Prehistoric massacre revealed. Perimortem cranial trauma from Potočani, Croatia

Ivor Janković1,2, Jacqueline Balen3, James C. M. Ahern1,2, Zrinka Premužić4, Mislav Čavka5,6, Hrvoje Potrebica7, and Mario Novak1,*

1 Institute for Anthropological Research, Ljudevita Gaja 32, Zagreb, Croatia
2 Department of Anthropology, University of Wyoming, Laramie, USA
3 Archaeological Museum in Zagreb, Zagreb, Croatia
4 Independent researcher
5 Department of Diagnostic and Interventional Radiology, University Hospital Dubrava, School of Medicine, University of Zagreb, Zagreb, Croatia
6 Chair of Social Medicine and Organization of Health Care, School of Medicine, University of Zagreb, Zagreb, Croatia
7 Department of Archaeology, Faculty of Humanities and Social Sciences, University of Zagreb, Zagreb, Croatia
* Corresponding author: mario.novak@inantro.hr

With 8 figures

Abstract: During archaeological rescue excavations carried out in 2007 at Potočani in continental Croatia, a pit containing numerous human skeletal remains (MNI = 41) was discovered. The remains were mostly articulated but also commingled and showed no clear pattern of organization. There were no associated artifacts, just a few pottery fragments probably belonging to the Copper Age Lasinja Culture (c. 4300 to 3950 BCE). Anthropological analyses suggest the presence of individuals of all ages and both sexes with many crania exhibiting various perimortem injuries. Three human bone samples from different layers were dated to around 4100 cal BCE by radiocarbon analysis. These radiocarbon dates combined with other aspects of archaeological context, indicate that the deposition was a single episode rather than a long-term accumulation. All this suggests a single violent encounter (massacre). Here we present results of the bioarchaeological analysis of four adult crania with clear signs of perimortem trauma. These include blunt force trauma as well as cuts and penetrating injuries indicating the use of different weapons/tools.

Keywords: violence; mass grave; Prehistory; injury; Copper Age

Introduction

The study of violence in prehistory may provide additional information on human social relations in the past as its occurrence may be associated with conflict-prone subsistence contexts such as competition for scarce resources, population density, or territorial defense (e.g. Martin & Harrod 2015; Sala et al. 2015; Walker 1989). Intentional violence, particularly that of mass character, is not a phenomenon associated only with modern societies but was already present in prehistory. For example, skeletal evidence of organized violence on a massive scale in modern humans was recorded near Lake Turkana in Kenya where a group of prehistoric hunter-gatherers were massacred around 10,000 years ago (Mirazón Lahr et al. 2016). Additionally, Meyer et al. (2015) recently published the results of their study of the Early Neolithic (7,000 years ago) mass grave from Schöneck-Kilianstädten in Germany containing the remains of massacre victims.

A prehistoric (Copper Age) mass grave from Potočani is the first such find from the territory of Croatia, and one of the few similar finds within the European context. Comprehensive bioarchaeological, genetic and isotopic analyses of the human skeletal remains recovered from this burial should provide valuable insights into its demographic structure and the relationships between violence and social complexity, ritual and social complexity, and technology and violence. The aim of this paper is to present the first results of the bioarchaeological analysis of four selected crania with clear signs of perimortem damage from Potočani and to try to identify the possible weapons/tools that caused these injuries. Furthermore, Potočani will be compared with similar prehistoric sites from Europe in order to shed more light on the context of this mass burial.
Material and methods

During the field survey of the southern slopes of the Papuk mountain in Požega Valley in northern Croatia, a small pit containing human skeletal remains was uncovered by heavy rain in 2007 (Fig. 1). Subsequent excavations yielded surprising results, as the pit (measuring approximately 2 × 2 meters and less than a meter in depth, although it was originally somewhat deeper) contained a large number of human skeletal remains. The minimum number of individuals, based on frontal bones, is 41, and the collection represents both sexes and all age groups. MNIs determined from other bones in the sample (e.g. femur, tibia, mandible) are consistent with that determined from frontal bones. Thirteen crania (slightly more than one third of the total sample) exhibited evidence of perimortem trauma. The other 28 crania do not show any evidence of perimortem trauma or, in a couple of cases, are too fragmentary for accurate observation.

