Data S1

Combined archaeological, anthropological and genetic data: sites and burials

Related to STAR METHODS

Albertirsa Site 22 (Pest County, Hungary)

Albertirsa Site 22 is located northeast of the settlement, north of highway 4, on a hill west-east oriented. In 2016 and 2017, rescue excavations were carried out by the team of the Ferenczy Museum Center, led by Katalin Ottományi, Róbert Patay, Katalin Kovács and Tibor Ákos Rácz. The excavated part of the cemetery consists of a total of 76 Avar-period graves. The anthropological analysis of human bones was performed by Antónia Marcsik and Tamás Hajdu, the archaeozoological analysis by Éva Ágnes Nyerges. The cemetery has been processed archaeologically by Mónika Jászberényi in her MA thesis in 2021 (Supervisor: Tivadar Vida, Eötvös Loránd University, Budapest).
The cemetery was in use from the early Avar period until the late Avar period, in the 7th-8th centuries. Patches of burials in the soil appeared immediately after the humus layer was removed. In several cases, contemporaneous ’robber shafts’ could also be observed. Most of the graves were disturbed, only a third of them remained intact. In the excavated area, the cemetery stretches from west, southwest to east, northeast, and the burials are oriented from northwest to southeast.
The early burials were located on the western side, on the hillside, here the graves were shallower, and, with one or two exceptions, they were all disturbed. As grave goods, a few animal bones, mainly iron and bronze objects – buckles and belt fittings – lay in the graves. Heading east, the burials were getting later, in this part the grave pits were deeper (in some cases more than 2 m deep), with the exception of children's graves. This part of the cemetery dates back to the middle and late Avar period. Earrings, various iron artefacts (knives, buckles), animal bones and hand-shaped, small vessels placed mostly next to the legs represented the most common grave goods here.

- **I18742 - Feature 77/Str. 80**

Grave of a 25-34 years old individual. Rectangular grave pit, skeleton lying on its back in extended position, the western part of the grave was disturbed. Grave goods: 1. Iron knife fragment; 2. three small bronze debris; two bronze hair clamps and three iron fragments; From the grave filling: two fragments of a bronze mount and one iron fragment.
Chronology: 2nd half of the 7th century. (The grave was located in the earlier part of the cemetery.).
The genomic profile of this middle Avar period DTI individual matches the other elite related individuals from the early Avar period in the DTI harboring 90-98% of Eastern Steppe ancestry source AR_Xianbei_P_2c (Fig i).

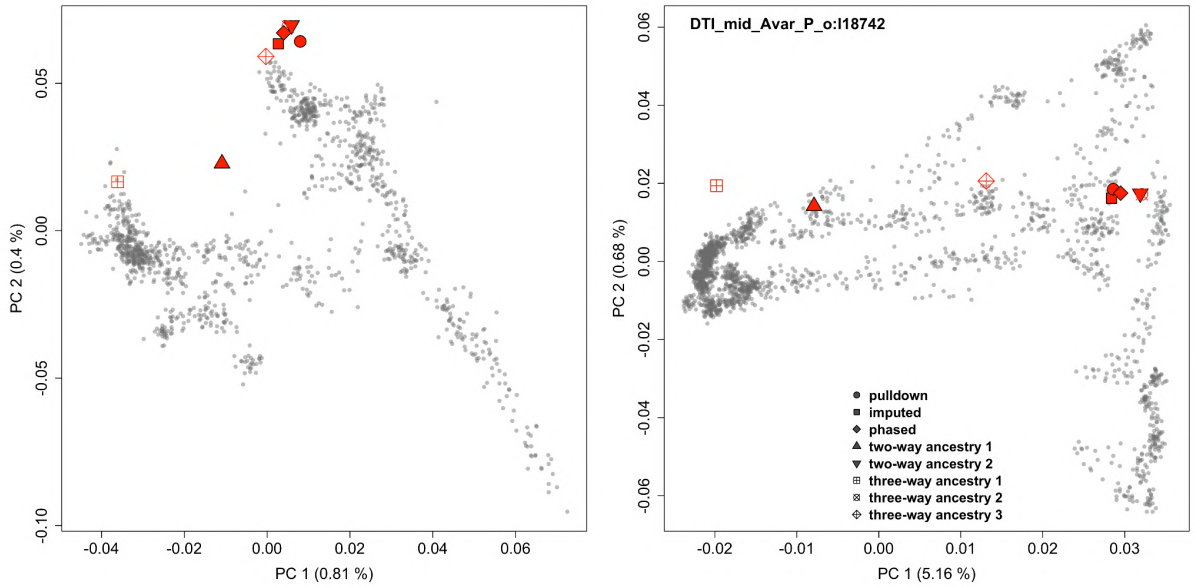

Figure i. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **I18743 - Feature 45/Str. 47**

Grave of a female (23-27 years old). Rectangular grave pit, skeleton lying on its back in extended position, the western part of the grave was disturbed. Grave goods: 1. 27 beads, 4 iron fragments, and one bead corroded with iron at the top right of the chest; 2. an iron buckle on the right hip-bone; 3. a spindle ring on the outside of the left hip-bone; 4. fragments of an iron knife beside the spindle; 5. front and back plates of a small bone box under the right forearm and pelvis (Ungulata, maior, ribs); 6. a fragment of a bronze earring between the two femurs; 8. bone plates of a bow between the two femurs; 7. animal bones next to the pelvis, between the two lower legs and between the two femurs (One Bos taurus os sacrum, two Bos taurus vertebrae caudalis, one Ungulata (maior)/Bos taurus costa and two vertebrae caudalis).
Chronology: 2nd quarter or middle of the 7th century. (The grave was located in the earlier part of the cemetery.). The genomic profile of this individual matches the other elite related individuals from the early Avar period in the DTI region harboring 90-98% of Eastern Steppe ancestry source although AR_Xianbei_P_2c failed as source for this individual (Fig Sii).

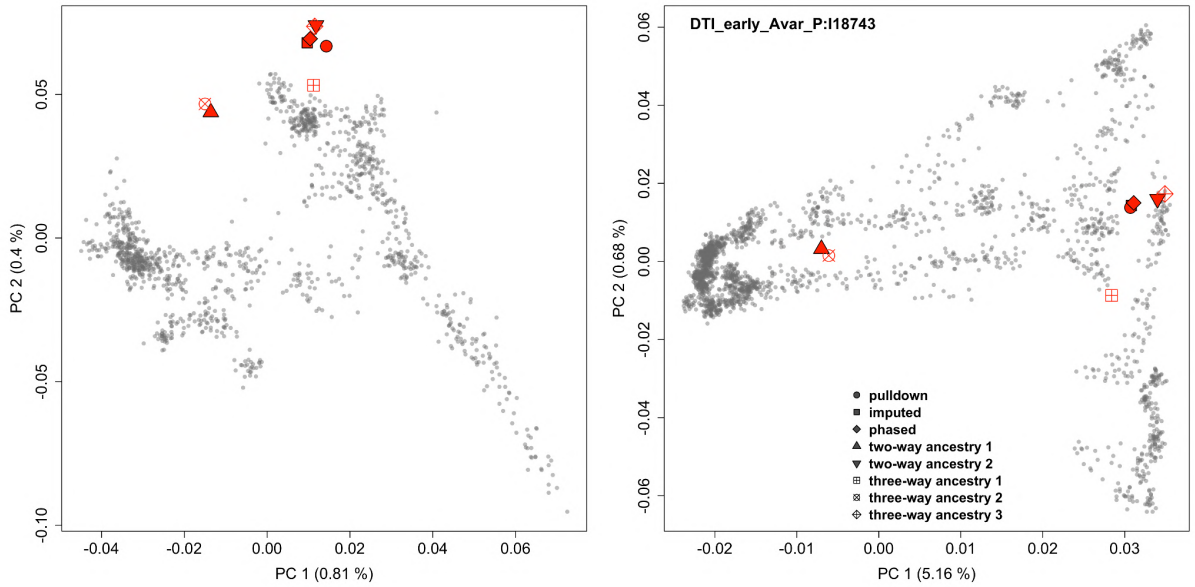

Figure ii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

Albertirsa, Szentmártoni út (Pest County, Hungary)

The site is located north of Albertirsa, southwest of the junction of highway 4 and Tápiószentmártoni street, on the western edge of the Cegléd hills. In 2017, rescue excavations were carried out by the team of the Ferenczy Museum Center, led by Tibor Ákos Rácz. The anthropological analysis of human bones was performed by Antónia Marcsik and Tamás Hajdu.

