Estonian Journal of Archaeology, 2023, 27, 2, 129–158 https://doi.org/10.3176/arch.2023.2.03

Pre-Roman Iron Age inhumations: a multi-proxy analysis of a burial complex from Tallinn, Estonia

Maris Niinesalu-Moon
maris.niinesalu@ut.ee
Faculty of Arts and Humanities, Institute of History and Archaeology, University of Tartu, Jakobi 2, 51005 Tartu, Estonia

Keiti Randoja
keitirandoja@gmail.com
Arheox Ltd., Paekalda 24a-17, 13628 Tallinn, Estonia

Anu Lillak
anu.lillak@ut.ee
Faculty of Arts and Humanities, Institute of History and Archaeology, University of Tartu, Jakobi 2, 51005 Tartu, Estonia

Ester Oras
ester.oras@ut.ee
Institute of Chemistry, University of Tartu, Ravila 14a, 50411 Tartu, Estonia / Faculty of Arts and Humanities, Institute of History and Archaeology, University of Tartu, Jakobi 2, 51005 Tartu, Estonia / Swedish Collegium for Advanced Study (SCAS), Linneanum, Thunbergsvägen 2, 752 38 Uppsala, Sweden

Mari Tõrv
mari.torv@ut.ee
Faculty of Arts and Humanities, Institute of History and Archaeology, University of Tartu, Jakobi 2, 51005 Tartu, Estonia

Kristiina Johanson
kristiina.johanson@ut.ee
Faculty of Arts and Humanities, Institute of History and Archaeology, University of Tartu, Jakobi 2, 51005 Tartu, Estonia

Ragnar Saage
ragnar.saage@ut.ee
Faculty of Arts and Humanities, Institute of History and Archaeology, University of Tartu, Jakobi 2, 51005 Tartu, Estonia

Alexandre Lucquin
alexandre.lucquin@york.ac.uk
BioArCh, Department of Archaeology, University of York, Environment Building, Wentworth Way, Heslington, York YO10 5NG, UK

Sirje Hiie
sirje.hiie@mail.ee
Archaeological Research Collection of Tallinn University, Rüütli 10, 10130 Tallinn, Estonia

Aivar Kriiska
aivar.kriiska@ut.ee
Faculty of Arts and Humanities, Institute of History and Archaeology, University of Tartu, Jakobi 2, 51005 Tartu, Estonia

Valter Lang
valter.lang@ut.ee
Faculty of Arts and Humanities, Institute of History and Archaeology, University of Tartu, Jakobi 2, 51005 Tartu, Estonia

Received 2 June 2023, accepted 1 September 2023, available online 23 November 2023

ABSTRACT

This article presents the results of a multi-proxy study conducted on a triple burial found at a settlement site at Pärnu Road 41, Tallinn, Estonia, dating to 405–360 cal BC (Pre-Roman Iron Age). Through archaeological and chemical analyses, including AMS dating, archaeobotany, osteology, stable isotope analysis, lipid analysis, metallography and XRF analysis, this study proves valuable insights into the provenance, diet, and burial practices of the woman and children buried in the grave at Pärnu Road 41.

The stable isotope analysis of strontium, carbon and nitrogen suggests that the individuals were of local origin and did not travel long distances during their lifetime. It is likely that the diet of the woman was mainly based on terrestrial protein, which is also supported by lipid analysis performed of pot sherds. These results correspond with the dietary stable isotope values of individuals from Estonia dated to the second half of the Bronze Age and the Pre-Roman Iron Age. Based on the find context of carbonized grains, the partial burning of the female skeleton and the fire pit built contemporaneously above the grave, it is likely that grains and fire could have played an important role in inhumation burials. However, because of the scarcity of inhumation burials in pit graves, it is unclear whether or not the triple burial at Pärnu Road 41 represents a widespread burial practice alongside the stone graves typical of this period. Moreover, it is possible that the observed rituals are linked to foreign customs, as the buried individuals may have had familial ties to immigrants from different regions of eastern Europe, as indicated by a unique bronze bell-pendant found in the grave.

This study also introduces the discovery of the earliest known iron smithing site in Estonia. Spherical magnetic droplets found within the burial soil were proven to be hammer scales, formed as a by-product of iron working. The appearance of hammer scales in the soil of a burial dated to the 4th century BC challenges the previously established timeline of iron working in the region.

Introduction

In 2019 rescue excavations of a prehistoric settlement site at Pärnu Road 41 in Tallinn (northern Estonia) unearthed an inhumation burial of a woman accompanied by two children (Figs 1–2). The earth grave with grave goods of eastern European origin represents a poorly studied grave type of the Pre-Roman Iron Age (500 cal BC–50 cal AD, the dates of subperiods here and below are according to Kriiska et al. 2020a, fig. 1). From the period under study, graves with above-ground structures such as stone cists and early *tarand* graves are abundant in the archaeological material, while inhumations in pit graves are known by a few probable grave goods and human bones found occasionally in earthworks (Lang 2011). The most notable features of the grave, however, are the unique find of a bronze bell-pendant as well as the features associated with a probable funerary ritual – charred grains and a fire pit set upon the burial. These features require further investigation of the burial and have raised questions about the provenance of the individuals buried as well as the dating of the funerary rituals and the positioning of the burial type in the socio-cultural context of Pre-Roman Iron Age Estonia.

For this, we decided to conduct a multi-proxy analysis of the burials and the finds associated with it by means of osteological analysis of the human remains,

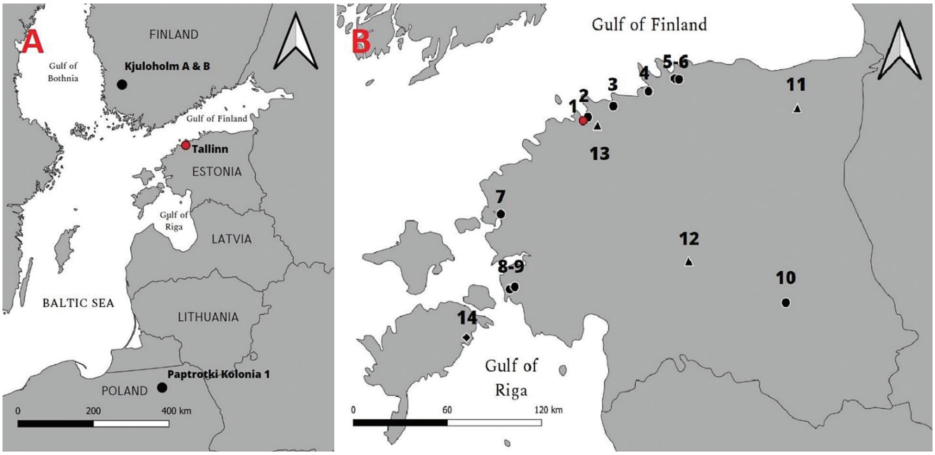

FIG. 1. Sites mentioned in the article. A – sites in Finland and Poland in relation to the Pärnu Road 41 site in Tallinn. B – sites in Estonia: ● Bronze and Pre-Roman Iron Age burials and settlement sites: 1 – Pärnu Road 41, 2 – Kuristiku, 3 – Jõelähtme, 4 – Muuksi, 5 – Tõugu; 6 – Ilumäe, 7 – Alu, 8 – Kaseküla, 9 – Kõmsi, 10 – Tamsa; ▲ Iron smelting sites: 11 – Metsküla, 12 – Olustvere, 13 – Rae; ♦ Other sites: 14 – Asva.

AMS dating, dietary stable isotope analysis (δ^{13}C and δ^{15}N) as well as strontium isotope analysis, lipid analysis of the pottery fragments associated with the burial, archaeobotanical study of the charred plant remains, and the metallography and typology of the finds. Through this, we will answer some of the many questions that have arisen with the discovery of the triple burial, such as the differences in the burial practice of the Pärnu Road 41 grave in comparison to the other known grave types of the Pre-Roman Iron Age, the provenance and diet of the individuals buried in the grave and the date, origin and purpose of the spherical metallic droplets found within the grave filling. As very few inhumation burials outside of *tarand* graves are known from the period, the multi-proxy analysis of the Pärnu Road 41 grave is vital for broadening our understanding of Pre-Roman Iron Age burial practices.

BURIAL DESCRIPTION

The Pärnu Road 41 burial is part of a site that encompasses archaeological layers from multiple prehistoric periods and contains a Stone Age settlement site as well as early Iron Age fire pits and undated ard markings. The site is situated on a coastal plain in front of the Baltic Clint at ~20 m above sea level (shore displacement chronology calculated with the program Ranta-ajoitus Eesti 0-7700BP ver. 1.2a (6.4.04) (Jussila & Kriiska 2004a; 2004b), meaning that the site was located approximately 1 km from the sea during the Pre-Roman Iron Age. The location of this Pre-Roman Iron Age site is not exceptional as there are numerous other sites dating to the Bronze and Early Iron Ages, such as settlement sites and prehistoric field remains, known from coastal plains that have formed in clint bays in northern and north-eastern Estonia (Kriiska et al. 2020b; Khrustaleva & Kriiska 2022).

FIG. 2. A – fire pit above the burial with limestone constructions at Pärnu Road 41, B – burial of the woman in situ. Photos by Keiti Randoja.

The burial was discovered under an oval-shaped fire pit (Fig. 2: A) measuring 2.6 × 1 m SW–NE and consisting mostly of flat limestones measuring from 7 × 5 cm to 40 × 30 cm, with a thickness of 3–5 cm. The limestone slabs were laid in at least three layers, with most of the stones placed horizontally, but some of them also sideways. The part of the fire pit consisting of stones reached 32 cm into the grave pit. Pieces of handmade ceramics dating typo-chronologically to the 1st millennium cal BC and a few pieces of slag were discovered in the black ashy sand between and around the stones of the fire pit. Beneath the layers of stone, dark gray ashy sand continued until a piece of jewelry, a few pot sherds, and human remains were found together with many charred grains. The burial pit was well defined, but severely damaged by later earthworks; the remaining pit measured ca 180 × 105 cm and oriented SW–NE. All three identified burials were in the same burial pit; there were no separate pit borders to be seen in the composition of the sooty sand around the bones. All burials were disturbed, fragmented, and partially preserved. The undisturbed sections of the burials were close to each other, but were not overlapping. The commingled bones from the burials were found in the upper layers as well as in the areas where the burial pit had been disrupted and the lower part of the adult skeletal remains disturbed.

The adult individual was excavated first (Burial 1). The skeleton was lying on its back directed SW–NE, with the head toward SW. Although the lower limbs were extended from the hip and the upper limbs were slightly abducted from the shoulders (Fig. 2: B), their initial position in the grave cannot be ascertained. The cranium, especially the facial part, and mandibula had severe signs of burning that can be associated with the bonfire on top of it. There were signs of heat-related activity also on the left side of the pelvic region of the skeleton – the iliac crest as well as the head of the femur showed signs of having endured high temperatures.

In addition to the adult burial, there were two juvenile burials under the fire pit. First, a few bones from Burial 2 were found close to Burial 1 (ca 10 cm SSW of the cranium). Right next to the disturbance of the burial pit, there was the only probably intact fragment of Burial 2 – five articulated fragments of vertebrae, a few cranial fragments and long bone fragments. Based on the intact vertebral fragment and the position of the cranial fragments, Burial 2 was also laid supine, but was E–W oriented. The other bones were scattered in the area around this intact vertebral fragment, also in the vicinity of the cranium of Burial 1.