A comprehensive study of all postcranial elements found in the Potočani burial did not reveal any evidence of weapon-related trauma. Cultural remains were scarce and included broken pottery fragments of the Lasinja Copper Age culture (Potrebica & Balen 2008). Three bone samples were directly dated by radiocarbon to around 4100 years cal BCE (Beta 233122: 5240 ± 40 \(^{14}\)C BP; Beta 233123: 5310 ± 40 \(^{14}\)C BP; UCIAMS 140250: 5325 ± 20 \(^{14}\)C BP).

As indicated by excavation documentation, the human remains were mostly articulated but the individual skeletons became partially commingled due to the haphazard placement of the bodies at interment and post-depositional processes. Due to this commingling and because the rescue excavation was time-limited (precluding the on-site presence of a bioarchaeologist), cranial – post-cranial associations are now indeterminate. There is no evidence to indicate that the burial was disturbed by later activity, agricultural or otherwise.
Four crania with clear signs of perimortem trauma were selected for this analysis, as these show all four different types (puncture, penetrating, blunt force, cut) of perimortem injuries observed in the sample, and are the best preserved specimens. The other ten crania show very similar distribution and patterning of perimortem trauma as seen in the four presented in this paper. This study included assessment of age at death, sex, trauma and pathological conditions based on standards of bioarchaeological practice. Sex assessment was based on standard methodology and scoring systems described in Buikstra & Ubelaker (1994) and concentrated on nuchal, mastoid and supraorbital regions, glabella, mental eminence, and on the overall robusticity of specimens. Age at death was determined based on cranial suture closure and dental attrition scoring systems described in Meindl & Lovejoy (1985) and Brothwell (1981). Sex and age estimations were limited to cranial features because of the lack of associations between cranial and postcranial remains. Macroscopic identification and examination of trauma was based on the methods described in Maples (1986), Ortner (2008) and Sauer (1998). Antemortem injuries were identified by evidence of healing and bone remodeling (Sauer 1998), while perimortem injuries were identified with the following criteria: absence of healing and formation of new bone (Sauer 1998), fragments remaining attached to one another (Sauer 1998), internal beveling (Fachinni et al. 2007), defined or sharp edges (Wheatley 2008), and flat or polished surfaces with macroscopically visible striations (Wakely 1997). Considering that ground pressure and post-mortem damage can mimic perimortem injuries (Murphy et al. 2010), the differential texture and color of the lesions were used to differentiate between perimortem and postmortem trauma (Facchini et al. 2007; Sauer 1998).

Radiographic imaging was done utilizing a Multidetector computerized tomography (MDCT) unit (Emotion 16, Siemens AG Medical Solutions, Erlangen, Germany). Scanning parameters were 16 × 1.2 mm collimation and 1.0 reconstruction increment (RI) with 130 kV and 190 mAs respectively. 3 dimensional (3D) Volume Rendering Technique (VRT), Maximum Intensity Projection (MIP) and Multiplanar Reconstructions (MPR) were done with OsiriX MD Imaging software, v 7.0.4. (Pixmeo, Geneva, Switzerland).

**Analysis of crania**

Cranium 1 (Fig. 2, Fig. 3)

The cranium probably belonging to a gracile young adult male (20–35 years) exhibits three definite and one possible perimortem fractures:

![Fig. 2. Location of injuries on ectocranial (A) and endocranial (B) surface of cranium 1. Photo: I. Janković.](image-url)
1. **penetrating trauma on the right parietal bone**, located 61 mm lateral to the sagittal suture (superior-most lesion in Fig. 2A, B and Fig. 3), 35 mm anterior to the lambdoid suture and 39 mm superior to the squamosal suture. It is round-shaped and measures 10 mm in diameter on the ectocranial surface, while it forms a funnel-shaped lesion 24 mm in diameter on the endocranial surface.

