When Humans Were the Hunted: Bone-Tipped Arrowpoints in Prehispanic Sierras of Córdoba, Argentina

Matías E. Medina (paleomedina@gmail.com)  
Consejo Nacional de Investigaciones Científicas y Técnicas, Universidad Nacional de La Plata

Cristian Lallami  
Universidad Nacional de Rosario

Sebastián Pastor  
Consejo Nacional de Investigaciones Científicas y Técnicas, San Fernando del Valle de Catamarca

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Abstract

Projectile points are one of the most commonly preserved artefacts at archaeological sites worldwide, yet few studies have investigated how hunting and warfare intended use affected the design and morphological variation of this technology. This paper presents the techno-typological study carried out on seven bone projectile points closely associated to a burial assemblage excavated from El Alto 5 (~ 550 cal BP; Sierras of Córdoba, Argentina). The bone point assemblage provides a useful comparative model for interpreting the function of arrowpoints where this contextual data is unavailable, concerning primarily with the question of how archaeologists can accurately differentiate the arrow tips used for defense or attack from those used for hunting. Bone arrowpoints have barbed shoulders to resist removal from the wound and stems with serrated edges for a secure hafting. They required shafts few millimeter thicker than stone-tipped arrows for hafting, involving more kinetic energy to inflict severe injuries. The identification of a dark residue spattered over the blades opens the possibility that poison was applied to enhance the effectiveness of the shoot. The study is considered a starting point to build more accurate models to identify interpersonal violence during the Late Prehispanic Period of Sierras of Córdoba and neighboring regions, where most bone points occurred as domestic refuse and are not directly associated to human skeletal remains.

Introduction

Projectile points are one of the most commonly preserved artefacts at archaeological sites worldwide (Christenson 1986; Churchill 1993; Hughes 1998; Knetch 1997; Langley 2016; Loendorf et al. 2015; Lyman 2009). The Late Prehispanic Period of Sierras of Córdoba (~ 1220 – 330 cal BP, Argentina) was not an exception and arrowpoints made on stone and bone constitute one of the most numerous artefacts generated by people neither wholly foragers nor wholly farmers involved in what Smith (2001) defined as low-level food production (see Medina et al. 2016). There, bone arrowpoints show a wide range of morphological and size diversity, even at the same assemblage, probably involving different and insufficient explored functional task (Berberián 1984; González 1943; Marcellino et al. 1967; Medina et al. 2014; Medina & Balena 2021; Outes 1911; Serrano 1945). It was argued, for example, that the diversity of arrow tips were crucial for shooting small-to-large game at different distance and cover structures, including dangerous animal as humans that are more difficult to kill and require long-distance shooting (Medina & Balena 2021). However, little attention has been paid to the functional characteristics of bone projectile technology and the role that performance plays in morphological variation, a topic that needs further research (see Medina et al. 2019; Medina & Balena 2021, Medina & Pastor 2021; Pastor et al. 2005, Pauttassi & Rivero 1999; Rivero & Recaide 2011).

If it is possible to identify the differences in design that are associated with intended use, then this will provide an important analytical method for inferring warfare or subsistence practices that are frequently invisible in the archaeological record. In this regards, universal observations indicate that projectile points were often made differently for warfare from hunting (see Christenson 1997; Loendorf et al. 2015). Hunting and warfare projectile points differ in that the former is undertaken to obtain meat on the day-to-day basis, while the primary intent of the latter is to kill or wound enemies during raids. As a result, different constraints exist for these two tasks. Hunting points were made to kill as rapidly as possible to avoid the effort of track the prey (Loendorf et al. 2015). In contrast, warfare points were designed to maximize the probability that injury or death resulted, regardless how long this might take (Loendorf et al. 2015; Luik 2006). Thus, arrowpoints that participate in warfare —including those ethnographic ones described in or close to Sierras of Córdoba— are narrow types, invariably barbed and generally poisoned to produce more serious wounds (see Berón 2018; Bixio & Berberián 2017; Christenson 1997; Dobrizhofer 1967 [1783–1784]; Falkner 2008 [1774]; Heath & Chiara 1977; Jones 2007; Loendorf et al. 2015; Lozano 1754; Rosales 1877). Nevertheless, such classification of warfare and hunting weapons is subjective and if necessary, warfare arrowheads could be used in hunting and viceversa (Loendorf et al. 2015; Luik 2006).

