

A case of human bone Chalcolithic technology from the Perdigões site (Alentejo, Portugal)

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## Abstract

A human femur diaphysis in the form of a burin was excavated from a secondary burial context containing osteological remains and industry in the Archaeological Complex of Perdigões (Portugal). The majority of these evidences are thermo-altered and highly fragmented. Radiocarbon dates for this context place it in the middle 3<sup>rd</sup> millennium BC. Typological analyses indicate that the human femur fragment is a burin and use-wear comparisons suggest that it was used to drill hide.

**Key words:** human bone tool, use-wear, Chalcolithic, Perdigões.

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## Introduction

The use of human bone remains as raw material for the production of artefacts is a relatively uncommon feature. Many of the known examples come from the New World (e.g. Baby, 1961; Hester, 1969; Pereira, 2005; Andrushko et al., 2010) but the earliest known evidence is reported in the Middle Palaeolithic site of La Quina, France (Verna and d'Errico, 2011). Upper Palaeolithic Europe yields several examples of the use of human remains for the production of artefacts, such as the Aurignacian sites of southwestern France containing perforated or artificially grooved human teeth used as pendants, a practice also recorded on Gravettian and Magdalenian contexts (Henry-Gambier et al., 2004; Henry-Gambier and White, 2006; White, 2007). Another example are skull-cups, found in the Magdalenian (Buisson and Gambier, 1991; Bello et al., 2011), but also in the Neolithic (Boulestin et al., 2009) and Bronze Age (Cáceres et al., 2007).

A review of available literature suggests that the majority of human bone tools in the Mediterranean region are of Holocene chronology (Camps-Fabrer, 1993; Delibes and Paz, 2000; Molleson, 2002; Stefanovic, 2006; Soltysiak and Grezak, 2012). Besides these examples, the use of human bones to produce tools is not frequent in this region, contrarily to what occurs in American prehistoric assemblages (Turner and Turner, 1999; Hargrave et al., 2015).

We report the finding of a new case of human bone technology from the Chalcolithic levels of the Archaeological Complex of Perdigões (Portugal).

## Archaeological setting

The Archaeological Complex of Perdigões (PDG) is a set of Neolithic-Chalcolithic structures mostly distributed within a series of roughly concentric ditched enclosures (Figure 1). The site is located in Reguengos de Monsaraz in the Portuguese region of Alentejo (South Portugal). PDG has been subjected to archaeological research since 1997 resulting in the excavation of several different funerary contexts (Lago et al., 1998; Valera and Godinho, 2009; Valera et al., 2014a, 2014b). A diversified industry on equines, cervids, swines and ovicaprid remains (burins, needles, handles, pins, spatulas and pointed utensils in general) was excavated from this site. Preliminary studies suggest that specific bones of a specific taxon were selected for each typology but no functional information exists yet due to the lack of functional analysis. In general, modified bones belonged mainly to the appendicular skeleton, although bones from the axial skeleton were also used, namely ribs.

Figure 1

Evidence of cremated human remains was found near the centre of the PDG enclosures in 2010. The osteological material and the funerary pack excavated from this deposit are in a secondary context associated to arrowheads, fauna, very few ceramic items and several ivory anthropomorphic figurines. Available palaeobiological data is partial but both adult and non-adult human remains were identified, comprising a preliminary MNI of 105 individuals (Silva and Cunha 2011; Silva et al., 2013; Valera et al., 2014a, 2014b). There seems to be no difference in the treatment of human and faunal remains: they were disarticulated, most of them were submitted to fire and are highly fragmented in a similar manner. Although no indicators of in situ fire were registered there is evidence of fire on both fresh and dry bones (Silva and Cunha, 2011).

The specimen here discussed comes from a level radiocarbon dated to  $3850 \pm 30$  BP, 2459-2206 cal. BC  $2\sigma$  (Beta-313720, sample type: human bone) (Valera et al., 2014a). The dates obtained for this context are consistent with a secondary continuous and long lasting deposition of cremated remains, or depositions over a shorter period incorporating bones cremated at different times (Valera et al., 2014a: 23).

#### Specimen description

A fragment from a well-preserved human left femur with the diaphysis complete circumference (maximum length 88 mm, maximum width 31 mm) was identified as a possible modified bone (Figure 2). The specimen lacks both epiphyseal portions due to fragmentation and anthropic modification in the proximal and distal areas respectively. The diameter of the shaft and the robustness of the bone are compatible with an adult individual. Signs of complete remodelled periostitis reveal that the individual suffered from an infectious disease some time prior to his death.