2. **penetrating trauma on the right parietal bone**, located 20 mm postero-inferior to the first one (middle lesion in Fig. 2A and Fig. 3 and inferior-most lesion shown in Fig. 2B). It is located 12 mm anterior to the lambdoid suture and 13 mm superior to the squamosal suture. It is round-shaped and measures 13 mm in diameter with two short straight fracture lines: one posterior toward the occipital bone, measuring 8 mm in length; and the second in the superior direction towards the sagittal suture, measuring 13 mm in length. On the endocranial surface the trauma forms a funnel-shaped lesion 23 mm in diameter.

3. **penetrating trauma on the occipital bone**, 8 mm posterior to the asterion (inferior-most injury shown in Fig. 2A and Fig. 3). It is round-shaped and measures 13 mm in diameter. The superior part of the occipital (including the superior part of the injury) is missing (postmortem damage). Clear signs of bone chipping around the trauma are present. On the endocranial surface, the trauma forms a funnel-shaped lesion 16 mm in diameter.

4. **a possible blunt force trauma** is present on the left parietal and the left temporal bone (in the region of the left

---

**Fig. 3.** CT reconstruction showing endocranial lesions on cranium 1.
squamosal suture), 12 mm posterior of the pterion (not shown in figures). This slight lesion is round-shaped, 17 mm in diameter, while the inferior half of the lesion is missing post-mortem. On the endocranial surface, it forms a funnel-shaped lesion 20 mm in diameter.

**Cranium 2 (Fig. 4)**
The cranium probably belonging to a young adult female (20–35 years) exhibits three perimortem fractures:

1. a puncture wound on the left side of the frontal bone reaching the left parietal bone and crossing the coronal suture (Fig. 4A). It is located 31 mm lateral to bregma and 59 mm medial to pterion. The injury is elongated in shape and measures 28 × 9 mm. Its superior edge is sharp with minor bone chipping while the anterior part of the trauma, measuring 8 mm in length, did not penetrate the skull. On the endocranial surface, it forms a funnel-shaped lesion.

2. a cut (made by a sharp weapon/tool) on the right parietal close to the lambdoid suture, located 37 mm lateral to lambda, and 52 mm medial of the asterion (Fig. 4B). It is elongated in shape and measures 37 × 9 mm. The superior edge is smooth and sharp (pointing to the superior direction of injury infliction) while the inferior edge is rough and irregular showing some whitish bone, which would indicate recent postmortem damage. The injury did not fully penetrate the skull.

3. a cut on the left parietal bone located between the sagittal and lambdoid sutures, about 26 mm lateral of lambda (Fig. 4C). The injury is elongated in shape measuring 58 × 10 mm. Part of the medial edge (35 mm in length) was damaged postmortem. The medial portion of the lesion is slightly elevated.

**Cranium 3 (Fig. 5, Fig. 6)**
The cranium of an adult middle-aged male (35–50 years) exhibits three perimortem fractures:

1. blunt force trauma on the central part of the frontal bone, about 44 mm anterior to bregma and 68 mm posterior to nasion (Fig. 6A). The injury is oval-shaped, measuring 21 × 13 mm. The fracture line is located in the middle of the injury. The blow did not penetrate to the endocranial side and only a slight fracture line is observed.

2. blunt force trauma on the right side of the frontal bone and right parietal bone at the coronal suture (Fig. 6B).
Most of the injury is located on the frontal bone, and is of irregular-oval shape, measuring $31 \times 29$ mm. Concentric fracture lines are present around the edge of the trauma, and the lesion is slightly larger on the endocranial surface, forming a funnel-shaped lesion.

3. Blunt force trauma on the right parietal bone, 5 mm lateral of the sagittal suture and 68 mm posterior of the coronal suture (Fig. 6C). It is oval-shaped, measuring $22 \times 14$ mm. Two massive irregular fracture lines are present: the first spreads diagonally to the left parietal bone and measures 72 mm in length while the second goes in the opposite direction toward the posterior part of the right temporal bone, measuring 49 mm in length. On the endocranial surface the injury forms a funnel-shaped lesion.

