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THE DEVELOPING CRAFT OF BONE TOOL TECHNOLOGY AT CHALCOLITHIC TELEILAT GHASSUL, JORDAN

B. AbuHelaleh[1], S. Bourke[2], U. Thun Hohenstein[3]

1. ***Petra College for Tourism and Archaeology, Al Hussein Bin Talal University, 71110 Ma'an, Jordan.***
2. ***NEAF, SOPHI, A14, University of Sydney, Sydney, Australia.***
3. ***University of Ferrara, Department of Humanities, Corso Ercole I d'Este 32 – 44121 Ferrara, Italy***

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Corresponding author: bellal.abuhelaleh@gmail.com

ABSTRACT

The Late Neolithic and Chalcolithic site of Tuleilat Ghassul is located on the northeastern corner of the Dead Sea and was occupied throughout the Fifth Millennium BCE. It is the type-site of the Ghassulian culture and, covering 20 hectares, is one of the largest Chalcolithic sites in the southern Levant. This paper analyses the worked bone objects from Hennessy's (1967-77) and Bourke's (1994-99) Sydney University excavations at Ghassul, currently stored in the Salt, Amman Citadel and Yarmouk University museums in Jordan. The aim is to investigate the production methods and describe specific form/function combinations of worked bone tools at Ghassul and to contextualize the assemblage through comparative analyses with contemporary artefacts recovered in Jordan.

Results display a variety bone objects categories like pointed tools, spatulas and decorated objects. Stereomicroscopic analysis documents different production processes on bone objects surfaces. Bone objects at Teleilat Ghassul illustrate the development of bone crafting during Chalcolithic period.

KEYWORDS: Ghassul, Jordan, Bone objects, Chalcolithic, Teleilat Ghassul

1. INTRODUCTION

Teleilat Ghassul has long been famous for its nearly unbroken sequence of occupation throughout the Fifth Millennium BCE, spanning the transition from the Late Neolithic into the Early Chalcolithic in its earliest phases, and then the full span of the Ghassulian Chalcolithic culture. First excavated by the Pontifical Biblical Institute (1929-38, 1959-60), and then by the University of Sydney (1967-77, 1994-99), the sequence begins with two phases of single-room Late Neolithic semi-subterranean roundhouse dwellings, followed by eight phases of rectilinear multi-room Chalcolithic period occupation (Hennessy, 1982; Bourke, 2008).

The Ghassul sequence reveals major changes to subsistence and material culture over the course of the near-millennium long sequence of Chalcolithic occupation, culminating in the 'Classic' Ghassulian assemblages of the last three phases (Hennessy Phases A-C). Archaeozoological analyses by Mairs (Mairs, 2009) and archaeobotanical analyses by Meadows (Meadows, 2005) revealed that significant changes in economic activities, including aspects of 'secondary products revolution' - more specifically the development of wool fiber production and dairying, donkey domestication, the use of deep plough and field rotation practices, the domestication of the olive and the increased utilization of other fruit along with more productive cereals (Bourke 2002, 2008) – occurred during the second half of the Fifth millennium BCE, (Bourke et al., 2001, 2004). In material cultural terms, the diversification of the Ghassulian material assemblage over time, featuring a greater range of items, many carefully crafted from exotic materials, becomes ever more elaborate. One feature of the later Ghassulian horizons is the production of figurative polychrome wall paintings, such as the PBI 'Star', 'Bird', 'Notables' and Hennessy's 'Procession' (Drabsch and Bourke, 2014), which together draw attention to the development of elaborate public cult practices, in the service of an emerging elite.

A variety of bone objects found within the site during previous archaeological excavation were preserved in Jordanian Museums. Thirty-four of these were awls, spatulas, and decorated objects. We are looking to apply Archaeozoological analysis to understand the production methods and describe specific form/function combinations of worked bone tools.

2. BONE OBJECTS

Bone tools from Teleilat Ghassul came from the collections in the Amman Citadel Museum, Salt Archaeological Museum and Yarmouk University Archaeological Museum. 34 bone objects which can be found in the bone objects sample were studied. Unfortunately, there was no access to raw material or production debitage as it is no longer preserved or stored in museums or by the Jordanian Department of Antiquities. It's possible that some bone artifacts assemblages were removed to be studied outside Jordan, which may limit our understanding of the production process.

