Izvorni znanstveni radovi

The Middle Paleolithic Percussion or Pressure Flaking Tools?

The comparison of experimental and archaeological material from Croatia

Srednjopaleolitički udarači ili pritiskači?

Usporedba eksperimentalnoga i arheološkog materijala iz Hrvatske

Izvorni znanstveni rad
Prapovijesna arheologija

Original scientific paper
Prehistoric archaeology

UDK/*UDC* 903.011(497.5-16)"6323"
Primljeno/*Recieved:* 01. 04. 2003.
Prihvaćeno/*Accepted:* 11. 06. 2003.

Dr. sc. IVOR KARAVANIĆ
Odsjek za arheologiju
Filozofski fakultet
Sveučilište u Zagrebu
Ivana Lučića 3
HR - 10000 Zagreb
ikaravan@ffzg.hr

TOMISLAV ŠOKEC
Shell U.K. Exploration and Production
1 Altens Farm Road Nigg
Aberdeen, AB12 3FY
United Kingdom
tom.sokec@expro.shell.co.uk

A lithic knapping experiment was done to establish the morphology of the marks which appeared on bone retouchers (flaking tools) and to explore differences arising from the use of bone retouchers using both percussion and pressure. The morphological characteristics of the marks on retouchers caused by percussion flaking and those caused by pressure flaking have been established. The comparison of experimental and archaeological material seems to suggest the presence of both techniques in the Mousterian of north-western Croatia. Based on this evidence the authors believe that the Neanderthals were capable of retouching their tools by using both percussion and pressure techniques, although the results of this experiment are not enough to prove that they actually did so. However, the morphology of marks made by pressure flaking is not uniform and the similar marks may derive from some other activity.

Key words: experimental archaeology, percussion flaking, pressure flaking, retouchers, marks, Mousterian, Vindija, Veternica, Croatia.

Ključne riječi: eksperimentalna arheologija, odbijanje udarcem, odbijanje pritiskom, obrađivači, oštećenja, musterijen, Vindija, Veternica, Hrvatska.

INTRODUCTION

Actualistic experimentation has been used in archaeology as an accessory method in the reconstruction of prehistoric lifeways. For example, animal butchering experiments using stone tools (e.g. JONES, 1980; TOTH, 1987), have proved to be very instructive. Experimental archaeology has greatly contributed to the establishment of the technological processes in the production of Paleolithic (INIZAN ET AL., 1992) and Neolithic tools (VUKOVIĆ, 1973, 1974), and to reconstructing the use of those tools.

This work reports an experiment, designed to help answer questions about Middle Paleolithic bone retouchers (flaking tools). Part of this experiment was already reported by AHERN ET AL. (in press) including analysis of probable bone retouchers from Vindija Cave. This paper presents more detail description of the experiment and analysis of bone samples (possible retouchers) from two cave sites in Croatia (Vindija and Veternica). By comparing the marks on experimental objects with those on archaeological materials, we: 1) established what bone remains were most likely used for retouching, and 2) tried to achieve a more complete interpretation of the ways in which these Middle Paleolithic tools were used (percussion flaking, pressure flaking, or both). This also allowed us to reexamine the hypothesis that the pressure flaking technique was used already in the Mousterian for retouching the stone tools.

BACKGROUND

The problem of the Middle Paleolithic percussion and pressure retouchers

Already at the beginning and during the first half of the 20th century, the use of bone tools during the Lower and Middle Paleolithic was often discussed in scientific literature (e.g. MARTIN, 1906, 1907-1910; BREUIL, 1932, 1938). In addition to different interpretations of Middle Paleolithic bone artifact use, there emerged the question as to whether those "accessory" bone tools were already used in the Mousterian for retouching stone tools, not only by percussion, but also by pressure. While H. Martin believed that pressure flaking technique has been used for retouching stone tools already during Mousterian, F. Bordes was more skeptical about this possibility (see BORDES, 1961). Although this problem has not yet been solved, the marks on the retouchers (flaking tools) can sometimes be clearly differentiated from other usual marks on bone material, i.e. those caused by breakage, defleshing, jointing or skinning; as well as from the marks of gnawing or trampling and other activities (cf. VINCENT, 1987; BINFORD, 1981; BRAIN 1981; WHITE, 1992; CAPALDO & BLUMENSCHINE, 1994; BLUMENSCHINE ET AL., 1996; VILLA & BARTRAM, 1996).

Generally, we can define retouchers as bone objects with small punctiform pits or parallel linear marks on the distal end, vertical on the main axes of the object. In some cases the marks caused by non-human agents of bone modification are similar to those caused by retouching (cf. LEONARDI, 1979; VINCENT, 1988; BONNICHSEN & SORG, 1989), which can make the determination of the retouchers more difficult. However, Middle Paleolithic retouchers are presented in both old and recent publications (e.g. MARTIN, 1906; BORDES, 1961; FEUSTEL, 1973; LEONARDI, 1979; VINCENT, 1988; MALEZ, 1981; BARTOLOMEI ET AL., 1994). Although the basic function of these tools is generally clear, the more precise cause of marks on them (i.e. by pressure or percussion), has been less frequently discussed.

Vindija and Veternica caves in light of this problem

The sites of northwestern Croatia (i.e. Krapina, Vindija, Velika Pecina, Veternica) are world wide known in paleoanthropology because of important finds of fossil hominids and/or their material cultures. The faunal assemblages from the majority of these sites yielded retouchers which were identified, but never discussed in detail (MALEZ, 1981; PATOU-MATHIS, 1997; T. D. WHITE personal communication). Typical retoucher samples from two of these sites (Vindija and Veternica) will be presented in this paper and discussed in detail.

Several objects, which can be classified as retouchers, were found in the Mousterian levels of Vindija cave in the northwestern Croatia. The site is important for finds of the late Neanderthals (WOLPOFF ET AL., 1981; WOLPOFF, 1996) and the Mousterian industry (MALEZ, 1978; KARAVANIĆ & SMITH, 1998) from level G3; and for the possible association of the Upper Paleolithic bone artifacts with the late Neanderthals in level G1 (MALEZ ET AL., 1980; SMITH & AHERN, 1994; KARAVANIĆ, 1995; KARAVANIĆ & SMITH, 1998, 2000; STRAUS 1999). Two Neanderthal specimens, a right mandibular ramus and posterior corpus (Vi 207) and an anterior left parietal (Vi 208) from level G1 were directly dated by AMS radiocarbon only to 28 and 29 ka B.P. providing a temporal window of overlap between Neanderthals and early modern humans in Central Europe (SMITH ET AL., 1999).