Burial 3 was on top of a fieldstone boulder found within the soil on the left side of the cranium of Burial 1 (ca 15 cm W of the cranium) and consisted mainly of teeth in two layers. The teeth were no longer positioned anatomically, but there were a few exceptionally poorly preserved cranial fragments in the lower layers next to the fieldstone. The position of the skeleton cannot be established by the remains.

It is not certain how the adult and juvenile burials were associated. Burials 1 and 2 were differently oriented – the adult was SW–NE oriented, and the child E–W oriented so that their crania (= heads) were placed close to each other. The disturbances had misplaced many of the bones – most of the commingled bones were found in the vicinity of later earthworks or in the mixed soil. It also seems that during some of the earthworks the bones were noticed, and the found bones were placed close to other (in situ) bones – there were a few juvenile bones placed in the right acetabulum of Burial 1, where the burial pit had been disturbed and the femur was missing.

Methods

OSTEOLOGICAL ANALYSIS

The adult skeleton was recorded on a skeletal recording sheet – the bones present were cataloged and checked for sex and age assessment features and trauma. Conventional methods (Ubelaker 1989; Schwartz 1995; Buckberry & Chamberlain 2002; AlQahtani et al. 2010) were combined for more accurate results.

The juvenile skeletons were recorded as commingled bones as it was complicated to reliably associate bone clusters during the excavation process. Two of the clusters were defined as Burial 2, one as "most probably Burial 2", two teeth clusters as Burial 3 and three clusters were not convincingly associated with any of the burials.

AMS DATING

To date the event of the burial of the three individuals, AMS (accelerator mass spectrometer) radiocarbon dating of bone was performed at the CHRONO Centre in Queen's University Belfast. The sample included two individuals from the grave

(Burials 1 and 2), short-lived samples in the form of grain seeds (n = 3) from the grave pit, and to determine the contemporaneity of the burial and the nearby heath, charcoal was dated too (Table 1). For bone collagen extraction, the protocols from Brown et al. (1988), Bronk Ramsey et al. (2004) together with an alkali step (Brock et al. 2010) were followed. The degree of preservation of bone protein and thus the reliability of the dates was assessed as a combination of the %C, %N, atomic C:N ratio and the collagen yield (>1%) (van Klinken 1999; Bronk Ramsey et al. 2004). The obtained AMS dates were calibrated with OxCal v4.4.4 (Bronk Ramsey 2021), using the IntCal20 atmospheric calibration curve (Reimer et al. 2020) and rounded by five.

TABLE 1. Results of the radiocarbon dating

Sample ID	Sample	Lab code UBA-	Date BP	Date cal (95.4%)
Grain 4	*Hordeum vulgare*	45531	2232 ± 32	392–202 cal BC
Grain 2	*Hordeum vulgare*	45537	2290 ± 31	405–209 cal BC
Grain 5	*Hordeum vulgare*	45558	2314 ± 34	463–209 cal BC
Adult female	*Pars petrosa*	45541	2276 ± 30	400–208 cal BC
Fire pit	Charcoal	45545	2354 ± 31	540–381 cal BC
Non-adult	*Pars petrosa*	45548	2333 ± 30	513–234 cal BC

STRONTIUM ISOTOPES

Strontium isotopes, i.e., the ratio of $^{87}Sr/^{86}Sr$ in tooth enamel, were measured to estimate the place of birth of the deceased (Price et al. 2002; Bentley 2006). The principles of estimating human provenance with strontium isotopes have been more thoroughly explained by Oras et al. (2016) and more recently in the eastern Baltic context by Price et al. (2021), relying on a comparison of the local (place of death) geologically determined bioavailable strontium signal with the isotopic signals measured from tooth enamel reflecting the bioavailable strontium at the place of birth. Strontium values can also be combined with carbonate oxygen $\delta^{18}O$ measurements from the enamel, which can help to define the provenance of the deceased (cf. e.g., Lightfoot et al. 2016; Price et al. 2020).

A total of six samples were taken, four from the adult female and one from each child (Table 2). The multi-sample approach for the woman targeted different teeth that are expected to reflect any temporal changes in the geographical location during her childhood, with premolars showing the earliest (in utero) and M3 the latest childhood (late teenage years) location. The teeth were first washed in ultrapure MilliQ water in an ultrasonic bath, changing the water after each wash until it was transparent and hence no more secondary mineral components were attached to the tooth surface. Thereafter small pieces of enamel were removed using a clean saw-drill, and any darker areas as well as possible dentin remains were removed with drill bits to avoid any potential secondary contamination.

TABLE 2. Results of the $^{87}Sr/^{86}Sr$ and $\delta^{18}O$ isotopic measurements

Sample ID	Burial	Sampled tooth	Sr sample weight (mg)	O sample weight (mg)	$^{87}Sr/^{86}Sr$	$\delta^{18}O$(‰; VPDB)
Par-1a	1-female	M3 LR	8.40	6.40	0.7120	–6.58
Par-2a	1-female	1PM UL	19.20	5.90	0.7113	–8.29
Par-3a	1-female	M2 UR	8.40	6.40	0.7124	–5.75
Par-4a	3-child	M2 UR	11.10	6.50	0.7126	–6.27
Par-5a	2-child	M2 UR	10.10	7.40	0.7118	–5.09
Par-6a	1-female	M2 UR	10.50	11.20	0.7112	–6.29

Samples were analyzed at the University of North Carolina at Chapel Hill, Department of Geological Sciences, using TIMS (thermal ionization mass spectrometry). Approximately 7 mg of the crushed sample was dissolved in 3.5M HNO_3 and then strontium was purified using Eichrom Sr-Spec resin with the elution of Sr in water. Strontium was analyzed on a VG Sector 54 TIMS as a metal in dynamic multicollector mode with ^{88}Sr = 3V. Strontium isotopic ratios were corrected for mass fractionation using an exponential law correction and normalized to $^{86}Sr/^{88}Sr = 0.1194$. Replicate analyses of the NBS 987 Sr standard currently yield $^{87}Sr/^{86}Sr = 0.710250 \pm 0.000020$. The internal precision of each sample is better than the reproducibility of the standard, and thus the uncertainty of the standard is the uncertainty ascribed to each unknown.

DIETARY ISOTOPES

Stable isotope analysis is a well-established method for the investigation of ancient diets. In short, stable carbon isotopes show the dietary inclusion of C_3 or C_4 plants as well as marine, freshwater and terrestrial protein. Stable nitrogen isotopes show the inclusion of dietary protein at a trophic level. The main principles of the method involving dietary reconstruction based on the stable carbon isotope ($^{13}C/^{12}C$) and stable nitrogen isotope ($^{15}N/^{14}N$) have been thoroughly explained in multiple previous papers (e.g., Vogel & van der Merwe 1977; Schoeninger & DeNiro 1984; DeNiro 1985; Schoeninger & Moore 1992; Sealy 2001; Hedges & Reynard 2007; Grupe et al. 2009).

Bone powder samples were taken from the burials with a dental drill. With the aim of detecting possible changes in the diet of the Pärnu Road 41 woman throughout her lifetime, samples were taken from skeletal elements that have a different turnover rate, following previous similar studies (Eriksson & Lidén 2013). A sample taken from the femur shows long-term dietary signals (10–15 years), while a sample from the rib fragment shows a signal up to 5 years before the death of the woman (Hedges et al. 2007; Fahy et al. 2017). As the tissue in tooth dentin does not undergo remodeling, the samples taken from the molars show dietary signals from a person's childhood during tooth formation (around 2–4 years for the first mandibular molar, 6–8 years for the second mandibular molar and around 11–15 years for the third mandibular molar) (Eriksson & Lidén 2013).

Altogether six samples weighing between 0.0568 and 0.1417 mg were taken from the remains with a dental drill at the Laboratory of Archaeology, University of Tartu. Bone collagen was extracted from the samples following the modified Longin (Longin 1971) method (Brown et al. 1988) at the Archemy Lab, University of Tartu. The $\delta^{13}C$ and $\delta^{15}N$ values together with the %C, %N were measured with a Thermo Delta V Plus mass spectrometer coupled to Thermo HT Plus and ConFloVI at the Department of Geology, University of Tartu. The δ-values were calibrated according to international standards provided by the IAEA (International Atomic Energy Agency). The international standards used for δC were IAEA N-1 (0.43), IAEA N-2 (20.41) and USGS25 (–30.41) and for δN IAEA CH 3 (–24.72) and IAEA CH 6 (–10.449).

LIPIDS

One sherd (AI 8244: 191/3) from the vessel discovered in relation to the female burial was analyzed for lipid residues absorbed into the pot. The sample was removed from the internal surface of the sherd using a clean drill bit by first removing ca 1 mm of the upper layer of the sherd, which was discarded to avoid any direct contamination, and then drilling into the sherd to remove 0.92 g of ceramic powder. Lipids were extracted using the acid-catalyzed methylation procedure with methanol (MeOH) and sulfuric acid (H_2SO_4), followed by heating on a heating block at 70 °C for 4 h (Craig et al. 2013; Heron et al. 2015; Courel et al. 2020). After heating, the lipids were extracted with *n*-hexane (3 × 2 mL) and dried under the gentle stream of nitrogen at 37 °C. The samples were dissolved in 90 mL of *n*-hexane with the addition of 10 µg of the internal standard of C_{36} (*n*-hexatriacontane). Thereafter the qualitative and quantitative molecular analyses were performed using GC-MS (gas chromatography-mass spectrometry), GC-FID (gas chromatography-flame ionization detector) and GC-C-IRMS (gas chromatography-combustion-isotope ratio mass spectrometry) – the first at the Institute of Chemistry, University of Tartu, and the latter two at the BioArCh facility, University of York.

For estimating general preservation and the quantity of lipids, GC with a FID was used at the BioArCh facility, University of York. An Agilent 7890B Series gas chromatograph and a DB-1HT polyimide-coated fused silica column (15 m × 320 µm × 0.1 µm; J&W Scientific, Folsom, CA, USA) were used. The injected sample size was 1 µL. A splitless injector was used at 300 °C with helium carrier gas. The temperature was set at 100 °C for 2 min, with a gradient of 20 °C/min up to 325 °C, and the latter was maintained for 3 min, with a total run time of 16.25 min. Data was acquired using OpenLab CDS software.

GC-MS analysis for the detection of different lipid components was conducted at the Institute of Chemistry, University of Tartu, with an Agilent 7890A Series gas chromatograph and an Agilent 5975C Inert XL mass selective detector with a DB5-MS (5%-phenyl)-methylpolysiloxane column (30 m × 0.25 mm × 0.25 µm).

The injected sample size was 1 μL. The splitless injector and the interface were maintained at 300 °C and 280 °C, respectively, and helium 6.0 was used as the carrier gas at a constant flow. The GC column was inserted directly into the ion source of the mass spectrometer. The ionization energy was 70 eV and spectra were obtained by scanning between m/z 50 and 800 amu. The temperature program was set as follows: 50 °C for 2 min, thereafter a gradient of 10 °C/min up to 325 °C, and was maintained there for 14.5 min, with a total run time of 44.5 min. Compounds were identified with both Agilent MassHunter and Chemstation software, using also NIST14 mass spectral library.