113 archaeological features of an Avar-period settlement and a cemetery have been discovered. The cemetery area was only partially affected by the investment. 22 northwest-southeast oriented burials were excavated, with a total of 26 individuals. Half of the burials were male graves, the rest were women and children.

The depth of the graves (after removing the humus layer) was usually 60-100cm. Some graves were dug shallower than this, typically children's graves or those without grave goods. However, disturbance was registered in only 8-9 cases. Several graves were dug exceptionally deep (even deeper than 2 m from the contemporaneous surface). Traces of coffins and other grave structures (imprints of planks or mostly post holes) were relatively well preserved.

There were only three graves with no grave goods in the cemetery, all three children, two of them were disturbed. The undisturbed graves reveal relative wealth. Usually more than 15 different grave goods or clothing items have been found in each case. Knives and, in female graves, spindle whorls were the most common grave goods. Bronze belt sets were also observed in several cases and gold earrings were found in two burials. The number of weapon burials were relatively high: in four graves the remains of a composite bow, in one grave the remains of a short sword, elsewhere quivers, arrows and a sabre have also been unearthed with the remains of a wooden scabbard. Ceramic pots and sheep or poultry bones were found in almost every case, generally next to the legs of the deceased, and, in addition, in children's graves eggs were very common.

- **I18744 - Feature 141/Str. 231**

Grave of a child (11-12 years old). Rectangular burial pit. At both ends of the pit a wall-to-wall trench-like digging. Undisturbed skeleton lying on its back in an extended position. Grave goods: 1. fragments of an iron object between the left arm and the pelvis; ceramic fragments from the grave filling.
Chronology: late 7th century – first half of the 8th century. The genomic profile of this middle Avar period DTI individual is outlier respect to the other Avar period DTI individuals from same site, region and period harboring only ~50% of the Eastern Steppe ancestry source matching AR_Xianbei_P_2c and ~50% matching the local Carpathian Basin groups (Fig Siii).

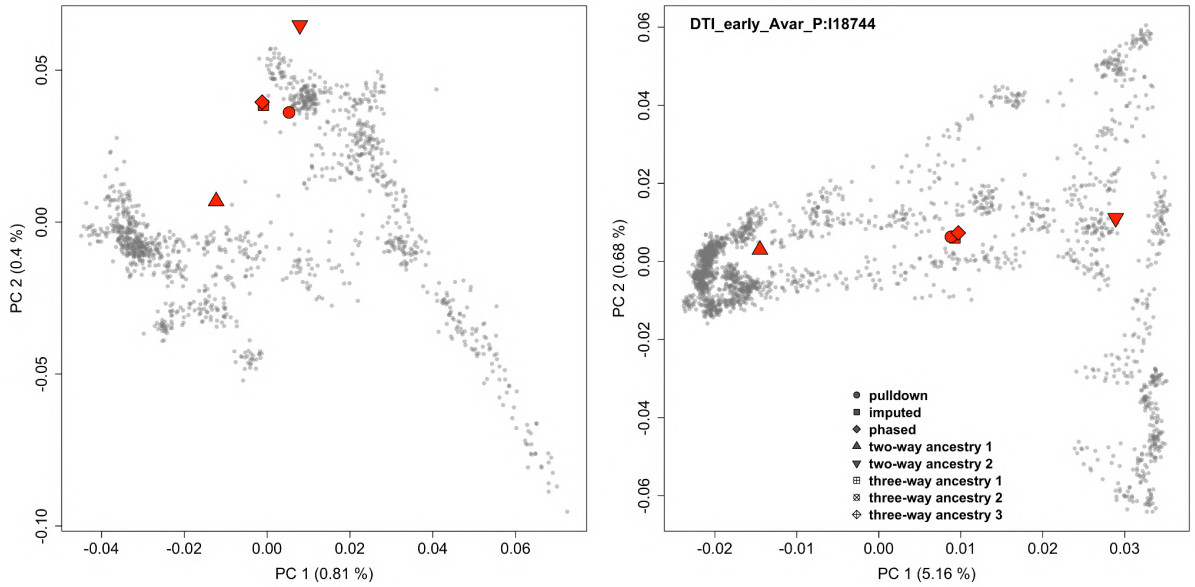

Figure iii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **I18224 - Feature 158/Str. 248**

Grave of a female (35-39 years old) and a child (2-2.5 years old). Rectangular burial pit. Double burial: the adult lay on its back, the skeleton of the child was disturbed, incomplete, close to the adult. Grave goods: 1. an iron knife under the adult's right hand; ceramic fragment from the grave filling.

Chronology: late 7th century – first half of the 8th century**.** The genomic profile of this middle Avar period DTI individual matches the other elite related individuals from the early Avar period in the DTI harboring 90-98% of Eastern Steppe ancestry source AR_Xianbei_P_2c. Although with respect to the majority of the individuals the remaining ~10% of its ancestry best matches the local preceding Carpathian Basin groups (Fig iv).

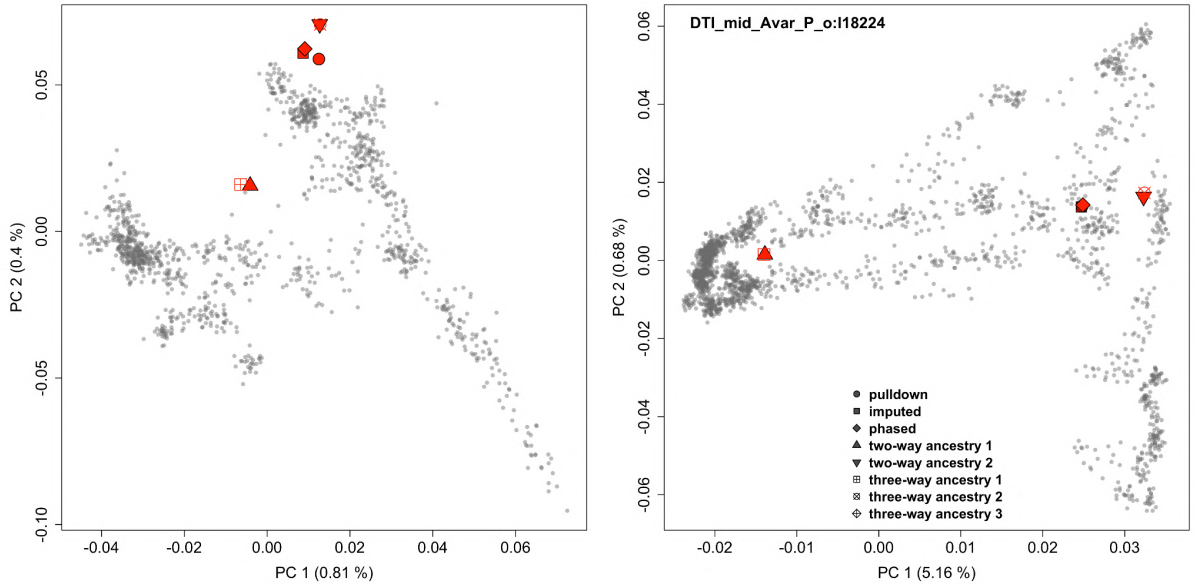

Figure iv. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **I18223 - Feature 202/Str. 292**

Grave of a female (40-49 years old) and a child (2.5-3.5 years old). Rectangular burial pit. Disturbed adult skeleton lying on its back, in an extended position. Grave goods: 1. a coffin clamp next to the north side wall; 2. a coffin clamp at the feet, next to the north side wall; 3. a fragment of a coffin clamp next to the south side wall; 4. a gold earring next to the skull, on its left side; 5. a fragment of the above mentioned gold earring; 6. a spindle whorl next to the left knee; 7. an iron buckle under the left hip-bone; 8. a gold earring on the right side of the skull, outside the coffin; 9. fragments of an iron object on the right side of the skull, outside the coffin; 10. an iron knife on the right side of the skull, outside the coffin; 11. fragments of bronze plates from the grave filling; 12. iron fragments from the grave filling.