Instead of many stone tools retouched by percussion, Mousterian levels of this site yielded several stone tools which may have been retouched by pressure (for example sidescrapers with parallel retouch on thin and sharp working edge). When the faunal material from Vindija cave was reviewed, T. D. White (personal communication) isolated a number of fragments with various marks that he determined to be gnawing and flaking marks, cutmarks and percussion notches. A total of 9 possible retouchers were identified. One of these is from the Upper Paleolithic level $F_{/d}$, another is from either $F_{/d}$ or Complex G, two are from Level G_3, one is from G_d (lower part of G Complex, probably Level G_4 or G_5), and four from the general provenience of Complex G. We will discuss three pieces with slightly different marks from the "flaking group fragments" (Fig. 2, 2, 3, 4; Fig. 3, 2, 4, 5), which in comparison to our experimental material all suggested percussion or pressure flaking.

Like Vindija, Veternica cave, located near Zagreb, has produced abundant archaeological and paleontological material that has been published in a number of works (e.g. MALEZ, 1981; MIRACLE & BRAJKOVIĆ, 1992). Many bone fragments, which seem to be retouchers, made out of compact animal tibia were found in Mousterian levels *i* and *h*. M. MALEZ (1981, 81) suggested percussion retouching, or the use of fragments as supports, or anvils on which retouching was done, as the cause of the transversal recesses on the surface of the bone fragments from this site. Differently from Vindija, no stone tool items that may suggest the use of pressure retouching were found in the Veternica Mousterian assemblage. From the Veternica sample we have analyzed in detail only one bone fragment, chosen because it contains deep and long marks, which makes it clearly different from the Vindija sample (Fig. 2, 5; Fig 3, 6), but similar to one from our experimental sample (Fig. 2, 6).

It is apparent that all the marks on bone objects from Vindija and Veternica are not identical, but rather show considerable morphological differences in profile, width and depth of notches. These differences could have been caused by different uses of these objects.

However, marks caused by non-human agents can sometimes be similar to those caused by retouching or by other human activity (cf. LEONARDI, 1979; VINCENT, 1988; BONNICHSEN & SORG, 1989). Bearing this fact in mind, we have selected for detailed analysis only a few above mentioned pieces, which have similar marks like those on the experimental material damaged by retouching the stone tools using percussion or pressure technique. Morphology of these marks can be generally explained 1) small (2 mm or less) and punctiform pits with distinctive scaling on the edges (percussion flaking); 2) short (2-15 mm) and linear channels with U-shaped cross-section (pressure flaking).

EXPERIMENT

The making of retouchers (flaking tools)

In 1996 the experiment was performed with the right radius and ulna of domesticated cattle. Some flesh remained around the epiphyses of the bone and the diaphyses were covered with periosteum. Two quartzite pebbles were used for the making of retouchers (flaking tools). The radius was laid on its semicircular side. We tried to puncture the diaphyses cortex by striking it with an unworked quartzite pebble. This resulted in an elliptical depression, the crumbling of the bone and often the pebble slid because of the slipperiness of the periosteum. Thus it was not possible to control the direction of the bone fracture. Because of this problem we made a chopping tool.

A bigger pebble was alternately hit a number of times with a smaller pebble on both sides of the same end. This is the usual technique for the production of this kind of tool (see TOTH, 1987, SCHICK & TOTH, 1993, 121). The flakes that were produced in the process were used for removing the remaining flesh and periosteum. After that, the bone breakage was continued with the chopping tool (Fig. 1). This resulted in better control of fracture direction and more efficient piercing of the bone. The part of radius that broke off, was later used in the second part of the experiment. We also chopped part of the ulna and used it in the experiment.

Retouching of stone tools by percussion and pressure

The second phase of the experiment comprised retouching (by pressure) of the previously made quartzite and chert flakes with the radius, and chert flakes with the ulna. A piece of radius was used as a pressure flaking tool (Fig. 2, 6), while one of the diagonally opposite parts of ulna was used for percussion retouching (Fig. 2, 1a), and the other for pressure retouching (Fig. 2, 1b). The edge of the stone flake was pressed by the middle part of the end of the bone fragment and fracturing was caused by a downward directed movement. We worked for a longer period of time with the flaking tool made from the radius. Instead of the ends of bone fragments (tips), we decided to use the middle part (surface near the end) for pressing, because on the archaeological material (Mousterian retouchers) the marks usually appeared on this place.

Afterwards, we performed the soft hammer percussion retouching using the wider part of the ulna as working surface (Fig. 2, 1a).