3. METHODOLOGY

Bone tools categories have been classified based on a variety of scientific characteristics and methodologies. We considered the local production need for bone tools and the variety of demands by ancient societies. Classification was undertaken based on the shape and size of the bone tools. This lead to a better understanding of the categories of bone tools (Abuhelaleh et al., 2015; Beyries, 1987; Choyke and Schibler, 2007; Cristiani, 2008; D'Errico, 2001; Gebel et al., 2017; Karasneh, 1989; Nielsen, 2009; and Yerkes et al., 2003).

There is no particular scheme that can be applied simply to Jordanian bone tools due to the scarceness of published data for the Chalcolithic period. But data from published Chalcolithic and Neolithic sites in the Near East were compared. (Abuhelaleh et al., 2015; Garfinkel and Horwitz, 1988; Gebel et al., 2017; Karasneh, 1989; Nielsen, 2009).The previous study by Mairs L. D., who divided bone objects from Teleilat Ghassul in three categories (Points, shuttels, Rods/'Spacers'), was also considered (Mairs, 2009).

Our research recognizes the change of human demands and society, organization through Neolithic to the Chalcolithic. Although animal resources related to the diversity of environments surrounded through Neolithic and Chalcolithic periods (Abuhelaleh et al., 2015; Barone, 1980; Becker, 2013; Choyke and Schibler, 2007; Karasneh, 1989; Nielsen, 2009).

Archaeozoological and taphonomic analysis weredone by the use of Leica EZ4 HD stereomicroscope in order to document all anthropic modification on bone tools surfaces and also to distinguish butchering processes from production traces. Data collected from bone tools were used to reconstruct technologies, steps of production and the possible ancient use for each category (Camps-Fabrerm, 1990; Choyke and Schibler, 2007; Cristiani, 2008; Bertolini and Thun Hohenstein, 2017; D'Erricoa, 2001; Martin, 1999).

Osteological analysis was applied on bone tools by the use of animal skeletal collection to classify bone tools sources and past human manipulation of animal species from the surrounded environment (Boessneck et al., 1963; Martin, 1999; Schmid, 1972).

4. CATEGORIES

Based on bone tools typology, the tools were classified into three main categories; 1. Pointed bone tools, 2. Spatulas, 3. Decorated tools (Fig. 1). Bone tools categories contain subdivision categories related to specific production, final shapes and size.

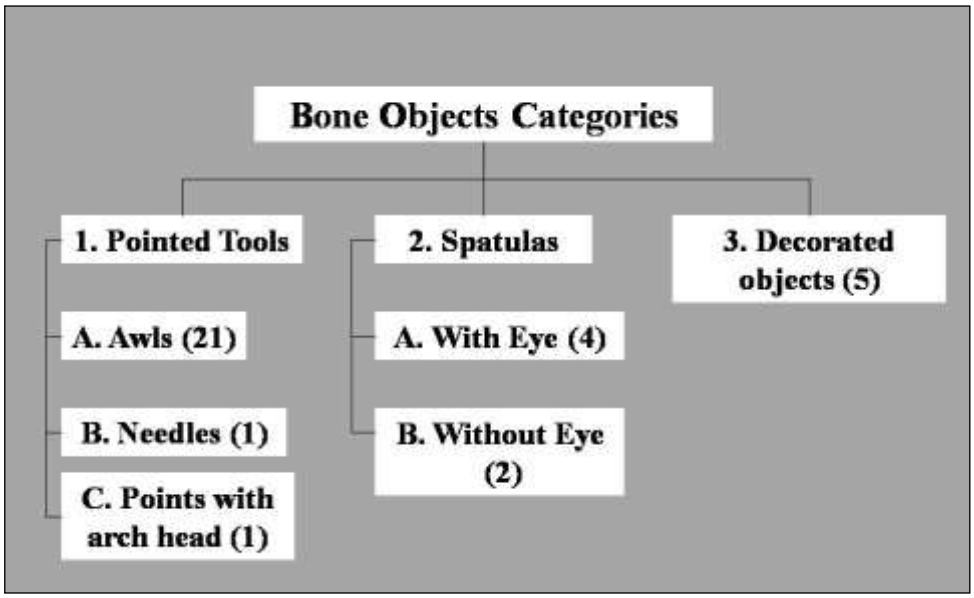

Figure 1: Scheme of bone objects categories from Teleilat Ghassul

4.1. Pointed tools

In this category bone tools were classified into three types; the first type is Awls: 21 awls were found and present two subdivision categories between short and long awls. One of the awls contains semi dental modification on both lateral sides from dorsal view (Fig. 2). Most of the awls are in good preservation conditions. It was found that only 5 awls have a complete proximal head. Most of the awls are made from the metapodial portion from middle to distal side. While few others are made from the middle shaft of long bones. There were fractures on the proximal side in most of them, and this could happen during the use of tools. Anthropic modification was noted on the surface of bone tools. Longitudinal scraping on ventral and dorsal surfaces was covering most surfaces. It shows the use of heavy tools to shape surface. There was a record of the use of retouch stone tools in this process.