Chronology: late 7th century – first half of the 8th century. The genomic profile of this middle Avar period DTI individual matches the other elite related individuals from the early Avar period in the DTI harboring 90-98% of Eastern Steppe ancestry source AR_Xianbei_P_2c (Fig v).

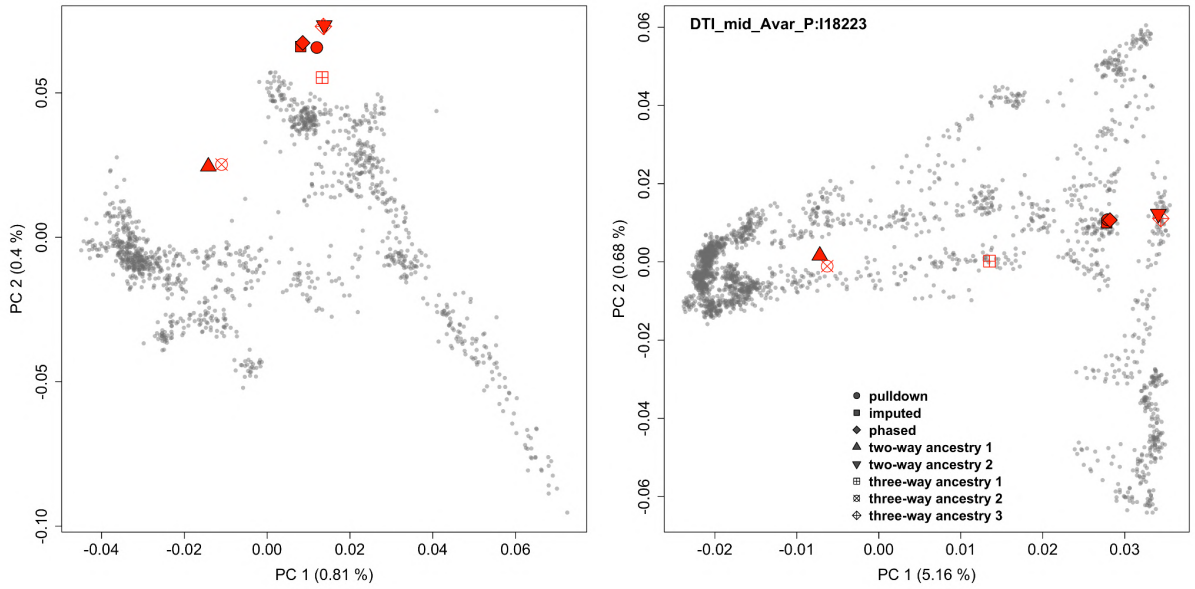

Figure v. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **I18225 - Feature 137/Str. 227**

Grave of an adult female (30-39 years old). Rectangular burial pit. Traces of oval posts in the four corners of the pit. The undisturbed skeleton lay on its back in an extended position.
Grave goods: 1. a bronze earring on the right side of the skull; 2. a bone needle case in the middle of the chest; 3. a fragment of a spindle whorl on the inside of the left forearm; 4. a fragment of a spindle whorl under the left forearm; 5. a hand-shaped pot between the two

femurs; 6. animal bones on the lower legs; 7. bronze earring on the left side of the skull; ceramic fragments from the grave filling. Chronology: first half of the 8th century.
The genomic profile of this individual matches the other elite related individuals from the late Avar period in the DTI harboring ~80% of Eastern Steppe ancestry source AR_Xianbei_P_2c but unlike the majority of DTI late Avar period individuals the the remaining ~20% matches different local Carpathian Basin sources (Fig vi).

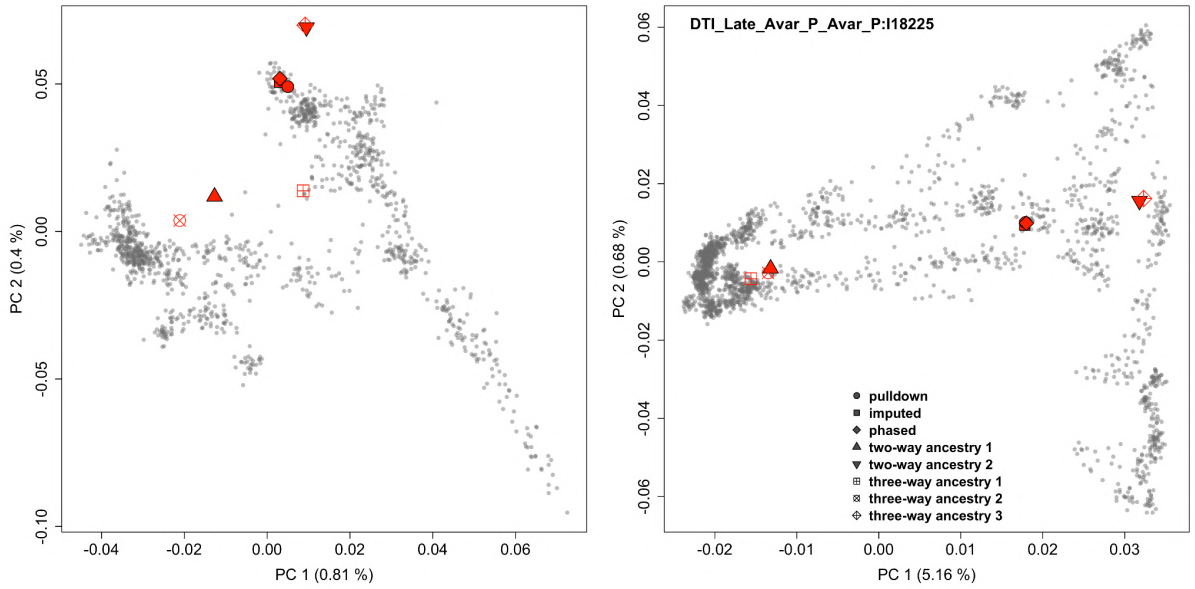

Figure vi. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **I18222 - Feature 152/Str. 242**

Grave of a male (35-44 years old). Irregular rectangular, very wide and deep pit, with side benches. Undisturbed skeleton lying on its back in an extended position. Left arm next to the body, right arm slightly bent. Right leg straight, left leg slightly bent. Grave goods: 1. bone plates of a bow to the left of the skull; 2. tree residue at the left elbow; 3. bone plates of a bow on the left forearm; 4. fragments of an iron knife on the left forearm; 5. four bronze fittings on the pelvis and underneath; 6. an iron buckle in the middle part of the pelvis; 7. a bronze buckle on the pelvis; 8. two small bronze fittings on the left hip-bone; 9. bone plates of a bow outside the left knee; 10. animal bones at the leg; 11. a small ceramic mug at the left ankle; ceramic fragments from the grave filling. Chronology: first half of the 8th century.
The genomic profile of this individual matches the other elite related individuals from the late Avar period in the DTI harboring ~60% of Eastern Steppe ancestry source AR_Xianbei_P_2c and ~40% of a source best matching North_Caucasus_7c (Fig vii).

