Insights into the Late Mesolithic toolkit: use-wear analysis of the notched blades. Case-studies from the Iberian Peninsula

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Key words
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• Notched Blades
• Use-Wear Analysis
• Iberian Peninsula

Parole chiave
• Mesolitico recente
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• Analisi funzionale
• Penisola Iberica

Summary
During the last decades we have gained a considerable amount of data about the Mesolithic lithic toolkit in the Western Mediterranean. A large set of instruments probably existed for a variety of purposes: foraging practices (both hunting and fishing), food processing, crafting activities, etc. Disposable tools, scarcely elaborated, coexisted with formal and more complex instruments, often composed of multiple parts and realized on a variety of raw-materials (e.g. stone, shell or bone inserts; bone or wood hafts, etc.). In this paper we will consider one particular type of tool that appears in the Western Mediterranean starting from the Seventh-Sixth millennia BC: the notched and denticulated blades. We will consider and interpret from a functional viewpoint materials from five different Late Mesolithic contexts: the Cocina Cave and Vallmayor IX in the NE of the Peninsula, Artusia rock-shelters in Navarre and Atxoste and Mendandia rock-shelters in the Basque country.

Riassunto
Durante l’ultimo decennio, la nostra conoscenza dello strumentario litico Mesolitico nel Mediterraneo Occidentale si è considerevolmente arricchita. Sappiamo che esistevano una varietà di strumenti utilizzati per scopi diversi: l’ottenimento di alimenti (sia attraverso la caccia, che la pesca), l’elaborazione di tali alimenti, la produzione di artefatti, etc. Strumenti di natura speditiva, scarsamente elaborati, coesistettero con strumenti formali, più complessi, spesso costituiti di più parti e di materie prime diverse (es. inseriti in pietra, conchiglia, osso, manici in legno o osso, etc.). In questo articolo ci concentreremo su un particolare tipo di strumento che compare nel Mediterraneo Occidentale tra il VII-VI millennio a.C.: le lame con incavi e denticate. Consideriamo i materiali provenienti da cinque diversi siti del Mesolitico recente: la Grotta Cocina e il sito di Vallmayor IX in NE della Penisola Iberica, Artusia rock-shelters in Navarra e i siti di Atxoste e Mendandia rock-shelters del Paese Vasco.

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Introduction

Our knowledge of the Mesolithic craftsmanship has increasingly grown during the last decades. The period is considered a time of technological innovation characterized by a variety of sophisticated equipment, including bow and arrow, fishing gears (such as nets, traps, hooks) and seagoing craft such as canoes (see for example Pickard & Bonsall 2007; Lozovski et al. 2013). Altogether this set of artefacts implied the development of fresh knowledge, know-how and tools; in turn, such transformations in technology were associated with broader social and economic changes involving mobility patterns, groups size and site location, duration and seasonality of the occupations, subsistence strategies, symbolic and burial behaviours, etc. (Zvelebil 2009; Jordan & Cummings 2014; Warren 2014).

Nevertheless, from an archaeological point of view, it is not always simple to highlight such diversity in technology and crafting techniques. Most of the Mesolithic crafting processes involved perishable materials, such as wood, vegetal fibres, animal skins, etc., which are only rarely conserved in the archaeological contexts. In this sense, the application of traceological analysis on both coarse and flaked stone tools has represented an important instrument for detecting and processing activities that otherwise would have not been emerged from the archaeological record. For example, the study of the use-wear patterns has demonstrated that vegetal elements, both ligneous and non-ligneous plants, covered an important role within the Mesolithic crafting system (Clarke 2009; Gijn 2010; Guéret 2013, Guéret et al. 2013 among others). Bone and antler tools were intensively produced and used as well (Gijn 2007; Osipowicz 2007; Maigrot et al. 2014; Bergsvik & David 2015). A broad variety of crafting tools probably existed; disposable, scarcely elaborated elements coexisted with formal and more complex instruments, often composed of multiple parts and realized on an assortment of materials (i.e. stone, shell or bone inserts; bone or wood hafts, etc.).

Recent researches on the Late Mesolithic complexes in Europe and North Africa have shown that not only hunting weapons (i.e. triangles and trapezes industries) were geographically distributed over large areas, but also some crafting tools were characterized by certain homogeneity from a technological and functional point of view in almost the entire Western Mediterranean (Gassin et al. 2014). Notched blades, removed by pressure or indirect percussion, became one of the characteristic elements of the flaked stone assemblage starting from the 9-8th millennium BP depending on the geographical area (Perrin et al. 2009). In the absence of any functional study, different hypotheses were proposed to explain the production and use of these notched blades: blank tools used to scrape wooden sticks in order to shape arrow shafts, the notches created by the work itself (Rozoy 1978); tasks correlated with an intensification of plant processing (Rahmani & Lubell 2012), etc.