Fig. 1 Breaking of bone with a chopping tool

Sl. 1. Lomljenje kosti sjeckalom

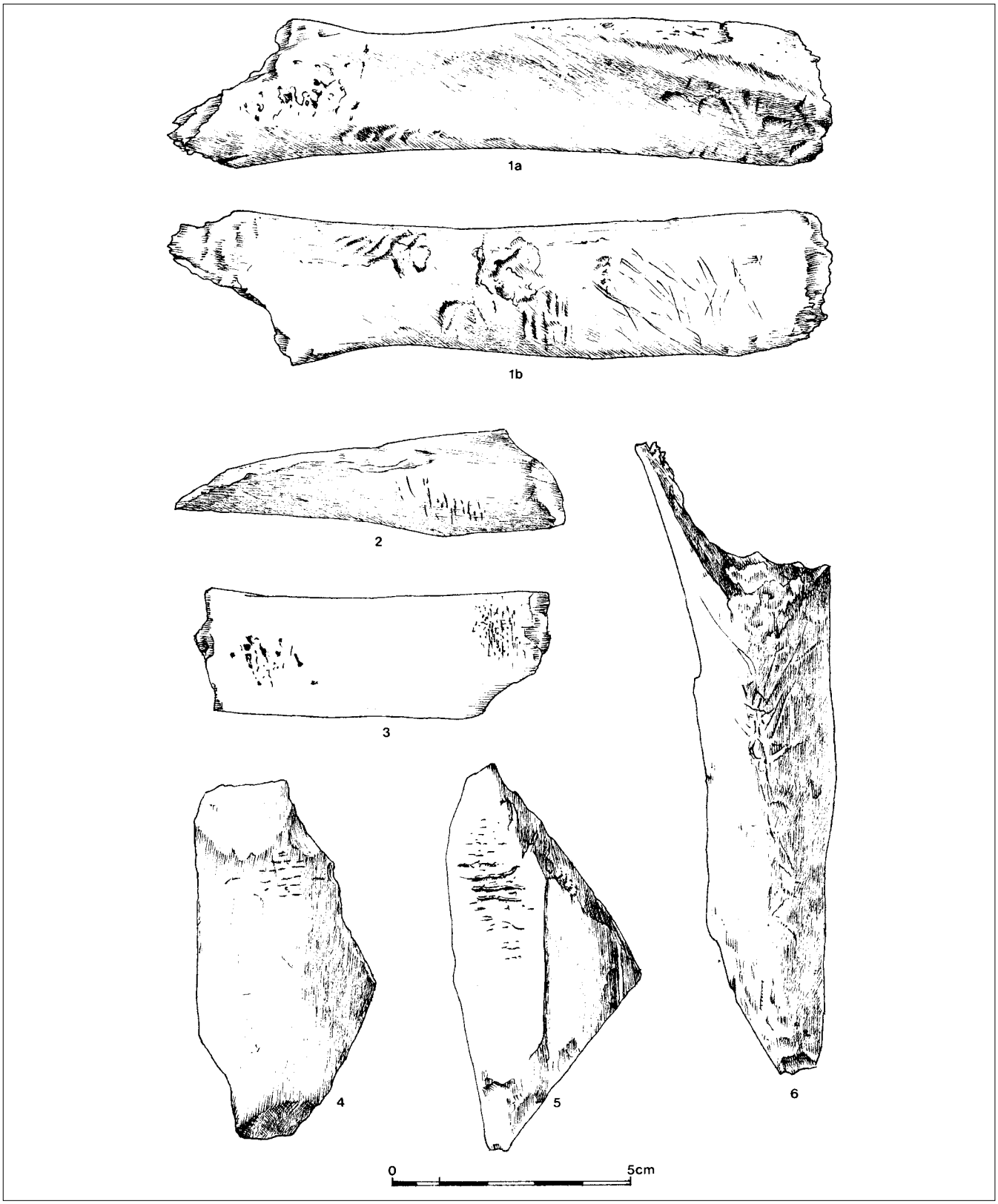

Fig. 2
Flaking tools: 1a. experimental percussion flaking marks on an ulna (left), 1b. experimental pressure flaking marks on an ulna (right); 2. pressure flaking marks from Vindija level G3; 3. percussion flaking marks (left) and pressure flaking marks (right) from Vindija complex G (down); 4. pressure flaking marks from Vindija complex G (level unknown); 5. pressure flaking or anvil marks from Veternica; 6. experimental pressure flaking marks on a radius. Modified after Ahern et al. (in press). Drawings: M. Gregl

Sl. 2.
Alatke za odbijanje: 1a. oštećenja na ulni od eksperimentalnog odbijanja udarcem (lijevo), 1b. oštećenja na ulni od eksperimentalnog odbijanja pritiskom (desno); 2. oštećenja od odbijanja pritiskom na nalazu iz sloja G3 Vindije; 3. oštećenja od odbijanja udarcem (lijevo) i oštećenja od odbijanja pritiskom (desno) na nalazu iz kompleksa G (dolje) Vindije; 4. oštećenja nastala pritiskom na nalazu iz kompleksa G (sloj nepoznat) Vindije; 5. oštećenja nastala odbijanjem pritiskom ili korištenjem nalaza iz Veternice kao nakovnja; 6. oštećenja na radijusu nastala eksperimentalnim odbijanjem pritiskom. Modificirano prema Ahern i dr. (u tisku). Crtež M. Gregl

The results of the experiment

The typical scalar, conchoidal strike marks caused by the piercing of the bone by the chopping tool are visible on the edges of the fragment of radius (see WHITE 1992, 136, Fig. 6, 12), and they are identical to those on the archaeological material from Vindija. In the process of piercing a case of "flake still in place" also occurred. That is often visible on archaeological material that has undergone chopping (see LYMAN, 1987). The most characteristic feature is that the bone edge is thinner towards the place of puncture. Furthermore, the recesses made by chopping tool blows are visible on the fragments (Fig. 2, 1a - right end of the bone, 1b - medial part of the bone), usually concentrated around the place of puncture.

After continuous retouching of quartzite, a large concave recess as well as a number of small irregular U-shaped cross-section grooves appeared on the pressure flaking tool made out of the radius (Fig. 2, 6). On the same fragment, as well as on the ulna fragment that was used for retouching of chert (Fig. 2, 1b), channels caused by the sliding of the pressure flaking tool along the edge of the retouched artifact were observed. This occurred because of the slipperiness of the bones, since, during the experiment, we could not completely remove periosteum from the bones. However, this condition of the bone surface is appropriate to the prehistoric situation, since the retouching was done nearly after butchering.

Small (2 mm or less), concentrically distributed, punctiform recesses that are scaled on the edges, were created on the working surface of the ulna as a result of percussion retouching of chert (Fig. 2, 1a - left end of the bone). On the other hand, the marks caused by pressure retouching of chert and quartzite are short (2-15 mm) and linear channels with U-shaped cross-section (Fig. 2, 1b - right part of the bone). It is important that on experimental material we can clearly distinguish morphology of the marks caused by percussion flaking from the marks caused by pressure flaking, which was not always possible (see BORDES 1961). However, it can be presumed that the marks caused by the retouching of quartzite by percussion would be different from those caused by the retouching of chert by the same technique. This was not checked in this experiment.

It was observed that retouch obtained by pressure on chert is diminutive, shallow, semi-steep, and somewhere slightly stepped; while the same retouch on quartzite is distinctively denticulate.