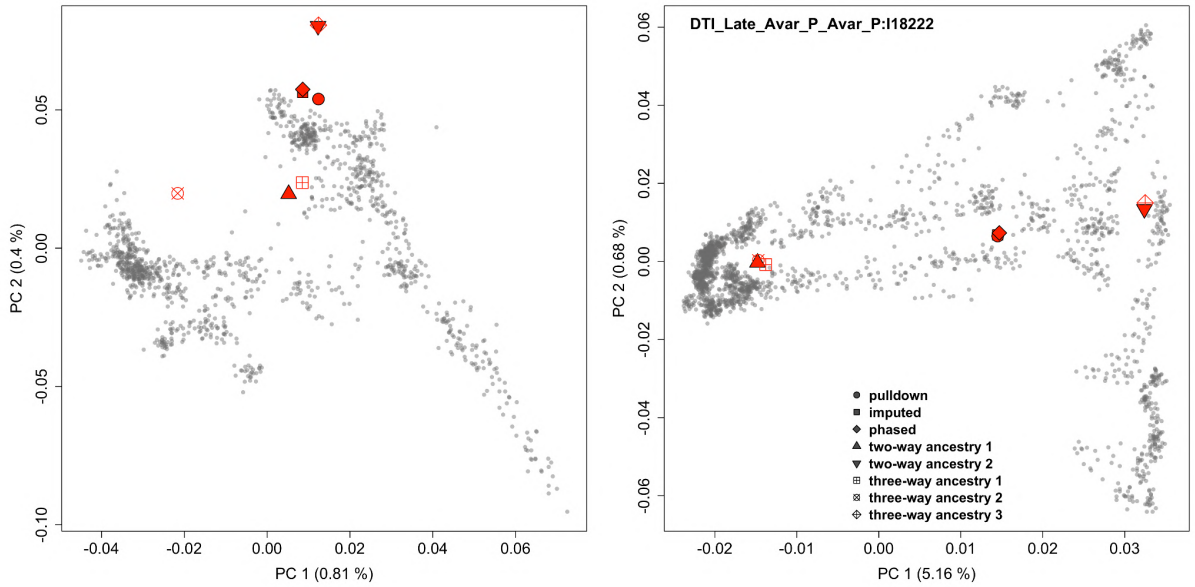

Figure vii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

Alsónyék, elkerülő út (Tolna County, Hungary)

The Alsónyék, elkerülő út Site 2 was excavated in 2008 and 2009 by János Gábor Ódor (Wosinsky Mór Museum). The site is located in the Transdanubia, in the Sárköz region between the Danube and the Szekszárd hills, near the floodplain of the Danube. An area of 11238 m² was uncovered along a driveway of the M6 motorway, which yielded Neolithic, Bronze Age, Iron Age, 5th-century as well as Avar-period finds.

A part of a larger cemetery - 238 Avar-period graves - was excavated. The main orientation of the burials was W-E, but small groups with N-S, E-W and SW-NE orientation could be also observed. Some wealthy graves occupied central positions in the cemetery, and the others settled around these graves in rows. A large amount of the burials was secondary disturbed in ancient times, which is also a typical phenomenon in Avar-period cemeteries.

The grave goods included jewels (earrings, beads, bracelets), clothing accessories (belt buckles and fittings), weapons, tools (iron knives and spindle whorls, needle cases, tweezers), and ceramic vessels. The cemetery was archaeologically evaluated and published by Bernadett Kovacsóczy (Kovacsóczy 2017 and Kovacsóczy 2018); anthropological analysis was carried out by Tamás Szeniczey and Tamás Hajdu (Szeniczey et al. 2017).

- **I16759 - Feature 424 (Grave 134)**

Rectangular grave pit (125 cm long, 45 cm wide and 3 cm deep). W-E orientation. Recently disturbed during the removal of the humus layer. Remains of two incomplete skeletons in bad, fragmentary condition. Skeleton I: male (50-59 years old) and Skeleton II: unknown (2-3 years old). On the bones of the adult person traces of osteoarthritis were observed. Grave goods: 1. Bronze earring with bead pendant, 2. bronze earring.

Chronology: first half of the 8th century. This late Avar period individual shows a genomic profile best matching the preceding local Carpathian Basin groups (~95%) with 5% of admixture with eastern sources (Fig viii).

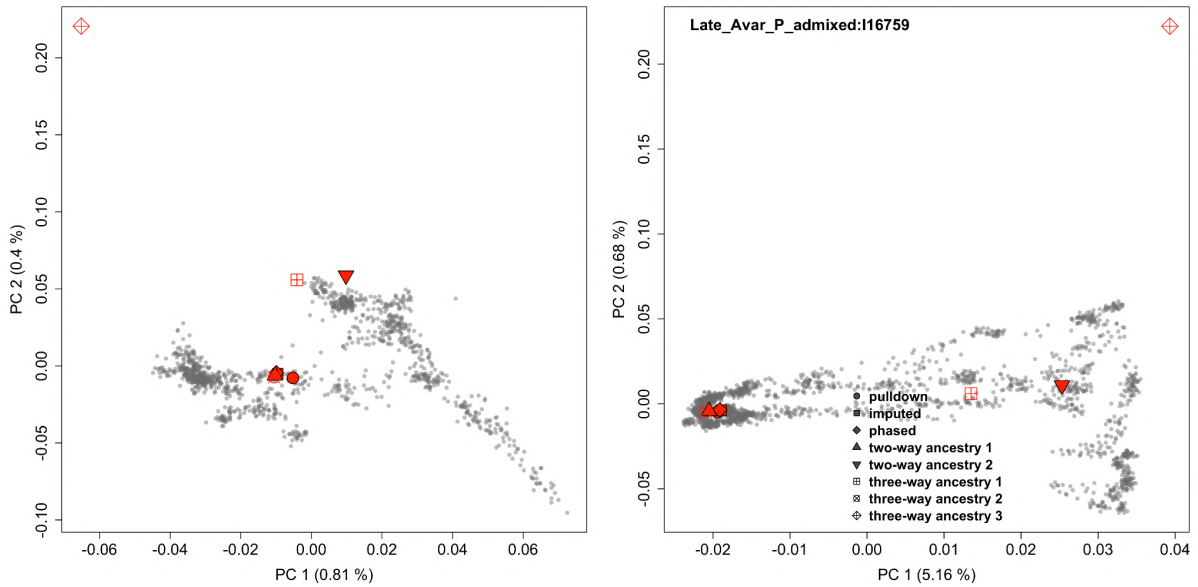

Figure viii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual

Árpás, Dombiföld-Szérűskert (antique *Mursella*, County Győr-Moson-Sopron, Hungary)

- **A181029 - solitary grave**

Solitary grave of a 18-20 years old male**.** A solitary grave found (1981) among the ruins of late Roman *Mursella* (modern Kisárpás, H) yielded a rich assortment of finds, most of them late Roman products such as a large grey jug, a small green glass cup and a copper-alloy cauldron with handles, but also included artefact types suggesting eastern connections like the belt and shoe buckles, animal bones, and a small animal statue (Bóna 1991, Tomka 2001).

The jug and the glass cup would not be out of place in a burial of the late antique population, but the deposition of the cauldron reflects Barbarian customs. The small animal statue, interpreted as a golden horse figure, probably the adornment of a wooden carving, whose parallels point towards the Eurasian steppe. One intriguing question during the detailed assessment of the grave was whether the burial had been the interment of an acculturated steppe nomad or a Roman provincial?

Burial rites and funeral customs provide the answer to this question. A sheep *sacrum* and a *caudal vertebra* lay between the feet of the deceased, and a cattle tarsal was found by the right foot. While the latter may represent a food offering, the presence of sheep bones reflects a still living steppe custom. The sheep sacra found in graves of the Avar period were part of the legacy of the communities of Steppe ancestry. The grave goods and the burial rite would suggest that the grave represents the burial of an individual of eastern lineage. The finds and burial customs date back to the second quarter of the 5th century, when Pannonia came under the rule of the Huns. The genomic profile of this individual lay along a West-to-East Eurasia admixture cline. It overlaps in PCA and can be modeled with the earlier Iron Age individuals sampled in Scythian/Sarmatian context in the Pontic-Caspian and Kazakh Steppe (Fig ix).