With the exception of the proximal portion that presents post-depositional and recent fragmentation, the remaining areas of the specimen have the same brownish coloration. Surface alterations consistent with taphonomic post-depositional processes involving other materials from the same deposit are present in the form of small calcite accumulations, and general modification in colour due to exposition to the ashes and coal present in the sediment. These changes are evidenced in several materials from the same deposit but this fragment does not present fire-induced alterations.

## Figure 2

The femur distal portion has a bevelled oblique fracture of roughly 40° that corresponds to the best-preserved area of the specimen. This portion is interpreted as a sharpened active margin with a rounded extremity. The anterior distal portion is battered but the adhering bone fragments also have localised polishing and rounding. Morphologically this specimen seems to be a burin or a “point” as defined by Scheinsohn (1997). No cutmarks or other indicators of anthropogenic fracturation were registered in the remaining surfaces.

## Use-wear approach

An observation through FEI QUANTA 600 ESEM (Environmental scanning electron microscope) operated at low vacuum mode (LV(ESEM (FEIQUANTA[CC1])) was made in order to ascertain details on the polished, rounded and smoothed areas of the bone, and to functionally evaluate its technological characteristics. The microscopic analysis allowed to confirm the general polishing of the active area. The lesser-polished surfaces of the bone are the areas that were less exposed to abrasion and consequently do not present traces of use.

## Figure 3

Several oblique and transverse striae were identified, with varying degrees of depth and sometimes associated to micro-fractures of the surrounding tissues (Figure 3). The first group of marks (Group A) is found scattered in the active extremity, comprising both fine and wide semi-perpendicular striae of variable depth. It is possible to interpret these striae as the product of the manufacture process (including cutmarks), with some of these striations being lightly affected by wearing due to the interaction between the tool and the raw material. A second group of marks (Group B) corresponds to deep striae, highly polished in cusps, edges and bottoms, oriented semi-perpendicular to the axis of the tool. Although with differences in depth, both groups share most of their characteristics and could be the result of small variations related to performing the same action. However, studies combining experimental activities and ESEM observations characterized this type of microwear as the result of a perforation action through rotation movements in order to drill hides (Buc and Loponte, 2007; Buc, 2011; Santander, 2010). Moreover, studies developed using Metallographic

microscope observations described similar use-wear as result of piercing hide with twisting motions (as a drill) (Gates St. Pierre, 2007; Mozota and Gibaja, 2015; synthesis in Bradfield, 2015).

To strengthen the morpho-functional identification of the tool, the images obtained through ESEM observations were compared with others obtained at well-controlled experimental activities comprising metallographic and ESEM observations, (Buc, 2011; Stone, 2011; Santander, 2010; Santander and López, 2012). Close similarities were found between the striae on the Perdigões bone tool and those obtained from other experimental tools used in hide drilling. Specifically, with some minor differences in the striae width, two experimental artefacts MTBSE-7 and MTBSE-17 (Figure 4), both used in hide drilling, show use-wears (Figure 4) matching those found on the archaeological tool recovered from Perdigões. MTBSE-7 is a pointed bone tool made from an *Ovis aries* tibia fragment, worked through percussion and grinding, and used in the piercing of dry *Ovis aries* hide. During the experimentation, the artefact was used in 60 strokes, with bi-directional movements in a 90° angle over the hide. MTBSE-17 corresponds to a splinter of *Ovis aries* metatarsus, obtained through direct percussion, taking a spontaneously obtained pointed end. This pointed end was used to pierce hide with bi-directional movements in a 90° angle. After 60 strokes it became blunt, losing all effectiveness and preventing any perforation.

Figure 4

#### Discussion and conclusions

In this article we presented a burin made on a human femur and we suggest that it was used to pierce hide. Three main variables were considered for striae morphology: depth, thickness and polishing location. In the case of the striae observed in the PDG specimen, the combined observation of these variables reflects an intensive work over soft raw materials of animal origin. Use-wear produced during hide piercing could display different morphologies and striae organization (Buc, 2011), differences being more closely related with time and recurrence of use than to the nature of the raw material. Lemoine (1994) studied bone tools from Mackenzie Delta Inuits, stressing the role of grease even on dry skin as a lubricant reducing tribological consequences, in the sense that it may decrease the number of striae and further wear the striae produced.

