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Bone technology in the Late Neolithic Vinča culture: Manufacturing pointed tools

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ABSTRACT

The bone industry of the Late Neolithic/Early Eneolithic Vinča culture was rich and diverse; different osseous raw materials (diverse skeletal elements) were used for the production of everyday items, weapons and ornaments. The selection of raw materials was usually strict – certain skeletal elements were consistently used for specific artefact types, often depending on their physical properties. The manufacturing techniques display a certain level of standardisation, in particular, the most common tool type, medium-sized pointed tools (awls), was generally produced by using the same manufacturing techniques and resulting in more or less standardised products. In this paper, an overview will be provided of manufacturing techniques used for the production of pointed tools from several Vinča culture sites: Vitkovo, Pločnik and Vinča – Belo Brdo, reconstruction of the *chaîne opératoire*, the morphological features of the subtypes and variants, and their overall cultural and economic importance will be discussed.

1. Introduction

The study of bone tools in archaeology has undergone significant advances in the past few decades, becoming more diverse and with the notable development of multi-methodological and theoretical approaches. Studies now include thorough analyses of bone tool assemblages from different sites, regional studies of raw material choices, traceological research and reconstruction of use, social aspects of bone tool production and use, among other research directions in order to document, in detail, the production and use lives of these enigmatic tools (e.g., Baron and Kufel Diakowska eds., 2011; Bradfield, 2019; Buc, 2019; Choyke and Bartosiewicz eds., 2021; Lang ed., 2013; Legrand-Pineau et al. eds., 2010; Mărgărit et al. eds., 2014; Mărgărit et al., 2018; Wild et al. eds. 2021).

Evaluation of manufacturing techniques also represents one of the most important areas of prehistoric bone technology studies, and their reconstruction can provide insights intotechnological know-how, cultural preferences, as well as the place and the importance of bone tools within a given community. I. Sidéra showed that the usage of different techniques may also represent local, regional identities, and may reflect cultural differentiation (Sidéra, 2005). A. Choyke proposed the concept of the *manufacturing continuum* that analyses the effort invested into the production of a tool. This concept places bone objects on a hypothetical axis ranging from expedient, *ad hoc* tools, up to carefully made items, produced following strict procedures with large labour and skill investment (Choyke, 1997; 2001). Careful analyses of manufacturing procedures can, therefore, show the importance and value of bone objects within a certain community and the tasks associated with them.

Standardisation in production, usually considered as a mark of increased production and a step towards specialisation, has more or less established steps in production, resulting in similar or even identical end-products. At the same time, however, it tends to reduce effort and time investment to increase productivity, i.e., tends to choose technological procedures that are more efficient. Along with demands for efficiency, cultural preferences, tradition, importance of end-products, social relations involved in bone tool production and use, are all factors that influence the selection of manufacturing techniques and processes among possible technical solutions (see also Caple, 2006; Horsfall, 1987; Hayden, 1998).

Prehistoric technologies, including bone technology, encompass both finely produced items, with large labour and skill investment, and the quickly produced objects with minimised effort (Caple, 2006). The balance between these two ends, in particular, the aim for reduced effort but carefully made items, along with cultural preferences and local technological traditions, are what constitutes specific, particular traits of the bone technology within a given community. Studies of bone tool technology may provide information on everday activities, but also on diverse economic and socio-cultural aspects, including raw material

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managment, relations with the environment, level of technological know-how, organisation of production, or overall importance of specific crafts.

In this paper I analyse technological procedures for the production of medium-sized pointed bone tools (usually labelled *awl* in typological schemes; French – *poinçon*). These points are not only the most numerous bone tool type in the Late Neolithic Vinča culture, but also usually the most common tool type in the majority of Neolithic collections, often comprising approximately 50% of the bone tool assemblage (e.g., Legrand, 2005; Legrand and Radi, 2008; Russell, 1990, 2016; Vornicu, 2014). Such frequency provides a good basis for the study of possible variety in manufacturing techniques, investment in time and labour, morphological features, and overall *manufacturing continuum*, and therefore may provide better insights into the bone technology and its importance in everyday life and economy. These tools have been argued to have been predominantly used for everyday tasks involved in processing organic materials – for making products from hides, plant fibres, basketry, etc., from initial preparation of the raw materials up to the production of final products (Legrand, 2007, 2008; Russell, 2005, 2012). Their frequency also shows that the need for them was rather high. The analysis will be based on the reconstruction of the *chaîne opératoire* (*sensu* Leroi-Gourhan, 1964; see also Inizan et al., 1995, p. 14), and will include the study of the manufacturing techniques an morphological features.