In order to improve the discussion over the functional role of late prehispanic bone arrowpoints, this paper presents the techno-typological study carried out on seven bone projectile points closely associated to a burial assemblage excavated from El Alto 5 (Pampa of Achala, Córdoba Province) (Fig. 1). The study assumes that the design of the bone points used to kill an adult male provides a useful comparative model for interpreting the function of arrowpoints where this contextual data is unavailable, concerning primarily with the question of how archaeologists can accurately differentiate the arrow tips used for defense or attack from those used for hunting. While the sample is small, the study is considered a starting point to shed light on the causes of bone arrowpoints variability and build more accurate models to identify interpersonal violence during the Late Prehispanic Period, where most bone points occurred as domestic refuse of campsites and they were not directly associated to human skeletal remains.

Site Description

El Alto 5 is a rockshelter with a covered surface of 14 m² located at northern Pampa of Achala (~31° 23’ 47.616, -64° 44’ 12.695, 1680m asl, Córdoba Province). During its excavation, two overlapping inhumations were discovered (see Díaz et al. 2015; Pastor et al. 2012). Burial 1 (~ 550 cal BP [640–500, 95%]; 593 ± 41 BP human bone, AA-92443) and Burial 2 (~ 840 cal BP [930–740, 95%]; 972 ± 43 BP human bone, AA-96770; calibrations from OxCal 4.3 using SHCal20 (Bronk Ramsey 2009; Hogg et al. 2020)). Burial 1 is the focus of this research because it presents clear evidence of a violent death, offering an excellent opportunity to assess the design of the weapons used to kill people during Late Prehispanic Period. The Burial 2 was impacted by the Burial 1 when the later was opened few centuries after and it was not treated in depth in this paper.

The Burial 1 corresponds to a young adult male buried in a flexed position (Fig. 1). The age of death was estimated in 25–35 years (see Díaz et al. 2015). The inhumation presents bone lesions caused by the impact of projectile points and bone projectile points in close association to the body (see Díaz et al. 2015). Six of the points were found in the rib cage, where vital organs as the lungs and heart are located. The internal hemorrhage caused by this type of wounds makes it impossible running to flight and were fatal. A bone projectile point was found embedded on the XI dorsal vertebra (Fig. 1), affecting severely the medullar cavity of the victim and its mobility (see Díaz et al. 2015). Something similar occurred with the left humerus. This skeletal element presents an embedded fragment of a bone projectile point that crosses transversally from side-to-side the proximal diaphysis of the bone few centimeters below the tubercles (see Díaz et al. 2015). The projectile point impacted on the lateral side of the bone, showing that the victim try to present a smaller target in a lateral position to avoid a rapid kill shot to the heart and lung (see Loendorf et al. 2015: 944). Trauma was also identified on the skull (Fig. 1). In this regards, the left
sphenoid evidences a bone injury compatible with the flatted cross-section of most of the bone arrowpoints found in the burial (see Díaz et al. 2015). However, the point was withdrawn after impacted. Moreover, the broken tip of a bone point was recorded embedded on the lateral side of right rib (Fig. 1). Finally, a perimorten trauma, interpreted as caused by the edge of a stone tool, was recorded in a right rib (see Díaz et al. 2015).

Material And Methods

The seven complete or nearly complete bone projectile points from the Burial 1 of El Alto 5 were studied taking the position that there are particular characteristics of points that are useful for inferring some aspects of the total implement from which the points came. Broken tips that continued embedded on bones were not analyzed. The bones used to make the tools were anatomical and taxonomical identified using reference collections. Basic point shapes and features, as well as metric attributes (weight, length, neck width, blade width, thickness, angle of barbs, etc., Fig. 2), were undertaken using the protocol described for projectile point technology (Buc 2012; Julien 1982; Langley 2018; Loendorf & Rice 2004; Pettillon 2006).