In this work we will consider the notched or denticulated blades from five different Late Mesolithic contexts of the Iberian Peninsula (Fig. 1). The traceological analysis of those elements is presented and discussed in the light of experimental works recently performed (Gassin et al. 2013; Guéret et al 2013; Gassin et al. 2014).
Methods of analysis

Tracology has today a well-established method shared by most of the analysts. During the last forty years, the tracological approach to the study of the lithic industries has been defined and updated by the works of several authors. Since the pioneer works of Semenov, new techniques and methodologies have been introduced constantly. For a detailed state of the art, one can look at the recent synthesis of Marreiros et al. (2015). Nevertheless, apart from the methodological improvements that occur along with the appearance of new techniques and analytical tools, one can fundamentally divide the tracological work into three main steps:

I. A first evaluation of the conservation of the archaeological material is done through stereoscopic microscopy. A sample of artefacts is observed, in order to identify the presence of eventual post-depositional alterations and, thus, to evaluate the feasibility of the analysis;

II. Once defined the state of conservation of the assemblage, a detailed analysis of each single artefact is undertaken. The first step of the analysis involves the employment of stereoscopic microscope. The analysis of edges and surfaces is directed to the identification of possible active zones (PUAs - Possibly Used Areas) (Gijn 1989). Moreover, the macroscopic observations allow a first level of inference; it is already possible to formulate hypotheses about the hardness of the worked materials (i.e. soft, medium, hard) and about the type of movement performed (i.e. longitudinal, transversal, circular, impact, etc.). The analysis of macro-traces is also important for the recognition of possiblehafted parts, transportation traces, post-depositional and post-excavation modifications, etc. Several works of reference are available for the so-called 'macro-traces' among which: Tringham et al. (1974), Odeli & Odeli-Vereeken (1980), González & Ibáñez (1994). The categories considered in this study have been mainly taken from these works, classifying the macro-traces on the basis of semi-qualitative variables.

III. When possible used areas (PUAs) or other modified zones are detected, artefacts have been submitted to a detailed microscopic analysis through the employment of reflected-light microscopy (Olympus BH2, 50X-400X). The objective of this analysis is, first of all, to prove the nature of the previously identified PUAs. If PUAs are actually used we call it AUA (Actually Used Areas) (Gijn 1989). Once the consistency of the traces has been proved, the analysis is directed toward the interpretation of the micro-features through the observation of their characteristics. For the definition of the semi-qualitative variables employed for micro-wears classification one can refer to several works among which Gijn (1989), González & Ibáñez (1994) and Gassín (1996).

The number of tools analysed in this work amounts to 89 elements. All the notched blades showing traces of use have been analysed both macro- and microscopically. Wears identified in the archaeological specimens have been compared with the experimental samples. Indeed, fresh experimental data has been obtained during a collective blind test performed in Barcelona in October of 2012, allowing greater care to be taken with our interpretations (Gasín et al. 2014).

Archaeological contexts and studied materials

Atxoste

Atxoste site is located in the Puerto de Azácesta, near the village of Vírgala Mayor. It is a limestone rock-shelter with south orientation with a south orientations located a few meters away from the Berón River (Alday 1996). Near Atxoste, in a range of one kilometre of distance, there are other two Mesolithic sites: Kanpanoste (Cava 2004) and Kanpanoste Goikoza (Alday 1998). All of those sites are located in a strategic position for territorial control, connecting the lower valleys with the highlands and the mountain ridges. Atxoste stratigraphy goes from the Upper Palaeolithic to the Early Neolithic. Analysed tools belong to layers IV and Illb2, both belonging to the Geometric Mesolithic horizon. The former, which is superposed to the Notched and Denticulated horizon, is dated around the half of the 8th millennium BP (GrA-13469: 7480±50 and Gr-A-13418: 7340±50). The latter, superposed to the layer IV without any clear stratigraphic break, is dated to the end of the beginning of the 7th millennium BP (GrA-13458: 7140±50 and GrA-13415: 6940±40 (Alday 2002, 2005; Alday & Cava 2009)).

The number of analysed tools amount to 13 tools, three of which are characterized by a truly denticulated edge, while the remaining shows a single notch. Both voluntary retouched notches and involuntary fractures are present. Average dimensions are comprised between 32-26 x 29-18 x 3-4 mm.

Mendandia

Mendandia is a medium-sized rock-shelter located in the Oquina-Sáseta area (Treviño) at ca. 740 m a.s.l. (Alday 2006). The site shows several common features with the other Mesolithic settlements of the Basque region: a rock-shelter near permanent water-sources, located in a strategic overview position. Like Atxoste site, Mendandia rock-shelter is interpreted as a temporary camp, part of a larger network of complementary sites, recurrently occupied by groups of nomadic hunter-gatherers (Alday 2002, 2005, 2009; Montes & Alday 2012).