Another topic is related with the intensive rounding and almost complete absence of striae in the tip of the tool. As previously suggested (Buc 2011; Buc and Loponte, 2007; Santander, 2010; Santander and López 2012), skin piercing creates intensive polishing on the tool, which in combination with grease lubrication produces a very smooth surface with almost no striations. Both use-wear indicators (striae and polishing) are well observed in the Perdigões artefact, this way strengthening our technological adscription of the tool as a burin involved on hide drilling.

In what concerns its archaeological significance we must emphasize that, as far as we know, no published utilitarian human artefacts exists in Western Iberia that could allow for further comparison. As it happens in many ditched enclosures throughout Europe, the manipulation of human remains outside formal funerary contexts is also documented at Perdigões. Scattered human bones were found in structured depositions together with faunal remains, pottery shards and stones in ditches 3 and 4 of this enclosure (Valera and Godinho 2009; Valera et al. 2014a, 2014b). In these contexts, human and faunal remains were submitted to a similar treatment. Rather than being accompanied by any particular votive material assemblage, they are just one more type of item used in the construction of the meaning and purpose of the deposition. Therefore, at Perdigões, human remains are used outside formal funerary rites and procedures. However, this is the first time that they were identified as raw material for tool production. That brings up ontological questions about this particular object.

At a cognitive level, this artefact raises issues on the human remains de-humanization and objectification, or the personification of a particular tool. Its intentional deposition on a funerary context where the majority of the industry was submitted to fire, together with the absence of indicators of direct contact with fire in the human bone tool, might suggest that the preservation of this particular piece was significant enough to prevent risking its destruction by fire.

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## References

- Andrushko V, Schwitalla A, Walker P. 2010. Trophy-taking and dismemberment as warfare strategies in prehistoric central California. *American Journal of Physical Anthropology* **141**(1): 83-96. DOI: 10.1002/ajpa.21117
- Baby R. 1961. A Hopewell human bone whistle. *American Antiquity* **27**: 108-110.
- Bello S, Parfitt S, Stringer C. 2011. Earliest Directly-Dated Human Skull-Cups. *PLoS One* **6**(2): e17026. DOI: 10.1371/journal.pone.0017026
- Boulestin B, Zeeb-Lanz A, Jeunesse C, Haack F, Arbogast R-M, Denaire A. 2009. Mass cannibalism in the Linear Pottery Culture at Herxheim (Palatinate, Germany). *Antiquity* **83**: 968-982.
- Bradfield J. 2015. Use-Trace Analysis of Bone Tools: A Brief Overview of Four Methodological Approaches. *South African Archaeological Bulletin* **70**(201): 3-14.
- Buisson D, Gambier D. 1991. Façonnage et gravures sur des os humains d'Isturitz (Pyrénées-Atlantiques). *Bulletin de la Société Préhistorique Française* **88**(6): 172-177.
- Buc N. 2011. Experimental Series and Use-Wear in Bone Tools. *Journal of Archaeological Science* **38**(3): 546-557. DOI: 10.1016/j.jas.2010.10.009
- Buc, N, Loponte D. 2007. Bone tool types and microwear patterns: some examples from the Pampa region, South America. In *Bones as Tools: Current Methods and Interpretations in Worked Bone Studies*, BAR International Series 1622, Gates St-Pierre C, Walker RB (eds.). Archaeopress: Oxford; 43-157.
- Cáceres I, Lozano M., Saladié P. 2007. Evidence for Bronze age cannibalism in El Mirador Cave (Sierra de Atapuerca, Burgos, Spain). *American Journal of Physical Anthropology* **133**: 899-917.
- Camps-Fabrer H. 1993. L'emploi d'ossements humains durant l'Holocène sur le pourtour de la Méditerranée occidentale et dans les pays voisins. *Préhistoire Anthropologie Méditerranéennes* **2**: 65-117.
- Delibes G, Paz F. 2000. Ídolo-espátula sobre radio humano en el ajuar de un sepulcro megalítico de la Meseta. *SPAL : Revista de Prehistoria y Arqueología de la Universidad de Sevilla* **9** : 341-349.