2. The archaeological background

2.1. The Vinča culture

The Vinča culture is a phenomenon widespread in the Central Balkans and South Pannonian region, in present-day Serbia, the eastern parts of Croatia and Bosnia and Herzegovina, the northern parts of Montenegro, and in the regions of Oltenia and Transylvania in Romania (Garašanin, 1979; Srejović, ed., 1989). Over one hundred sites are known today, mainly settlement sites; some only from field surveys, while some have been extensively excavated (Fig. 1). The Vinča culture is dated to the period between 5400 and 4500/4450 cal BC (Borić, 2009; cf. also Orton, 2012; Tasić et al., 2015). The Vinča culture communities based their subsistence on agriculture and animal husbandry and their material culture included rich and diverse ceramic production (cooking, storage and consumption vessels, anthropomorphic and zoomorphic figurines, weights, etc.), as well as a chipped and ground stone industry and also a bone tool industry (Antonović, 2003; Bulatović, 2018; Chapman, 1981; Garašanin, 1979; Filipović and Obradović, 2013; Nikolić ed., 2008; see also papers in Radivojević et al. eds., 2021).

2.1.1. The site of Vinča – Belo Brdo

The site of Vinča – Belo Brdo, the eponymous site of the Vinča culture, is situated on the right bank of Danube, near the confluence of the Bolečica stream into the Danube, approximately 28 km from the centre of the city of Belgrade, in the present-day suburb of Vinča. The site was discovered in the early 20th century, and the first excavations were initiated already in 1906 by Miloje Vasić. M. Vasić excavated a large area and at the same time uncovered the entire stratigraphic sequence of the Vinča tell, which comprises approximately 9 m thick cultural layers. Excavations were renewed in the 1970s and again in 1998, and, with small pauses, are still on-going (Nikolić ed., 2008). The site of Vinča – Belo Brdo is the most extensively researched and, at the same time, extraordinary Vinča culture site, with the richest and the most elaborate material culture, including finely produced ceramic artefacts, such as ornithomorphic vessels and figurines, and large quantities of imported items such as obsidian and marine shells, etc., suggesting that this site had an important role in the economy of the region and was located on important trade and exchange routes (see Vitezović and Antonović, 2020, and references therein).

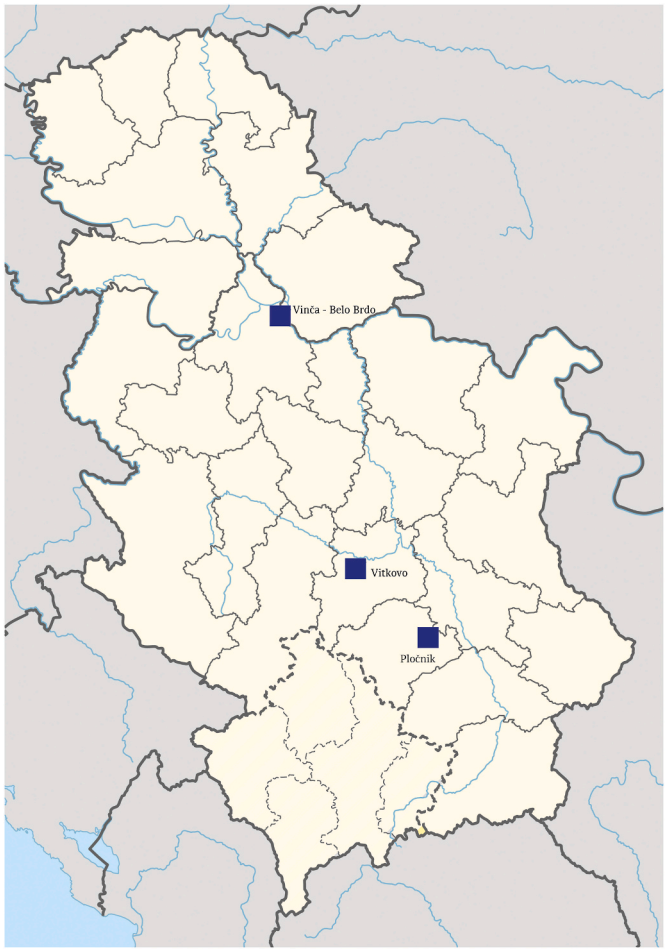

Fig. 1. Map showing the sites mentioned in the text: Vinča – Belo Brdo, Vitkovo and Pločnik.

2.1.2. The site of Vitkovo

The site of Vitkovo or Vitkovačko Polje is situated in the vicinity of the town of Aleksandrovac in central Serbia. The prehistoric settlement was situated in the valley of the river Stubalska Reka; it was discovered in the mid-20th century, and excavated in 1969 and 1971. In 2001, small-scale rescue excavations were carried out, and one large rubbish pit, presumably connected to the house remains noted near-by, was discovered (Čađenović et al., 2003, 2003a, 2003e, 2007).

2.1.3. The site of Pločnik

The site of Pločnik is situated in southern Serbia, 27 km to the west from the town of Prokuplje. A large prehistoric settlement was located on the terrace of the river Toplica. It was discovered in 1927 and the first excavations were carried out already in 1928. Excavations were renewed in 1960s and 1970s and resumed again in 1996–2012. Several trenches were excavated, revealing rich archaeological remains from the Vinča culture settlement, including ceramic vessels, ceramic figurines, chipped stone and obsidian tools, ground stone tools, and also traces of copper processing and copper artefacts (Kuzmanović Cvetković, 2017; Radivojević et al. eds., 2021).