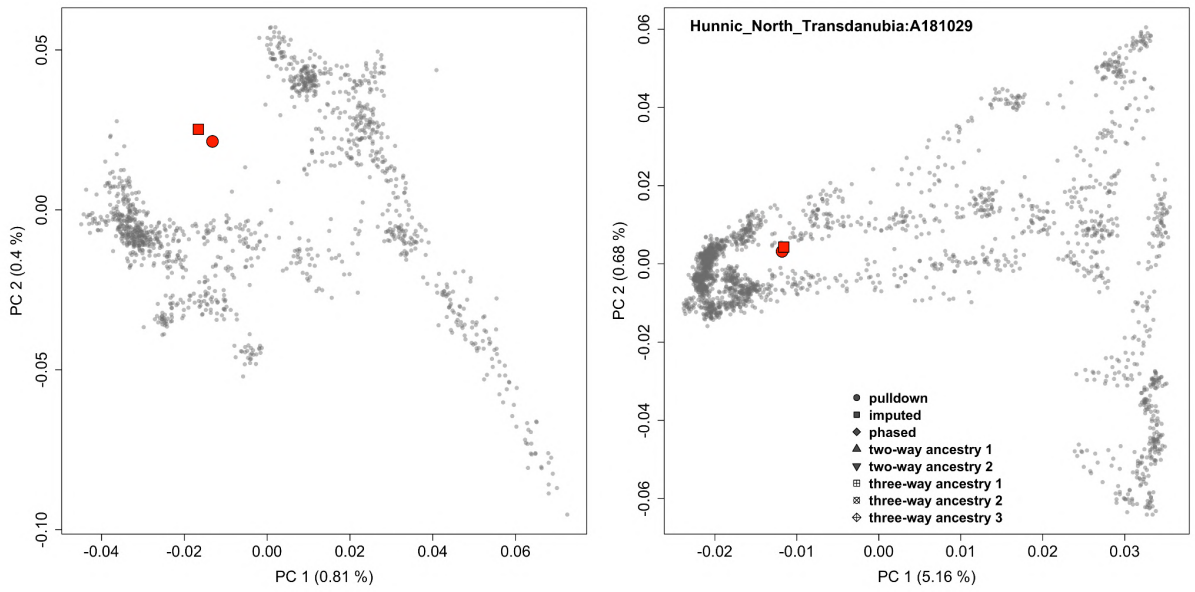

Figure ix. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they provided results for the individual.

Békésszentandrás, Benda-tanya (Békés county, Hungary)

Two early Avar-period graves, including one richly furnished grave of a female, were unearthed at the Benda-tanya site in Békésszentandrás in 2015.

- **A1803 - Grave 87**

Grave 87 is presented in detail by Csáky et al. 2020. The woman buried here had horse harness elements as grave goods and a grave structure with sidewall-niche, typical of groups arriving from the Eastern European steppes in the Early Avar period (Transtisza group).
The genomic profile of this individual belonging to the Transtisza group matches the eastern profile of the early Avar period DTI elite (Fig x).

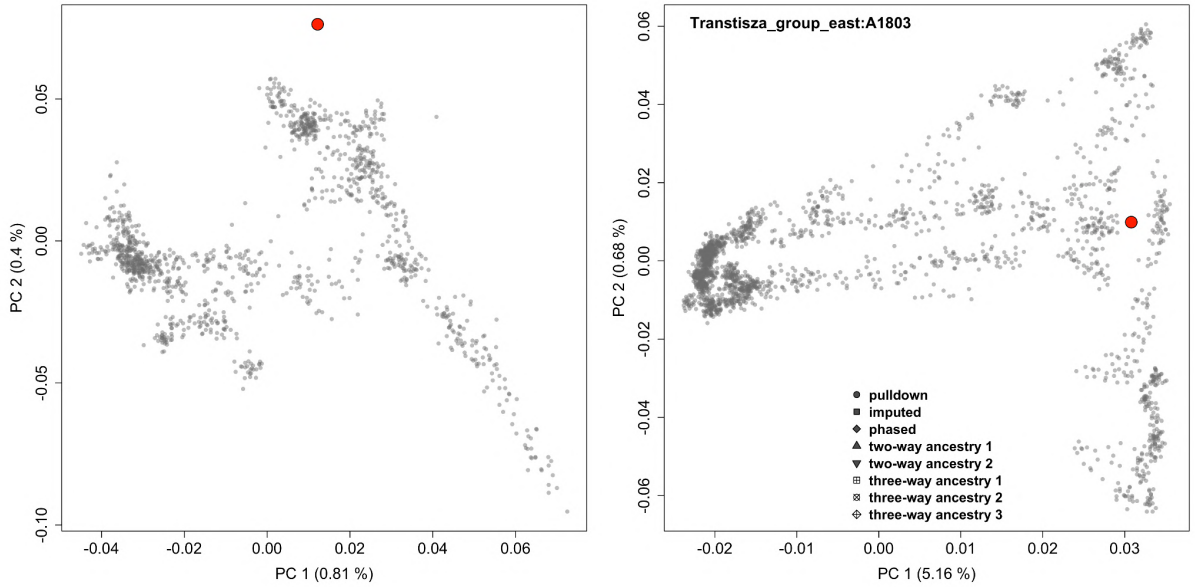

Figure x. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

Berettyóújfalu, Nagy-Bócs-dűlő (Hajdú-Bihar county)

The Nagy-Bócs-dűlő site is located in the southeastern part of Hajdú-Bihar county, 3.5 km south of Berettyóújfalu and south-southeast of the Berettyó river. The area was surrounded on three sides by the marshy floodplain of the river until the drainage works began in the second half of the 19th century. The site covers an area of several hectares, and due to its favourable location, traces of almost continuous human settlement can be detected from the early Neolithic to the Middle Ages. Archaeological excavations in the area prior to the establishment of the Bihar Regional Landfill in 2004 and 2005 revealed nearly 70,000 sqm and 2,000 archaeological features by the archaeologists of the Déri Museum, Debrecen (Dani et al. 2006).; in 2011, an additional 23,440 sqm was excavated.
A total of 38 graves dating back to the Avar period were found at the site. The dating of 5 of these burials is questionable, they lay scattered and were dug into trenches from the 9th century. Two graves (one male and one female) were found in the SW corner of the excavation area, next to each other, but separated from the other burials by approx. 200 m. A contiguous cemetery was excavated at the eastern boundary of the site, consisting of 2 groups of graves. The burials of the smaller group of 7 graves were arranged in 2 rows, while approx. at a distance of 20 m, 24 graves were found, arranged in 3 more irregular rows. The orientation of the graves was NE-SE, their depth was max. 80 cm (measured from the trimmed surface), but on average more shallow, between 20 and 40 cm. Coffin traces and traces of wooden structures were often observed in the grave pits. he anthropological analysis was carried out by Antónia Marcsik.

- **I16741 - Feature 1398/Str. 3111**

A poorly preserved skeleton of a maturus (?) male buried in a rectangular grave pit on his back in an extended position. Traces of a coffin. Undisturbed burial. Grave good: 1. two flints; 2. iron object; 3. pierced, tinned small strap end, and 2 tiny fittings; 4. iron knife, 5. iron chisel, 6. hand-shaped ceramic fragment at his left foot.

This late Avar period individual shows an admixed genomic profile with a ~20% Eastern Steppe component and a ~80% source that best matches the preceding local Carpathian Basin groups (Fig xi).