It was also noted that short awls have wide size compared to the small thickness of long awls. Thickness of short awls could be related to use of complete middle shaft of the bone. Instead of the use half of shaft in long awls.

One of the awls contains semi dental modification on both lateral sides from dorsal view. The dental view has thickness of bone without sharp head. This awl has similar proximal head shape of short thick awls. This object is made from the proximal to the middle shaft of the radius bone belonging to a medium animal size.

Figure 2: Bone object N. J2682, dental awl; A: Frontal view of left lateral side, B: Dorsal view of left lateral side, C: view of longitudinal and perpendicular scraping on proximal portion by Stereomicroscopy, D: view of lateral side of dental modification by Stereomicroscopy.

The second type is Needles. Small size needle with piercing on proximal portion were found (Fig. 3). Needle has an external arch shape on proximal portion, surrounding the piercing. Diameter of inside circle is 2.2-2.4 mm, which makes it as a unique shape different from known other needle from other prehistoric sites in Jordan. Needle has a reddish brown color which could be related to burning of bone to increase its hardness. We noted a circular

and parallel scraping on proximal portion. Other longitudinal scraping was documented on middle to distal of shaft surface.

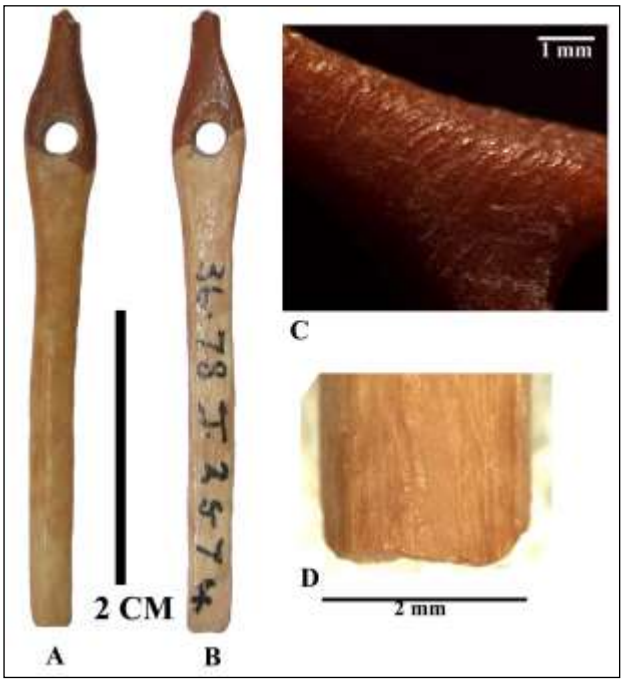

Figure 3: Bone object N. J2574, Needle with piercing; A: Frontal view, B: Dorsal view, C: perpendicular scarping in circular direction (Stereomicroscopy photo), D: view of longitudinal scraping on distal portion (Stereomicroscopy photo).

The third type is point with an arched head: only one arched head object was found. It was produced from the middle shaft of the long bone from a large animal. On proximal surface from front view; we note a variety of scraping directions. It could be related to work with course and hard surface. While we documented on dorsal view a parallel inclined scraping on both lateral sides of object. This type of modification could be related to cutting and smoothing the object.

4.2. Spatulas

Six Spatulas fabricated from large animal ribs were found. There are two subdivisions of these categories. First; four spatulas with piercing. Mairs suggested the name of this category as shuttles (Mairs, 2009). The piercing was made from both surfaces and the proximal edge was polished. Object J.2581 has a broken part of pierced circle on distal portion, which can be as a result of production fail or broken during use of tool (Mairs, 2009). Abrading technique was used to smooth distal portion (Fig. 4).