- Gates St-Pierre C. 2007. Bone Awls of the St. Lawrence Iroquoians: A Microwear Analysis. In *Bones as Tools: Current Methods and Interpretations in Worked Bone Studies*, Gates St-Pierre C, Walker RW (eds.). BAR International Series 1622. Archaeopress: Oxford; 107-118.
- Hargrave EA, Schermer SJ, Hedman KM, Lillie RM (eds.). 2015. Transforming the Dead: Culturally Modified Bone in the Prehistoric Midwest. University of Alabama Press: Tuscaloosa.
- Hester T. 1969. Human bone artifacts from southern Texas. *American Antiquity* **34**: 326-328.
- Henry-Gambier D, Maureille B, White R. 2004. Vestiges Humains des Niveaux de l'Aurignacien Ancien du Site de Brassempouy (Landes). *Bulletins et Mémoires de la Société d'Anthropologie de Paris* **16(1-2)**: 49-87.
- Henry-Gambier D, White R. 2006. Modifications artificielles des vestiges humains aurignaciens de la grotte des Hyènes et de la galerie Dubalen: quelle signification. In *El Centenario de la Cueva de El Castillo: El Ocaso de los Neandertales*, Cabrera V., Bernaldo de Quiros F (eds.). Ministerio de Educación y Ciencia: Madrid; 71-88.
- Lago M, Duarte C, Valera A, Albergaria J, Almeida F, Carvalho AF. 1998. Povoado dos Perdigões (Reguengos de Monsaraz): dados preliminares dos trabalhos arqueológicos realizados em 1997. *Revista Portuguesa de Arqueologia* **1(1)**: 45-152.
- Lemoine G. 1994. Use wear on bone and antler tools from the Mackenzie Delta, Northwest Territories. *American Antiquity* **59(2)**: 316-334.
- Molleson T. 2002. Two spindles made from human fibulae from Tell Nebi Mend, Syria. *BANEA Newsletter* **15**: 10-11.
- Mozota M, Gibaja J. 2015. "For a few awls more". Bone tools in northeastern Iberia Neolithic burials (4th-5th millennia cal BC). A morpho-technical and functional approach. *Journal of Archaeological Science: Reports* **4**: 65-77.
- Pereira G. 2005. The utilization of grooved human bones: a reanalysis of artificially modified human bones excavated by Carl Lumholtz at Zacapu, Michoacán, Mexico. *Latin American Antiquity* **16(3)**: 293-312.
- Santander B. 2010. *La industria ósea y su uso en materiales animales blandos. Una aproximación traceológica a un conjunto arqueológico del norte de Chile*. Master dissertation. Universidade de Trás-os-Montes e Alto Douro, Portugal.
- Santander B, López P. 2012. Análisis de Microhuellas de Uso Mediante Microscopio Electrónico de Barrido (MEB) de Artefactos Óseos de un Sitio Arcaico Tardío del Valle de Mauro (Región de Coquimbo, Chile): Aportes para una Reconstrucción Contextual. *Revista Chilena de Antropología*, 26, 129-150.

- Scheinson V. 1997. *Explotación de Materias Primas Óseas en la Isla Grande de Tierra del Fuego*, PhD dissertation. Universidad Nacional de Buenos Aires, Argentina.
- Silva AM, Cunha C. 2011. Relatório antropológico. In *Projecto “gestão da morte e temporalidade nos Perdígões”*: relatório de progresso – campanha de 2011, Valera A (coord.). NIA, ERA Arqueologia S.A.: Lisboa.
- Silva AM, Cunha C., Pereira D. 2013. Relatório antropológico. In *Projecto “gestão da morte e temporalidade nos Perdígões”*: relatório de progresso – campanha de 2012, Valera A (coord.). NIA, ERA Arqueologia S.A.: Lisboa.
- Soltysiak A, Grezak A. 2012. Worked Human Femur from Gohar Tepe, Iran. *International Journal of Osteoarchaeology*. DOI: 10.1002/oa.2296
- Stefanovic S. 2006. Human rib as a pendant at the Early Bronze Age necropolis in Mokrin. *Journal of the Serbian Archaeological Society* **22**: 243-251.
- Stone EA. 2011. *Through the Eye of the Needle. Investigations of Ethnographic, Experimental, and Archaeological Bone tool Use Wear from Perishable Technologies*. Ph.D. Dissertation. The University of New Mexico, USA.
- Turner CG, Turner JA. 1999. *Man Corn: Cannibalism and Violence in the Prehistoric American Southwest*. University of Utah Press: Salt Lake City.
- Valera AC, Godinho R. 2009. A Gestão da Morte nos Perdígões (Reguengos de Monsaraz): Novos Dados, Novos Problemas. *Estudos Arqueológicos de Oeiras* **17**: 371-387.
- Valera AC, Silva AM, Márquez-Romero JE. 2014a. Temporality of Perdígões enclosures: absolute chronology of structures and social practices. *SPAL* **23**: 11-26.
- Valera AC, Silva AM, Cunha C, Evangelista LS. 2014b. Funerary practices and body manipulation at Neolithic and Chalcolithic Perdígões Ditched enclosures (South Portugal). In *Recent Prehistoric enclosures and funerary practices in Europe*, BAR International Series 2676, Valera AC (ed.). Archaeopress: Oxford; 37-57.
- Verna C, d’Errico F. 2011. The earliest evidence for the use of human bone as a tool. *Journal of Human Evolution* **60(2)**: 145–157. DOI: 10.1016/j.jhevol.2010.07.027
- White R. 2007. Systems of Personal Ornamentation in the Early Upper Palaeolithic: Methodological Challenges and New Observations. In *Rethinking the Human Revolution: New Behavioural and Biological Perspectives on the Origin and Dispersal of Modern Humans*, Mellars P, Boyle K, Bar-Yosef O, Stringer C (eds.). McDonald Institute for Archaeological Research: Cambridge, UK; 287-302.