3. Materials and methods

Artefacts included in this analysis come from assemblages that differ in quantity and quality. The awls included in the analysis from the site of Vinča – Belo Brdo come from the assemblage collected during the excavations in the first half of the 20th century. It is a rather rich assemblage, comprising approximately 1000 objects which were previously

analysed and published in short reports (Srejović and Jovanović, 1959; Bačkalov, 1979). Renewed analysis, which includes a detailed techno-typological analysis, is still on-going (Vitezović, 2021a), and approximately 100 awls available for analysis were included in this study. Artefacts were collected selectively during excavations, i.e., there were almost no faunal remains to be examined (very limited amount of faunal remains was collected), and the assemblage also contained predominantly complete or almost complete objects, while manufacture debris and severely fragmented items are present only in small quantities.

The assemblage from the site of Pločnik includes all the artefacts collected during the excavation campaigns from 1996 to 2011 and 2012–2013 (Vitezović, 2021b, 2021c). Faunal remains were collected by hand, and subsequently examined (by the author and by a faunal specialist) for all fragments with traces of manufacture and use. Therefore, it is possible that some smaller fragments remained unnoticed and not collected, but careful examination of the faunal material reduced the sample bias. The entire bone tool assemblage attributed to the Vinča culture horizon comprises approximately 300 artefacts, and awls comprise 60 items (Vitezović, 2021b, 2021c).

The assemblage from Vitkovo encompasses approximately 40 bone objects (20 awls), collected during rescue excavations within one rubbish pit (Vitezović, 2012; Vitezović and Bulatović, 2013). Faunal remains were collected rather carefully, although by hand, and subsequently examined for all possible traces of manufacture and/or use (by the author and by a faunal specialist).

Manufacturing traces were observed with the naked eye and using a low magnification (up to 20x), and only selected items were studied with a magnification up to 45x.[1] Analytical criteria for interpretation were established based on the published data from different authors (Christidou, 1999, 2001; Legrand, 2007; Legrand and Radi, 2008; Maigrot, 2003; Mărgărit et al. eds. 2014; Mărgărit et al., 2018; Newcomer, 1974; Ramseyer, ed., 2004; Semenov 1976; Sidéra, 1993, 2005).

These assemblages are not ideal; and a certain sample bias is present in all of them – in the case of the site of Vinča – Belo Brdo, material was collected selectively; in the case of Pločnik and Vitkovo, material was not sieved, and also Vitkovo was excavated on a small area. However, both the Pločnik and Vinča – Belo Brdo collections are rather large and come from large-scale excavations, and careful examination of all faunal remains from Pločnik and Vitkovo reduced some of the sample bias. The preservation of the faunal material from all three sites is good, but not exceptional – while some of the bone artefacts have rather well preserved surfaces, some are covered with carbonate crusts, have eroded surfaces, or have traces of burning.

Because of these differences in data quality and the nature of the assemblages, statistical analyses were not possible; that is to say, it was not possible to determine the ratio of debris vs. finished tools, and also, since tools from metapodial bones were less fragmented and more likely to be collected by the excavators, the ratio of metapodial bones vs. ribs may not be accurate. Nevertheless, these assemblages provide important information regarding the technological procedures practiced within the Vinča culture bone industry

Bone points from the Vinča culture were classified into two main subtypes according to the raw material used, which at the same time, determines their morphology – awls produced from long bones (with a circular or semi-circular cross-section, subtype I1A, with several variants) and awls produced from flat bones (with a thin cross-section, subtype I1B, with variants) (Vitezović, 2007, 2016a).

[1] Microscope that was used is Eakins (model: SZM7045).

4. Results

4.1. Awls from long bones

4.1.1. Raw material selection

Metapodial bones from small ruminants were the most frequent raw material (Fig. 2). Sheep/goat (*Ovis aries/Capra hircus*) metatarsal and metacarpal bones predominate, although metapodials from roe deer (*Capreolus capreolus*) are present as well, in particular at Vinča – Belo Brdo. Usually, metapodials from adult animals were used, although there are cases when bones from younger individuals, with unfused or partially fused epiphysis, were used – one example comes from Pločnik (Fig. 2d) and one from Vinča – Belo Brdo (Fig. 3). Other long bones are rarely used, though it is possible that tibiae and larger long bones were occasionally used (especially for the awls produced on more or less regular splinters from diaphyses). As an exception, and thus far unique find, a bone tool made from fox (*Vulpes vulpes*) ulna, was discovered at Pločnik (Vitezović, 2021b, p. 51, Fig. 24).

4.1.2. Manufacturing techniques and morphological features

The most frequent variant, awls from small ruminant metapodial bones, have a semi-circular cross-section and a segment of the epiphysis preserved at the base (variant I1A1) (Figs. 2–5).