Quartzite was harder to retouch by pressure than chert and it left bigger marks on the surface of the bone. In both cases we can conclude that the retouching with pressure technique, using the middle part near the edge of bone retouchers (not a tip), produced different kinds or retouch (what partially depends upon retouching raw material), but not necessary parallel retouch which has been often associated with this kind of flaking. On the other hand, retouch obtained by percussion on chert flakes during this experiment is stepped, steep or semi-steep and, in some places, slightly denticulate.

THE COMPARISON OF THE ARCHAEOLOGICAL AND EXPERIMENTAL MATERIAL

The position of marks on the prehistoric pressure flaking tools from Vindija and Veternica is vertical or at a slight angle in relation to the longest axis of the artifact, while the positions on the experimental artifacts vary to a greater extent. The reason for this can lie in the lesser skill of the experimenter and the slipperiness of the bone that was used.

Sharp flake edges were usually chosen to perform pressure retouching on chert during experiment. Therefore, angles between the dorsal and ventral surfaces of the experimentally retouched chert flakes by pressure were usually between 50 and 55 degrees, while the same angles on the chert flakes retouched by soft hammer percussion technique usually varied between 60 and 85 degrees. A few tools with angles less than 55 degrees between dorsal and ventral surfaces of the working edge are found in the late Mousterian stratigraphic levels of Vindija (G_3, $G_{2/3}$, G_2, $G_{/g}$), and they might have been retouched by pressure.

Microscopic analysis showed similarities between the marks made by the pressure flaking performed with ulna (Fig. 3, 3) and the marks on the bone fragment from Mousterian level G3 of Vindija (Fig. 3, 4). However, some differences *vis à vis* other fragments from Vindija (Fig. 3, 5) and Veternica (Fig. 3, 6) were also noticed. These concern the depth and width of marks that may also have been caused by pressure. The reason for this can lie in the strength of pressure applied and in the different stone material that was retouched. Furthermore, greater resemblance is visible between the marks on the experimental radius retoucher that were caused by pressure retouching of quartzite (Fig. 2, 6) and those marks on the archaeological material from Veternica (Fig. 2, 5; Fig. 3, 6). However, it does not seem possible that the long, deep and wide marks on the bones from Veternica were made by the pressure retouching of quartz from this site because quartz is, like quartzite, very hard to break and experiments have shown that retouching by pressure of quartzite is very difficult.

A possibility that shouldn't be overlooked is that the bones with deeper and wider oblong marks were used as anvils or for some other purpose that we have not been able to reconstruct.

However, we should also take into consideration the fact that the morphology of marks depends on hardness and elasticity of the bone, which are in turn determined by a number of factors. For example the time that had passed since the death of the animal may affect the hardness and elasticity of the bone (VINCENT 1988).

Microscopic analysis confirmed a similarity between the marks on the experimental material caused by percussion retouching of chert (Fig. 3, 1), and the marks on the bone fragment from Vindija (Fig. 3, 2). Those marks can be described as small and punctiform pits with distinctive scaling on the edges. Generally they are uniform, although there are some morphological differences between them. In this