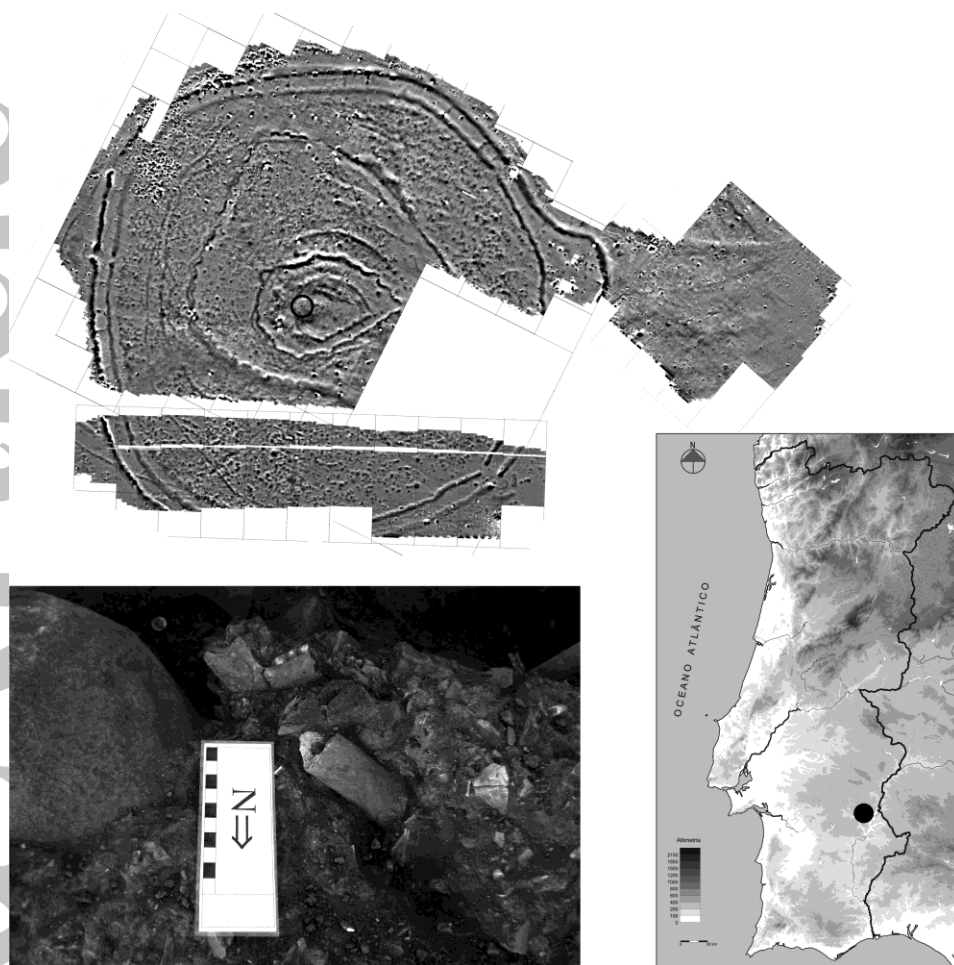


Figure 1: Location of Perdigões ditched enclosure; magnetogram of the site (after Valera et al., 2014a) with location of the artefact's context of provenance; detail of the deposition of the artefact.