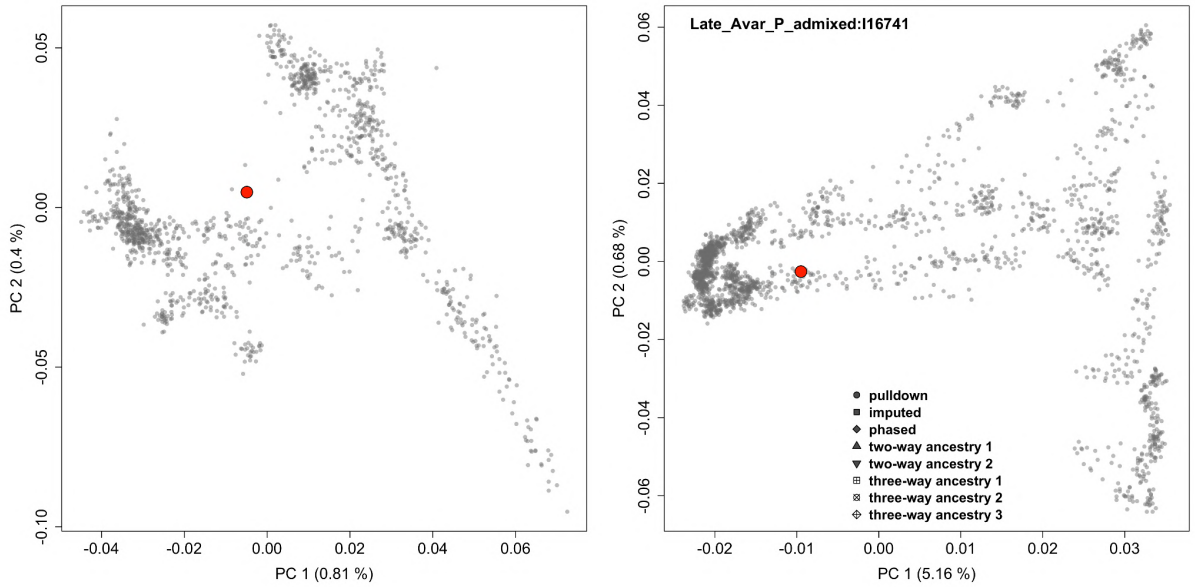

Figure xi. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

Csepel-Kavicsbánya (Budapest, Hungary)

Situated on one of the islands of the Danube river, this lavishly furnished, Avar period (early/mid-7th century) burial was found in 1924. The detailed description of the archaeological context is presented in Csáky et al. 2020.

- **A1801 - solitary grave**

This sample originates from a 45-50 years old male was buried in a solitary grave, whose sword decorated with gold plates indicates the high social status of the deceased. The genomic profile of this individual matches the other elite related individuals from the early Avar period in the DTI region harbouring 90-98% of Eastern Steppe ancestry source AR_Xianbei_P_2c (Fig xii).

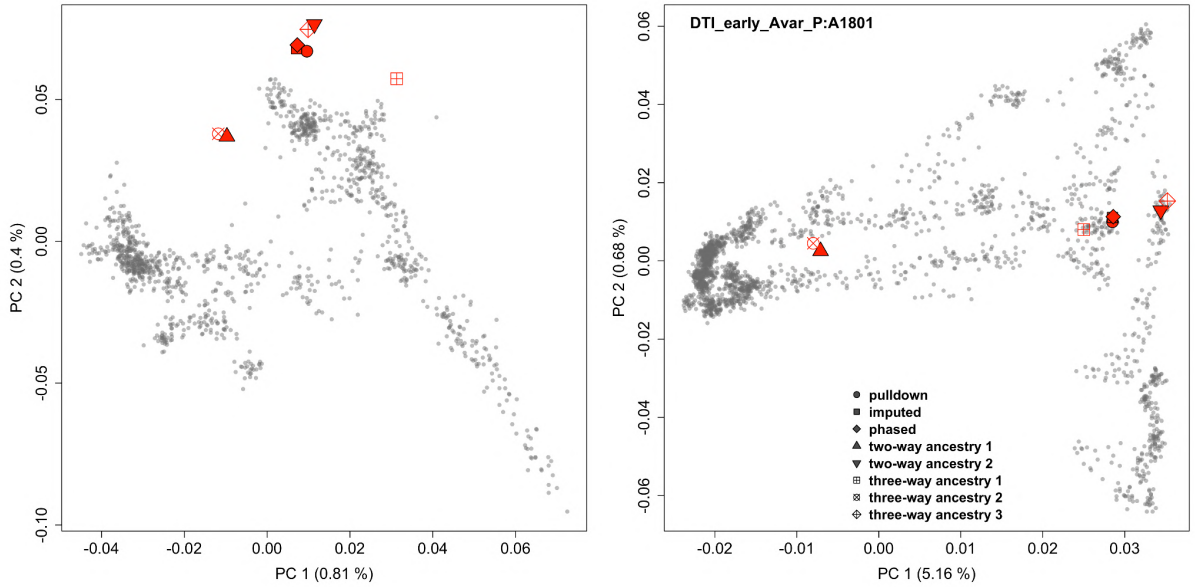

Figure xii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

Debrecen, Bordás-tanya (Hajdú-Bihar county, Hungary)

Rescue excavations led by Barbara Kolozsi have recently been carried out on the path of the highway around Debrecen, west of the city. The excavated area is on the right bank of the Tócó stream, on an elevation in a region once intersected by ancient watercourses. The excavation took place during the autumn of 2003 and the spring and summer of 2004 on a roughly 500/600 m² large surface. Beside an Avar-period settlement and a cemetery, remains of a Sarmatian settlement were discovered too.
The village was bordered by its cemetery (altogether 224 graves) to the south. When examining the village and the cemetery together, both the settlement structure and the finds seem to support their contemporaneity and close relationship. The material remains are typical for the 7th–9th centuries Avar-period population. The analysis of the human bones was performed by Antónia Marcsik.

- **I16743 - Feature 936/Str. 936**

Grave of a female (35-39 years old). Small, rectangular grave pit. The body was laid on its left side in a shrunken position. Grave goods: spindle whorl, iron fragment.
This late Avar period individual shows a genomic profile best matching the preceding local Carpathian Basin groups, Szolad_south_6c (~95%), with 5% of admixture with eastern sources (Fig xiii).

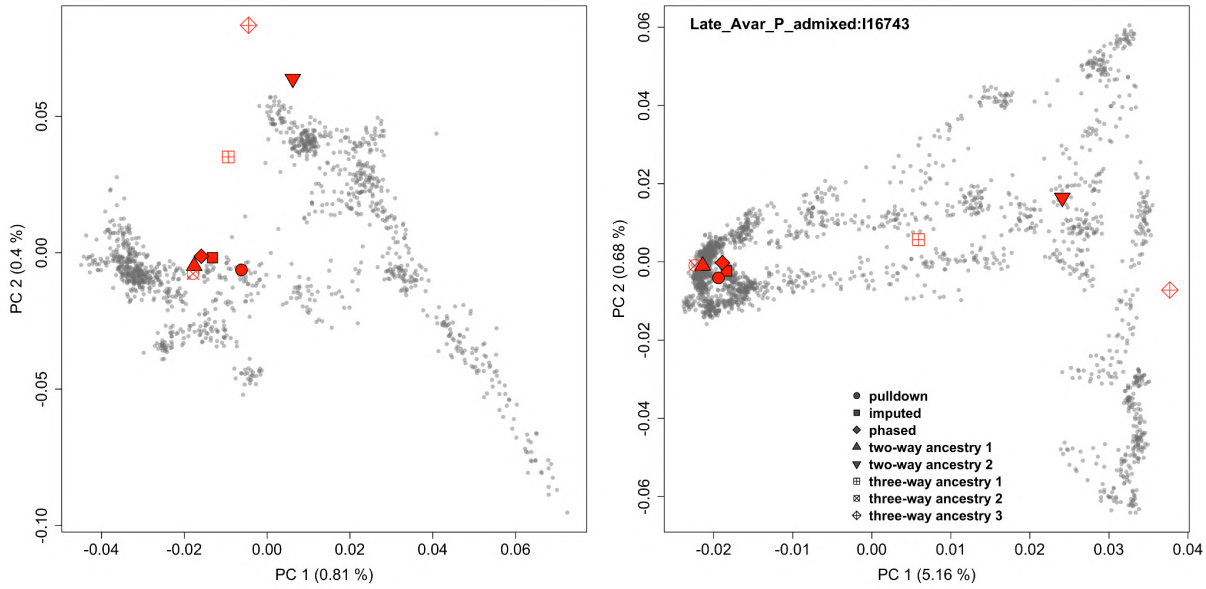

Figure xiii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

Derecske, Bikás-dűlő (Hajdú-Bihar county)

The site of Derecske, Bikás-dűlő – which is located on the south-western outskirts of Derecske, between the streams of Sárréti (Kálló) canal and Lyukas-dábó – was excavated by the archaeologists of the Déri Museum in 2016–2017 led by Tamara Hága (Priskin et al. 2021). During the rescue excavation connected to the construction of M35 motorway 65 861 square metres were investigated, where three cemetery sections were found from the Avar period on the northern, eastern and southern part of the site. An isolated grave from the early Avar period, with partial remains of a horse was also uncovered on the northern half of the site. The southern cemetery section, where the examined grave lay, consisted of 380 graves from the 7th–9th centuries. The anthropological analysis was carried out by Antónia Marcsik.