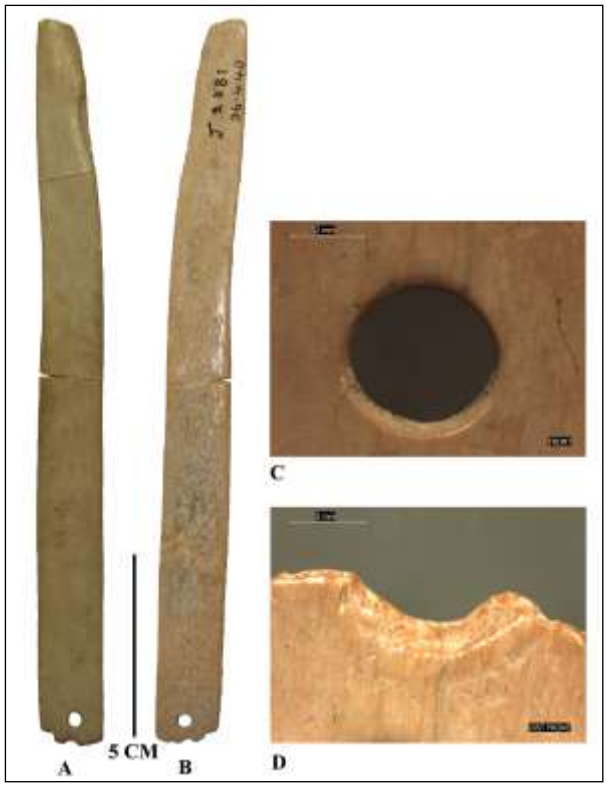

Figure 4: Bone object N. J2581, Spatula with piercing; A: Frontal view, B: Dorsal view, C: view of piercing border from frontal view (Stereomicroscopy photo), D: view of broken piercing on the border of distal portion (Stereomicroscopy photo).

The second category contains two spatulas; the first one is a broken proximal portion of spatula while the second one is uncompleted. The distal portion was broken.

In this category, human used to cut ribs in two symmetrical half long the shaft axes, in order to get thin spatulas. In general, all spatulas are thin and have a length that is more than 150 mm and the surfaces were smoothed by stone tools in longitudinal direction.

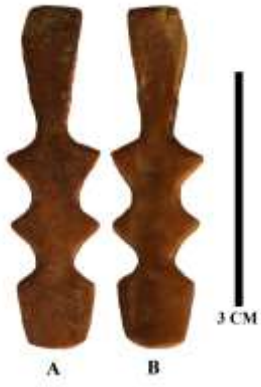

Figure 5: Bone object N. J.2355, Decorated pendant; A: Frontal view, B: Dorsal view.

4.3. Decorated objects

Five objects made from bones were documented. The first object (J.2355, Fig. 5) is a small pendant made from the middle shaft of a large animal long bone. It has an arch inclination on proximal portion and two concave inclinations to inside from both lateral sides and the distal portion has a straight edge. The object has a reddish brown color due to light burning.

The second object (J. 2563, Fig. 6) is middle shaft of metacarpal of middle size animal. This object contains on the dorsal side two small piercing. It was pierced by drilling on the external side of the bone and the hole could be used to insert a cord.

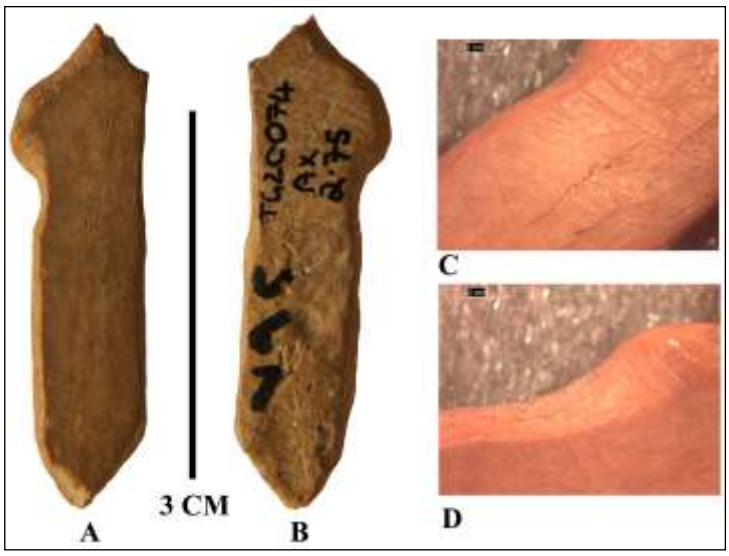

Figure 6: Bone object N. TG 20074, Decorated bone; A: Frontal view, B: Dorsal view, C: unsystematic perpendicular cut marks on frontal surface (Stereomicroscopy photo), D: view of perpendicular scraping on left lateral side (Stereomicroscopy photo).