The most common technique for blank production was longitudinal division of the bone and subsequent forming of two or four end-products (see Table 1).[2] Usually, the sulcus was further deepened by grooving with a chipped stone tool until two identical halves were obtained (Fig. 6). Then these halves were either broken into two pieces (most likely by direct percussion), thus providing a total of four blanks (two with a distal and two with a proximal epiphysis), or the proximal epiphysis was removed by percussion and then only two, but longer, tools were produced, with the distal epiphysis preserved at the basal part as a handle. Since the tools with distal epiphyses prevail, it seems that the second option was more frequent.

This technique leaves characteristic traces, parallel striations (sometimes even irregularities of the used chipped stone tool may be noted) and a V-shaped profile (Newcomer, 1974; Legrand and Radi, 2008; Sidéra, 2004, Fig. 4). Furthermore, depending on how the division was executed – more or less carefully, a different (smaller or larger) portion of the other half may remain attached (see details on Fig. 5c, d and Fig. 7a). Usually, parallel striations from grooving may be visible on the basal part of the tool (Fig. 4c), while they are completely erased in the mesial and distal parts by later manufacture and use. Several blanks with traces of grooving enabled the reconstruction of the details of this technique. In particular, one “mistaken” artefact (manufacture debris) from Vitkovo should be mentioned – it is a fragment of a long bone on which remains of the groove may be observed that was not deep enough, and the bone was divided a couple of millimetres away from this groove (Fig. 7b). Such errors were easily repaired by abrasion.

The final shape of the tool was obtained by abrasion with an abrasive stone tool that leaves characteristic traces (Sidéra, 2004, Fig. 5) (Fig. 5c). It is possible that occasionally even two tools with different grains (one coarser and one more fine-grained tool) were in use. The same method – abrasion, was also used for repair and resharpening.

I. Sidéra analysed three manufacturing methods for the production of metapodial awls used by Neolithic communities in Europe: 1)

[2] It is not possible to provide statistical data regarding the usage of these techniques, since preservation of the bone and the intensity of use may obliterate manufacturing traces and they cannot be reconstructed with certainty. Furthermore, there are also fragmented items for which it is also impossible to determine the exact manufacturing process. Also, some stages can only be speculated upon, as no debris with those exact traces was noted. Table 1 provides information regarding the manufacturing techniques observed at Pločnik (the assemblage that is the best in terms of data quality and sample bias).