- **I16812 - Feature 1341/Str. 1503**

In the rectangular grave pit with rounded corners a 30-35-years old, 172cm tall man was laid in an extended position on his back, with his head aligned to the northeast. The grave was oriented NE–SW. L: 260 cm, W: 110 cm, D: 200 cm.
After the grave was backfilled, a shallower, rectangular pit (Feature 1451/Str. 1622) was dug beside its western side (partially cutting it), into which an approximately 8-9-years old, fully harnessed stallion with a withers height of 142 cm was deposited. The animal was aligned in the opposite direction as the human body, with its head towards the southwest. The horse was placed in the grave lying on its stomach, with the legs drawn underneath the body. The head was turned leftward. O: SW–NE, L: 230 cm, W: 90, D: 150 cm.
The deceased was laid to rest in a coffin made of oak planks. He was buried with his weapon belt. It was adorned with pressed silver-gilt mounts made in the Byzantine style. Beside his body was placed a single-edged iron sword with straight blade and D-shaped suspension loops, decorated with silver-gilt fittings. In the coffin under the deceased a complete lamellar armour was deposited with its inner side upwards, rotated at 90°. It was made up of over 500, approximately rectangular iron plates (*lamellae*) and of a *ca*. 6.5 cm wide chain armour. This is the first instance that a virtually complete and undisturbed cuirass of the Avar period has been excavated by archaeologists, documented *in situ* and then block lifted for conservation and further study, as a result of which countless new details could be added to our knowledge of the armour's elements and its structure, which enabled a highly accurate reconstruction of the lamellar armour of the Avar period.
The last lumbar vertebra, the sacrum and nine coccygeal vertebrae of a 4-5-years old horse represent the remains of a food offering placed across the foot of the deceased in the coffin. The bow stiffened by antler plates was broken in two before its deposition on the coffin, in the deceased's foot region. The quiver adorned with carved antler and bone plates containing four iron arrows and the iron spear were buried with the harnessed horse (with iron bit in its mouth, the saddle embellished with carved antler plates on its back, a pair of iron stirrups, and the reins, the breast collar and the hip strap adorned with pressed silver-gilt rosette mounts and strap-ends, decorated with an interlace motif).

Based on the grave goods and radiocarbon dating (Sigma2 94.5% probability 580AD-645AD; Major et al. 2021) the man and the horse could be dated to the first third of the 7th century.
This individual belonging to the Transtisza group shows an admixed genomic profile with a ~30% Eastern Steppe component and a ~70% source that best matches a preceding local Carpathian Basin group (Fig xiv).

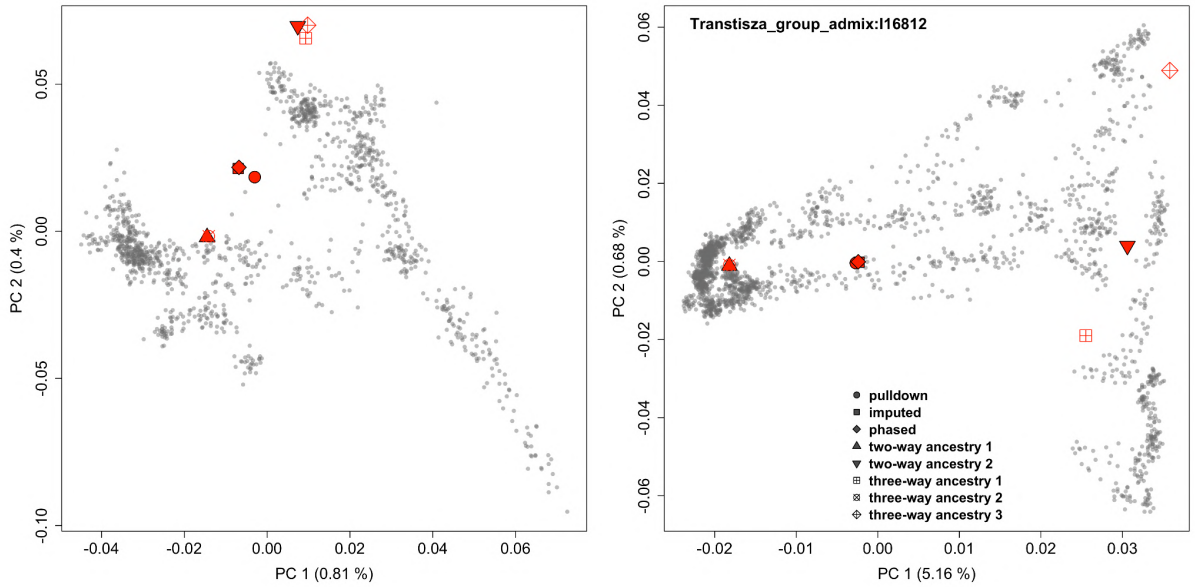

Figure xiv. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

Derecske, Hosszú-lapos (Hajdú-Bihar county)

The Derecske-Hosszú-lapos site is located 3 km northwest of Derecske city center. During the construction of M35 motorway in 2016, Salisbury Ltd. carried out excavations on 7,200 m2, led by Zoltán Farkas. Remains from several archaeological periods were excavated here, among others Avar-period graves that can be divided into two groups. The first includes 4-5 richly furnished graves, dated to the early Avar period, first half of 7th century (gold earrings, Byzantine coins, silver bracelet, silver chain, bronze needle). The other group includes 70 NW-SE oriented graves of a late Avar cemetery (8th century AD). The grave goods are modest, usually only iron buckles, iron knives, ceramic vessels, and, exceptionally, some cast bronze belt ends or beaded earrings were found in the graves. The anthropological analysis of human bones was performed by Tamás Hajdu and Antónia Marcsik.

- **I20798 - Feature 19/Str. 28**

Grave of a female, 25-30 years old. Rectangular grave pit (270cm x 122cm x 104cm). Orientation: NW-SE. Grave goods: beads, silver earring, iron knife, and a ceramic pot.
This late Avar period individual shows an admixed genomic profile with a ~35% Eastern Steppe component and a ~65% source that best matches the North_Caucasus_7c group (Fig xv).