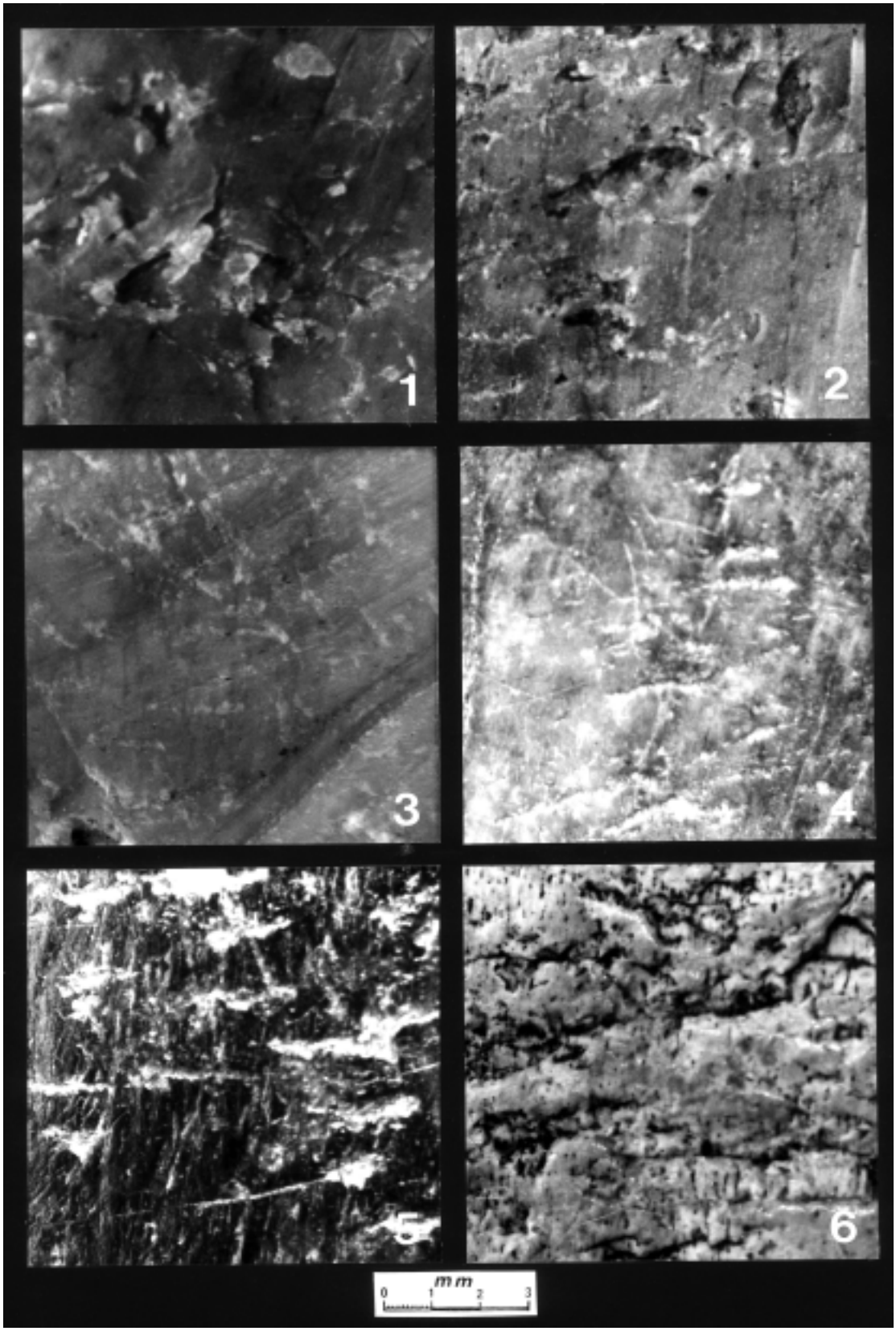

Fig. 3
Microscopic view: 1. experimental percussion flaking marks on an ulna; 2. percussion flaking marks from Vindija complex G (down); 3. experimental pressure flaking marks on an ulna; 4. pressure flaking marks from Vindija level G3; 5. pressure flaking marks from Vindija complex G (level unknown); 6. pressure flaking or anvil marks from Veternica. Modified after Ahern et al. (in press)

Sl. 3.
Pogled kroz mikroskop: 1. oštećenja na ulni od eksperimentalnog odbijanja udarcem; 2. oštećenja od odbijanja udarcem na nalazu iz kompleksa G (dolje) Vindije; 3. oštećenja na ulni od eksperimentalnog odbijanja pritiskom; 4. oštećenja od odbijanja pritiskom na nalazu iz sloja G3 Vindije; 5. oštećenja nastala pritiskom na nalazu iz kompleksa G (sloj nepoznat) Vindije; 6. oštećenja nastala odbijanjem pritiskom ili korištenjem nalaza iz Veternice kao nakovnja. Modificirano prema Ahern i dr. (u tisku)

case majority of pits on archaeological material are more lenticular than pits on experimental material, which are often triangular.

The marks on experimental material are usually more frequent than the marks on archaeological material, what can be explained by different intensity of tool use (use of experimental tools was more extent).

It should be mentioned that one bone fragment from the Veternica assemblage, in addition to displaying distinctive grooves, also has punctiform marks typical of percussion flaking. This could suggest possible use of the same object as both a percussion and pressure flaking tool. The different marks on the opposite ends of the fragment from Vindija (Fig. 2, 3) may also suggest the use of both techniques.

Another issue of importance concerns the smaller dimensions of retouchers. The smaller dimensions probably are not the result of breakage during use or as a consequence of overburden weight. Besides the archaeological material, the small, but efficient experimental soft hammer made of the piece of ulna, shows that even the small Middle Paleolithic percussion retouchers could still have been functional. However, we shouldn't completely exclude the possibility of the breakage of some retouchers that is suggested by the illogical distribution of the punctiform marks probably caused by percussion on one end of the fragment from the Veternica assemblage.

DISCUSSION

The experiment showed that marks on retouchers caused by the percussion flaking of stone tools, may differ from those that were caused by pressure. The recesses made by the percussion technique are small (2 mm or less) and punctiform pits with distinctive scaling on the edges, while marks made by pressure are short (2-15 mm) linear channels with U-shaped cross-section. Channels made by pressing the quartzite are much deeper and wider than those derived from pressing the chert.

According to NAMI & SCHEINSOHN (1997), pitting can be caused by pressure retouching when pointed retouchers were used, which was not the case in our experiment where pitting was exclusively associated with percussion technique. Our experiment has also shown that pressure retouching, using the middle part near the distal edge of bone retouchers (not a tip), can produce different kinds of retouch but not necessarily parallel retouch, which has been often exclusively used as proof for the presence of the pressure retouching technique.

There are significant morphological differences among the marks on the retouchers from archaeological sites. It can be presumed that some variations in the morphology of marks are caused by the different strength of pressure, duration of work, kind of the stone that was retouched, sharpness of the stone edge, and the skill of the tool-maker. Furthermore, it is possible that some differences depend on the elasticity and hardness of the used bone, as A. VINCENT (1988) has already suggested. These probably vary depending on the age of the animal, the skeletal element, and the time that had passed since the death of the animal. To establish more accurate relationships among the range of mentioned parameters, it will be necessary to perform a number of similar experiments that will include the use of different animal bones on different kinds of raw materials.

However, even if all differences between percussion and pressure marks are specific for this experiment, it is hard to reject hypothesis concerning the presence of pressure retouching technique in the Mousterian, because the marks caused by experimental pressure retouching in this experiment are similar to some marks found on archaeological material from Vindija. Furthermore, the macroscopic and microscopic analyses established that the two different groups of marks (one caused by percussion and another by pressure) on experimental material, may well correspond to the same groups of marks found on archaeological material. Thus, we tentatively conclude that both mentioned flaking techniques (percussion and pressure) were actually used in the Moustterian of Vindija and suggest that Neanderthals were capable of both percussion and pressure retouching using bone retouchers. This ability has been questioned by BORDES (1961), but more recently supported by Shchelinskiď (PLISSON, 1988) on the basis of a comparison of archaeological and experimental material. However, further analysis, especially of taphonomic processes, is required before we can definitively determine whether or not the bones from Vindija were used as both percussion and pressure retouchers.

ACKNOWLEDGMENTS

We are grateful to late Maja Paunović and Marija Poje for their help. Katica Kalac, Tim D. White, Jožica Zupanič, Preston T. Miracle, Tihomila Težak-Gregl and Sanjin Mihelić provided various forms of assistance with respect to this paper. Miljenko Gregl prepared the drawings, and Hrvoje Potrebica translated this paper into English. Further correction was provided by Lawrence G. Straus and James Ahern. We are also grateful to the janitor Štef because he saved the experiment by chasing away the dog.

