Journal of Human Evolution 61 (2011) 125–131

Contents lists available at ScienceDirect

Journal of Human Evolution

journal homepage: www.elsevier.com/locate/jhevol

News and Views

# Bone as a technological raw material at the Gran Dolina site (Sierra de Atapuerca, Burgos, Spain)

Jordi Rosell [a,*], Ruth Blasco [a], Gerard Campeny [a], J. Carlos Díez [b], Rodrigo Alonso Alcalde [c], Leticia Menéndez [a], Juan Luis Arsuaga [d,e], José M. Bermúdez de Castro [f], Eudald Carbonell [a,g]

[a] Institut Català de Paleoecologia Humana i Evolució Social (IPHES), Universitat Rovira i Virgili (URV), Campus Catalunya, Avinguda de Catalunya, 35, 43002 Tarragona, Spain
[b] Laboratorio de Prehistoria, I+D+I. Universidad de Burgos, Plaza Misael Bañuelos s/n, 09001 Burgos, Spain
[c] Laboratorio de Prehistoria, I+D+I. Universidad de Burgos - Museo de la Evolución Humana, Paseo de la Sierra de Atapuerca s/n, 09002 Burgos, Spain
[d] Departamento de Paleontología, Facultad de Ciencias Geológicas, Universidad Complutense de Madrid, 28040 Madrid, Spain
[e] Centro de Investigación (UCM-ISCIII) de Evolución y Comportamiento Humanos, C/Sinesio Delgado, 4 (Pabellón 14), 28029 Madrid, Spain
[f] Centro Nacional de Investigación sobre Evolución Humana (CENIEH), Avenida de la Paz 28, 09004 Burgos, Spain
[g] Visiting professor, Institute of Vertebrate Paleontology and Paleoanthropology of Beijing (IVPP), Beijing, China

ARTICLE INFO

*Article history:*
Received 25 May 2009
Accepted 8 February 2011

*Keywords:*
Bone tools
Middle Pleistocene

## Introduction

Ever since Dart (1957) proposed the existence of the Osteodontokeratic industry, the use of bone tools in Pre-Upper Palaeolithic/Later Stone Age (LSA) periods has been a controversial subject. With the aim of providing data on this subject, modified bones from level TD10-1 of the Gran Dolina site (MIS 9, Sierra de Atapuerca, Burgos, Spain) are presented here.

In the 1970s, many researchers accepted the existence of human-modified bones in the Lower and Middle Palaeolithic (Wolberg, 1970; Leakey, 1971; Ghosh, 1974). Nevertheless, the studies of Binford (1981) and Brain (1981) led to a revision of many objects previously interpreted as artefacts made from animal material, including modified bones in the Middle Palaeolithic site of Cueva Morin, Spain (Binford, 1983; Freeman, 1983). Studies of bone tools have become important for understanding the technological and cultural development of human groups in the past. Thus, bone technology should be included as one piece of the "modern human behavioural repertoire," in addition to microlithic technology, blade production, increased geographic range, specialised hunting, the use of aquatic resources, use of pigments, and symbolic art (see McBrearty and Brooks, 2000; Henshilwood et al., 2001; inter alia).

However, not all bone tools are related to modern human behaviour. From a technological point of view, bone tools include: 1) intentionally polished bones, 2) bones knapped by direct percussion (retouched edges or flaked), and 3) unmodified bones used for a particular purpose. Yet, only intentionally polished bones are considered modern human behaviour because polishing involves an important step in the making and handling techniques of bone artefacts. The technique of polishing bone tools originated in Africa during the Middle Stone Age (MSA) and their use was more widespread in the LSA and the Upper Palaeolithic.