Pieces were examined with 10-20X hand lens. This approach was sufficient to identify the manufacturing techniques used to produce bone points, macro-wear traces (striation, rounding, fractures, etc.) and damage resulting from post-depositional processes (Buc 2012; Orlowska 2016; Zhilin, 2015). During this analytical procedure, mastic and other residues observed on point were also documented. The fractures were described according to Pettillon (2006) and functionally interpreted based on the bibliography.

The use and performance of bone projectile points as arrow, dart or spear was based on the correspondence between the size of the proximal end for hafting and the diameter of the shaft (Christenson 1986; Odar 2012; Ratto 1991; Thomas 1978; Zhilin 2015). For stemmed projectile points as the ones studied here, the neck width was expected to be the same size or slightly smaller than the shaft (Christenson 1986). In this regards, arrowhead bases or stems are no more than 10mm wide, darts are about 15mm wide and spears are about 20-25mm wide (Zhilin 2015). Differences in arrowshaft diameters were related here to the range in what the projectile points would be used (see Christenson 1986). Smaller arrowshaft diameters were designed light to travel long distances with a flattened trajectory. Conversely, larger diameter of arrowshafts were used when archers look for a high impact force at relatively close range (see also Witthoft 1968).

Gross weight was also considered for delivery-system identification, assuming that projectile points with a weight lighter than 4,49gr were used on arrows, 4,5-20gr on darts or throwing spears and those with heavier weights than 20gr on thrusting spears (Fenenga 1953: 318). However, gross weight was taken with caution because long and thin bone arrowpoints weighting 5-20gr are not uncommon in the literature (Cattelain 1997; Fabra et al. 2015; Ikäheimo et al., 2004; Luik 2006; Rousselet & Grahammer 2004; Zhilin 2014). Thus, the gross weight was considered as a secondary variable to reinforce the arguments of bone points as bow-delivered projectile points when distinction with darts was not easy. Moreover, the gross weight, complemented with the proxy data of shaft diameter, was also used to roughly assess the mass and velocity of the bone-tipped projectiles (Tomka 2013) in comparison to those tipped with the tiny lithic arrowpoints that dominated late prehispanic assemblages (Supplementary Fig. 1). Descriptive statistics and Mann-Whitney tests were used for these comparison. The metric attributes of lithic arrowpoints were taken from the study of the collection of the Museo Arqueológico Numba Charava (Villa Carlos Paz, Córdoba) carried out by C. Lallami (Supplementary Table 1).

The angles and the width of barbs were used to assess the capacity of bone tips to resist removal from the wound (Julien 1982: 30). Shoulders were considered barbed when the angles were less than 70°, assuming that when the angle decreases, the capacity of the barb to resist removal increases. Finally, the system of hafting was hypothesized by the morphology of the proximal end, ethnographic technologies and additional technological element associated, as serrated edges or traces of glue preserved at stems (Knetch 1993).

Results

The main characteristics of bone projectile points from El Alto 5 are in Table 1-3 and Figures 3-9. In brief, the projectile points have long triangular-shaped blades (isosceles type), barbed shoulders and slightly contracted stems with serrated edges. The piece EA5-7 was the exception, having a slightly expanded blades (isosceles type), barbed shoulders and slightly contracted stems with serrated edges. The piece EA5-7 was the exception, having a slightly expanded

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The width of the stems and the gross weight indicate that, once finished, the bone projectile points were hafted to a bow-and-arrow weapon delivery system. The width of the stems from EA5-4 and EA5-5 exceed by 0.5 and 0.6mm the criteria of Zhilin (2015) for arrow identification. However, their weight (4.9 and 4.3gr) supports that they were bow-delivered projectile points. Ethnographic examples from South America of arrowshafts of ≥10mm in diameter tipped with organic points of similar size and shape confirm this assertion (Holmberg 1978; Kozak et al. 1979; Meyer 1898; Politis 2007; Politis et al. 2013; Vivante & Gancedo 1972).