REFERENCES

AHERN, J. C., KARAVANIĆ, I., PAUNOVIĆ, M., SMITH, F. H. & JANKOVIĆ, I., in press., New hominid fossil and archaeological discoveries and interpretations from Vindija cave, Croatia, *JHE,* New York

BARTOLOMEI, G., BROGLIO, A., CASSOLI, P. F., CASTALLETI, L., CATTANI, L., CREMACHI, M., GIACOBINI, G., MALERBA, G., MASPERO, A., PERESANI M., SARTORELI, A. & TAGLIACOZZO, A., 1994., La Grotte de Fumane. Un site aurignacien au pied des Alpes *Preistoria Alpina* 28 (1992), Trento, 131.-179.

BINFORD, L. R., 1981., *Bones: Ancient Men and Modern Myth,* New York, Academic Press

BLUMENSCHINE, R. J., MAREAN, C. W. & CAPALDO, S. D., 1996., Blind tests of inter-analyst correspondence and accuracy in the identification of cut marks, percussion marks, and carnivore tooth marks on bone surface, *JAS* 23, New York 493.-507.

BONNICHSEN, R. & SORG, M. H., (Eds), 1989., *Bone Modification*. Orono, Center for the Study of the First Americans

BORDES, F., 1961., *Typologie du Paléolithique ancien et moyen.* Bordeaux, Delmas

BRAIN, C. K. , 1981., *The Hunters or the Hunted?* Chicago, The University of Chicago Press

BREUIL, H., 1932., Le feu et l'industrie de pierre et d'os dans legisement du *Sinantropus* à Chou-Kou-Tien, *L'Anthropologie* 42, 1.-17.

BREUIL, H., 1938., The use of bone implements in the Old Palaeolithic period, *Antiq* 12, London 56.-67.

CAPALDO, S. D. & BLUMENSCHINE, R. J., 1994., A quantitative diagnosis of notches made by hammerstone percussion and carnivore gnawing on bovid long bones, *AmAntiq* 59, Washington 724.-748.

FEUSTEL, R., 1973., *Technik der Steinzeit*. Weimar, Hermann Böhlaus Nachfolger

INIZAN, M.-L., ROCHE, H. & TIXIER, J., 1992., *Technology of Knapped Stone*. Meudon, CREP, CNRS

JONES, P. J., 1980., Experimental butchery with modern stone tools and its relevance for Palaeolithic archaeology, *WArchaeo* 12, London, 153.-165.

KARAVANIĆ, I., 1995., Upper Paleolithic occupation levels and late-occuring Neandertal at Vindija Cave (Croatia) in the context of Central Europe and the Balkans, *JAnthR* 51, Albuqverqve, 9.-35.

KARAVANIĆ, I. & SMITH, F. H., 1998., The Middle/Upper Paleolithic interface and the relationship of Neanderthals and early modern humans in the Hrvatsko Zagorje, Croatia, *JHE* 34, New York, 223.-248.

KARAVANIĆ, I. & SMITH, F. H., 2000., More on Neanderthal problem: The Vindija case, *CA* 41, Chicago, 838.-840.

LEONARDI, P., 1979., Una serie di ritoccatoi prevalentemente musteriani del Riparo Tagliente in Valpantena presso Verona, *Preistoria Alpina* 15, Trento, 7.-15.

LYMAN, R. L., 1987., Archeofaunas and butchery studies: A taphonomic perspective. In (M. Schiffer, Ed) *AAMT 10*. New York, Accademic Press, 249.-337.

MALEZ, M., 1978., Novija istraživanja paleolitika u Hrvatskom zagorju (with German summary). In (Ž. Rapanić, Ed) *Arheološka istraživanja u sjeverozapadnoj Hrvatskoj. IzdanjaHAD* 2, Zagreb, 6.-69.

MALEZ, M., 1981. Paleolitik na području Zagreba (with German summary). In (Ž. Rapanić, Ed), *Arheološka istraživanja u Zagrebu i njegovoj okolici. IzdanjaHAD* 6, Zagreb, 65.-108.

MALEZ, M., SMITH, F. H., RADOVČIĆ, J. & RUKAVINA, D. ,1980., Upper Pleistocene hominids from Vindija, Croatia, Yugoslavia, *CA* 21, Chicago, 365.-367.

MARTIN, H., 1906., Ossements utilisés par l'homme mousrérien de la station de la Quina (Charente), *BSPF* (séance du 26 avril), Paris, 1.-8.

MARTIN, H., 1907-1910., *Recherches sur l'evolution du Moustérien dans le gisement de la Quina (Charente)*. Premier volume: Industrie osseuse. Paris, Schleicher

MIRACLE, P. T. & BRAJKOVIĆ, D., 1992., Revision of the ungulate fauna and Upper Pleistocene stratigraphy of Veternica (Zagreb, Croatia), *GeoC* 45, Zagreb, 1.-14.

NAMI, H. G. & SCHEINSOHN, V. G., 1997., Use-wear patterns on bone experimental flakers: A preliminary report, In (L.A. Hannus, L. Rossum, & R.P. Winham, Eds), *Proceedings of the 1993 Bone Modification Conference*. Sioux Falls, SD, Augustana College, 256.-264.

PATOU-MATHIS, M., 1997., Analyses taphonomique et palethnographique du materiel osseux de Krapine (Croatie): Nouvelles donnees sur la faune et les restes humains, *PréhistoireE* 10, 63.-90.

PLISSON, H., 1988., Technologie et tracéologie des outils lithiques moustériens en Union Soviétique: les travaux de V. E. Shchelinskiď. In (M. Otte, Ed), *L'homme de néandertal, Vol. 4: La technique.* Liege, ERAUL, 121.-168.

SCHICK, K. D. & TOTH, N., 1993., *Making Silent Stones Speak*. New York, Simon & Schuster

SMITH, F. H. & AHERN, J. C., 1994., Brief comunnication: addition cranial remains from Vindija Cave, Croatia, *AJPA* 93, New York, 275.-280.

SMITH, F. H., TRINKAUS, E., PETTITT, P. B., KARAVANIĆ, I. & PAUNOVIĆ, M. 1999., Direct radiocarbon dates for Vindija G1 and Velika Pecina Late Pleistocene hominid remains, *PNAS, USA* 96, 12281.-12286.

STRAUS, L. G., 1999. The Neanderthal problem continued, *CA* 40, Chichago, 352.-355.

TOTH, N., 1987., The First Technology, *SA* 256, 104.-113.