Site stratigraphy ranges from Late Mesolithic to Early Neolithic. Analysed tools belong to the Geometric Mesolithic level (layer III - GrN-22743: 7620±50 BP) and to the so-called Notched and Denticulated Mesolithic (layer IV - GrN-22745: 7780±40 BP (Alday 2006)). The number of analysed tools amounts to 12 notched blades, eight of which present exclusively one notch, while the remaining four are characterized by a truly denticulated edge. Average dimensions are comprised between 44-38 x 34-23 x 3-4 mm.

Artusia

Artusia rock-shelter is located in the municipality of Unzué, in the Navarra region. The rock-shelter opens near the ‘Aroyo de Artusia’ creek, a seasonal affluent of the Zidacos River. The site is located in one of the narrow sectors of the valley, partially protected by conglomerate deposit. However, only part of the prehistoric deposit has been preserved against the erosive processes. During the years 2009-2010 excavation campaigns have been carried out revealing a stratigraphic series which ranges from the Upper Paleolithic to the Mesolithic (Rojo et al. 2012). Both Geometric Mesolithic and Notched and Denticulated Mesolithic layers have been detected.

The number of analysed tools amounts to 15 notched blades, eight of which present exclusively one notch, while the remaining four are characterized by a truly denticulated edge. Average dimensions are comprised between 32-21 x 15-9 x 4-2 mm.

Valmayor XI

Valmayor is a rock-shelter located in the Mequinenza municipality (Zaragoza). The site opens in the Mequinenza gorge, near the creek’s mouth. Currently, the site is covered by the waters almost all year round, except during very dry seasons. This is the case of the summer of the 2011, when the first and the last excavation campaign has been carried out at the site (Rojo et al. 2012).

Site stratigraphy goes from Geometric Mesolithic to Early Neolithic levels. An intermediate layer between Mesolithic and Neolithic horizons has been detected. It represents an intermediate stage, where a Mesolithic assemblage is mixed with few ceramic fragments, even if it is not clear whether such commingling is the result of a
Polish is always asymmetric, with a bevel on the ventral face, cha-
tto woody plants or hard-animal material such as bone and antler. The
ping a variety of materials, from soft vegetal and animal substances,
the worked materials. Indeed, the notches appear to be used for scra-
observed implements. A major variability has been observed among
by the scraping action itself.
notches we can imagine that the edge-fractures have been produced
only in the case of denticulated edges with very short and continuous
concave active zone with a robust straight-angled edge (Fig. 2, a).

Patterns observed on archaeological tools. Therefore, we think that
the ventral one. The other way around, a positive rake with a scraping
motion with the ventral face as a rake face would produce quite a simi-
lar polish, but with a different distribution of the use polishes; indeed in
those cases, on the retouched dorsal face, the polish is usually not
much developed. Finally, some notches show a rather rough polish on
the ventral face, with striations and micro-fractures (Fig. 2, d). In those
cases, traces show a major variability, from dry-wood to hide working.
The most common use, on the basis of the analysed sample,
is associated with bone working (24.10%), followed by hide-working
(19.28%) and woodworking (10.84%), at least among the determined
materials. Hard indeterminate materials represent the 19.26%, while
indeterminate materials represent the 15.66% of the AUAs (Fig. 3).

In general, different uses are associated with most of the analysed
sites (always in the case that a sufficient sample of materials has been
analysed) (Tab. 1).

Finally, we have to remark that such tools are generally characte-
rized by a scarce development of the use-wears. Edge exploitation
is never very intense and we do not generally observe resharpening
retoches made in order to prolong the tool use-life. This pattern
could indicate that such tools were mainly employed for brief tasks,
possibly related to very specific phases of wood/bone/hide artefacts
manufacturing and/or maintenance. Therefore, despite notched bla-
des appears quite homogeneous and standardized objects on a te-
chnological level, from a functional point of view they can be defined
as disposable tools, being generally used briefly to carry out a variety
of crafting tasks.

Results & Discussion

Of the totality of analysed notched blades more than 60% show traces of use (n. 56). Moreover, several blades of this assemblage
were characterized by more than one area of use (AUAs), with 22
items which show a double active zone and 3 items characterized by
three active zones. Therefore, the final number of activities recognized
amounts to 83 areas of use.

Our analysis highlighted certain homogeneity among the analy-
sed materials, both on a technological and functional level. Used blan-
ks are mainly blades with one or more notches produced on the dorsal
face of the tool. Flakes are only marginally employed to produce such
type of tools, at least during the chronologies considered in this study.