GC-C-IRMS analysis was conducted at the BioArCh facility, University of York, using acid-extracted samples to estimate the $^{13}C/^{12}C$ ratio in two most abundant fatty acids ($C_{16:0}$ and $C_{18:0}$). The samples were analyzed with a Delta V Advantage isotope ratio mass spectrometer (Thermo Fisher Scientific, Bremen, Germany) linked to a Trace Ultra 1310 gas chromatograph (Thermo Fisher Scientific) with a GC IsoLink II interface (CuO combustion reactor maintained at 850 °C). Parallel acquisition of the molecular data was achieved by directing a small part of the flow into an ISQ mass spectrometer (Thermo Fisher Scientific). All samples were diluted with hexane and subsequently 1 μL of each sample was injected into a DB-5MS fused-silica column (PN 122-5562UI; 60 m × 250 μm × 0.25 μm; J&W Scientific). The split/splitless injector was operated in splitless mode. The temperature was set at 50 °C for 0.5 min and raised by 25 °C min^{-1} to 175 °C, then raised by 8 °C min^{-1} to 325 °C, where it was maintained for 20 min. Ultra-high purity grade helium with a flow rate of 2 mL/min was used as the carrier gas. The eluted products were combusted to CO_2 and ionized in a mass spectrometer by electron impact. The ion intensities of m/z 44, 45, and 46 were monitored in order to automatically compute the $^{13}C/^{12}C$ ratio of each peak in the extracts. Computations were made with Isodat (version 3.0; Thermo Fisher Scientific) and IonOS/LyticOS software (Isoprime, Cheadle, UK), and were based on comparisons with a repeatedly measured standard reference gas (CO_2). The results of the analysis are reported in parts per mille (‰) relative to an international standard (V-PDB) and corrected for the carbon atom added during methylation using a mass balance equation (Rieley 1994).

PLANT REMAINS

Most of the plant remains were gathered during excavation on spot. Several seeds and seed fragments were detected later among human bone finds. Only carpological finds could be identified, whereas vegetative remains of plants were not collected. Plant remains were identified with the naked eye and a Nikon DS-Fi1 stereomicroscope at 2×, 3× and 4× magnification. Identification of grains was performed with the help of the manual by Stefanie Jacomet (2006), the handbook by Cappers and Neef (2012) and the reference collection of seeds and fruits of the Archaeological Research Collection, Tallinn University. The elements used to identify the grains mostly included shape in front view, side view and section view, and the positioning of the embryo.

FINDS

Archaeological finds were analyzed by visual observation and using typo-chronological comparisons with materials gathered earlier from both Estonia and neighboring regions. Metal artifacts – a bracelet (AI 8244: 190) and a bell-pendant (AI 8244: 189) – were analyzed by a non-invasive pXRF (portative X-ray fluorescence spectrometer) to determine the presence or absence of zinc in these two objects.

METALLOGRAPHY

Metallographic analysis was carried out to identify the magnetic pieces that were abundant in the earliest layers on top of the undisturbed natural sand. The magnetic pieces were either flakes or large globular or irregular droplets. Two magnetic pieces were sampled for metallographic analysis. Both were mounted in transparent thermoplastic and ground until the largest cross- section was visible. The samples were ground with diamond suspensions and polished with a suspension of high purity alumina and colloidal silica. The samples were then photographed with an optical microscope. A full cross-section was stitched together using the Adobe Photoshop Photomerge function by means of overlapping images captured at 50× magnification.

Results

OSTEOLOGICAL ANALYSIS

Osteological analysis of the remains showed that the adult individual was a female, based on the morphological traits of the pelvis and sacrum (according to Krogman & Isçan 1986 and Schwartz 1995). The pelvis indicated that the adult individual was rather young (phase III according to Buckberry & Chamberlain 2002) and based on the attachment of epiphyses (Schaefer et al. 2009) and erupted molars (AlQahtani et al. 2010), the individual was most likely 18–25 years old. The muscle attachments were rather robust and the bottom articular surface of the T6 body showed depressions, indicating that the young woman may have endured hard physical stress or trauma (Waldron 2009, 45; Roberts & Manchester 2010, 140).

The sex of the juvenile individuals was not assessed as skeletal sexual dimorphism develops in puberty (Buikstra & Ubelaker 1994, 16) and the bones belonged to children. The age of the juvenile individuals from Burials 2 and 3 was based on tooth eruption charts (Ubelaker 1989; AlQahtani et al. 2010) as no other age diagnostic elements were properly present. The children's ages were quite similar: 3–5.5 years (3–5 years by Ubelaker 1989 / 4.5 years ± 12 months by AlQahtani et al. 2010) for Burial 2 and ca 4–6.5 years (5 years ± 16 months by Ubelaker 1989 / 5.5 years ± 12 months by AlQahtani et al. 2010) for Burial 3.

AMS DATING

The solid borders of the grave pit together with the assumption that the grave was disturbed in historic times suggests that the three individuals within the grave were

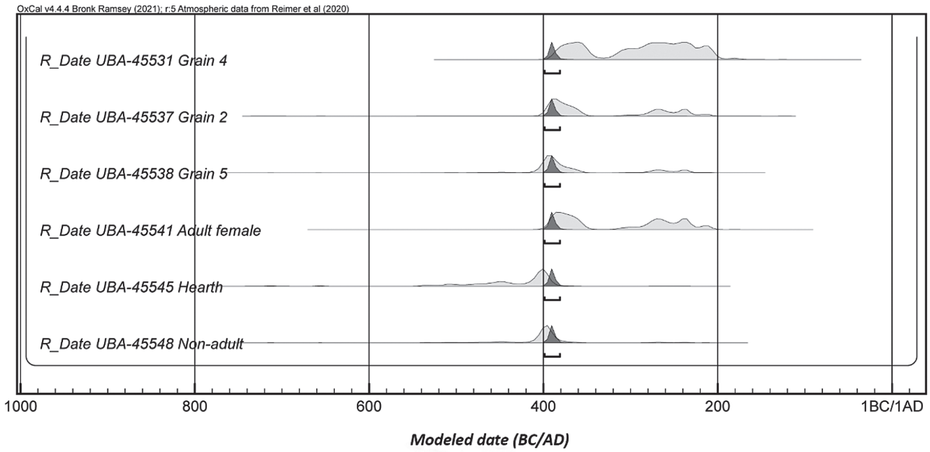

FIG. 3. Results of radiocarbon dating modeled with the function *R_Combine*.

placed simultaneously. To test the hypothesis of the burial being a single event, we performed the consistency test (*R_Combine*) in OxCal v4.4.4 between the uncalibrated dates of two of the individuals (Fig. 3). The chi-square test shows that these dates are statistically consistent (df = 1, T = 1.483, T' [5%] = 3.841), indicating that these individuals were indeed placed in the grave during a single event. With a probability of 95.4%, the burial event occurred either during i) 405–360 cal BC (92.7%), ii) 275–260 cal BC (1.7%) or iii) 245–235 cal BC (1.0%). To narrow down the date of the burial, we used the dates of the seeds found in the grave pit, assuming that these were placed in the grave during the burial. Again, the chi-square test demonstrates that all the dates (n = 5) are statistically consistent (df = 4, T = 4.467, T' [5%] = 9.488), with an overall agreement index (A_{comb}) being 121.8%. Thus, we may conclude that the burial of the three individuals took place at the beginning of the 4th century cal BC (405–360 cal BC, 95.4%).

Regarding the funerary ritual, it was crucial to find out whether the hearth found nearby and partially overlying the burial was simultaneous. The chi-square test (df = 5, T = 6.984, T' [5%] = 11.071; Fig. 3) with an overall agreement index (A_{comb}) being 101.9% indicates that the hearth is contemporaneous with the burial (Fig. 3). However, in this dataset (n = 6), the date of one grain (UBA-45531) does not meet the threshold of the agreement index (A = 36.6%, instead of >60%) and should thus be considered an outlier. Consequently, we might assume that the fire was lit above the burial shortly during or shortly after the burial event; however, without a rigid analysis of the stratigraphic relations between these two, we cannot conclude that this was the case.

SR ISOTOPES

Plotting the strontium results of the female and the two children on the currently available and previously published local N-Estonian baseline of 0.7106–0.7137 (according to Oras et al. 2016), we are most likely dealing with individuals of

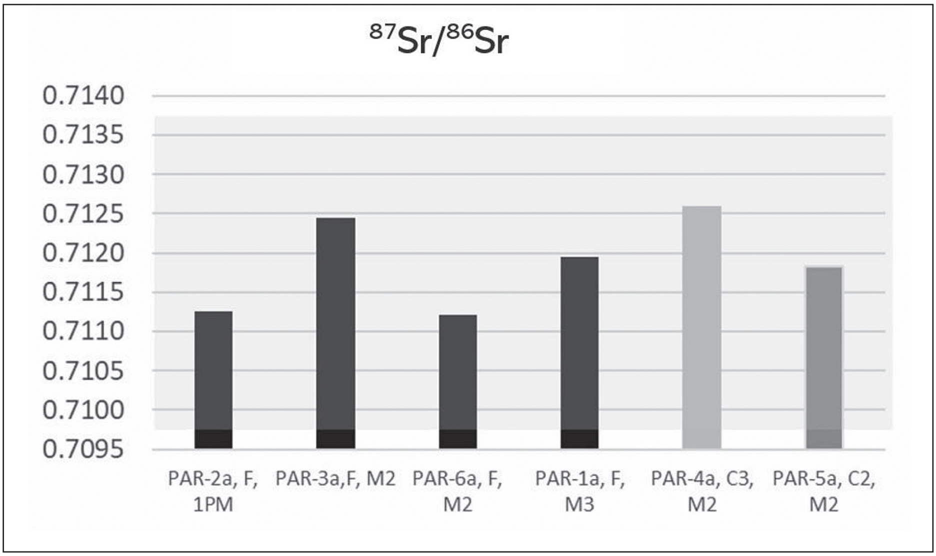

FIG. 4. $^{87}Sr/^{86}Sr$ ratios of female (F) and children (C) samples. The shaded area expresses the local baseline on the northern coast of Estonia according to Oras et al. 2016.

local origin (Fig. 4). All the four measurements for the female remain within the range of 0.7112–0.7120. Although the samples measured from different teeth vary to some extent, it is not so significant as to show any considerable biographical variation and migration during her lifetime, at least not clearly involving different geological formations. The strontium values of the two children are 0.7118 and 0.7126, respectively, coinciding by and large with the female, and hence being also of local origin. Although the oxygen isotope value of the female premolar sample has a somewhat more depleted result < –8 ‰ (Table 2), this and the rest of the $\delta^{18}O$ values remain within the local groundwater and rainfall baseline expected for (NE) Estonia (Oras et al. 2016; Price et al. 2016; 2020).

DIETARY ISOTOPES

In total, six samples were taken from Burial 1 (adult female) and Burial 2 (non-adult). No samples were taken from Burial 3 (non-adult) due to insufficient dentin. Of six samples, the sample from the non-adult molar from Burial 2 (n = 1) was lost because of equipment failure. The other five samples (n = 5), all from the adult female, produced sufficient collagen with C:N ratios between the acceptable 2.9–3.6 (DeNiro 1985; Table 3), ranging from 3.2 to 3.3. The range of carbon and nitrogen concentration in the collagen samples is 36.14–39.80 and 12.62–14.47, respectively.

The $\delta^{13}C$ values of samples from the adult female range from –21.50 to –21.15 with a mean of –21.33 (±0.12). The corresponding $\delta^{15}N$ values range from 10.20 to 10.89 with a mean of 10.52 (±0.23).