Third object (J. 2359) is a broken portion of a vertebra with piercing made by drilling from both sides. The size suggests that it belonged to large animal. The remainder of the tool is not present and, therefore, its purpose is uncertain.

The fourth object (TG. 20074) is a small decorated bone that can be connected to another part of decorated object or a tool. This object made from a large animal bone and has been smoothed using an abrading technique and there are a variety of perpendicular cut marks on the surface and parallel perpendicular scraping on lateral sides. The object is 46 mm long, complete and looks like knife handle.

The last object (J. 2353, Fig. 7) is a perforated bone with 11 pierced 'eyes'. These were made by drilling from both sides and are not completely symmetrical. Between each piercing, there are parallel perpendicular lines on both sides of the object, produced by sawing. The object is 100.1 mm long and the piercings are close to equidistant at 7.3 mm. It is made from the shaft of a large animal long bone. It has been smoothed on the lateral sides at both ends but no other modification has been was found. This object was mentioned by Scham and Garfinkel as perforated rods (Scham and Garfinkel, 2007).

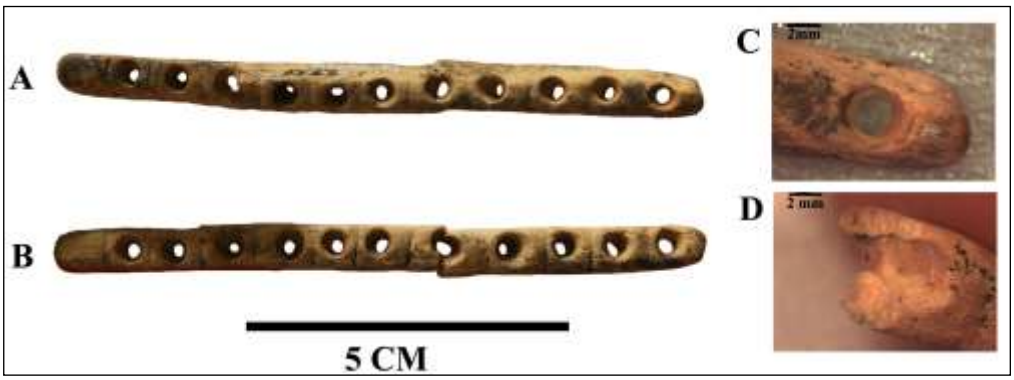

Figure 7: Bone object N. J. 2353, perforated bone; A: Frontal view, B: Dorsal view, C: view of piercing and smoothing by abrading technique on left side (Stereomicroscopy photo), D: view of internal surface of piercing hole number 7 (Stereomicroscopy photo).

5. ANTHROPIC MODIFICATION

Based on the analysis of each category by using a stereomicroscope, a variety of common anthropic modification, that represent various manipulations of bone tools surface, were noted.

On pointed objects, cut marks located on articulation portions of bone and connected to disarticulation of carcass, were noted (Fig. 8).

Most of the awls contain longitudinal scraping on surfaces. This seems to be as a result of cleaning of the ventral and dorsal surfaces. Circular cut marks on the proximal portion which could be related to using of tools were documented. Also on proximal and middle portions of the pointed tools, soft polishing was observed. While on distal portion smoothing of articulation by abrading technique was noted.