In contrast, the presence of polished implements during earlier time periods is largely attributed to friction and abrasion resulting from use rather than to intentional modification or transformation (Villa and d'Errico, 2001). Swartkrans is a well-known lower Pleistocene (previously Plio/Pleistocene) case of bones and horncores with smoothed distal ends that is thought to result from digging out termite mounds by early hominins (Backwell and d'Errico, 2001). In this case, no clear intentionality is seen in the modification of these elements. The case of the Middle Palaeolithic site of Salzgitter Lebenstedt (MIS 3) in Germany is more complex (Gaudzinski, 1999). In this site, several proboscidean ribs with polished distal ends were recovered. Some bones present clear signs of previous preparation by direct percussion, but the polishing is unintentional and is probably due to subsequent use. Nevertheless, in the MSA sites of Blombos Cave and Klasies River Mouth (South Africa), some pointed bones are interpreted as projectiles. These show the presence of techniques such as scraping in early periods (McBrearty and Brooks, 2000). Therefore, the use of polishing as a technique seems to be limited to anatomically modern humans.

The second type of modified bones, those shaped by direct percussion, is more ancient and such bones are relatively frequent in archaeological contexts. In the last few decades, new Lower Palaeolithic sites with shaped bone tools have been located in Europe. Some examples are Castel di Guido (Radmilli and Boschian,

* Corresponding author.
*E-mail address:* jordi.rosell@urv.cat (J. Rosell).

0047-2484/$ – see front matter 
doi:10.1016/j.jhevol.2011.02.001

1996), Fontana Ranuccio (Biddittu and Celletti, 2001), or Polledrara (Anzidei, 2001) in Italy, Bilzingsleben in Germany (Mania and Mania, 2005), or Vertesszöllös in Hungary (Dobosi, 2001), *inter alia*. At these sites, the artefacts are frequently made on proboscidean bones. Generally, they are large tools attributed to Technological Mode 2 or Acheulean technology. Several researchers consider that the use of bones in these sites is due to the lack of appropriate lithic raw material in the surrounding area (Anzidei, 2001; Dobosi, 2001; Gaudzinski et al., 2005).

The third type of bone tools is unmodified bones. As previously suggested, it is possible to include bones modified by use (e.g., bone hammers) in this category. Generally, these are long bones, whole or fragmented, used to hit or to press lithic elements in order to make flakes or to configure the edges of stone flakes. The interaction between these elements with other harder materials frequently produces characteristic marks in the shaft of bones, similar to percussion pits (Pickering and Egeland, 2006; *inter alia*). Pits are often closely associated with clustered striae, from slippage of stone against bone during impact events. However, when these marks are isolated, they can be similar to chopmarks. These tend to be short and deep with an oblique section. Therefore, chopmarks are the result of blows, using a blade-cutting instrument that generates short and deep cuts, which are generally isolated and without internal microstriations (Armand and Delagnes, 1998; Malerba and Giacobini, 1998; d'Errico and Henshilwood, 2007). Although bone hammers are mentioned in the Lower Palaeolithic of Boxgrove, England (Roberts and Parfitt, 1999), their use is generally related to the Middle Palaeolithic or Mode 3 contexts, such as the Middle Pleistocene French sites of Orgnac 3 (MIS 8; Moncel et al., 2005), Biache-Saint-Vaast (MIS 7; Auguste, 1992), and Lazaret Cave (MIS 6; Valensi, 1996). By the Upper Pleistocene, these elements become more frequent. Examples of this are the sites of Peña Miel, Abric Romaní, Prado Vargas Cave, and Axlor in Spain (Barandiarán, 1987; Aïmene, 1998; Navazo et al., 2005; Mozota, 2009), Riparo Tagliente and Riparo di Fumane in Italy (Malerba and Giacobini, 1998), or Combe Grenal, Artenac, and La Quina in France (Chase, 1990, Armand and Delagnes, 1998; Verna and d'Errico, 2011), *inter alia*.

These three types of tools also have behavioural implications. While retouched bones or unmodified used bones show the same types or morphologies from lithic tools, polished bones allow the fashioning of new morphologies (new tools) related to an increasingly diverse range of activities, including such things as fishing, sewing, etc.