The stem width and shape also indicate that hafting bone projectile points requires shafts few millimeter thicker than stone-tipped arrows (Table 2), involving more kinetic energy (Table 3) and, in consequence, more capacity to inflict severe injuries once the projectile reaches the target, especially at close range (see Tomka 2013). The presence of adjacent small notches along the edge of the stems and the mastic residues (see below) show that arrowheads were firmly fastened to the distal end of shafts using sinew cords and glue (Figure 6c, 7d and 10). This hafting method, in conjunction with barbed tangs, high kinetic energy and penetration power at short distance, favors that the projectile cannot be easily withdrawn from the wound, inclusive with the point attached to the arrowshaft. Wounds under such circumstances were fatal, even if lung or heart were not injured.

The mastic used for hafting was preserved on the stems of EA5-6 (Figure 8d), showing that notches were effective traps for glue preservation. Mastic is semi-transparent, shiny and looks like resin. Moreover, a relatively hard, dark brown and shiny resinous residue is spattered over the surface of most of the blades (Table 1 and Figure 3-9). Surprisingly, neither Diaz et al. (2015) nor Pastor et al. (2012) remarked on the presence of these residues. The substance looks heterogeneous in its composition, with muscovite or biotite inclusions visible at low-magnification. The residue is firmly adhered on the surface of the bone and does not penetrate the bone tissue as commonly occurred with manganese. The residue looks like as purposely applied on blade surface and not accumulated incidentally by post-depositional processes, mostly when the bones of the inhumation were not affected by this substance. Moreover, it resembles the black tar-like poison used on bone arrowpoints by ethnographic foragers throughout the world (see Borgia et al. 2017; Bradfield et al. 2020; Lombard 2020), including those ones described for neighboring regions of Sierras of Córdoba (Heath & Chiara 1977:89; Lozano 1754:425).

Finally, specimen EA5-1 presents a bending fracture near the tip. The fracture looks similar to the impact breakage pattern described by the weapon literature (Knecht 1997; Petillon 2006; Zhilin 2015). Thus, it is probable that the bending fracture was the result of very strong impact applied obliquely or transversally to the artefact when impacted on the target.

Discussion

Arrowheads from El Alto 5 were part of a specialized mechanism system designed to wound enemies severely from a short distance. They have long blades, narrow tips, barbs and the potential to inflict serious injuries. If the head was able to penetrate to a sufficient depth, the barbs would keep it stuck in the wound, creating a lethal wound regardless how long this might take. Even if the wound was not fatal, the removal of the arrow would take time and pain, immobilizing the enemies. Moreover, the weight of the bone-tipped projectiles has a higher knock-down power at close range and the ability to open a more serious bleeding wound than the smaller stone-tipped arrowpoints that dominated Late Prehispanic Period assemblages. The lethality of the wound increase if the arrow were poisoned, which enhance the effectiveness of the shoot. In this regards, barbed and poisoned arrows were cited by early colonial documents from central Argentina, causing fear among the Spaniards soldiers. For example, in 1544 the captain Diego de Rojas was wounded at few leagues north of Sierras of Córdoba "with a poisoned arrow, and the wound was nothing more than a scratch, but on the third day the herb began to work and he started to hit himself and make headbutts" and finally died (Bixio & Berberián 2017: 66). Thus, the possibility that poison was applied on bone arrowpoints from El Alto 5 is open.

However, residue analysis should be conducted before any decisive functional label is assigned to this substance (see Borgia et al. 2017) and poison recipes also need to be closely explored (Jolís 1972 [1789]:103-104; Lozano 1754:425; Politis 2007:202; Rosales 1877:118; Vivante & Palma 1966).

Although the raw material was the by-products of food consumption, the manufacturing of the bone projectile points required a high manufacture effort, showing that late prehispanic groups elaborated costly, standardized and reliable tools for warfare. Experiments carried out by Zhilin (2015) showed that, once bone has been softened in water for two months, it took about 3–4 hours to produce a needle-like arrowpoint. Similar hours of manufacturing was proposed for the bone arrowpoints from El Alto 5, but this time is speculative and presented solely to provide a frame of reference for ensuing discussion. Whatever, bone arrowpoints were clearly more time-consuming for fashion than the point attached to the shaft using sinew cords and glue (Figure 6c, 7d and 10). This hafting method, in conjunction with barbed tangs, high kinetic energy and penetration power at short distance, favors that the projectile cannot be easily withdrawn from the wound, inclusive with the point attached to the arrowshaft. Wounds under such circumstances were fatal, even if lung or heart were not injured.