The isotope values gained from the adult female burial show that the individual's diet was likely terrestrial, with the main protein source consisting of domestic animals such as pig, sheep, goat, and cattle (Fig. 5), as demonstrated by zooarchaeological

TABLE 3. Isotope values of the Pärnu Road 41 woman

Sample ID	Sex/Age	Skeletal element	Atm % N	Atm % C	$\delta^{13}C$	$\delta^{15}N$	C:N
PM41 M1 F	Adult female	Femur	13.99	38.95	–21.38	10.36	3.3
PM41 M1 R	Adult female	Rib	14.18	39.09	–21.41	10.56	3.2
PM41 M1 M1	Adult female	1st molar	12.62	36.14	–21.50	10.89	3.3
PM41 M1 M2	Adult female	2nd molar	13.42	37.24	–21.15	10.63	3.2
PM41 M1 M3	Adult female	3rd molar	14.47	39.80	–21.22	10.20	3.2
PM41 M2 M2	Non-adult	2nd molar	–	–	–	–	–

material from that period (Lang 2007, 110–112). It is unlikely that the woman's diet included fish and other aquatic sources in a large quantity. This is also supported by the $\delta^{15}N$ values that are sufficient to show the consumption of terrestrial animals, but not sufficiently high to indicate the consumption of marine or freshwater resources (Schoeninger & DeNiro 1984; DeNiro 1985; Hedges & Reynard 2007).

The results of $\delta^{13}C$ are too narrow to indicate any major dietary changes throughout the woman's lifetime as the skeletal elements tested for childhood dietary signals (M1 and M2) as well as adult dietary signals (M3, rib and femur) are within the range of –21.5 to –21.2. This also applies to the results of $\delta^{15}N$ ranging from 10.2 to 10.9, which is less than one trophic level. The highest $\delta^{15}N$ value, however, was gained from the 1st molar, which forms around 2–4 years of age and may therefore suggest the remaining influence of breastfeeding in dentin collagen (Fuller et al. 2006; Tsutaya & Yoneda 2015).

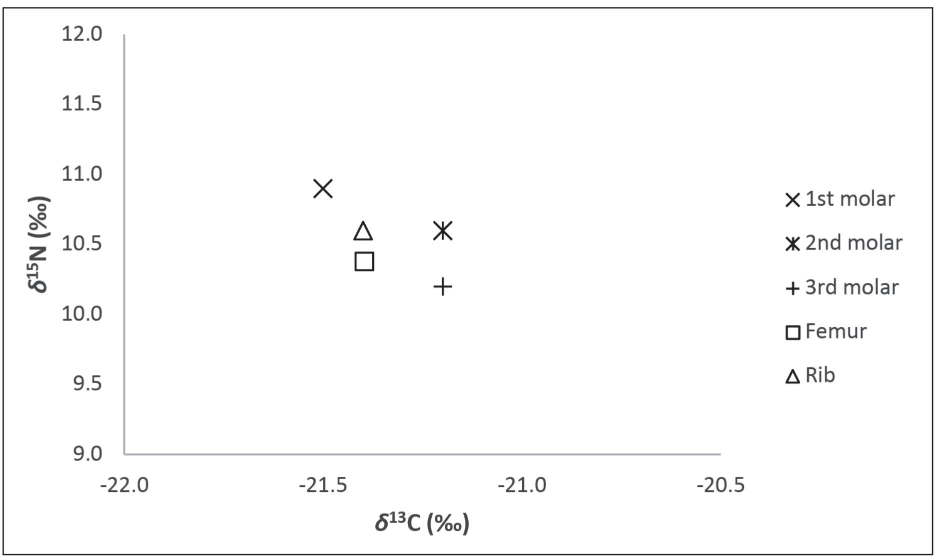

FIG. 5. Results of the plotted dietary stable isotope analysis of the Pärnu Road 41 woman.

POTTERY LIPIDS

The lipid content estimated by GC-FID showed a rather low lipid yield of 15.09 $\mu g/g^{-1}$, which is still a sufficient lipid yield for further interpretation (Evershed 2008). The major compounds detected were saturated fatty acids in the range of $C_{16:0}$ to $C_{22:0}$ (trace), whereas $C_{16:0}$ and $C_{18:0}$ fatty acids were dominating, with the former being somewhat more abundant. There were considerable inclusions of terpenous compounds, namely traces of dehydroabietic acid and phenanthrene carboxylic acid derivatives, hinting at coniferous tree resins (Colombini et al. 2005), which most likely derived from wood fuel used during cooking. A low amount of C_{18} *ω*-(*o*-alkylphenyl)alkanoic acid was detected with its isomer E/H ratio of 4.68 and may hint at potential plant inclusion, namely cereals/fruits/non-leafy vegetables (Bondetti et al. 2021). However, the lack of long chain alkanes, the higher abundance of unsaturated fatty acids and the lack of wax esters as supportive evidence for plant substances were not identified. Phytanic acid with a high SRR value of 83.7 (Lucquin et al. 2016) was detected, which might be indicative of aquatic substances. However, necessary supportive evidence for processing aquatic products was missing, i.e., a full set of aquatic biomarkers *ω*-(*o*-alkylphenyl)alkanoic acids with carbon atoms ranging from C_{16} to $C_{20/22}$, formed during the heating of polyunsaturated fatty acids of aquatic organisms, which ought to be further accompanied by isoprenoid fatty acids (phytanic, pristanic, and 4,8,12-trimethyltridecanoic (TMTD) (Hansel et al. 2004; Craig et al. 2007). Cholesterol as an indicator of adipose fats of either terrestrial or aquatic animals was not detected either. Hence, a purely biomarker-based approach was not able to determine the substances cooked in the vessel. The isotope results measured for the two most abundant fatty acids, $C_{16:0}$ and $C_{18:0}$, were –28.1 and –27.8, respectively, providing the $\Delta^{13}C$ ($C_{18:0}$-$C_{16:0}$) of 0.23, which plots the sample isotopically in the range of omnivorous (most likely porcine) terrestrial animals. Hence, on the basis of these data, we could conclude that the pot most likely contained carcass fats of terrestrial animals, probably suids or other omnivorous organisms, although a small proportion of planty substances cannot be entirely excluded.

PLANT MACROREMAINS

Cereal grains were gathered from the soil around the burials (Fig. 6: A). The grains were gathered chiefly from within the grave depression. Altogether 132 cereal grains were gathered from the site (Table 4). Among these, the majority (n = 62) belong to hulled barley (*Hordeum vulgare*). Only five grains of common wheat (*Triticum aestivum*) were gathered. One grain was tentatively identified as naked barley (*Hordeum vulgare* var. *nudum*) and one as possible emmer or spelt (*Triticum dicoccum/spelta*). Sixty-three grains were broadly categorized as belonging to Cerealia, among these 51 fragments that could not be identified more specifically. All grains were heavily burnt, some severely swollen, thus being apparently related to the fire pit associated with the burial.

TABLE 4. Cereal grains found in the burial soil

Triticum aestivum	5
Hordeum vulgare	62
cf. *Hordeum vulgare* var. *nudum*	1
cf. *Triticum dicoccum/spelta*	1
Cerealia sp.	12
Cerealia fr.	51
All	132

Three barley grains were chosen for dating from the grave depression of Burial 1. The obtained results indicate an Early Iron Age date (Table 1), which means that the dated grains are the oldest found in Estonia so far. They are also among the earliest dated grains in the whole eastern Baltic. The oldest directly dated cereal grain in the eastern Baltic is from the Lithuanian site Kvietiniai, where the barley grain yielded a date of 1392–1123 cal BC (Grikpėdis & Motuzaite Matuzevičiūtė 2020).

POTTERY

There are several chronological layers in the pottery found at the plot of Pärnu Road 41. The layers include Stone Age Corded Ware[1], Pre-Roman Iron Age Ilmandu Ware[2] and cord[3]- and comb[4]-decorated pottery, Pre-Viking (550–800 AD) and Viking Age (800–1050 AD) fine-grained[5] and coarse-grained[6] pottery, as well as various Medieval/Modern Age (from 1225 cal AD) ceramics[7].

A pot (or two similar pots), the numerous sherds of which were found in the fire pit near the burials (AI 8244: 191–193), represents the Ilmandu Ware (Fig. 6: E). It has coarse rock temper, the outer surface is completely and the inner surface partly striated; its strongly curved shoulder is decorated with two horizontally parallel impressions of twisted cord, while the rim is decorated with stick impressions. Pots with similar shape, surface finish and decoration have been reported from several northern Estonian cemeteries and settlement sites and can be dated to the (Early) Pre-Roman Iron Age (Lang 2007, 130; Laneman & Lang 2013).

1 E.g., AI 8244: 238, 243, 249, 259.

2 E.g., AI 8244: 191–193, 397, 926, 1571, 1707, 1805, 1858, 1882, 1910.

3 E.g., AI 8244: 2060.

4 E.g., AI 8244: 489, 1565, 1602, 1866.

5 E.g., AI 8244: 358, 359, 371–373, 390, 483, 486, 510, 1559, 1803, 1803, 1827, 1931, 1943, 2086.

6 E.g., AI 8244: 472, 832, 947.

7 E.g., AI 8244: 544, 846, 853, 1743, 1752.

GRAVE GOODS

Bronze bracelet with open ends (AI 8244: 190): diameter 53–67 mm, made of very thin wire (ø 2–2.5 mm in the middle part, 2 × 1 mm at the ends), which is almost round-shaped in cross-section but flattened at both ends (Fig. 6: D). No decoration is visible. The bracelet is a very simple one, without any characteristic and distinguishable features, which makes it difficult to compare with other bracelets. However, a fragment of a similarly thin and simple plausible bracelet was found in the Tõugu IIC *tarand* grave in northern Estonia dated to the Early Pre-Roman Iron Age. Due to its simplicity, the Tõugu fragment was initially considered a piece of

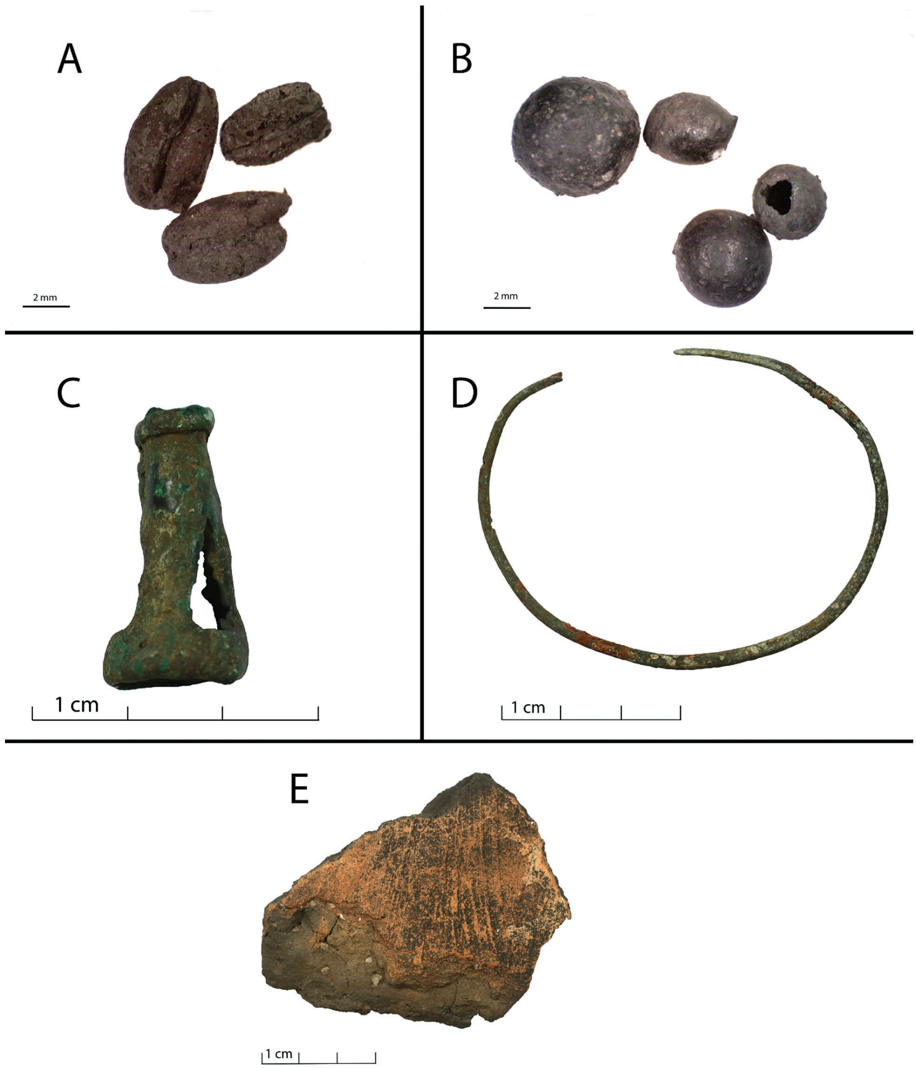

FIG. 6. Types of artifacts associated with the Pärnu Road 41 triple burial. A – burned cereal grains (*Hordeum vulgare*), B – hammer scales, C – bronze bell-pendant, D – bronze bracelet, E – Ilmandu-type ceramics sherd. Photos by Maris Niinesalu-Moon.

bronze wire; however, it can originate from a very similar bracelet as we now have from Tallinn (Lang 2000, 121, fig. 42: 3).

