technique (Pelegrin 2004, 163, 164). As an appropriate tool to produce such traces we can consider any pointed piece, including discarded and reutilized tools (for example, needles or tiny awls, etc.). Therefore, one of the possible interpretations for the wolf canine could be its usage as a pressure tool in backed tool production. The usage of retouchers, compressors and other pressure tools from hard animal tissues are widely discussed in the literature and its variability increases (e.g. Castel/Chauvière/Madelaine 2003; Castel/Madelaine 2006; David/Pelegrin 2009; Hutson et al. eds. 2018). On the microlithic backs from the settlement units S1–S4 and adjacent areas from Dolní Věstonice II, where a crossed abrupt retouch was used, we documented possible evidence of a pressure usage (Fig. 5: 1–3; cf. Pelegrin 2004; Polanská 2016). The question of lithic artefact modification, where the retouch produced by direct or partial pressure together with the wolf canine with the traces after negative removals (after the pressure on other objects) remains open. Such interpretation would be an ideal scenario sufficiently supported by the presence of more hard animal tissue artefacts of similar or close morphological type beside the microsaws production in the Moravian Pavlovian. However, the occurrence of similar organic objects, or more precisely their deeper description, is still very low.

Raven femur

Two types of striations have been identified on the raven bone surface. The first type of striation undoubtedly belongs to stigmata related to the bird bone decarnization, similarly identified at other archaeological sites (Laroulandie 2009). The second type of traces remains problematic due to the regular diagnostic features that can lead to the misinterpretation of stigmata as a result after sawing. The whole complex of the morphological features and alterations recognized on this raven femur does not correspond to the activities, such as decarnization or disarticulation of bird bones as described in the literature (Laroulandie 2009).

The experiment showed (Table 1) that the overall tool morphology played a less important role than its form and modifications caused by the active edge. The experimental bone with soft tissues cleaned by the burin demonstrates the greatest similarity with our archaeological sample, if compared to the bone bearing the traces after blade work. The cleaning resulted into the rows with fine transversal striations and with the regular spacing between each short and shallow incisions. Trajectory of the tool movement is determined just by the flattened surface of rows and is rarely accompanied by the longitudinal direction stigmata. This probably presents the decarnization effect on the fresh bone with soft tissues still preserved (periost and muscles), while the waste from the soft material is accumulated on the active edge of the burin. The striation regularity results from the appropriate tool angle (held close to 90°), steady pressure on the worked material, kinetics of the tool and the quality of the bone tissue. Still, it is necessary to remember, that such stigmata are influenced by the personal choice and skills of the individual cleaning the material too.

The first problematic detail is the V-shaped bottom edge of the striation observed on the archaeological sample. Such a feature is nearly absent on the experimental sample and must be correlated to the stone tool edge morphology and the pressure intensity on the bone surface. This question remains thus open for future research. The second group of striations might be associated with decarnization as well, respectively, with a longitudinal bone scraping by a firm edge (burin edge) and with a steady regular pressure on the bone surface. Due to the absence of further details about the activities related to the bird bone processing at the Dolní Věstonice site, this question remains yet unexplained (cf. Wertz/Wilczyński/Tomek 2015). The closest example is described by Z. M. Bocheński et al. (2009, 2658) in the case of a griffon vulture (*Gyps fulvus*) ulnar fragment from the Pavlov I site, where two groups of incisions on its proximal part have been described. Eight incisions have been observed on the ventral bone side and then another 18 slight incisions with a regular interval were located on its dorsal side.

Table 1. Comparative summarization of the experimental background to the human manipulation with chicken femurs.

Tool	Working edge	Retouch	Active part of the tool	Applied technique	Trajectory (kinetic of the movement; motion)	Position of the material	References
Endscraper	convex	yes	corniche of the front (<i>la ligne de front</i> , front edge)	scraping	reciprocating (longitudinal) motion	front-face to the user	e.g. <i>Dauvois 1977</i>
Blade	straight and linear	no	cutting edge	planing	rectilinear motion, edge is transversal to the worked surface	front-face to the user	e.g. <i>Rigaud 2007</i>
Dihedral burin	straight and linear	no	<i>chanfrein</i>	planing/ scraping	reciprocating motion, edge is transversal to the worked surface	front-face to the user	e.g. <i>D'Errico 1991; Fillipov 1983; Rigaud 2007</i>

CONCLUSIONS

Here, we present three objects with atypical traces of their surface modifications. The beaver incisor was modified during the short-term malocclusion before the individual's death. The wolf canine bears evidence of pressure causing the predepositional breakage of the tooth. The enamel (hard and fragile) removal and exposition of dentine (soft and elastic) changed the mechanical properties of the canine during the pressure backing of the selected lithic artefacts. The raven femur was likely defleshed in its fresh stage using a dihedral burin or other closely related artefact with similar cutting-edge shape. If we compare these three case objects to the complex Gravettian animal hard tissue artefacts and art discovered in the Dolní Věstonice – Pavlov – Milovice microregion, they are seemingly of less importance. Still, their study enhances our understanding of human and natural modifications in this time period and opens question which are not fully explored.