For example, in 1544 the captain Diego de Rojas was wounded at few leagues north of Sierras of Córdoba, with clear evidences of physical violence (Díaz 1945). In this regards, the design of the bone projectile points from El Alto 5 is consistent with a time period where social tensions increased across the Sierras of Córdoba, with clear evidences of physical violence (Díaz et al. 2015; Fabra et al. 2015; González 1943; Paulotti 1943; Rivero & Recalde 2011; Weyembergh 1880).

As mentioned above, the archaeological record from the Late Prehispanic Period also include arrowheads of different size, shape and raw materials. The fact that the bone arrowheads analyzed here had been found particularly from a burial context and embedded on human bones suggests their use for warfare. It is certainly possible that they were also used occasionally for some other purpose as hunting large-game, but only if it does not alter the function it was originally designed for. Conversely, the small and light lithic arrowheads that dominated assemblages were probably used on the day-to-day basis for hunting, especially when projectile tips were not securely hafted and the main shaft will often come away from the tip once it struck the prey, enabling hunters to recover the shaft and use it again, avoiding the implication of the costly work involved in its manufacture (see Medina & Balena 2021).

According to the results, the classification of arrowheads on the basis of their function is justified and it would be useful for future analysis. With the dynamism of society becoming more complex, it is expected that tools and weapons also became more specialized, especially when subsistence activities...
were diversified and interpersonal violence increased regarding to previous archaic periods. The people who made bone projectile points with the characteristics described here had an idea of the purpose for which they were making them – i.e. defense or attack, which influenced their choice of the size of bone for obtaining the blank and the design of the arrowhead (Luik 2006).

**Conclusion**

The El Alto 5 bone arrowpoint assemblage provides direct evidence of the weapon system used to kill or injury enemies during the Late Prehispanic Period. Thus, the assemblage can therefore be used as a comparative model to identify interpersonal violence where this type of bone arrowpoints were collected, but no in direct association with dead bodies.

Further contextual evidence supports the arguments. First of all, fragments of bone projectile points are always recorded in low frequency when compared to the easy-to-make stone arrowtips, probably because they were used intermittently or occasionally and not on the day-to-day basis as probably occurred with stone-tipped projectile. Secondly, campsites show a complementary pattern to that seen in El Alto 5, with a bone point assemblage dominated by stems or fragment thereof, implying that even if barbed arrowheads or shafts were recovered from the enemy dead bodies, they require reparation. This explains the frequency of isolated stems recovered on campsites, where complete bone arrowheads were rare or occasional (Medina et al. 2014; Medina & Balena 2021; Medina & Pastor 2021). Finally, the record of late prehispanic human skeletal remains with clear evidence of death caused by bone-tipped projectiles similar to the described here, reinforce the functional hypothesis that they were used in raid against other groups (Fabra et al. 2015; González 1943; Weyenberg 1880).

Ethnohistorical and few archaeological observations indicate that village raids and punitive attacks were relatively common and may have played a crucial role in shaping the social and political landscape of the Sierras of Córdoba at the end of the Holocene (Bixio & Berberián 2017; Díaz et al. 2015; Fabra et al. 2015; González 1943; Paulotti 1943; Rivero & Recalde 2011; Weyembergh 1880). The analysis of bone projectile points embedded on human bones makes available new archaeological insights into the intensification of social relation during the Late Prehispanic Period, enabling reconstruction not only of the method of warfare, but also of technological level, social organization and how late prehispanic groups expressed social identity adding stylistic attributes to weapons. In this regards, results expand the frame of reference to identify interpersonal violence in those sites where barbed bone projectile points were found, but not associated or embedded to human remains as also occurred in neighboring regions (Buc 2012; Di Matteo et al. 2018; Lothrop 1932; Messineo et al. 2013; Reichlen 1940; Rusconi 1933; Wynveldt et al. 2020). However, it still remains for future research to focus in how the intensity or the frequency of warfare varied at the broad temporal-scale of the Late Prehispanic Period.