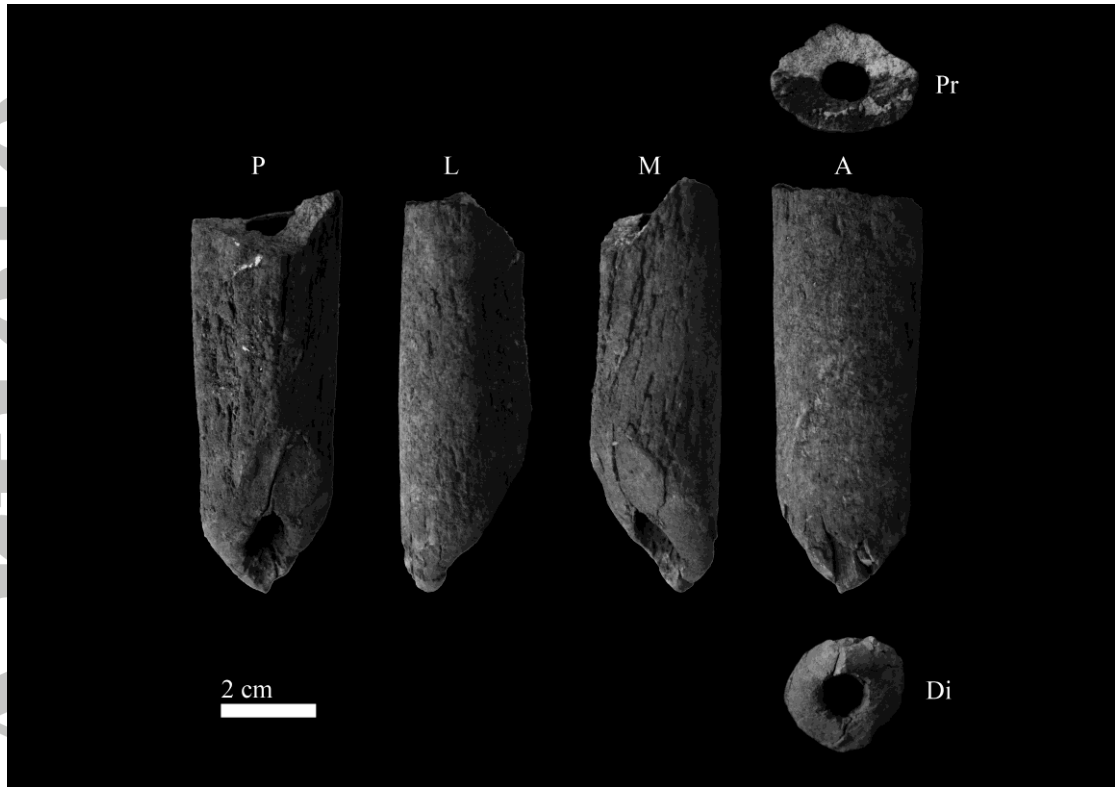


Figure 2: Views of the human femur tool from PDG: P = posterior, L = lateral, M = medial, A = anterior, Pr = proximal, Di = distal.