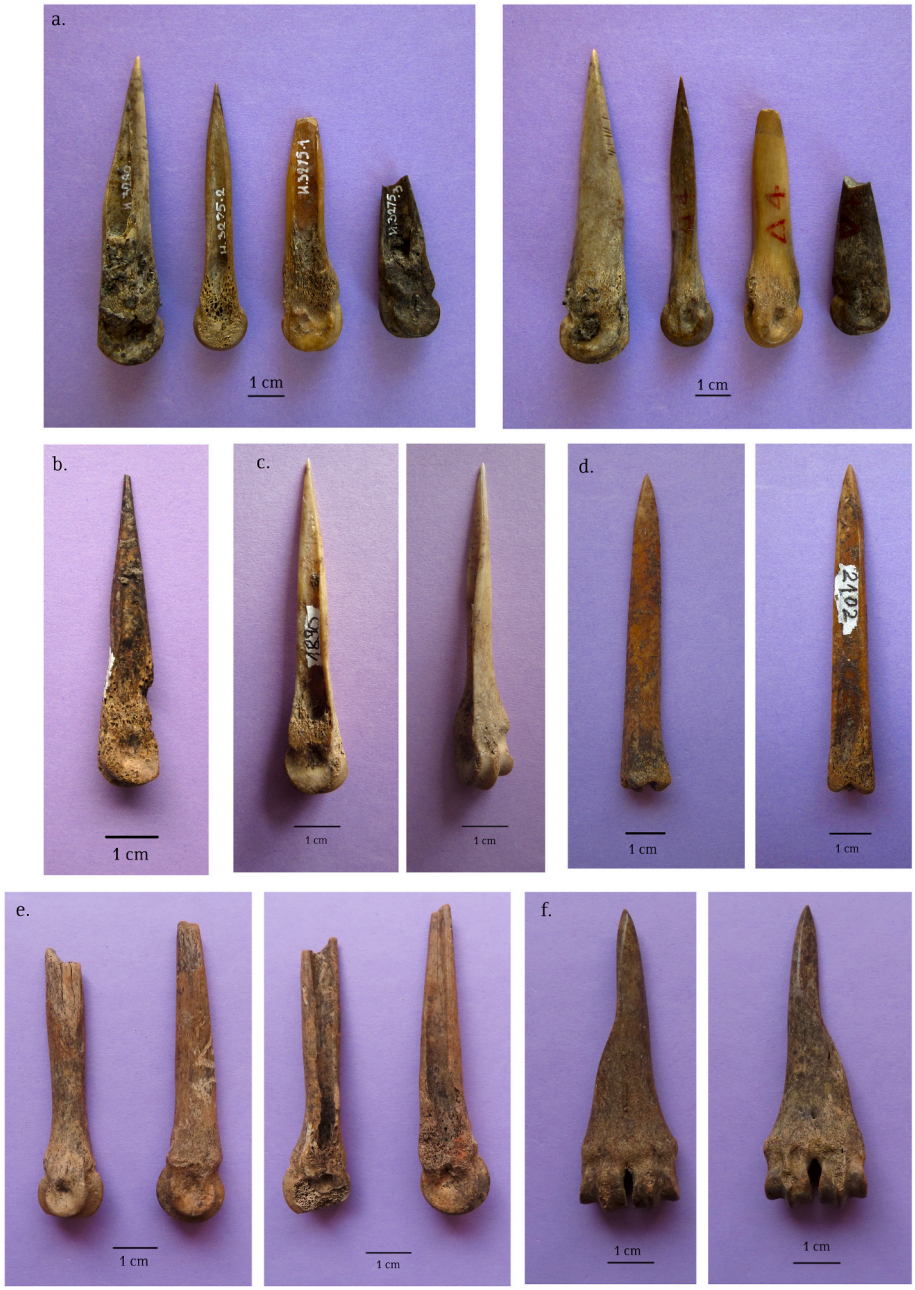

Fig. 2. Points of subtype I1A, produced from metapodial bones: a) from Vinča – Belo Brdo, b-d) Pločnik, e-f) Vitkovo.

manufacture using abrasion only; 2) manufacture by first sawing the metapodia in half and then abrading them; 3) manufacture by first abrading and then by sawing (Sidéra, 2005, and references therein; see also Sénépart et al., 2004; Sidéra, 2004). While the first method was noted among the Early/Middle Neolithic Starčevo culture communities (Vitezović, 2016b), it was not noted within the Vinča culture assemblages. The second method, described above (Fig. 6a), was the most widespread, and it was also used by other Late Neolithic communities in adjacent areas (Sidéra, 2005).

I. Sidéra noted the use of the third method among the Cortaillod culture communities, and there is evidence that it was used, albeit rarely, by Vinča culture communities as well (Fig. 6b). One technical piece recovered at Pločnik points to the possibility that this method was used – roe deer metapodial bone with abraded surfaces (Fig. 7c). However, it is difficult to reconstruct the use of this technique (abrasion, then sawing) if the objects were finalised by and/or repaired by abrasion. Thus far, awls with traces showing that their side edges were worked upon with a chipped stone tool only have not been noted. Awls that have a slightly abraded distal epiphysis on their bases may be the result of this technique – but this abrasion may also be the result of repair and resharpening. One such awl was noted at Pločnik (Vitezović, 2021b, p. 50, Fig. 22), almost completely preserved, with traces of fine abrasion on the entire surface, while the epiphysis on the basal part is mildly rounded and smoothed. Traces of use are also prominent.

There is another method that was used, known from the Late Neolithic in the Carpathian basin – *quartering* (Choyke and Tóth, 2013; Vornicu, 2014), also labelled *débitage by successive partition* (LeDosseur, 2014). After longitudinal division into halves, metapodial bones were further divided into quarters, by grooving with a chipped stone tool and abrasion. The result are slender points, with a small segment of the epiphysis at the basal part (most often proximal). As the method of abrasion only (the first method described in Sidéra, 2005), which

Fig. 3. Point from sheep/goat metapodial bone with unfused epiphysis (Vinča – Belo Brdo).

produced rather slender and thin points, was now abandoned, perhaps this quartering method was used when there was a need for very thin tools.

Several awls from Pločnik with a small segment of the proximal epiphysis at the basal part and a small cross-section may have been produced by the quartering technique (Vitezović, 2021b, 48–49). However, they do not have regular form, and it is possible that this technique was not used regularly, but that awls with a cross-section this small were produced from irregularly split long bones instead. On the other hand, the quartering technique was probably used for production of awls with the epiphysis removed from the base (i.e., the base was cut and smoothed) (variant I1A2). One awl may be mentioned from Pločnik (Fig. 2b; Vitezović, 2021b, p. 48, Fig. 21), almost completely preserved, produced from an almost flat segment of the diaphysis of a sheep/goat metapodial bone. The base is straight cut and smoothed, and the distal part of the artefact is finalised by cutting and abrading.

As mentioned above, repair and sharpening on all these awls was done by abrasion. These awls may be completely used, and reduced in size from intensive use and resharpening. Two examples from Pločnik can be mentioned here, produced from longitudinally split metapodial bones, finalised by scraping and abrasion. Their surfaces are polished and intensively worn from use, and their size is quite reduced– their preserved lengths are 43 and 48 mm, respectively (Fig. 8a and b).

Rarely, more *ad hoc* awls from long bones were produced. One variant is awls from non-split bones – the bone is broken in the central part by direct or indirect percussion, and the tool was formed from the entire half of the metapodial bone (i.e., entire circumference of the diaphysis), with a complete epiphysis (distal or proximal) at the basal part. The point was made by abrasion. One such awl, completely preserved, comes from Vitkovo (Fig. 2f).

Splinters from irregularly broken pieces of different long bones (most likely produced during the butchering process, from bones broken to extract marrow) were occasionally used, more or less regularly formed by scraping with chipped stone tools and abrasion. There is a possibility that some of these awls were produced from tibiae or other long bones, however, this cannot be confirmed with certainty.