The used zone is always the concave part of the notch. Most of
the notches can be considered intentionally made; indeed, a scraping
motion with the ventral face as a rake face would produce quite a simi-
lar notch, but with a different distribution of the use polishes; indeed in
this case the bevel would be on the dorsal (retouched) face and not on
the ventral one. The other way around, a positive rake with a scraping
motion would produce a scarring which only partially matches the
patterns observed on archaeological tools. Therefore, we think that
the notches are the result of a voluntary retouch, creating a very short
concave active zone with a robust straight-angled edge (Fig. 2, a).
Only in the case of denticulated edges with very short and continuous
notches we can imagine that the edge-fractures have been produced by
the scraping action itself.

Also the cinematic of the tool appears almost identical in all the
observed implements. A major variability has been observed among
the worked materials. Indeed, the notches appear to be used for scra-
ping a variety of materials, from soft vegetal and animal substances,
to woody plants or hard-animal material such as bone and antler. The
polish is always asymmetric, with a bevel on the ventral face, cha-

characterized by a compact domed polish, while, on the retouched dorsal
face, the polish is sometimes weaker, sometimes compact and shiny.
This asymmetry results from a negative rake-cutting of different ma-
terials. The end-flank is always the ventral face; the dorsal face is the
rake face, with a rake angle near 90°.

From a functional point of view, it is often difficult to establish the
exact nature of the worked material, because of the overlaps be-
 tween use-wear traces. Some notches bear on the dorsal face a bright,
smooth polish and on the ventral face either an invasive pitted and
striated polish or a smooth polish with few striations (Fig. 2, b). Those
tools are often associated with woodworking activities or soft plant
scraping. On other notches, polish on the ventral face is limited to a
band along the very edge of the tool, creating a domed bevel, often
with some striations (Fig. 2, c). These tools are generally associated
with the work of very hard animal materials such as bone/antler. In
those cases, on the retouched dorsal face, the polish is usually not
much developed. Finally, some notches show a rather rough polish on
the ventral face, with striations and micro-fractures (Fig. 2, d). In those
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of crafting tasks.
**Fig. 2** - a) Schematic representation of the mode of use of the notched blades; b) Pitted-smooth polish with few striations (50X), probably resulting from wood working - Atxoste site; c) domed bevel, with some striations (100X), probably resulting from bone scraping - Cocina cave; d) rather flat bevel on the ventral face, with striations and micro-fractures (100X), probably resulting from vegetal (plant or wood) scraping - Artusia rock-shelter. / a) Rappresentazione schematica del modo d’utilizzo delle lame a incavi; b) Politura smussata con presenza di crateri e poche strie (50X), probabilmente prodotta dalla lavorazione del legno - riparo Atxoste; c) politura su angolo dall’aspetto arrotondato con presenza di strie (100X), probabilmente prodotta dalla lavorazione dell’osso - Grotta della Cocina; d) politura su angolo piuttosto piatta sulla faccia ventrale, con numerose strie e microfratture del bordo (100X), probabilmente prodotta dalla lavorazione di sostanze vegetali (piante o legno) - riparo Artusia.

**Tab. 1** - Sum and Percentage of AUAs for each class of worked material inferred per each site. Indeterminate or doubtful AUAs have been excluded. BO: Bone; HA: Indeterminate had material; HI: Hide (both fresh and dry hides); SF: Indeterminate soft material; VG: Soft vegetal substance; WO: Hard wood. / Somma e Percentuali di AUAs (Zone Usate) per ciascuna delle classi di materiali lavorati per ciascuna sito. BO: Osso; HA: Materiale resistente di natura indeterminata; HI: Pelle (sia fresca che secca); SF: Materiale indeterminato poco resistente; VG: Piante; WO: Legno.

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Conclusions

On the basis of the results of our analyses, we can consider notched blades a multi-tasking tool employed in a variety of crafting/manufacturing processes on different materials. The recurrent choice of regular blades and the scarcity or absence of notched flakes or flakes with naturally straight angle edges used to scrape the same range of materials, seem to point toward a well-established technical tradition. Nevertheless, making notches to scrape different materials does not need a high level of know-how, and could have invented independently in several places and times. Therefore, do Late Mesolithic notched blades represent a convergent behaviour in response to similar technical/economic needs? Or do they represent a shared tradition, which imply the existence of similar forms of artefact production and utilization among different groups?

Still, our data is not sufficient to hypothesize the presence of some technical heritage or a traditional way of doing things between Mesolithic groups. However, it is to remark that direct notches on regular blades represent one of the dominant tools of the Late Mesolithic industries of the Western Mediterranean; thus they represent the material outcome of a systematic behaviour, not an occasional or isolated practice. In the future, enlarging the sample of analysed sites, we will maybe prove the existence of ‘formal’ tools among Late Mesolithic communities, contributing to the debate about the transfer of ideas, technological know-how and traditions during Prehistory.

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