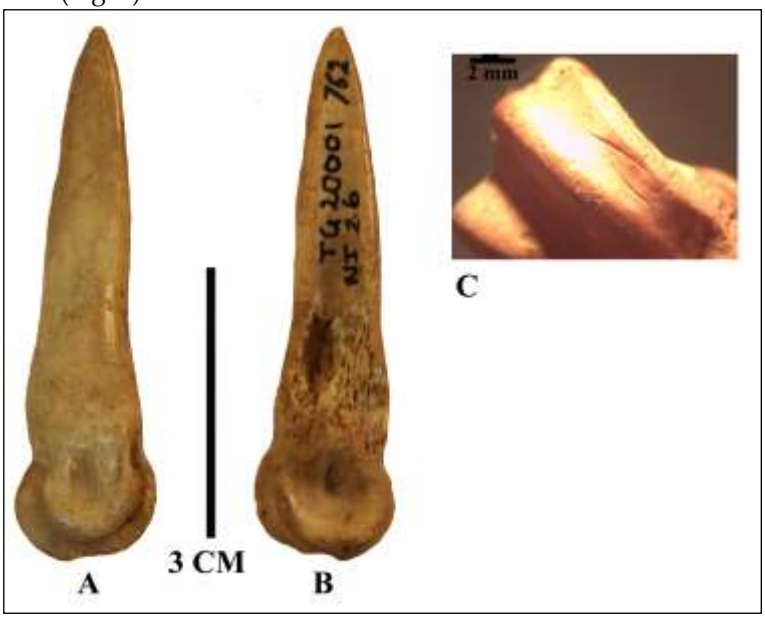

Figure 8: Bone object N. TG 20001, Short awl; A: Frontal view, B: Dorsal view, C: view of distal portion of the metapodial bone show cut marks during disarticulation of bone and smoothed lateral side by abrading technique (Stereomicroscopy photo).

Spatulas surfaces seem to be smoothed by use, so many of anthropic manufacturing marks are polished or canceled. But we document perpendicular and unsystematic scraping on the surfaces. Abrading technique is clear to be used on distal portion of spatulas. No burning on the spatulas surfaces was noted.

Some objects have coloured surfaces ranging from reddish brown to black but none seems to be highly burned (Fig. 9). Most of the pointed bone tools surfaces were preserved and manufacturing modifications are still evident on their surfaces.

Fractures on bone tools in many cases happen due to natural modification of site. Proximal head of pointed tools was preserved only in four cases. While the rest of bone points have ancient fractures which seem to be related to using of tools. Most of the spatulas were well preserved even they are thin and have a long shaft.

On pointed tools with an arch head proximal portion, small fractures from percussion were documented due to use of these tools with hard surfaces. Also on the proximal portion, a variety of unsystematic perpendicular scraping was observed.

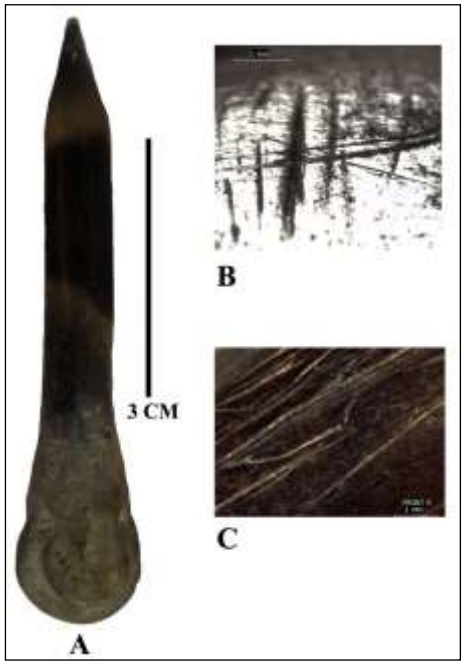

Figure 9: Bone object N. J. 8146, Burned short awl; A: Frontal view, B: View of perpendicular scraping on longitudinal cut marks, C: view of proximal portion show parallel scraping (B, C; Stereomicroscopy photo).

6. DISCUSSION

Pointed tools are the most represented in bone tools categories. The use of pointed tools has continued to dominate in daily working from the Neolithic period. Archaeozoological analysis noted circular traces on the proximal portion of awls. This could be related to the use for perforating leather and fur, these traces were found in many case studies during Neolithic and Chalcolithic periods like Baidha, Ba'ja, Ain Ghazzal, Basta, and Tell AbuSuwwan (Abuhelaleh et al., 2015; Garfinkel and Horwitz, 1988; Gebel et al., 2017; Karasneh, 1989; Nielsen 2009).

In spatulas categories, four pierced spatulas were documented. These modifications indicated the clear appearance of new daily activity within the site that could be related to weaving activity. The possible use of these tools to produce baskets was reduced due to the small thickness and long proportion of spatula. This can't support hard movements during production of baskets. Spatulas during Neolithic period were made of the longitudinal half of large size animal ribs. But Teleilat Ghassul spatulas are thinner in width and thickness, and they are longer than Neolithic ones.

Piercing became a main and interesting activity in producing decorated bone objects from Teleilat Ghassul. Other possibility was suggested by Bourke to use perforated rods object as raw bone to produce beads. But from the microscopic photo, it was observed that pierced entrances extended to outside. And also piercing is not systematic from both sides. And we note abrading of both lateral sides of the object. These results reduce the possibility of using it to produce beads. Also, we would like to mention that perforated rods with 11 piercing are made onlong bone from large size animal and not on ivory as mentioned in the work of Scham and Garfinkel (2007).