Other skeletal elements that appear exceptionally are ulnae. At Pločnik, one ulna awl was discovered, produced from a rather unusual species (fox – *Vulpes vulpes*) (Vitezović, 2021b, p. 51, Fig. 24). While the usage of ulnae is noted among other prehistoric communities (e.g., Camps-Fabrer and Provenzano, 1990), they were largely avoided in the Vinča culture.

4.2. Awls from flat bones

4.2.1. Raw material selection

Ribs were predominantly used; only a few *ad hoc* items may have been produced from other flat bone segments. It is difficult to determine

Fig. 4. Point from sheep/goat metapodial bone with epiphysis preserved (Vinča – Belo Brdo).

Fig. 5. Point from sheep/goat metapodial bone with epiphysis preserved, with microscpic details of manufacturing traces (Vitkovo).

Table 1
Manufacturing methods of awls from Pločnik.

Type/subtype/variant	Skeletal element	Manufacturing method	Total
I1A awl with fragmented base	Long bone	Longitudinal splitting by sawing, then abrasion	9
I1A1 awl with preserved epiphysis at the base	Metapodial bones, medium-size ruminant	Longitudinal splitting by sawing, then abrasion	14
I1A1 awl with preserved epiphysis at the base	Metapodial bones, medium-size ruminant	Sawing, abrasion; Quartering?	1
I1A1 awl with preserved epiphysis at the base	Ulna	Abrasion	1
I1A2 awl with removed epiphysis/ smoothed base	Long bone	Sawing, abrasion; Quartering?	3
I1A heavily fragmented awls	Long bone	Traces of abrasion visible	3
I1B awl with fragmented/ unworked base	Rib, medium-sized or large mammal	Ribs split into two plates; abrasion	12
I1B1 one-sided awls	Rib, medium-sized or large mammal	Ribs split into two plates; abrasion	16
I1B heavily fragmented awls	Flat bone	Traces of abrasion visible	1
			60

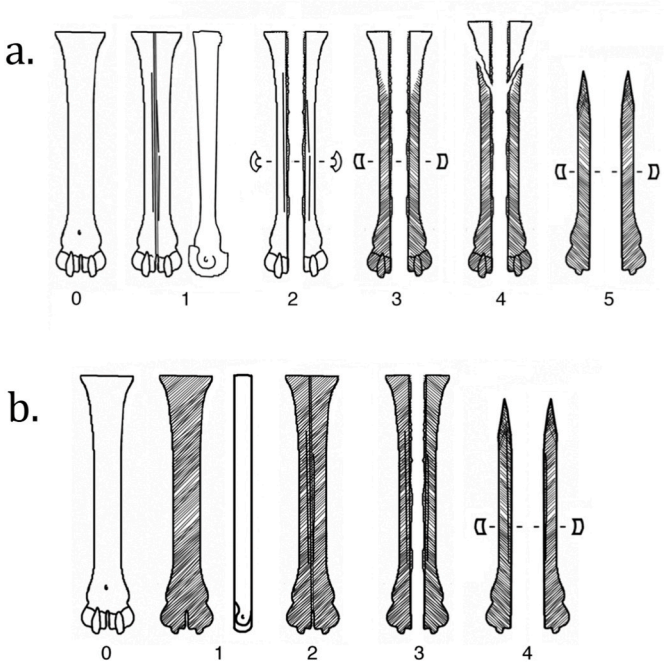

Fig. 6. Schematic reconstruction of the production sequence of metapodial points (adapted after Ramseyer ed. 2004).

the species of the ribs selected, but only large mammals were used and, judging from the size of some of them, *Bos* ribs were frequently, and probably predominantly, used.

4.2.2. Manufacturing techniques and morphological features

Awls belonging to this subtype (subtype I1B) were made mainly from split ribs, i.e., from one bone plate (Fig. 9).

The ribs were first prepared by removing the compact bone along the two edges of the rib and exposing the spongy tissue. Experiments have shown that it was necessary to remove at least one edge in order to split the rib. Furthermore, the ribs are very resilient and only fresh ribs can be successfully split (Christidou, 1999, p. 78–79; 2001, p. 42; Sidéra, 1993, p. 149). Elimination of the edges, and selection of rather thick parts of the ribs, such as the ventral halves of bovid ribs, provided conditions for obtaining products with regular shapes (Christidou, 1999, p. 77–78, 99–100; 2002, p. 42).

The removal of the edges was most likely performed by cutting and scraping with a chipped stone tool. Traces of this technique may be recognised in the very shape of the edge, which may be slightly wavy from the movement of the chipped stone tool along the edge (these traces are erased by later stages of manufacture and use). Ribs were then transversally divided into blanks, either by percussion or by transversal sawing – traces of cutting and sawing may be occasionally preserved at the basal part. Finally, ribs were split into two halves – two bone plates, most likely by indirect percussion (Sidéra, 2004) (Fig. 10). Rarely,

Fig. 7. Technical pieces (manufacture debris): a) bone fragment with traces of grooving with a chipped stone tool (Vitkovo); b) bone fragment with traces of manufacture (Vitkovo); c) metapodial bone with traces of manufacture (Pločnik).

unsplit ribs were used for the production of more massive, robust points.