Cranium 4 (Fig. 7)
The cranium of a young adult individual (20–35 years), most likely a gracile male, exhibits two perimortem fractures:

1. Blunt force trauma on the right parietal bone, located 49 mm lateral to the sagittal suture, 46 mm posterior to the coronal suture, and 48 mm anterior to the lambdoid suture (Fig. 7A, B). It is oval-shaped, measuring $28 \times 19$ mm. There are two adhering bone fragments that are depressed into the skull: anteriorly an elongated fragment $16 \times 6$ mm in dimension, and posteriorly an elongated fragment $18 \times 6$ mm in dimension. There is an irregular fracture line from the trauma in the inferior direction. It measures 41 mm in length and ends at the right squamosal suture. On the endocranial surface the injury forms a funnel-shaped lesion.

2. Blunt force trauma on the right parietal bone, superior to the right part of the lambdoid suture located 33 mm lateral of lambda (Fig. 7C). The inferior edge of the trauma touches the lambdoid suture. It is oval-shaped, measuring $26 \times 19$ mm in dimension with visible circular fracture line. The blow did not penetrate the skull but the endocranial surface shows a bulging of the lamella and two irregular fracture lines are observed.

Fig. 5. Position of all three perimortem injuries on cranium 3, superior view. Photo: I. Janković.
Fig. 6. Detailed view of injuries on ectocranial side of cranium 3. A: blunt force trauma on the central frontal bone, B: blunt force trauma on frontal and right parietal bones, C: blunt force trauma on right parietal bone. Photo: I. Janković.

Fig. 7. Detailed view of injuries on ectocranial (A, C) and endocranial (B) surfaces of cranium 4. Photo: I. Janković.
**Discussion and conclusion**

Radiocarbon dates obtained on three bones from the Potočani mass grave fit well within the timeframe of the so-called Lasinja culture of the Middle Copper Age (c. 4300 to 3950 BCE based on available radiocarbon dates; see Guštin (2005) and Balen (2008)). Lasinja culture is present on a wider geographic area, including continental Croatia, northern Bosnia, Slovenia, southern parts of Austria, and western Hungary (Balaton-Lasinja culture). Most common are settlements with either pit houses or above ground structures located on hill terraces above rivers. In Croatia only two inhumation burials dated to the Lasinja Culture are known so far (including Potočani), while in Hungary both inhumation and cremation burials are represented (Barna & Kreiter 2006).

The Middle Copper Age is a time when Neolithic traditions are finally abandoned and there is an influx of new populations into Southeastern Europe, making it a very dynamic age to live in (Parkinson 2006). Some of the novelties that appear during the Neolithic are smaller metal (copper) objects like beads and awls. Bigger tools, such as axes and wedges, appear during the later phases of the Neolithic and in the early Copper Age with the spread of metallurgy (Antonović 2014; Radivojević et al. 2010) but are surprisingly rare at Lasinja sites in Croatia. Therefore it is very hard to tell which, if any, weapons/tools made of metal were used to kill the Potočani population.

Based on the available data from Copper Age sites in Southeastern and Central Europe, it is clear that there is continuity in production of stone tools (such as various knives and axes), while there is an increase in production of metal objects. Smaller objects, such as adzes with narrow butts and fan-shaped cutting edges, and awls are relatively common and there is an increase in production of massive axe-adzes (Antonović 2009). The so-called hammer axes are also relatively common. These massive metal tools often exceed 3 kilograms in weight and could have been used very effectively as combat weapons, although it has been suggested that they also had symbolic value as indicators of the status of their owners (Antonović 2009). Another type of metal tool found at some sites is a metal wedge, either round or angular in diameter. A rare example of metal objects (a flat copper axe with a rounded blade and an elongated copper wedge) from Croatia that could have caused the trauma patterns seen at Potočani is found at the Lasinja Culture settlement Pajtenica located some 60 km east of Potočani (Fig. 8).

All four crania presented here exhibit a consistent pattern of trauma: multiple wounds in close anatomical association on each skull. All show multiple traumas on the right side, although different implements were used to make these injuries. The other nine crania with perimortem injuries show a pattern consistent with the four described here. Based on our analysis of perimortem trauma patterns, it is likely that metal axes and wedges caused cuts, puncture wounds and piercing injuries like those seen on crania 1 and 2, while the use of either metal objects (e.g. hammer-like axes), stone axes or hammers, or alternatively, clubs or objects of some other type of hard material (like bone or wood) were used to cause blunt force trauma, as seen on crania 3 and 4.