## Level TD10-1 of the Gran Dolina site

Gran Dolina is a large cavity (*circa* 18 m high) located in the Sierra de Atapuerca (Burgos, Spain), filled with lower and Middle Pleistocene sediments. Eleven stratigraphic units are identified at this site, enumerated from base to top between TD1 and TD11 (Fig. 1). Level TD10 is the most recent deposit at the site with archaeo-palaeontological remains. Its sediments are composed of sands with gravel and limestone clasts (Parés and Pérez-González, 1999). TD10 is divided into four litho-stratigraphic units: TD10-1 (including TD10-sup), TD10-2, TD10-3, and TD10-4 at the base. A variety of dating methods (U/Th, ESR, TL, IRSL) have been applied at the site and indicate that TD10-1 is located in MIS 9 (Berger et al., 2008).

With more than 20,000 artefacts, the lithic industry is abundant in this archaeological assemblage, and all the raw materials used in this level (two types of chert, quartzite, quartz, sandstone and limestone) are found within a 5 km radius of the site (García-Antón et al., 2002). From a technological point of view, TD10-1 is classified as a transitional moment between Mode 2 or Acheulean and Mode 3 or Mousterian (Rodríguez Álvarez, 2004; Menéndez, 2009). All the stages of the Lithic Operational Sequence are represented at the site. Flakes, denticulates, and side-scrapers are the most common objects.

Regarding the faunal remains, *Cervus elaphus* and *Equus ferus* are the most abundant ungulates. *Stephanorhinus* cf. *hemitoechus*, *Bison* sp., *Dama dama clactoniana*, *Megaloceros giganteus*?, *Hemitragus bonali*, and *Sus scrofa* are also documented. The faunal assemblage is characterised by adult animals, skeletal elements with high nutritional value, cutmarks related to large muscle mass removal, and low impact of carnivores. All these elements suggest that anthropic access to animals is mainly primary and immediate. This implies that the TD10-1 hominins mainly obtained the carcasses through hunting activities (see Supplementary Online Material [SOM] 1). Nevertheless, several carnivore remains are recovered in the analysed sample from TD10-1: *Ursus arctos*, *Canis lupus*, *Vulpes vulpes*, *Panthera leo fossilis*, and *Lynx sp.* Some of these predators were processed by hominins (a lion and a fox) while others were introduced naturally into the cave probably while scavenging the remains abandoned by human groups (Rosell and Blasco, 2009; Blasco et al., 2010).

## Data presentation

Three used bones have been recovered in the analysed sample from TD10-1 (excavation season 2000–2001): two modified bones (ATA'01 N13/14 and ATA'00 J19/19) and one bone hammer (ATA'01 M12/70).

### *ATA'01 N13/14*

This bone is a fragment of the midshaft (lateral and palmar surface) of a large bovid metatarsal (53 × 46 × 25 mm; Fig. 2; see also supplementary video in SOM 2). This piece, with a trapezoidal morphology, presents an important exostosis on the palmar face. On the opposite end, a series of overlapping planes and continuous retouches can be observed. These modifications yield a more or less straight dihedral side. On the medullary surface of the same edge, several scars anterior to the cortical surface configuration can be observed. The aim of these removals appears to be to thin the edge for its subsequent configuration. In general, this bone is configured by an overlapping, invasive retouch as a lateral side-scraper.

### *ATA'00 J19/19*

This is the midshaft of a long bone of a large-sized animal (similar to a large bovid; 98 × 39 × 12 mm; Fig. 2; see also supplementary video in SOM 3). This object presents a triangular morphology, with a series of unifacial retouches developed along the left edge. The angle of these removals is planar or semiplanar, continuous, and deep whilst on the distal segment. They are marginal and continuous, probably due to the reshapening. In this sense, it seems to represent a lateral side-scraper.

### *ATA'01 M12/70*

This bone corresponds to a long bone shaft of a medium-sized animal (similar to *Cervus elaphus*) that was broken while fresh (47 × 14 × 9 mm; Fig. 3). This fragment shows a concentration of oblique, short, and deep incisions on the cortical surface. Several of these marks have an irregular delineation that contrasts with the criteria commonly used to identify cutmarks (Binford, 1981; Potts and Shipman, 1981; Shipman and Rose, 1983; Bromage and Boyde, 1984). At level TD10-1, cutmarks are mainly associated with butchery activities (generally long, regular, and straight incisions). At a microscopic level, an oblique section can be observed on the ATA'01 M12/70 bone. The marks on this bone are similar to those identified during