If a blank was too wide, it may have been further reduced, probably by percussion – however, there are no traces of manufacture preserved that can shed some light onto this stage of production. Tools were finalised by abrasion (including the shaping of the pointed tip).

Occasionally, less carefully shaped ribs/fragments that were irregularly broken off were used; for example, one item from Pločnik (Vitezović, 2021b, p. 129, Fig. 72), produced from an irregular segment of the rib, has a piece of the second plate in the basal part. It was in a slightly *ad hoc* manner made, although it was very worn from use.

These awls have greater variations in dimensions, since the size of the raw material permits greater range. For example, one awl from Pločnik (Vitezović, 2021b, p. 53, Fig. 27) has a preserved length of 162 mm. The length of these awls may be related to their function, but also to the intensity of use and frequency of repair episodes.

Two variants may be noted. The most frequent are one-sided awls (variant I1B1) that may have a triangular form, more or less regular, or a rectangular form in the basal and mesial part and a triangular form in the distal part (Fig. 9). Their basal part may be straight (usually with traces of transversal cutting from extracting the blank), rounded (smoothed by abrasion) or unworked (probably the result from direct percussion used to extract the blank; also, it was probably inserted into some sort of handle). Occasionally, double-sided awls are encountered (variant I1B2), usually lozenge shaped (Fig. 11). Both ends have traces of use, although often one is more used. They are encountered at Vinča – Belo Brdo, though they are yet to be foundat Pločnik and Vitkovo.

5. Discussion

Metapodial awls are the most widespread tool type in the Neolithic period (see also Camps-Fabrer ed., 1990) known, from the Early Neolithic site of Çatal Höyük in Turkey (Russell, 2005, p. 339–340 Fig. 16.1; 2012, Fig. 15.2.), Khirokitia in Cyprus (Legrand, 2005), from the Late Neolithic sites of Nea Nikomedeia and Dhimini in Greece (Stratouli, 1998, taf. 25/1; taf. 33/4, 5, 6), Karanovo in Bulgaria (Lang, 2005, taf. 187/3, 187/4, 187/18), the site of Aszód–Papi in Hungary (Tóth, 2013, p. 329, 330), Twann (Schibler, 1981, taf. 1/1–7; 11/4–8) and Arbon Bleiche 3 (Deschler-Erb et al., 2002, p.342, abb. 507/1, 2, 4, 6) in Switzerland, and many more. However, technological features differ, reflecting different technological and cultural traditions.

Rib awls were also widespread in the Neolithic bone tool assemblages of Europe (see Camps-Fabrer ed., 1990, for more details), including sites such as Karanovo (Lang, 2005, taf. 190/2.) or Arbon Bleiche 3 (Deschler-Erb et al., 2002, p. 344, abb. 509/5, 15; 345, abb. 510/3–7.3).

As mentioned above, due to the uneven quality of the data it is not possible to estimate the ratio of metapodial bones vs. ribs in this study. However, it is obvious from assemblages where faunal remains were more carefully collected and examined that ribs were frequent (at Pločnik, for example, over 50 rib artefacts were recovered out of approx. 300 objects). Ribs were also a commonly used raw material in the osseous assemblages from other Vinča culture sites – such as Selevac (Russell, 1990), Divostin (Bačkalov, 1979), Drenovac, Motel Slatina (Vitezović, 2007), and many more.

R. Christidou noted two major systems of tool production in her analysis of Late Neolithic assemblages from Greece: 1. a specialised system, based on relatively complex sequences of reduction (*chaines de débitage*), and 2. a simpler one, based on fracturing or sorting fragments of long bones out of kitchen or butchery refuse (Christidou, 2001, p. 41). We can note a similar situation in these Vinča culture assemblages, with a strong prevalence of the first system.

The method of obtaining the raw material was also two-fold – metapodial bones were removed during the first stages of the butchering process (Olive, 1987) and presumably carefully stored for later use, while long bone splinters and ribs were obtained from the later stages of butchering and/or from kitchen refuse. In both cases, however, the selection of raw material was rather strict – and some bones were used rarely or never, even though they were also fit for the production of pointed tools (such as ulnae). The preference for the metapodial bones from small ruminants and rare use or complete absence of other long bones and bones from other species (for example, rare presence of ulnae and complete absence of identifiable long bones from pigs) is very conspicuous, not only in the assemblages included in this study, but within other Vinča culture bone tool assemblages (see e.g., Russell, 1990; Vitezović, 2007; also Vitezović and Bulatović, 2013). Metapodial bones of ruminants have straight shafts, relatively thick compact bone tissue, and a longitudinal sulcus that enables easy division – the mechanical and physical properties of these bones enable easy shaping and the production of tools fit for their intended purpose (Schibler, 2013, p. 341). However, the usage of other skeletal elements (e.g., sheep/goat ulnae, pig fibulae) in other prehistoric cultures (e.g., Vornicu, 2014; see Camps-Fabrer ed., 1990 for more details) shows there are no technical constraints, and therefore we may assume that such a choice of raw material was more cultural than technical. However, it is not possible to say whether this was directed by, for example, butchering practices and other practices for the exploitation of animals, whether the metapodial awls with distal epiphysis were simply “fashionable”, or whether the avoidance of certain animal species had deeper meaning.