Trauma patterns and location of injuries on the crania (on right postero-lateral and posterior cranial areas) strongly suggest execution, rather than battle. While a predominance of left-sided cranial injuries indicates face-to-face battle with predominantly right-handed opponents (Erdal 2012; Owens 2007; Standen & Arriaza 2000; Weber & Czarnetzki 2001; Willey 1990), the predominance of right-sided cranial injuries may indicate that the attacker(s) were behind the victims. This is further supported by the preliminary analysis of postcranial elements which are lacking typical defensive wounds or any weapon-related injuries (although such wounds can be difficult to identify; cf. Judd 2008). The use of different tools/weapons may suggest that several perpetrators were involved in the killing of the Potočani people.

---

**Fig. 8.** Elongated copper wedge (A) and flat axe (B) with rounded blade from Pajtenica near Đakovo in Eastern Croatia. Scale is 5 cm. Photo: I. Krajcar.
Although no weapons or tools were found in the Potočani pit, a well-known battle site in Tollense Valley in Northern Germany (Jantzen et al. 2011) shows a range of metallic and non-metallic weapons being in use in actual warfare during the Bronze Age, and this is especially important when trying to interpret perimortem lesions in Potočani. Nevertheless, Potočani are completely different from Tollense since (a) the distribution of trauma in Tollense strongly indicates face-to-face combat between the armed combatants, and (b) there are a number of metallic and non-metallic weapons still present at the site (some even embedded in bones) in the Tollense case. In Potočani we have a single episode of violence followed by placement of the dead in a shallow pit which is supported by the radiocarbon dates, taphonomy and arrangement of skeletal elements, and the lack of intentionally placed burial goods (ceramic vessels, animal remains) such as those seen in the Tiszapolgar and Bodrogkeresztur Copper Age Cultures. The few pottery fragments found in the pit during the excavation came from used and weathered vessels that most likely came into the pit unintentionally during the filling. The absence of observable perimortem trauma among the remaining 28 crania is also interesting, given that the Potočani people likely died and were interred simultaneously. Although the evidence is consistent with systematic execution of the Potočani people using methods that both left skeletal trauma and those that did not (Meyer et al. 2009), other scenarios are also possible.

There are several prehistoric mass burials that are chronologically and geographically relatively close to the Potočani burial. A pit containing the remains of 38 males was found at Esztergályhorváti, Hungary, dated to 4856–4728 cal BCE (Bronk Ramsey et al. 1999; Zoffmann 2007). The haphazard arrangement of the burial and presence of cranial traumas on one individual at Esztergályhorváti (Zoffman 2007) make it somewhat similar to Potočani. However, the presence of a “ritual” fire at the site is unlike the Croatian site. Pits containing remains of approximately 100 individuals were discovered at Alba Iulia-Lumea Nouă, Romania, and dated to ca 4600–4450 BCE (Gligor 2010). The Alba Iulia remains show evidence of secondary burial as well as postmortem modification, which Gligor (2010) interprets as evidence of ritual. Finally, the remains of at least 48 individuals were found in seven pits at Abony-Turjáynos-dúlő site in Hungary, and dated to between 3780–3650 cal BCE (Fábián et al. in press; Köhler et al. 2009). The authors studying these sites suggest that they have a ritual character (proper placing of human bodies, intentionally placed ceramic vessels, animal remains, traces of fire) that is apparently absent at Potočani and most probably cannot be directly compared.

Although geographically more distant from Potočani than the aforementioned Hungarian and Romanian sites, the human remains from the Copper Age mass grave at Titriş Höyük, Turkey exhibit numerous perimortem traumas. However, unlike Potočani, the Titriş Höyük case appears to be a secondary burial given the lack of articulations and the low frequencies of small bones (Erdal 2012). Erdal interprets the extensive cranial and postcranial perimortem trauma among the Titriş Höyük remains as resulting from interpersonal violence or warfare. Unlike Potočani, the Titriş Höyük cranial remains exhibit more injuries to the left side than to the right, and left-sided cranial injuries are usually considered to result from face-to-face combat (Erdal 2012; Owens 2007; Standen & Arriaza 2000; Weber & Czarnetzki 2001; Willey 1990). Consequently, given the predominance of right-sided traumas and lack of postcranial postmortem injuries among the Potočani remains, we once again contend that the Potočani deaths were more likely to have been executions than due to combat.