Bronze bell-pendant (AI 8244: 189): a blunt cone by its shape, cavernous, with three triangular openings in the walls; the hanging loop is broken. The height of the pendant is 29 mm, the lower diameter is 14–15 mm and the upper diameter 7–8 mm (Fig. 6: C). The bell-pendant is unique in Estonia but two analogous pendants – although dissimilar in the details of their shapes – have been found in south-western Finnish cemeteries of the Migration Period (Kivikoski 1973, figs 274 and 275). Bell-pendants of bronze were popular in large regions of the northern and eastern European forest (and forest-steppe) belt for long periods of time. They vary in shape and size; some types are furnished with hanging loops, some are not; some types have openings in their walls, some have not; they can be either triangular, round, or quadrangular in cross-section, etc. The oldest of them belong to the turn of the 2nd and 1st millennia cal BC (e.g., Patrušev & Halikov 1982, pls 92: 3, 99: 2, 111: 3, 135: 1; Berezanskaja & Kločko 1998, 79), while the youngest are dated from the turn of the 1st and 2nd millennia AD (e.g., Rozenfel'dt 1982, fig. 2). They were worn in groups as pendants among various head, neck and chest ornaments. By typological features it is impossible to date the Tallinn bell-pendant more exactly, nor is it possible to show any more precise area where it could have been produced.

Non-invasive pXRF analysis was carried out to determine the presence or absence of zinc in these two objects. Zinc was a significant alloying ingredient in Estonia from the 1st century AD (Roxburgh 2023, 23). The bell and the thin bracelet were made of zinc-free tin bronze. This supports a Pre-Roman Iron Age date for them.

METALLOGRAPHY

Metallographic analysis was performed on two magnetic pieces: one of them spherical (Fig. 7: A) and the other irregular (Fig. 7: B). While their shape was different, the microstructures were similar. The samples can be identified as spherical hammer scale, and both were formed in the process of forge welding of iron, during which

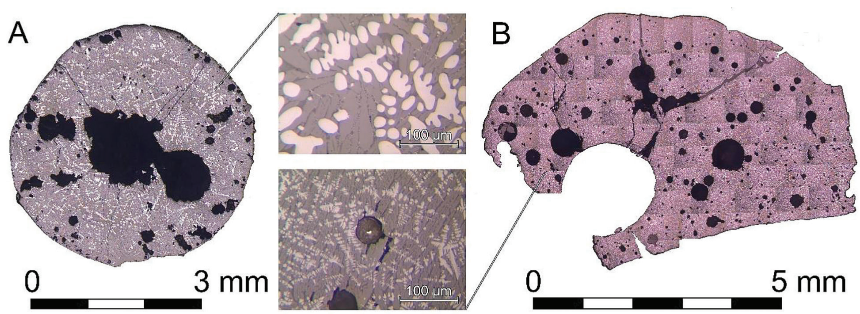

FIG. 7. Spherical (A) and irregular (B) hammer scales with corresponding microstructures. Photos by Mariann Bauvald, Sandra Sammler and Ragnar Saage.

molten slag was ejected (Dungworth & Wilkes 2009, 38). As the slag flew, it broke into separate droplets which spun into spheres (and irregular pieces) and solidified. The hollow cavities in both samples are characteristic of the formation process of spherical hammer scale described by Dungworth and Wilkes (2009) (Fig. 6: B).

The microstructure of the spherical and irregular hammer scale consisted of iron oxide dendrites in a matrix of fayalite and glass. The same microstructures were observed in the case of spherical hammer scale from the Bibracte oppidum in France from the 1st century cal BC and a 15th–16th century cal AD smithy from Colchester in England (Dungworth & Wilkes 2009, 35). This is an aspect of iron working – the tools and welding techniques leave closely comparable traces, regardless of spatial and temporal differences of smithing waste.

Discussion

BURIAL AND PROVENANCE

The triple burial at Pärnu Road 41 is unique in the archaeological material related to Early Roman Iron Age burials in Estonia. Multiple types of graves were in use during the Iron Age. The most notable of them had different types of above-ground stone structures, the construction of which started during the Middle Bronze Age (ca from 1250 cal BC). These structures include grave types such as stone-cist graves, ship graves, and numerous types of evolving *tarand* graves (Lang 2007, 147). The graves can contain both cremated and non-cremated burials often accompanied by numerous burial goods, including jewelry, weaponry, pottery, and animal bones. Other less known grave types include pit graves containing cremation burials that were placed in a hole dug in the ground, and pit graves with inhumations (Laul 2001, 28–29; Lang 2007, 217). Due to the small number of intact inhumation burials found, not much is known about them in terms of burial practices. Confirmed Pre-Roman Iron Age inhumation burials have been found at the Tamsa and Alu sites, while probable burials have also been identified by the finds of spoon-ended temple ornaments found in the ground in Saaremaa (Jaanits et al. 1982, 184; Lang 2007, 217; Kriiska et al. 2020a, 222).

The inhumation burial from Alu included the remains of at least two people found under a pile of stones removed from the field in later times. The remains were discovered in two distinguished areas. The bones were severely fragmented and disturbed to a degree that they were no longer articulated. No signs of burning or grains were detected in association with the remains (Laneman et al. 2015). The burial from Tamsa contained the remains of an unknown number of individuals. The remains of these individuals were also severely fragmented and commingled. Due to this, the initial position of the skeletons remains unknown, but it was mentioned that the bones had been in a "pile" prior to their reburial in 1936. In 1938 the reburied bones were found within a relatively small area of 2.5 × 2.5 m, with the uppermost parts of the bones recovered right under a thin section of soil. The layer of bones was 25–40 cm thick and contained finds of bronze dress pins, bracelets, and a knife.

No traces of fire or grains associated with the remains were documented (Ariste 1939, 1–3). While signs of fire have been found under almost all stone graves and have been associated with their construction (Lang 2000, 210–211), the instance of a fire pit constructed on top of an inhumation burial after the individuals had been interred is novel for that time. Only one instance of the use of fire on or in the vicinity of a grave has been documented from Pre-Roman Iron Age Estonia – in the Kõmsi I stone grave (Lõugas 1970). The use of fire was detected in the south-eastern part of the grave which also contained both calcined and barely burnt human remains within sooty soil (Lõugas 1970, 6, 11). It is probable that the fire was related to the cremation of the remains.

While no reference to the use of carbonized grains within graves have been found in Estonia outside the context of food-related pottery and grave goods, the ritual use of grains has been documented in other parts of Europe. An example that is not very distant in time and space is the Roman Period cemetery at Paprotki Kolonia site 1 in the Masurian Great Lakes district, Poland, where charred plant remains were found in dozens of grave pits and urns (Karczewski 2013, 126). Grains presumed to be part of a funerary ritual have also been found in a Hallstatt cultural complex necropolis in Croatia (Šoštarić et al. 2017) and as grave goods from Bronze to Late Iron Age graves in Sweden (Hansson & Bergström 2002, table 2). Since the grains in the Pärnu Road 41 triple burial were not contained in a vessel or in relation to the vessel fragments, being instead sprinkled around the head and chest of the female individual, it is likely that the grains from this burial also served a ritual purpose.

Next to these discovered and recorded inhumation burials, the Pärnu Road 41 burial seems quite different in terms of the skeleton being articulated and showing signs of heat damage, as well as the inclusion of carbonized grains in the grave. In this context it is uncertain whether the triple burial at Pärnu Road 41 is a form of inhumation burial regularly used within the Estonian territory during the Pre-Roman Iron Age or represents a deviant burial. Deviant burials, also known as non-normative burials, are a type of burial that does not fit into the known archaeological norm within a certain period or territory. These burials exhibiting different funerary rituals have also been associated with immigrants (Evans et al. 2006), which in the case of the Pärnu Road 41 burial could be linked to the find of a bell-pendant originating from eastern Europe. Based on the strontium analysis, the individuals buried in the Pärnu Road 41 grave displayed results compatible with the local (NE) Estonian baseline of 0.7106–0.7137, indicating that they were born and raised locally. It is important to note, however, that strontium isotope analysis is applicable only to the first-generation immigrants and not to the descendants of immigrants, e.g., the second- and third- generation immigrants. It is important to emphasize that both contacts and trade with eastern Europe, as well as migrations from there, are already known from the Stone Age and likely continued into the Pre-Roman Iron Age (e.g., Lang 2018, 193–226; Kriiska et al. 2020a, 53–55, 198–199), allowing for a possibility that the bell-pendant made its way into the Pärnu Road 41 grave either by trade or through the migration of people using them.

The Pärnu Road 41 triple burial displays the characteristics of a deviant burial within our limited knowledge of Pre-Roman Iron Age inhumation burials and the rituals associated with them. However, it is also probable that the burial represents a new type of practice during the Pre-Roman Iron Age and similar burials are yet to be discovered. This is supported by the fact that based on demographic analyses, only a small part of the population was buried in the graves with above-ground structures (Lang 2011), leading to the likelihood of the discovery of more inhumation burials in the future. Due to this, the Pärnu Road 41 triple burial retains some of its mystery until further burials are found.

DIET AND SUBSISTENCE

The subsistence strategy of the Pre-Roman Iron Age in Estonia was heavily influenced by the cultivation of multiple edible crops such as barley, wheat, and oats, as well as animal husbandry. Based on zooarchaeological analysis, domesticated animals included goats, sheep, pigs, cattle, and horses, with a notable trend towards sheep/goat rearing which persisted from the Late Bronze Age (850–500 cal BC) until the Iron Age. Some rabbit, fish and seal bones found in burial sites are also evidence of hunting and fishing (Kriiska et al. 2020a, 183–184).

The dominance of barley among the macrobotanical material from the Pärnu Road 41 grave is quite expected. Based on pollen samples and a grain imprint on a clay vessel, barley was cultivated in Estonia already at the end of the Stone Age, 3rd millennium cal BC (Lang 1996, 168–169; Poska & Saarse 2006, 176; Kriiska 2009, table 1 and references therein). Imprints of wheat and barley grains have also been found in pottery sherds from the Asva Bronze Age hill fort (Indreko 1939, 31; Lang 2007, 111), dated to around 900–500 cal BC (Lang 2007, 63). Based on the lipid analysis of the ceramic vessel, some inclusion of plant substances cannot be entirely excluded either.