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Možnosti modifikace tvrdých tkání

Tři gravettské předměty z Dolních Věstonic II (Česká republika)

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Souhrn

Studie představuje tři předměty z moravské gravettské lokality Dolní Věstonice II, a to bobří řezák, vlčí špičák a krkavčí stehenní kost, které nesou neobvyklé stopy povrchové úpravy. Některá poškození a lomy mohou být na zvířecích kostech a zubech způsobeny ještě během jejich života, jiná vznikají posmrtně během dekompozice měkkých tkání a disartikulace, nebo při následujících depozičních a postdepozičních procesech. Pokud se tato poškození vymykají inter-individuální variabilitě, patologickým podmínkám či tafonomickým stopám běžně pozorovatelným na zbývajícím osteologickém materiálu, je nasnadě úvaha, zda se nejedná o záměrná poškození, způsobená aktivitou člověka, a to během výroby předmětu z tvrdých živočišných tkání, jeho používání i odhození. V této studii jsme tak kladly důraz na komplexní morfometrický a technologický pohled při odlišení stop způsobených člověkem a dalšími tafonomickými činiteli.

Na základě archeozoologické analýzy publikované P. Wojtalem a kol. (2016) pro výzkum v Dolních Věstonicích II z let 1985–1989 jsou sledované tři druhy zastoupeny 11,4 % MNI pro vlky, 5,3 % MNI pro krkavce a 0,6 % MNI pro bobry. Bobří zub byl nalezen během výzkumu B. Klímy v roce 1986 v sídelním objektu K7 (temeno), datovaném přibližně na 31,0–30,6 tisíce let. Vlčí zub a krkavčí kost byly objeveny o rok později během výzkumu J. Svobody poblíž sídlištního objektu S1 (západní svah), datovaném na 31,0–29,3 tisíce let. Oba předměty se nacházely ve vzdálenosti přibližně 1 m od kostry muže DV16, a to vlčí špičák severně od jeho lebky a krkavčí stehenní kost ležela západním směrem od jeho dolních končetin. Z metodického hlediska byl dodržen běžný anatomický, tafonomický a archeologický protokol při práci s předměty z tvrdých živočišných tkání. Pro srovnání stop na krkavčí kosti byl navíc realizován experiment srovnávající zásahy zanechané neretušovanou čepelí, škrabadlem, klínovým rydlem a zobcem (hrotitým artefaktem) na šesti kuřecích stehenních kostech.

U stop na bobřím řezáku jsme vyloučily zásah člověkem a předpokládáme patologické podmínky ještě za života tohoto jedince. Nejpravděpodobnějším vysvětlením je manipulace s velmi těžkým předmětem, která způsobila vychýlení čelistí o 2–3 mm, a tedy dočasnou malokluzi před úhynem zvířete, např. při pokusu o útěk z lidské nebo přírodní pasti. Stopy na vlčím špičáku můžeme dát do souvislosti s postupným odstraněním skloviny, kdy se pravidelně zešíkmené zásahy sbíhají do společné špičky v zubovině (zásahy připomínají ořezanou tužku). Následně

podélné vylomení bylo s velkou pravděpodobností způsobeno jeho dalším použitím při tlaku na objekt s tvrdým povrchem, např. při výrobě mikrolitů technikou tlakem, čemuž nasvědčují i charakteristické stopy pozorované na kamenné industrii v daném místě. Na krkavčí stehenní kosti jsme našly komplex stop, a to série mělkých a šikmých zářezů a dále drobné lineární striace formující série krátkých paralelních zářezů, které mohou souviset s řezáním a škrábáním měkkých tkání z jejího povrchu.

Obr. 1. Plán lokality Dolní Věstonice II s detailem sídlištního objektu S1. 1 – vyznačená poloha vlčího špičáku; 2 – krkavčí stehenní kost. Hrob muže DV16 (obrázek upraven M. Polanskou na základě *Klíma 1995; Svoboda ed. 1991; 2016*).

Obr. 2. Dolní Věstonice II. Bobří řezák. 1 – Bukální (vlevo) a linguální (vpravo) strana zubu; 2 – bližší pohled na podélné mikrostriace na dně žlábků (pootočení zubu o +45°); 3, 4 – jemné paralelní a nepřekrývající se linie s různou hloubkou. Měřítka: makro = 3 cm; mikro = 1000 mikronů (foto S. Sázelová, B. Hromadová).

Obr. 3. Dolní Věstonice II. Vlčí špičák. 1 – mesiální (vlevo) a distální (vpravo) strana zubu; 2 – bližší pohled na hrotitou špičku (pootočení zubu o +90°) se dvěma typy záměrných úprav; 3 – přímé šikmé modifikace (odstranění; pootočení zubu o -30°); 4 – podélná fraktura, která souvisí s morfologií špičky. Měřítka: makro = 3 cm; mikro = 1000 mikronů (foto S. Sázelová, B. Hromadová).

Obr. 4. Dolní Věstonice II. Krkavčí stehenní kost. 1 – přední (vlevo) a zadní (vpravo) strana krkavčí stehenní kosti; 2 – bližší pohled (kost pootočena o +30°) na lineární alterace pokrývající většinu proximální části kosti; 3 – bližší pohled (kost pootočena o 0°) na lineární alterace pokrývající většinu proximální části kosti; 4 – bližší pohled (kost pootočena o -30°) na stigmata (zářezy) po odstranění svaloviny. Měřítka: makro = 3 cm; mikro = 1000 mikronů (foto S. Sázelová, B. Hromadová)..

Obr. 5. Vybrané kamenné artefakty ze sídelní jednotky S1 v Dolních Věstonicích II (obrázek M. Polanská).

Tabela 1. Srovnání experimentálních stop po lidské činnosti na kuřecích stehenních kostech.

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