Alongside the previously mentioned “ritual” sites, there are some prehistoric mass graves indicating massacres and in this regard they are more similar to Potočani. Probably the most famous prehistoric massacre sites are Asparn/Schletz (Teschler-Nicola et al. 1999), Talheim (Wahl & Trautmann 2012) and Schöndeck-Kilianstädten (Meyer et al. 2015). It has to be noted that these sites, located in Austria and Germany, are dated to the Early Neolithic (Linear Pottery culture or LBK) and as such are older by 500 to 1000 years than the Potočani burial. Skeletal remains of at least 67 individuals of both sexes and various ages were found within the fortification ditches around the LBK settlement of Asparn/Schletz in Lower Austria (Teschler-Nicola et al. 1999). Most bodies were found in unusual positions and many skeletons were incomplete with extremities missing. Bioarchaeological analysis showed that all skulls and skull fragments exhibit lethal perimortem fractures (Teschler-Nicola et al. 1999). According to the distribution and morphology of perimortem fractures, Teschler-Nicola et al. (1999) suggested that ‘the weapons responsible for such trauma seem to have been axes, hatchets and clubs’. At the grave site of Schönbeck-Kilianstädten in Germany, at least 26 individuals of both sexes and various ages were violently killed by blunt force caused by stone adzes and by arrows before being deposited in a commingled mass grave (Meyer et al. 2015). The authors emphasize the fact that this skeletal series is characterized by numerous perimortem fractures clearly indicating torture and/or mutilation such as the intentional and systematic breaking of lower limbs (Meyer et al. 2015). The third example is found in the burial pit at Talheim, Germany. It contained the remains of 34 individuals (men, women and children of different age categories) deposited haphazardly without intentional grave goods (Wahl & Trautmann 2012). Twenty of the 34 identified individuals exhibit unhealed traumas to the skull and the wound patterning indicates that the injuries were inflicted by ‘flat axes, shoe-last adzes, arrow points or tools with a blunt edge (club or the back end of a stone axe)’ (Wahl & Trautmann 2012).

The Late Neolithic sites of Eulau (Haak et al. 2008) and Bavenstedt (Schutkowski et al. 1996) also yielded multiple...
individuals exhibiting perimortem traumas. Although close in time to Potočani, the evidence from both of these sites is fundamentally different from that of Potočani. At Eulau there are multiple grave pits with either singular or multiple individuals laid out in an organized manner, unlike Potočani. Most of the Eulau individuals suffered perimortem traumas, including projectile wounds, penetrating wounds, and blunt force traumas. Meyer et al. (2009) suggest that one individual (#4) was executed, given the location of a large penetrating wound on the individual’s occipital combined with the individual’s short stature due to young (8–9 years) age. The double burial at Bavenstedt contained two individuals, both of who had been interred following deaths from infections caused by projectile points (Schutkowski et al. 1996).

The mass grave at Potočani at present seems more similar to the massacres at Asparn/Schletz, Talheim, Eulau, and Schöneck-Kilianstädten than the “ritual” grave sites at Esztergálgyhorváti, Alba Iulia, and Abony-Turjánoz-dűlő (although the latter are closer in time to Potočani). A more detailed bioarchaeological, genetic and stable-isotope analysis of the complete skeletal collection from Potočani that is in progress will provide data for a better understanding, and subsequently a more detailed insight into population structure and other biological properties of the Potočani people. It will also allow us to compare the sample to other geographically and chronologically close samples and finds. This will add to our understanding of complex patterns of contacts and behavior of Copper Age Europeans.

Funding: This work was supported by the project ‘Reconstructing prehistoric (Neolithic to Bronze Age) lifestyles on the territory of Croatia – a multidisciplinary approach’ financed by the Croatian Science Foundation [grant number 1450].

References


Manuscript received: 19 July 2016
Revisions required: 17 November 2016
Revised version received: 05 December 2016
Accepted: 05 December 2016