VILLA, P. & BARTRAM, L., 1996., Flaked Bone From a Hyena Den, *Paleo* 8, 143.-159.

VINCENT, A., 1987., Outillage osseux du paléolithique moyen a Bois-Roche (Cherves-Richmont, Charete)? Étude préliminare. *Préhistoire de Poitou-Charents, Problèmes actueles,* (Actes du 111e Congrès national des Societés savantes, Poitiers 1986). Paris, CTHS, 27.-36.

VINCENT, A., 1988., L'os comme artefact au paleolitique moyen: principes d'etude et premiers resultats, In (M. Otte, Ed), *L'homme de nédertal 6, La tehnicque.* Liege, ERAUL, 185.-196.

VUKOVIĆ, S., 1973., Eksperimenat u prethistorijskoj arheologiji, *VMiKH* 2, Zagreb, 22.-26.

VUKOVIĆ, S., 1974., Experiments in drilling holes in stones, *CalArchaeo* 2, Calgary, 20.-21.

WHITE, T. D., 1992., *Prehistoric Cannibalism at Mancos 5MTUMR-2346.* New Jersey, Princeton University Press

WOLPOFF, M. F., 1996., *Human Evolution*, New York, McGraw-Hill.

WOLPOFF, M. F., SMITH F. H., MALEZ, M, RADOVČIĆ, J. & RUKAVINA D., 1981., Upper Pleistocene human remains from Vindija Cave, Croatia, Yugoslavia, *AJPA* 54, New York, 499.-545.

SAŽETAK

Srednjopaleolitički udarači ili pritiskači? Usporedba eksperimentalnoga i arheološkog materijala iz Hrvatske

Eksperimentiranje je već duže vremena prisutno u arheologiji kao pomoćna metoda pri rekonstruiranju načina života i svakodnevne djelatnosti različitih prapovijesnih populacija. Primjerice, vrlo zanimljivim i korisnim pokazali su se eksperimenti komadanja životinja uporabom kamenih alatki (TOTH, 1987.). Nadalje, eksperimentalna arheologija uvelike je pomogla pri utvrđivanju tehnoloških procesa izradbe paleolitičkih (INIZAN ET AL., 1992.) i neolitičkih alatki (VUKOVIĆ, 1973., 1974.) te načina njihova korištenja.

U ovom se radu usporedbom eksperimentalnoga i arheološkog materijala nastoji postići potpunija interpretacija načina korištenja srednjopaleolitičkih koštanih ulomaka tzv. obrađivača, koji su služili za obradbu kamenih alatki u završnoj fazi proizvodnje. Međutim, nije nam poznato jesu li oni u srednjem paleolitiku, odnosno musterijenu, korišteni isključivo za obradbu kamenih alatki udarcem ili i pritiskom.

Obrađivači se općenito mogu definirati kao koštani ulomci s malim točkastim udubljenjima ili usporednim linearnim oštećenjima na distalnom kraju, okomitim na glavnu os predmeta. Oštećenja na obrađivačima ponekad se mogu jasno razlikovati od onih na kostima nastalih drugim aktivnostima (cf. VINCENT, 1987.; BINFORD, 1981.; BRAIN, 1981.; WHITE, 1992.; CAPALDO & BLUMENSCHINE, 1994.; BLUMENSCHINE ET AL., 1996.; VILLA & BARTRAM, 1996.), a katkad su slična onima nastalima prirodnim procesima ili životinjskim aktivnostima, što uvelike otežava njihovo prepoznavanje (cf. LEONARDI, 1979.; VINCENT, 1988.; BONNICHSEN & SORG, 1989.).

Više koštanih ulomaka, vjerojatno obrađivača, pronađeno je većinom u musterijenskim slojevima špilje Vindije u sjeverozapadnoj Hrvatskoj. Pri pregledu faunističkog materijala iz Vindije T. D. White izdvojio je više ulomaka s različitim oštećenjima. Dio izdvojenih ulomaka, koji vjerojatno predstavljaju obrađivače, analiziran je u ovom radu.

Poput Vindije i u špilji Veternici pored Zagreba pronađeno je više koštanih ulomaka koji su mogli biti obrađivači. Nastanak poprečnih udubina na površini ulomaka M. MALEZ (1981., 81.) je pripisao obrađivanju udarcem ili uporabi ulomaka za podlogu, odnosno nakovanj na kojemu je obavljeno obrađivanje.

Međutim, vidljivo je da sva oštećenja na koštanim ulomcima koji su mogli biti obrađivači iz Vindije i Veternice nisu identična već pokazuju znatne morfološke razlike u profilu, širini i dubini ureza, uzrokovane možda različitom uporabom tih predmeta.

Da bi se ustanovila morfologija oštećenja koja nastaju obrađivanjem kamenih alatki udarcem i pritiskom, proveden je eksperiment koji je ponajprije obuhvatio izradbu obrađivača. Izvršen je na desnom radijusu i ulni domaćeg goveda. Oko epifiznih dijelova kosti bilo je ostataka mesa, a dijafizni dio bio je presvučen pokosnicom. Radijus je položen na polukružnu stranu. Pokušalo se probijanje korteksa dijafize udarcima neobrađenog oblutka, što je rezultiralo eliptičnom udubinom i mrvljenjem kosti, te čestim klizanjem oblutka zbog klizavosti pokosnice. Takvim načinom nije bilo moguće kontrolirati smjer lomljenja kosti pa je pristupljeno izradbi sjeckala. Manjom valuticom udareno je više puta naizmjenično s jedne i s druge strane istog ruba valutice, što je uobičajena tehnika izradbe te alatke (vidi TOTH, 1987.; SCHICK & TOTH, 1993., 121.). Dobiveni odbojci upotrijebljeni su za skidanje pokosnice i preostalog mesa. Potom je razbijanje kosti nastavljeno sjeckalom (sl. 1.), što je rezultiralo boljom kontrolom smjera loma i učinkovitijim probijanjem. Odlomljeni dio radijusa kasnije je upotrijebljen u drugom dijelu eksperimenta, a dio ulne odvojen je od radijusa i također kasnije korišten u eksperimentu.