**Declarations**

**AUTHOR DECLARATIONS**

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**Ethics approval/declarations:** Not applicable.

**Consent to participate:** Not applicable.

**Consent for publication:** Not applicable.

**Availability of data and material/ Data availability:** The data that support this study are curated in the Museo Arqueológico Numba Charava and the Reserva y Laboratorio Achala Sacate (Villa Carlos Paz, Argentina).

**Code availability:** Not applicable.

**Authors’ contributions:** M.M analyzed and interpreted the bone projectile points of El Alto 5 from the technological point of view, prepared the figures 2-to-10 and was a major contributor in writing the manuscript. C.L. analyzed the metric attributes of lithic arrowpoints of the collection of the Museo Arqueológico Numba Charava (Villa Carlos Paz, Córdoba), prepared the Figure Supplementary 1 and wrote the tables. S.P. leaded the excavation of El Alto 5, prepared the Figure 1 and performed the examination of the data and the writing of the manuscript. All authors read and approved the final manuscript.

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Tables

Table 1. Main characteristics of bone projectile points from El Alto 5.
<table>
<thead>
<tr>
<th>Specimen Number</th>
<th>Shape</th>
<th>Portion</th>
<th>Element</th>
<th>Taxa</th>
<th>Cross-section</th>
<th>Max. length (mm)</th>
<th>Shoulder width (mm)</th>
<th>Max. thickness (mm)</th>
<th>Neck width (mm)</th>
<th>Barbs angle</th>
<th>Barbs width (mm)</th>
<th>W (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA5-1</td>
<td>long triangular-shaped blades (isosceles type) with barbed shoulders and stem</td>
<td>Pseudo mesial fragment</td>
<td>metatarsal</td>
<td>Lama sp.</td>
<td>Distal end: flattened</td>
<td>~75</td>
<td>18.2</td>
<td>3</td>
<td>8.7</td>
<td>70*</td>
<td>5.3</td>
<td>~</td>
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<td>Midpoint: flattened</td>
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<td></td>
<td>Proximal end: flattened</td>
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<tr>
<td>EA5-2</td>
<td>long triangular-shaped blades (isosceles type) with barbed shoulders and slightly contracted stem with serrated edges</td>
<td>Mesio-proximal fragment</td>
<td>Long bone</td>
<td>Macrovertebrate indet.</td>
<td>Distal end: flattened</td>
<td>~71</td>
<td>16.5</td>
<td>3.1</td>
<td>9.5</td>
<td>45*</td>
<td>4.8</td>
<td>~</td>
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<td></td>
<td>Midpoint: flattened</td>
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<td></td>
<td>Proximal end: flat-convex</td>
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<tr>
<td>EA5-3</td>
<td>long triangular-shaped blades (isosceles type) with barbed shoulders and stem</td>
<td>Pseudo medio-proximal fragment</td>
<td>Long bone</td>
<td>Macrovertebrate indet.</td>
<td>Distal end: flattened</td>
<td>87.2</td>
<td>--</td>
<td>4</td>
<td>7.8</td>
<td>35*</td>
<td>4.3</td>
<td>~</td>
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<td>Midpoint: flat-convex</td>
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<td>Proximal end: flat-convex</td>
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<td>EA5-4</td>
<td>long triangular-shaped blades (isosceles type) with barbed shoulders and slightly contracted stem with serrated edges</td>
<td>Pseudo medial fragment</td>
<td>Long bone</td>
<td>Macrovertebrate indet. (medium-large size)</td>
<td>Distal end: flattened</td>
<td>~95</td>
<td>22.2</td>
<td>4.3</td>
<td>10.5</td>
<td>35*</td>
<td>5.1</td>
<td>4</td>
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<td>Midpoint: flat-convex</td>
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<td>Proximal end: subrectangular</td>
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<tr>
<td>EA5-5</td>
<td>long triangular-shaped blades (isosceles type) with barbed shoulders and slightly contracted stem with serrated edges</td>
<td>Mesio-proximal fragment</td>
<td>Long bone</td>
<td>Macrovertebrate indet.</td>
<td>Distal end: flattened</td>
<td>~92.1</td>
<td>23</td>
<td>3.8</td>
<td>10.6</td>
<td>53*</td>
<td>5.8</td>
<td>4</td>
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<td>Midpoint: flat-convex</td>
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<td></td>
<td></td>
<td>Proximal end: flat-convex</td>
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<tr>
<td>EA5-6</td>
<td>long triangular-shaped blades (isosceles type) with barbed shoulders and slightly contracted stem with serrated edges</td>
<td>entire</td>
<td>Long bone</td>
<td>Macrovertebrate indet.</td>
<td>Distal end: flattened</td>
<td>88.8</td>
<td>17.3</td>
<td>3.9</td>
<td>8</td>
<td>56*</td>
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<td>Midpoint: flat-convex</td>
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Table 2. Descriptive statistics and Mann-Whitney test of the neck width (mm) of the bone projectile points from El Alto 5 and the small-stemmed lithic triangular arrow-points from museum collections of Sierras of Córdoba.