Fig. 8. Points from sheep/goat metapodial bone with epiphysis preserved (Pločnik).

Fig. 9. Points of subtype I1B, produced from ribs (Vinča – Belo Brdo).

It is also not possible to establish the technical and/or ergonomic reasons for the prevalence of some technological procedures over others (see also Mărgărit et al., 2018). Such technological choices may be simple habit of craftspersons from a given community, but may also be deliberately used to display group identity through communal knowledge.

Overall, the selection of raw materials as well as the production sequence were rather standardised and show a high technological know-how, although we can observe occasional "mistakes". Abrasion was an important technique, used for finalising the artefacts, for repairing mistakes, and also for repairing and resharpening used tools. Increased use of abrasion, along with more frequent rib points, may be the result of the increased production of bone items within the Vinča culture, along with attempt for increased efficiency (since abrasion is used to remove any mistakes resulting from less careful/faster production of blanks).

The traces of use on these awls are usually very prominent, showing they were intensively used; also, traces of resharpening and repair are often noted. Tips are often blunt, worn from use, and sometimes damaged. Traces of use consist of polished, shiny surfaces, sometimes with shallow striations of different orientation – such traces are consistent with usage on soft, organic materials, such as hides or plant fibres (see Christidou and Legrand, 2005; Legrand, 2007, 2008; Semenov, 1976). Their long use, along with their frequency, shows they constituted an important part of the tool-kit and everyday items.

The production of bone awls was a rather significant activity among Vinča culture communities, and these were important, widely used tools for a variety of everyday tasks. They reflect high technological know-how and overall highly planned, organised set of activities – from raw material selection, through the production sequence, up to organisation of tasks for which they were used, thus showing, in turn, high organisation and technological level of associated tasks, activities and crafts (from animal butchering to production of final products from diverse materials by using these bone tools).

6. Concluding remarks

Pointed tools (awls) constitute an important part of the Vinča culture bone industry, comprising over one-third, sometimes up to 50% of the entire assemblage. They were used for daily tasks, mainly for processing organic materials – hides, plant fibres, for basketry, etc. and their frequency, shows that there was relatively high demand for these craft products within the Vinča communities. They were produced in a standardised manner, resulting in standardised end-products, with relatively low ratios of *ad hoc* or less carefully made tools. Manufacturing techniques and selected raw materials show high

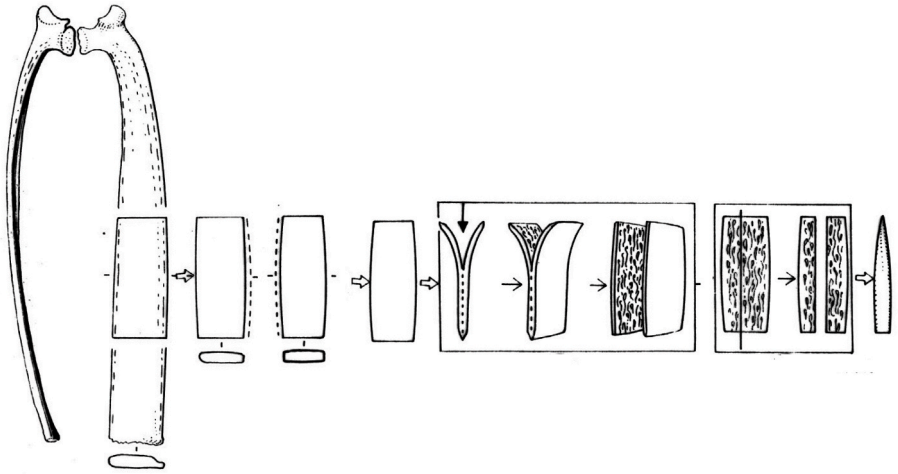

Fig. 10. Schematic reconstruction of the production sequence of metapodial points (adapted after Christidou, 2001).

Fig. 11. Double point from rib (Vinča – Belo Brdo).

technological know-how, but at the same time they reflect certain cultural preferences – selection of sheep/goat and roe deer metapodials and cattle ribs, while other long bones (*fibulae, ulnae* …) or from other species (from pigs – *Sus*, for example, etc.) are largely missing (although used in other cultures – e.g., Vornicu, 2014).

High standardisation and high level of technological know-how, as well as well organised production of these tools provide important information regarding craft production in general among the Vinča culture communities. The standardisation in their production and morphology suggest that the tasks they were used for (mainly production of items from perishable materials) were also highly standardised and well organised.

Author contributions

The assemblages included in this paper were analysed by the author.

Data availability

The data for this paper are presented in the paper and/or available in cited references.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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