However, the direct evidence of crop growing – finds of cultivated plant seeds – from the Bronze and Early Iron Ages is quite scarce throughout the eastern Baltic. The reason for this is likely the lack of systematic sampling (and the application of floatation methods during excavations) rather than the actual situation, as we know the first permanent field systems already from the Middle and Late Bronze Age (Lang 2007, 30). Cultivated plant seeds from the 1st millennium cal BC have so far been obtained from a total of seven Lithuanian sites and one Latvian site (Grikpėdis & Matuzevičiūtė 2020, table 1). In Estonia, cereal grains have been more abundantly gathered only from Pre-Viking and Viking Age hill forts. In these contexts, barley seems to dominate (Tvauri 2012, 103). In fact, it has been indicated that during the first half of the 1st millennium cal AD, barley was the most common crop all around the Baltic (Tvauri & Vanhanen 2016, 45; see also Grikpėdis & Matuzevičiūtė 2020, table 1). Wheat, mainly bread wheat, has been found solely in relatively small quantities in prehistoric sites, becoming the dominant crop only in the 2nd millennium cal AD (Tvauri & Vanhanen 2016, 46). Only one possible grain of emmer or spelt has previously been found in the Estonian prehistoric context.

It is unclear whether wheat was grown as a separate culture at that time or grew as a weed among barley (Tvauri & Vanhanen 2016, 45 and the references therein).

Reliance on terrestrial proteins, e.g., C_3-fed animals and animal products, is illustrated by the results of dietary stable isotope analysis. These animals likely included pig, both domesticated and wild species, as indicated by the lipid analysis of the pot fragment, but also other wild or domestic specimens such as cattle and goats/sheep, the bones of which have been found in multiple contemporary burial and settlement sites (Lang 2000, 106, 154–155, 163, 215–216). No direct information alluding to the consumption of either freshwater/brackish fish or marine resources, such as fish bones, could be found in the burial or from the lipid residues of the pot fragment, nor from the stable isotope results. This, however, does not negate the possibility of small-scale inclusion of freshwater/brackish fish or marine resources in the diet of this individual, as exemplified by previous zooarchaeological material such as seal and fish bones found in the Tõugu IIB *tarand* grave and the Ilumäe II settlement site (Lang 2000, 106, 182).

When comparing the results of the stable isotope analysis to other data from the Bronze Age and the Pre-Roman Iron Age, our results are comparable to those from Muuksi, Jõelähtme, Kaseküla and Kuristiku (Laneman 2012; Laneman & Lang 2013; Laneman 2021; 2022; Fig. 8). This shows that the diet of the Pärnu Road 41 woman throughout her lifetime was similar to that of late Bronze Age and Pre-Roman Iron Age individuals in western and northern Estonia. This is also

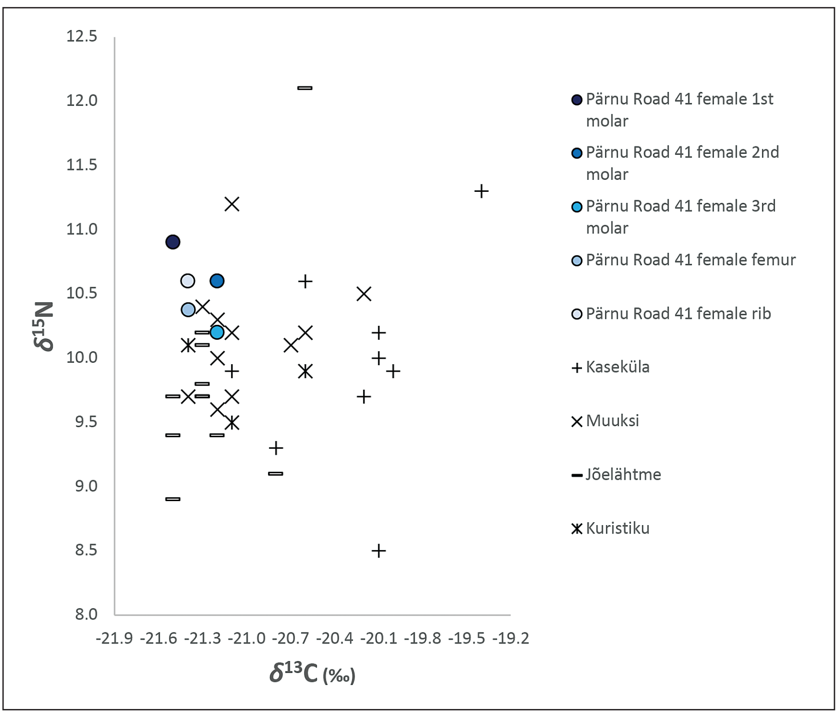

FIG. 8. Data from the Pärnu Road 41 woman in comparison to the data from other Estonian Bronze and Pre-Roman Iron Age burials.

supported by the results of strontium isotope analysis, which indicate that the woman was likely local and therefore participated in the same subsistence strategies as other locals, the most important being farming and animal husbandry, which were perhaps supported by hunting, gathering, and fishing.

METAL ARTIFACTS AND METAL PRODUCTION

The earliest iron artifacts found in Estonia have been dated to the Pre-Roman Iron Age based on their find context (Lang 1996, 47). As no direct evidence of local iron working was found until the discovery of the Pärnu Road 41 grave, it has been assumed that most of the early iron artifacts undoubtedly found their way to Estonia through trade. Some artifacts, however, show signs of local developments, which gave way to the idea that the items were likely made locally. This means that iron forging was already established in Estonia during the Early Pre-Roman Iron Age (Lang 2007, 122).

Further information on the early iron working in Estonia is from the Roman Iron Age in the form of smelting furnaces found in northern, eastern, and southern Estonian sites, e.g., Rae, Metsküla and Olustvere (Peets 2003, 51). During this period, the number of iron artifacts found in graves also increased drastically. According to the production technology of locally produced iron artifacts, the items associated with smithing, such as anvils, hammers, and tongs, were first used in Estonia during the Roman Iron Age (Kriiska et al. 2020a, 248).

Based on the slag droplets found in the grave context and the comprehensive multi-proxy analysis of the triple burial, including AMS dating, it is possible that the Pärnu Road 41 location also hosts the earliest known smithing site in Estonia. Spherical and irregular metallic droplets were found within the grave soil between the skeletal remains of the buried individuals, with some being packaged alongside the carbonized grains and some identified during a later re-examination of the skeletal material. Droplets were also collected from soil samples taken on the site using a magnet.

As the samples have been identified to be spherical hammer scales formed in the process of forge welding of iron, they are indicative of iron forging performed in the vicinity of the grave before the burial of the individuals in 405–360 cal BC. The dating of the forging evidence to the 4th century BC is groundbreaking in our understanding of the Early Iron Age in Estonia. The compiled research demonstrates that iron smelting began either in the 1st century cal BC or the 1st century AD (Peets 2003, 56). However, so far no iron working evidence has been found from earlier centuries that can be dated with certainty. Early iron objects are rare finds, and iron welding in the 4th century BC points to an advanced workshop. Hence, metalworking debris could originate from a high-status smithing operation.

The location of a metal working site may also have been related to the decision to bury the individuals in that area. Based on mythology, fire and metalworking has long been associated with ritual systems, superstition and even witchcraft (Budd & Taylor 1995; Hinton 1998; Tormey 2017). This is likely due to the process of iron working and smithing being used for the manipulation and transformation of metal, which in turn can be linked to the metaphoric transformation of body and soul from life into death. On the other hand, rituals, including iron working, can also represent the symbolism of breath and heat of life in terms of birth and rebirth (Shepherd 1997; Gansum 2004). The occurrence of other iron-working by-products, such as slag, has been noted in Iron Age cemeteries of Finland and Sweden and has been associated with funerary rituals. This has been, for instance, suspected to be the case with slag found in inhumation and cremation graves of the Kjuloholm A and B cemeteries in Finland (Shepherd 1997).

Conclusions

In this multi-proxy study of the Pärnu Road 41 triple burial in Tallinn, we analyzed the human remains of an adult woman and two children as well as the associated finds via different archaeological, osteological, and chemical methods, including AMS dating, stable isotope analysis, strontium isotope analysis and XRF analysis. As a result, we have successfully reconstructed the provenance and diet of the Pärnu Road 41 woman, uncovered a remarkable burial from a time about which little is known about inhumation burials in pit graves and discovered the earliest site of iron working in Estonia.

The results of the stable isotope analysis of strontium, carbon and nitrogen in this study indicate that the individuals buried in the Pärnu Road 41 grave were of local origin and had a diet similar to that of other individuals of Bronze and Pre-Roman Iron Ages. As the grains and charcoal associated with the ritual were dated to be contemporaneous with the burials with the consistency test (*R_Combine*) and considering the fact that the inhumed individuals were of local origin, it is possible that the funerary rituals associated with the grave could have been the norm during that period. Due to the scarcity of inhumation burials in pit graves found from the Pre-Roman Iron Age, this remains to be confirmed. It is also possible that the rituals can be linked to the immigrant status of the buried individuals, as strontium isotope analysis does not indicate differences in the second- or third-generation immigrants already born in the area. It has been noted, however, that immigrants may retain many of their customs and items after relocation. This could also explain the appearance of the bronze bell-pendant in the grave, which has been linked to eastern Europe.

Another surprising aspect of this study is the discovery of a potential earliest smithing site in Estonia, which is either contemporary or earlier than the triple burial. The existence of the smithing site was discovered through the study of spherical droplets found mixed in the soil of the burial. This find is ground-breaking in nature because the earliest traces of iron working in Estonia have previously been dated to the 1st century cal BC or the 1st century cal AD, meaning that this find has pushed the timeline back to the 4th century cal BC. In relation to the burial, it is likely that the memory of the iron working place could have influenced the decision to bury the individuals there due to the religious and mythological associations between metalworking and magical spaces.

The findings of this study have several implications for the understanding of Pre-Roman Iron Age burial practices and rituals, as the Pärnu Road 41 triple burial represents the best-preserved and most thoroughly analyzed pit grave dating to the 4th century cal BC. It also provides the springboard for future similar studies on the funerary rituals of Early Iron Age individuals, as well as for the study of early iron working in Estonia.

ACKNOWLEDGMENTS

We would like to thank Holar Sepp for running the EA-IRMS at the Department of Geology, University of Tartu, as well as Mia Lempiäinen-Avci from the University of Turku for her expert advice on plant microremain analysis. The authors would also like to thank the anonymous reviewer and Andrejs Vasks for their valuable comments.

This work was supported by the Foundation Osiliana and Arheox Ltd. (Keiti Randoja). The research was funded by the Postimees Fund grant No. POST126 (Ragnar Saage), the Estonian Research Council personal research grant (PSG492) (Ester Oras, Mari Tõrv, Kristiina Johanson), Swedish Collegium for Advanced Study Pro Futura Scientia Fellowship (Ester Oras). The project also received funding from the European Union HORIZON Coordination and Support Actions under grant agreement No. 101079396 and was supported by Innovate UK grant No. 10063975 (Mari Tõrv, Ester Oras) and Tallinn University research grant No. TF5519 (Sirje Hiie). The publication costs of this article were partially covered by the Estonian Academy of Sciences.

References

AlQahtani, S. J., Hector, M. P. & Liversidge, H. M. 2010. Brief communication: the London atlas of human tooth development and eruption. – American Journal of Physical Anthropology, 142: 3, 481–490.

Ariste, E. 1939. Kaevamisaruanne 24.–26. IX 1938. a. Manuscript at the Institute of History and Archaeology of the University of Tartu.

Bentley, R. A. 2006. Strontium isotopes from the Earth to the archaeological skeleton: a review. – Journal of Archaeological Method and Theory, 13: 3, 135–187.