<table>
<thead>
<tr>
<th>Bone projectile point from El Alto 5</th>
<th>Small-stemmed lithic triangular arrow-points</th>
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</thead>
<tbody>
<tr>
<td>N: 7</td>
<td>N: 272</td>
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<tr>
<td>Mean: 9,128</td>
<td>Mean: 4,536</td>
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<tr>
<td>Median: 8,8</td>
<td>Median: 5</td>
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<tr>
<td>Standard deviation: 1,119</td>
<td>Standard deviation: 0,772</td>
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<tr>
<td>U: 1.061, p&lt;0.001</td>
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</tbody>
</table>

Table 3. Descriptive statistics and Mann-Whitney test of the gross weight (gr) of the bone projectile points from El Alto 5 and the small-stemmed lithic triangular arrow-points from museum collections of Sierras of Córdoba.

<table>
<thead>
<tr>
<th>Bone projectile point from El Alto 5</th>
<th>Small-stemmed lithic triangular arrow-points</th>
</tr>
</thead>
<tbody>
<tr>
<td>N: 7</td>
<td>N: 272</td>
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<tr>
<td>Mean: 3,261</td>
<td>Mean: 0,822</td>
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<tr>
<td>Median: 3,07</td>
<td>Median: 0,795</td>
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<tr>
<td>Standard deviation: 1,182</td>
<td>Standard deviation: 0,334</td>
</tr>
<tr>
<td>U: 11.5, p&lt;0.001</td>
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</tbody>
</table>

Figures
Figure 1

Main characteristics of El Alto 5 (Sierras of Córdoba, Argentina): a-b. geographic location; c. Burial 1 dated at ~550 cal BP; d. crania with an injury compatible with the bone arrowpoint found in the burial; e. projectile point embedded on the XI dorsal vertebra; f. broken tip of a bone point embedded on the lateral side of right rib.

Figure 2

Metric attributes of bone projectile points
Figure 3

Bone projectile point EA5-1: a. anterior view; b. posterior view.

Figure 4

Bone projectile point EA5-2: a-b. anterior view and details of the dark resinous residue spattered over the surface; c-d. posterior view and details of the dark resinous residue spattered over the surface.
Figure 5

Bone projectile point EA5-3: a. anterior view (see the incised decoration on the blade); b. posterior view.

Figure 6

Bone projectile point EA5-4: a. anterior view; b. posterior views; c. details of the serrated edges of the stem.
Figure 7

Bone projectile point EA5-5: a. anterior view (red dashed line indicates an impact scar); b. posterior view; c. details of the dark resinous residue spattered over the surface.

Figure 8
Bone projectile point EA5-6: a. anterior view; b. posterior view; c. details of the dark resinous residue spattered over the surface; d. semi-transparent mastic residue on the notches of the stem.

Figure 9

Bone projectile point EA5-7: a. anterior view; b. posterior view; c. details of the dark resinous residue spattered over the surface.

Figure 10

**Supplementary Files**

This is a list of supplementary files associated with this preprint. Click to download.

- MedinaetalSupplentaryTable1.docx
- SupplementaryFigure1.jpg