As already stated, earlier bone objects were separated from the rest of faunal remains, making it difficult to find the debitage reduction sequence to increase data about production technique. But comparing bone tool with Neolithic published data, a similarity of bone tools typology and anthropic modification was recognized. Also metapodial bones and zeugopodial bones were mainly utilized as a raw material to produce pointed tools. Human groups in Teleilat Ghassul kept bone shafts with epiphysis as handle of awl and also produced two type of awl: long and short awls.

We noticed also the use animal bones from different ages of carcasses. Awls were made from subadult to adult animal's bones. Other categories can't be classified due to the removal of articulation portions of the bones used to produce objects.

7. CONCLUSION

Samples studied from Teleilat Ghassul site were well preserved and they present a variety of categories showing the development of bone crafting during Chalcolithic period.

Piercing became more developed and controlled during this period. This can be seen in pierced needle, spatulas and perforated rod. It can present one of the art features of bone industry during Ghassulian period.

Pierced spatula with their specified typology can be used only to handle soft tissue. It could be a clear evidence of weaving within Tuleilat Ghassul site.

Ghassulian human used domesticated animal and wild animals from the surrounded environment as sources of raw material to produce bone objects. Some samples from awls show theuse of sheep and goat to produce awls. While spatulas and decorated objects belong to large size animal bones.

Awls shaped in two dimensions between long and short shaft. This indicated more specialization and crafting demand of daily works. It's possible to use more short and thick awls to elaborate leather/fur from large size animal. While long and thinner awls can be used to elaborate leather/fur from medium size animals.

Decorated object style reflects different art and ritual ideas within Teleilat Ghassul site. Particularly there is no repeating of these objects between all bone object that came from this site.

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REFERENCES

Abuhelaleh, B., Al Nahar M., Thun Hohenstein, U., Berruti, G. L. F. and Cancellieri E. (2015) Experimental Study of Bone Artifact Manufacture from the Neolithic site Tell Abu Suwwan (PPNB-PN), Jordan. Adumatu, Vol. 32, pp. 7-20.

Barone, R. (1980) Anatomia comparata dei Mammiferi domestici. V1: osteologia. Edizione italiana a cura di Bortolami Ruggero. Edagricole.

Becker, C. (1991) The analysis of mammalian bones from Basta, a Pre-Pottery Neolithic site in Jordan: Problems and potential, *Paléorient*, Vol, 17, N.1, pp. 59–75.

Bertolini M., Thun Hohenstein U., (2017), Bevel-ended tools on large ungulate ribs during the Bronze Age in northern Italy: Preliminary result of functional and experimental analyses. *Quaternary International,* Vol. 427, pp. 253-267.

Beyries, S. (1987) Variabilité de l'industrie lithique au Moustérien: approche fonctionnelle sur quelques gisements français. BAR International, Oxford, Archaeopress Series, England 328.

Boessneck, J., Müller, H. and Teichert, M. (1963) Osteologische Unterscheidungsmerkmale zwischen Schaf (Ovis aries Linné) und Ziege (Capra hircus Linné). *Kühn-Archiv,* Vol. 78 N. 1/2, pp. 1–129.

Bourke S. (2008) The Chalcolithic Period, in: In: Adams R, editor. Jordan: An Archaeological Reader, London, pp. 109-160.

Bourke S., Zoppi U., Hua Q. and Gibbins S. (2004) The End of the Chalcolithic Period in the South Jordan Valley: New 14C Determinations from Teleilat Ghassul, Jordan. *Radiocarbon*, Vol. 46, N. 1, pp. 315-323.

Bourke, S. (2002) The Origins of Social Complexity in the Southern Levant: New Evidence from Teleilat Ghassul, Jordan. Palestine exploration quarterly, Vol. 134, pp. 2-27.

Bourke, S. (2007) The Late Neolithic/Early Chalcolithic Transition at Teleilat Ghassul: Context, Chronology and Culture. *Paléorient* Vol. 33, N. 1, pp. 15-32.

Bourke, S. (2008) The Chalcolithic period. In: Adams R, editor. Jordan: An Archaeological Reader. London, Equinox, pp. 60-109.

Bourke, S., Lawson, E., Barbetti, M. and Zoppi, U. (2001) The Chronology of the Ghassulian Chalcolithic Period in the Southern Levant: New 14C Determinations from Teleilat Ghassul, Jordan. *Radiocarbon* Vol. 43 N. 3, pp. 1217-1222.