Berezanskaja, S. S. & Kločko, V. I. 1998. Das Gräberfeld von Hordeevka. Mit Beiträgen von T. Goško & L. Litvinova. (Archäologie in Eurasien, 5.) Verlag Marie Leidorf GmbH, Rahden/Westf.

Bondetti, M., Scott, E., Courel, B., Lucquin, A., Shoda, S., Lundy, J., Labra-Odde, C., Drieu, L. & Craig, O. E. 2021. Investigating the formation and diagnostic value of *ω*-(*o*-alkylphenyl)alkanoic acids in ancient pottery. – Archaeometry, 63: 3, 594–608.

Brock, F., Higham, T., Ditchfield, P. & Bronk Ramsey, C. 2010. Current pretreatment methods for AMS radiocarbon dating at the Oxford Radiocarbon Accelerator Unit (Orau). – Radiocarbon, 52: 1, 103–112.

Bronk Ramsey, C. 2021. OxCal 4.4 Manual. https://c14.arch.ox.ac.uk/oxcal/OxCal.html

Bronk Ramsey, C., Higham, T., Bowles, A. & Hedges, R. 2004. Improvements to the pretreatment of bone at Oxford. – Radiocarbon, 46: 1, 155–163.

Brown, T. A., Nelson, D. E., Vogel, J. S. & Southon, J. R. 1988. Improved collagen extraction by modified Longin method. – Radiocarbon, 30: 2, 171–177.

Buckberry, J. L. & Chamberlain, A. T. 2002. Age estimation from the auricular surface of the ilium: a revised method. – American Journal of Physical Anthropology, 119: 3, 231–239.

Budd, P. & Taylor, T. 1995. The faerie smith meets the bronze industry: magic versus science in the interpretation of prehistoric metal making. – World Archaeology, 27: 1, 133–143.

Buikstra, J. E. & Ubelaker, D. 1994. Standards for data collection from human skeletal remains. (Arkansas Archeological Survey Research Series, 44.) Arkansas Archeological Survey, Fayetteville, AR.

Cappers, R. T. J. & Neef, R. 2012. Handbook of Plant Palaeoecology. (Groningen Archaeological Studies, 19.) Barkhuis, Groningen.

Colombini, M. P., Giachi, G., Modugno, F. & Ribechini, E. 2005. Direct exposure electron ionization mass spectrometry and gas chromatography/mass spectrometry techniques to study organic coatings on archaeological amphorae. – Journal of Mass Spectrometry, 40: 5, 675–687.

Courel, B., Robson, H. K., Lucquin, A., Dolbunova, E., Oras, E., Adamczak, K., Andersen, S. H., Astrup, P. M., Charniauski, M., Czekaj-Zastawny, A., Ezepenko, I., Hartz, S., Kabaciński, J., Kotula, A., Kukawka, S., Loze, I., Mazurkevich, A., Piezonka, H., Piličiauskas, G., Sørensen, S. A., Talbot, H. M., Tkachou, A., Tkachova, M., Wawrusiewicz, A., Meadows, J., Heron, C. P. & Craig, O. E. 2020. Organic residue analysis shows sub-regional patterns in the use of pottery by Northern European hunter-gatherers. – Royal Society Open Science, 7: 4, 192016.

Craig, O. E., Forster, M., Andersen, S. H., Koch, E., Crombé, P., Milner, N. J., Stern, B., Bailey, G. N. & Heron, C. P. 2007. Molecular and isotopic demonstration of the processing of aquatic products in Northern European prehistoric pottery. – Archaeometry, 49: 1, 135–152.

Craig, O. E., Saul, H., Lucquin, A., Nishida, Y., Taché, K., Clarke, L., Thompson, A., Altoft, D. T., Uchiyama, J., Ajimoto, M., Gibbs, K., Isaksson, S., Heron, C. P. & Jordan, P. 2013. Earliest evidence for the use of pottery. – Nature, 496: 7445, 351–354.

DeNiro, M. J. 1985. Postmortem preservation and alteration of *in vivo* bone collagen isotope ratios in relation to palaeodietary reconstruction. – Nature, 317, 806–809.

Dungworth, D. & Wilkes, R. 2009. Understanding hammerscale: the use of high-speed film and electron microscopy. – Historical Metallurgy, 43: 1, 33–46.

Eriksson, G. & Lidén, K. 2013. Dietary life histories in Stone Age Northern Europe. – Journal of Anthropological Archaeology, 32: 3, 288–302.

Evans, J., Stoodley, N. & Chenery, C. 2006. A strontium and oxygen isotope assessment of a possible fourth century immigrant population in a Hampshire cemetery, southern England. – Journal of Archaeological Science, 33: 2, 265–272.

Evershed, R. P. 2008. Experimental approaches to the interpretation of absorbed organic residues in archaeological ceramics. – World Archaeology, 40: 1, 26–47.

Fahy, G. E., Deter, C., Pitfield, R., Miszkiewicz, J. J. & Mahoney, P. 2017. Bone deep: variation in stable isotope ratios and histomorphometric measurements of bone remodelling within adult humans. – Journal of Archaeological Science, 87, 10–16.

Fuller, B. T., Fuller, J. L., Harris, D. A. & Hedges, R. E. M. 2006. Detection of breastfeeding and weaning in modern human infants with carbon and nitrogen stable isotope ratios. – American Journal of Physical Anthropology, 129: 2, 279–293.

Gansum, T. 2004. Role the bones – from iron to steel. – Norwegian Archaeological Review, 37: 1, 41–57.

Grikpėdis, M. & Matuzevičiūtė, G. M. 2020. From barley to buckwheat: plants cultivated in the Eastern Baltic region until the 13th–14th century AD. – Archaeobotanical Studies of Past Plant Cultivation in Northern Europe. Advances in Archaeobotany. Eds S. Vanhanen & P. Lagerås. Barkhuis, Eelde, 155–170.

Grupe, G., Heinrich, D. & Peters, J. 2009. A brackish water aquatic foodweb: trophic levels and salinity gradients in the Schlei fjord, Northern Germany, in Viking and medieval times. – Journal of Archaeological Science, 36: 10, 2125–2144.

Hansel, F. A., Copley, M. S., Madureira, L. A. & Evershed, R. P. 2004. Thermally produced ω-(*o*-alkylphenyl)alkanoic acids provide evidence for the processing of marine products in archaeological pottery vessels. – Tetrahedron Letters, 45: 14, 2999–3002.

Hansson, A. M. & Bergström, L. 2002. Archaeobotany in prehistoric graves – concepts and methods. – Journal of Nordic Archaeological Science, 13, 43–58.

Hedges, R. E. M. & Reynard, L. M. 2007. Nitrogen isotopes and the trophic level of humans in archaeology. – Journal of Archaeological Science, 34: 8, 1240–1251.

Hedges, R. E. M., Clement, J. G., Thomas, C. D. L. & O'Connell, T. C. 2007. Collagen turnover in the adult femoral mid-shaft: modeled from anthropogenic radiocarbon tracer measurements. – American Journal of Physical Anthropology, 133: 2, 808–816.

Heron, C., Craig, O. E., Luquin, A., Steele, V. J., Thompson, A. & Piličiauskas, G. 2015. Cooking fish and drinking milk? Patterns in pottery use in the southeastern Baltic, 3300–2400 cal BC. – Journal of Archaeological Science, 63, 33–43.

Hinton, D. A. 1998. Anglo-Saxon smiths and myths. – Bulletin of the John Rylands Library, 80: 1, 3–22.

Indreko, R. 1939. Asva linnus-asula. – Muistse Eesti linnused. 1936.–1938. a. uurimiste tulemused. Ed. H. Moora. Õpetatud Eesti Selts, Tartu.

Jaanits, L., Laul, S., Lõugas, V. & Tõnisson, E. 1982. Eesti esiajalugu. Eesti Raamat, Tallinn.

Jacomet, S. 2006. Identification of Cereal Remains from Archaeological Sites. Basel University, Basel.

Jussila, T. & Kriiska, A. 2004a. Ranta-ajoitus Eesti 0-7700BP ver. 1.2a (6.4.04).

Jussila, T. & Kriiska, A. 2004b. Shore displacement chronology of the Estonian Stone Age. – Estonian Journal of Archaeology, 8: 1, 3–32.

Karczewski, M. 2013. On the road to the Other World. Plants in the burial rites of Bogaczewo culture (Roman Period, northeast Poland). – Archaeologia Baltica, 18, 126–146.

Khrustaleva, I. & Kriiska, A. 2022. Jägala Jõesuu V Stone Age settlement site in northern Estonia: spatial and contextual analysis of finds. – Estonian Journal of Archaeology, 26: 2, 81–124.

Kivikoski, E. 1973. Die Eisenzeit Finnlands. Bildwerk und Text. Neuausgabe. Finnische Altertumsgesellschaft, Helsinki.

Klinken, G. J. van. 1999. Bone collagen quality indicators for palaeodietary and radiocarbon measurements. – Journal of Archaeological Science, 26: 6, 687–695.

Kriiska, A. 2009. The beginning of farming in the eastern Baltic area. – The East European Plain on the Eve of Agriculture. Eds P. M. Dolukhanov, G. R. Sarson & A. M. Shukurov. (British Archaeological Reports. International Series, 1964.) Archaeopress, Oxford, 159–179.

Kriiska, A., Lang, V., Mäesalu, A., Tvauri, A. & Valk, H. 2020a. Eesti esiaeg. (Eesti ajalugu, I.) Tartu Ülikooli Ajaloo- ja Arheoloogia Instituut, Tartu.

Kriiska, A., Khrustaleva, I. & Nordqvist, K. 2020b. The Iron Age habitation phase of the Vasa settlement site in north-eastern Estonia. – Archaeological Fieldwork in Estonia 2019, 45–50.

Krogman, W. M. & Isçan, M. Y. 1986. The Human Skeleton in Forensic Medicine. 2nd ed. Charles C Thomas Publisher, Springfield.

Laneman, M. 2012. Stone-cist grave at Kaseküla, western Estonia, in the light of AMS dates of the human bones. – Estonian Journal of Archaeology, 16: 2, 91–117.

Laneman, M. 2021. The date of the stone-cist cemetery at Jõelähtme reconsidered. – Estonian Journal of Archaeology, 25: 1, 55–89.

Laneman, M. 2022. The age of the stone-cist graves at the lower reaches of the Pirita River reconsidered: analysis of the radiocarbon data. – Estonian Journal of Archaeology, 26: 1, 27–55.

Laneman, M. & Lang, V. 2013. New radiocarbon dates for two stone-cist graves at Muuksi, northern Estonia. – Estonian Journal of Archaeology, 17: 2, 89–122.

Laneman, M., Lang, V. & Saage, R. 2015. Aruanne põllukivihunniku ja matmispaiga arheoloogilisest kaevamisest Raplamaal Alu lähistel 2015. a suvel. Lisa 1. Manuscript at the Institute of History and Archaeology of the University of Tartu.

Lang, V. 1996. Muistne Rävala: muistised, kronoloogia ja maaviljelusliku asustuse kujunemine Loode-Eestis, eriti Pirita jõe alamjooksu piirkonnas. (Muinasaja teadus, 4.) Teaduste Akadeemia kirjastus, Tallinn.

Lang, V. 2000. Keskusest ääremaaks: viljelusmajandusliku asustuse kujunemine ja areng Vihasoo-Palmse piirkonnas Virumaal. (Muinasaja teadus, 7.) Teaduste Akadeemia Kirjastus, Tallinn.

Lang, V. 2007. The Bronze and Early Iron Ages in Estonia. (Estonian Archaeology, 3.) University of Tartu Press, Tartu.