Druga faza eksperimenta provedena je uporabom dobivenog komada radijusa na odbojcima kvarcita i rožnjaka te ulne na odbojcima rožnjaka. Ulomak radijusa korišten je kao obrađivač za obradbu odbojaka pritiskom (sl. 2., 6), dok je jedan od dijagonalno nasuprotnih krajeva ulne upotrijebljen za obradbu udarcem (sl. 2., 1 a - lijevo), a drugi za obradbu pritiskom (sl. 2., 1 b - desno). Pritiskalo se na rub kamenog odbojka sredinom krajnjeg dijela koštanog ulomka, pri čemu je pokretom prema dolje izvršeno odlamanje. Potom je pristupljeno obradbi kamenog odbojka udarcem, pri čemu je radni dio ulne bio njezin deblji kraj.

Na rubovima fragmenta radijusa vidljive su tipične stepeničaste i konkoidalne udarne brazgotine (vidi WHITE, 1992., 136., sl. 6.,12) nastale probijanjem kosti sjeckalom, identične onima na arheološkome materijalu Vindije. Pri probijanju je došlo do slučaja "flake still in place", što je često vidljivo na arheološkome materijalu koji je pretrpio komadanje (vidi LYMAN, 1987.). Karakteristično je istanjenje ruba kosti prema mjestu proboja. Nadalje, na ulomcima su vidljive udubine, obično koncentrirane oko mjesta probijanja, nastale udarcima sjeckala.

Na pritiskaču od radijusa nakon uzastopne obradbe kvarcita pritiskom pojavila se veća konkavna udubina i više sitnih nepravilnih utora. Na istom predmetu kao i na kraju ulomka ulne, kojim je obrađivan rožnjak, primijećeni su kanali nastali zbog klizanja pritiskača po rubu obrađivanog predmeta. To se zbilo zbog masnoće i klizavosti kostiju s kojih pokosnica, tijekom eksperimenta, nije mogla do kraja biti uklonjena.

Od obradbe rožnjaka udarcima na radnom dijelu ulomka ulne nastale su sitne (2 mm ili manje), koncentrirano raspoređene točkaste udubine, čiji se periferni dijelovi ljuskaju (sl. 2., 1 a - lijevo). Za razliku od njih, oštećenja nastala obradbom pritiskom su duguljasta (2-15 mm), slična utorima (sl. 2., 1 b - desno) s poprečnim presjekom u obliku slova U. Međutim, valja pretpostaviti da bi oštećenja uzrokovana obradbom kvarcita udarcem bila nešto drukčija od onih dobivenih obradbom rožnjaka istom tehnikom, što nije provjereno ovim eksperimentom.

Zamijećeno je da je obradba dobivena pritiskom na rožnjaku sitna, plitka, polustrma, a gdjegdje blago stepeničasta, dok je na kvarcitu izrazito zupčasta. Ona, pak, dobivena udarcem kosti na odbojcima rožnjaka je stepeničasta, strma ili polustrma i ponegdje blago zupčasta. Kvarcit se teže obrađivao od rožnjaka pritiskom i jače je oštećivao površinu kosti.

Mikroskopska analiza pokazala je sličnost između oštećenja nastalih obradbom pritiskom ulne (sl. 3., 3) i oštećenja na koštanom ulomku iz musterijenskog sloja G3 Vindije (sl. 3., 4). Međutim, primijećene su i određene razlike, s obzirom na dubinu ureza, prema drugim ulomcima Vindije (sl. 3., 5) i Veternice (sl. 3., 6), koji su također mogli biti uzrokovani pritiskom. Razlog tomu može biti u jačini pritiska primijenjenog na različiti kameni materijal. Štoviše, veća sličnost je uočljiva između izraženih oštećenja radijusa nastalih obradbom kvarcita pritiskom i sličnih oštećenja na arheološkome materijalu iz Veternice (sl. 3., 6). Stoga je moguće da su duguljasti i duboki urezi na kostima iz Veternice nastali pri obradbi kvarcita pritiskom, a kraća i plića oštećenja na vindijskome materijalu pri obradbi rožnjaka pritiskom, pri čemu je bila potrebna manja sila. Ipak, obradba kvarcita pritiskom ne čini se vjerojatnom jer je taj materijal jako tvrd, pa je takva obradba teško provediva što je pokazao i ovaj eksperiment.

Mikroskopska analiza potvrdila je veliku sličnost oštećenja eksperimentalnog materijala, dobivenih obradbom udarcima (sl. 3., 1), s onima na koštanom fragmentu iz Vindije (sl. 3., 2).

Eksperiment je pokazao da se oštećenja na obrađivačima nastala udarcem pri izradbi kamenih alatki, mogu bitno razlikovati od onih nastalih pritiskom, a makroskopska i mikroskopska usporedba eksperimentalnog materijala s arheološkim upućuje na korištenje obaju navedenih tehnika u musterijenu. Ipak, u ovom radu ne može se pouzdano dokazati da su neandertalci obrađivali svoje kamene alatke udarcem i pritiskom. Naime, rezultati eksperimenta mogu biti specifični, a ne univerzalni, dok tafonomska analiza faunističkog materijala Vindije i Veternice koja bi omogućila pouzdano tumačenje porijekla različitih oštećenja na kostima u kontekstu svih procesa koji su na njih djelovali, od deponiranja do pronalaska, još uvijek nije učinjena.

Ustanovljene su značajne morfološke razlike između oštećenja obrađivača s arheoloških nalazišta. Za pretpostaviti je da su te varijacije uvjetovane različitom jačinom pritiska, vremenom rada, vrstom obrađivanog litičkog materijala i oštrinom ruba kamena, te vještinom izrađivača alatki. Nadalje, moguće je da ove razlike uvjetuje elasticitet i tvrdoća upotrijebljene kosti, kao što je to predložila A. VINCENT (1988.), što vjerojatno varira ovisno o vrsti i starosti životinje, kosturnom dijelu, te o vremenu koje je proteklo od njezine smrti. Za utvrđivanje točnijih odnosa unutar navedenih parametara bilo bi potrebno učiniti niz sličnih eksperimenata, koji bi obuhvatili uporabu različitih kosturnih dijelova životinja, na više vrsta sirovinskog materijala.