Bourke, S., Lovell, J., Seaton, P., Sparks, R., Meadows, J. and Mairs, L. (2007) Preliminary report on a Fourth Season of Excavation by the University of Sydney at Teleilat Ghassul, Jordan 1999, ADAJ Vol. 51, pp. 35-80.

Camps-Fabrer, H. (1990) i hes typologiques e l in ustrie osseuse prehistorique. Cahier III: Poincons, pointes, poignards, aiguilles. Aix-en-Provence, Universite de Provence.

Choyke, A. and Schibler, J. (2007) Prehistoric Bone Tools and the Archaeozoological Perspective: Research in Central Europe. In C. S Pierre and R. B. Walker (eds), Bones as tools: current methods and interpreta- tions in worked bone studies, Society for American Archaeology, Meeting 2007, *BAR International Series*, Oxford, pp. 51-65.

Clutton-Brock J. (1979) The Mammalian Remains from the Jericho Tell, *Proceedings of the Prehistoric Society,* Vol. 45, pp 135-157.

Cristiani, E. (2008) Analisi funzionale dei manufatti in materia dura animale del Riparo Dalmeri (Altopiano della Marcesina, Trento). *Preistoria Alpina*, Vol. 43, pp 259-287

D'Errico F., Henshilwood C. S. (2007) Additional evidence for bone technology in the southern African Middle Stone Age. *Journal of Human Evolution*, Vol. 52: 142-163.

D'Errico F., L.R. Backwell, and L.R. Bergerb. Bone tool use in termite foraging by early hominids and its impact on our understanding of early hominid behavior. *South African Journal of Science*, Vol. 97, pp. 71-75.

Dabsch B. and Bourke S. (2014) Ritual, Art and Society in the Levantine Chalcolithic: The 'Processional' wall painting from Teleilat Ghassul. *Antiquity*, Vol.88, pp. 1081-1098.

Drabsch, B. and Bourke, S. (2014) Ritual, art and society in the Levantine Chalcolithic: the 'Processional' wall painting from Teleilat Ghassul. Antiquity Publications Ltd, *Antiquity*, vol. 88, pp. 1081–1098.

Garfinkel, Y. and Horwitz. L. (1988) The Pre-Pottery Neolithic B Bone Industry of Yiftahel, Israel. *Paléorient*, Vol 14, N. 1, pp. 73–86.

Gebel H.G.K., Benz M., Purschwitz C., Kubíková B., Štefanisko D., al-Souliman A.S., Tucker K., Gresky J. and Abuhelaleh B. (2017) Household and Death: Preliminary Results of the 11th Season (2016) at Late PPNB Ba'ja, Southern Jordan. *NEO-LITHICS* Vol 17, N. 1, pp. 18-36.

Hennessy J. (1982) Teleilat Ghassul and its place in the archaeology of Jordan. *Studies in the History and Archaeology of Jordan*, Vol. 1, pp. 55-58.

Karasneh W. (1989) Bone artefacts from Basta, Ain Ghaza and Wadi Shoeb. MA thesis, Yarmouk University.

Martin L. (1999) Mammal remains from the eastern Jordanian Neolithic, and the nature of caprine herding I steppe. *Paléorient,* Vol. 25, N.2, pp. 87-104.

Meadows J. (2005) Early Farmers and their Environment: Archaeobotanical Research at Neolithic and Chalcolithic Sites in Jordan. PhD Thesis, La Trobe University.

Nielsen P. (2009) Worked bones in Pre-Pottery Neolithic B (PPNB) from southern Levant. Master thesis. University of Edinburgh.

S. Bourke, Zoppi U., Q. Hua & S. Gibbins (2004) The end of the chalcolithic period in the south Jordan valley: New 14C determinations from Teleilat Ghassul, Jordan. *Radiocarbon*, Vol. 46, N. 1, pp. 315-323.

Scham S. and Garfinkel Y. (2000) Perforated rods - new Chalcolithic ivory type. *BASOR N*. 319, pp. 1-5. Schmid E. (1972) Atlas of animal bones for prehistorians, archaeologists and quaternary geologists. Elsevier Publishing Company, London.

Yerkes R. W., Barkai R., Gopher A. and Bar Yosef O. (2003) Microwear analysis of early Neolithic (PPNA) axes and bifacial tools from Netiv Hagdud in the Jordan Valley, *Israel. Journal of Archaeological Science,* Vol. 30, pp. 1051-1066.