Lang, V. 2011. Traceless death. Missing burials in Bronze and Iron Age Estonia. – Estonian Journal of Archaeology, 15: 2, 109–129.

Lang, V. 2018. Läänemeresoome tulemised. (Muinasaja teadus, 28.) Tartu Ülikooli Kirjastus, Tartu.

Laul, S. 2001. Rauaaja kultuuri kujunemine Eesti kaguosas. (Muinasaja teadus, 9.) Tallinn.

Lightfoot, E., Naum, M., Kadakas, V. & Russow, E. 2016. The influence of social status and ethnicity on diet in mediaeval Tallinn as seen through stable isotope analysis. – Estonian Journal of Archaeology, 20: 1, 81–107.

Longin, R. 1971. New method of collagen extraction for radiocarbon dating. – Nature, 230: 5291, 241–42.

Lõugas, V. 1970. Kõmsi I tarandkalme kaevamiskirjeldus. Manuscript at the Institute of History and Archaeology of the University of Tartu.

Lucquin, A., Colonese, A. C., Farrell, T. F. G. & Craig, O. E. 2016. Utilising phytanic acid diastereomers for the characterisation of archaeological lipid residues in pottery samples. – Tetrahedron Letters, 57: 6, 703–707.

Oras, E., Lang, V., Rannamäe, E., Varul, L., Konsa, M., Limbo-Simovart, J., Vedru, G., Laneman, M., Malve, M. & Price, T. D. 2016. Tracing prehistoric migration: isotope analysis of Bronze and Pre-Roman Iron Age coastal burials in Estonia. – Estonian Journal of Archaeology, 20: 1, 3–32.

Patrušev, V. S. & Halikov, A. H. 1982 = **Патрушев В. С. & Халиков А. Х.** Волжские ананьинцы (Старший Ахмыловский могильник). Наука, Москва.

Peets, J. 2003. The Power of Iron: Iron Production and Blacksmithy in Estonia and Neighbouring Areas in Prehistoric Period and the Middle Ages. (Muinasaja teadus, 12.) Teaduste Akadeemia Kirjastus, Tallinn.

Poska, A. & Saarse, L. 2006. New evidence of possible crop introduction to north-eastern Europe during the Stone Age. Cerealia pollen finds in connection with the Akali Neolithic settlement, East Estonia. – Vegetation History and Archaeobotany, 15: 3, 169–179.

Price, T. D., Burton, J. H. & Bentley, R. A. 2002. The characterization of biologically available strontium isotope ratios for the study of prehistoric migration. – Archaeometry, 44: 1, 117–135.

Price, T. D., Peets, J., Allmäe, R., Maldre, L. & Oras, E. 2016. Isotopic provenancing of the Salme ship burials in Pre-Viking Age Estonia. – Antiquity, 90: 352, 1022–1037.

Price, T. D., Peets, J., Allmäe, R., Maldre, L. & Price, N. 2020. Human remains, context, and place of origin for the Salme, Estonia, boat burials. – Journal of Anthropological Archaeology, 58, 101149.

Price, T. D., Bläuer, A., Oras, E. & Ruohonen, J. 2021. Baseline $^{87}Sr/^{86}Sr$ values in southern Finland and isotopic proveniencing of the cemetery at Ravattula Ristimäki. – Fennoscandia Archaeologica, XXXVIII, 135–152.

Reimer, P. J., Austin, W. E. N., Bard, E., Bayliss, A., Blackwell, P. G., Bronk Ramsey, C., Butzin, M., Cheng, H., Edwards, R. L., Friedrich, M., Grootes, P. M., Guilderson, T. P., Hajdas, I., Heaton, T. J., Hogg, A. G., Hughen, K. A., Kromer, B., Manning, S. W., Muscheler, R., Palmer, J. G., Pearson, C., van der Plicht, J., Reimer, R. W., Richards, D. A., Scott, E. M., Southon, J. R., Turney, C. S. M., Wacker, L., Adolphi, F., Büntgen, U., Capano, M., Fahrni, S. M., Fogtmann-Schulz, A., Friedrich, R., Köhler, P., Kudsk, S., Miyake, F., Olsen, J., Reinig, F., Sakamoto, M., Sookdeo, A. & Talamo, S. 2020. The IntCal20 Northern Hemisphere radiocarbon age calibration curve (0–55 cal kBP). – Radiocarbon, 62: 4, 725–757.

Rieley, G. 1994. Derivatization of organic compounds prior to gas chromatographic-combustion-isotope ratio mass spectrometric analysis: identification of isotope fractionation processes. – Analyst, 119: 5, 915–919.

Roberts, C. A. & Manchester, K. 2010. The Archaeology of Disease. History Press, Stroud.

Roxburgh, M. A. 2023. A 'Roman Brass' Age: a transformation in copper-alloy composition in Estonia and northern Latvia during the Roman Iron Age, identified by pXRF. – Estonian Journal of Archaeology, 27: 1, 3–29.

Rozenfel'dt, I. G. 1982 = **Розенфельдт И. Г.** Древности западной части Волго-Окского междуречья в VI–IX вв. Наука, Москва.

Schaefer, M., Black, S. M., Schaefer, M. C. & Scheuer, L. 2009. Juvenile Osteology. Academic Press, London.

Schoeninger, M. J. & DeNiro, M. J. 1984. Nitrogen and carbon isotopic composition of bone collagen from marine and terrestrial animals. – Geochimica et Cosmochimica Acta, 48: 4, 625–639.

Schoeninger, M. J. & Moore, K. M. 1992. Bone stable isotope studies in archaeology. – Journal of World Prehistory, 6: 2, 247–296.

Schwartz, J. H. 1995. Skeleton Keys: An Introduction to Human Skeletal Morphology, Development, and Analysis. Oxford University Press, New York.

Sealy, J. C. 2001. Body tissue chemistry and palaeodiet. – Handbook of Archaeological Sciences. Eds D. R. Brothwell & A. M. Pollard. John Wiley & Sons, 269–279.

Shepherd, D. J. 1997. The ritual significance of slag in Finnish Iron Age burials. – Fennoscandia Archaeologica, 14, 13–22.

Šoštarić, R., Potrebica, H., Hršak, J. & Essert, S. 2017. Archaeobotanical components of grave goods in prehistoric tumuli 6 and 7 at the archaeological site of Kaptol-Gradci, near Požega (Croatia). – Acta Botanica Croatica, 76: 2, 183–190.

Tormey, W. 2017. Magical (and maligned) metalworkers: understanding representations of early and high medieval blacksmiths. – Magic and Magicians in the Middle Ages and the Early Modern Time. Eds A. Classen & M. Sandidge. De Gruyter, Berlin, Boston, 109–148.

Tsutaya, T. & Yoneda, M. 2015. Reconstruction of breastfeeding and weaning practices using stable isotope and trace element analyses: a review. – American Journal of Physical Anthropology, 156: S59, 2–21.

Tvauri, A. 2012. The Migration Period, Pre-Viking Age, and Viking Age in Estonia. University of Tartu Press, Tartu.

Tvauri, A. & Vanhanen, S. 2016. The find of Pre-Viking age charred grains from fort-settlement in Tartu. – Estonian Journal of Archaeology, 21: 1, 33–53.

Ubelaker, D. H. 1989. Human Skeletal Remains: Excavation, Analysis, Interpretation. Taraxacum, Washington, DC.

Vogel, J. C. & Merwe, N. J. van der. 1977. Isotopic evidence for early maize cultivation in New York State. – American Antiquity, 42: 2, 238–242.

Waldron, T. 2009. Paleopathology. Cambridge University Press, Cambridge.

Eelrooma rauaaegsed laibamatused: Tallinnast leitud hauakompleksi analüüs

Maris Niinesalu-Moon, Keiti Randoja, Anu Lillak, Ester Oras, Mari Tõrv, Kristiina Johanson, Ragnar Saage, Alexandre Lucquin, Sirje Hiie, Aivar Kriiska ja Valter Lang

RESÜMEE

Artiklis käsitletakse 2019. aastal päästekaevamiste käigus Tallinnast Pärnu mnt. 41 avastatud kolmikmatust. Ovaalse paekividega tuleaseme all paiknenud täiskasvanud naise ja kahe väikelapse matus dateeriti haualeidude põhjal eelrooma rauaaega. Selle ajastu kontekstis on maahaud Eestis haruldane. Eelrooma rauaajast tuntakse valdavalt kivikonstruktsioonidega kalmeid. Varasesse rauaaega on seni dateeritud vaid kaks maahaudadega matmispaika (Tamsa ja Alu leiud) ning sarnast kalmevormi on oletatud ka mõne lusikotstega oimuehte leiukoha puhul Saaremaal. Pärnu mnt. 41 matuse teevad eriliseks ka hauaga seotud tulease ja karboniseerunud viljaterad, milliseid Eestist pole matustega seoses seni leitud.

Kolmikmatuse põhjalikumaks uurimiseks tehti inimluude osteoloogilised määrangud ning süsiniku, lämmastiku ja strontsiumi isotoopanalüüsid, määrati hauast leitud taimejäänused, selgitati vasted esemeleidudele, dateeriti AMS meetodil erinevaid orgaanilisi materjale, tehti savinõukildude lipiidide ning tagiliblede (sepistamisel eralduva sulametalli jahtumisel tekkivate tootmisjääkide) metallograafiline analüüs.

AMS-dateeringud osutavad, et nii matused kui nende kohal paiknenud tulease pärinevad vahemikust u 405–360 aastat eKr ning on arvatavasti rajatud ühe sündmuse käigus. Sarnase vanusega on ka naise pea ja õlgade juurest leitud viljaterad, mis kinnitab, et need olid osa matuserituaalist. Haua lähedalt väljakaevatud teisest tuleasemest leitud savinõukillud pärinevad ühest või kahest (varasest) eelrooma rauaaegsest Ilmandu-tüüpi savinõust, millele on vasteid mitmetest Põhja-Eesti kalmetest. Matustega seonduvad ka kaks pronkseset – lihtne avatud otstega käevõru ja kellukesekujuline ripats. Käevõrule on lähim paralleel leitud Põhja-Eestist Tõugu II tarandkalmest ja tüpokronoloogiliselt saab selle samuti dateerida varasesse eelrooma rauaaega. Kellukesekujulisi ripatseid ei ole seni Eestist leitud. Sääraseid kasutati ulatuslikel aladel Ida- ja Põhja-Euroopa metsavööndis ja lähimad leiud on teada Soome rooma rauaaegsetest kalmetest. Portatiivne röntgen-fluorestsents-spektromeetria (pXRF) osutab, et ehted on tehtud tsingivabast tinapronksist, mis toetab nende eelrooma rauaaegse vanuse määrangut. Pärnu mnt. 41 hauda maetud inimeste

hammaste strontsiumi isotoopväärtused näitavad, et nii naine kui ka lapsed olid suure tõenäosusega kohalikud, kes ei ole oma eluajal teinud suuremaid rändeid. Stabiilse süsiniku ja lämmastiku isotoopide väärtuste, arheobotaaniliste määrangute ning savinõukildude kõrbekihtide lipiidanalüüsi tulemused osutavad, et naine toitus peaasjalikult teraviljadest (hauast leitud viljaterade alusel odrast ja nisust), mis ei erine teistest Eestis pronksi- ja eelrooma rauaajal elanud inimestest. Samuti ei muutunud tema toitumine elu jooksul oluliselt.

Tagiliblede leiud haua täitekihist osutavad, et haua rajamise ajal või enne seda paiknes läheduses sepikoda. See on seni vanim teadaolev rauasepistuse koht Eestis, mis korrigeerib rauatöö alguse siin kolme sajandi võrra varasemaks kui oli teada seniste leidude alusel.