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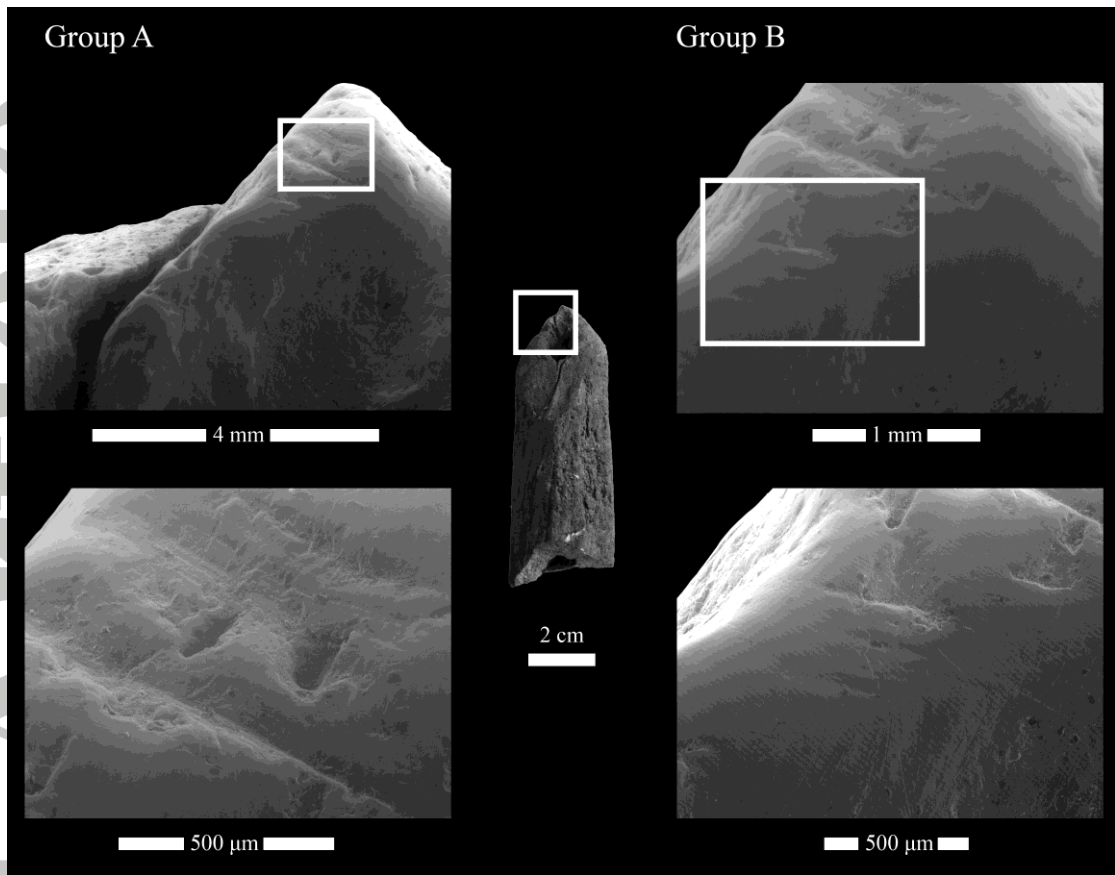


Figure 3: ESEM details of striae (Groups A and B) identified on the PDG specimen.

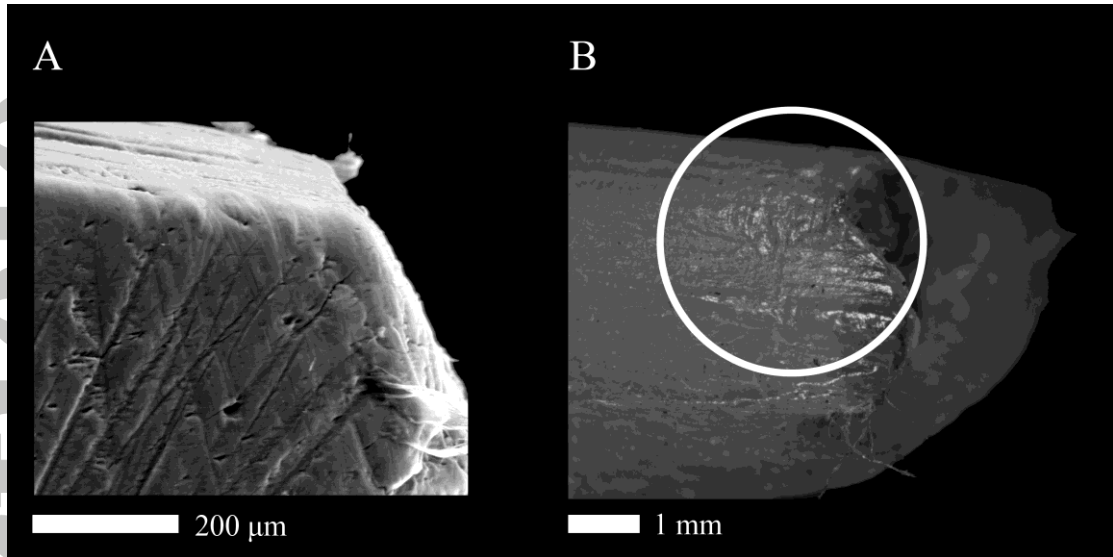


Figure 4: Comparative experimental bone tools (Santander, 2010). A) MTBSE-7 tool with striae and intensive polish as a result of hide drilling revealed over manufacture striation. B) MTBSE-17 tool with striae and intensive polish after 60 strokes during hide drilling.

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