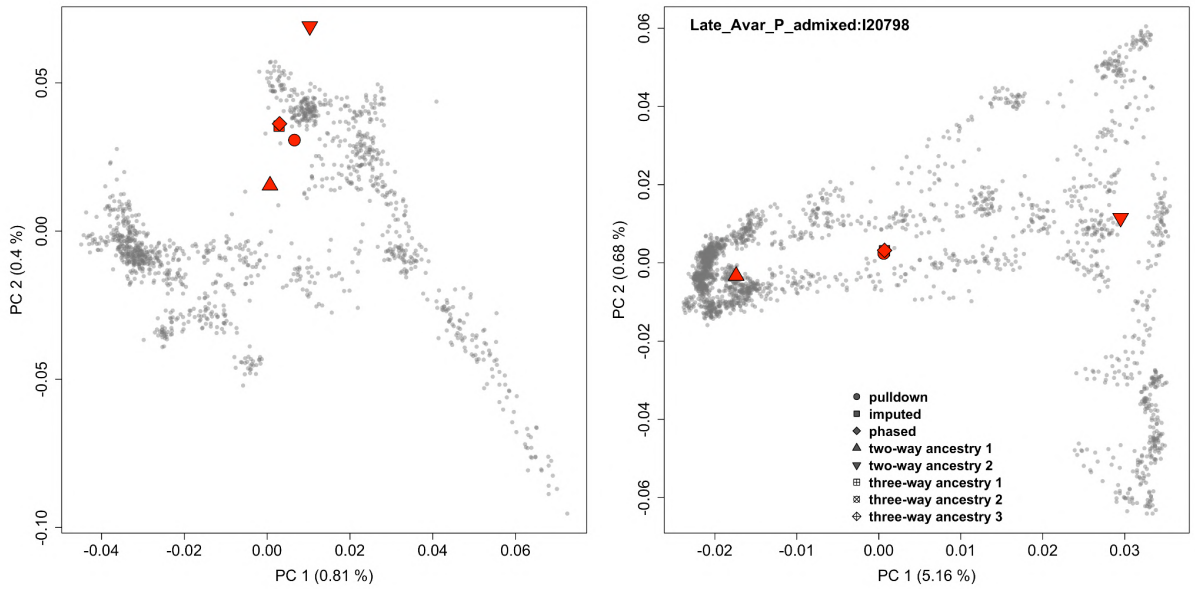

Figure xv. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **I20799 - Feature 53/Str. 62**

Grave of a female, 18-20 years old. Rectangular grave pit (241cm x 84cm x 34cm). Orientation: NW-SE. Grave good: iron buckle.

This late Avar period individual shows an admixed genomic profile with a ~35% Eastern Steppe component and a ~65% source that best matches the preceding local Carpathian Basin groups (Fig xvi).

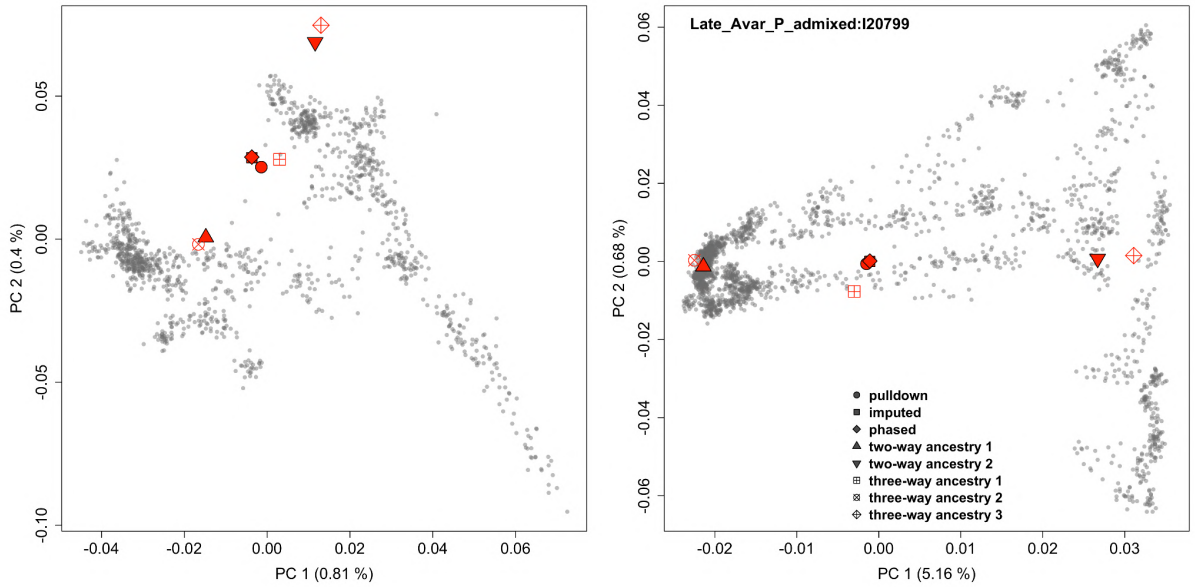

Figure xvi. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

Derecske, Karakas-dűlő (Hajdú-Bihar county, Hungary)

The site is located west of the settlements of Berettyóújfalu and Derecske, in Karakas-dűlő, on a flat hilltop, where 14008 sqm has been excavated by the Salisbury Ltd. (excavation leader: Zoltán Farkas). In addition to Copper Age and Sarmatian-period finds, early Avar graves (early 7th century) have been unearthed in the northern part of the site. The graves were poorly furnished, but a drilled coin of Justinian I (542-565) was also found in Grave 5/5. Samples were taken from a Sarmatian and two Avar-period graves. The anthropological analysis was carried out by Tamás Hajdu and Antónia Marcsik.

- **I20802 - Feature 55/Str. 55**

Grave of a 25-34 years old male. The grave pit is rectangular (265cm x 110cm x 88cm). Orientation SE-NW. In the northeast corner of the shaft, at a depth of 55 cm, the long bones of an adult were found, in a secondary position. The tomb, however, belonged to a child. The burial was disturbed; the child's bones were partially found in a secondary position.
Grave goods: 1. Bronze bracelet. 2. Fragment of an iron sickle(?). 3. Bronze coin. 4. Iron object.

The genomic profile of this individual matches the one of the later Sarmatian period individuals from the same region, Transtisza (LS_P_Transtisza_4−5c) that overall matches also the ancestry of the Szolad_others_6c group and was therefore included in the LS_P_Transtisza_4−5c group for the group-based analyses (Fig xvii).

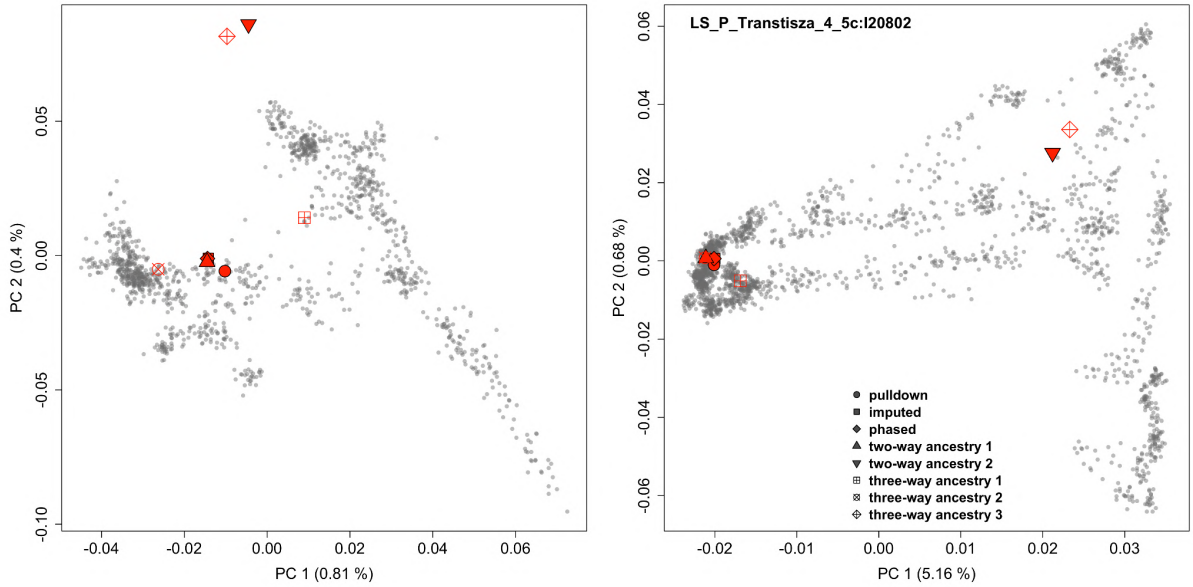

Figure xvii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **I20801- Feature 19/Str. 19**

Grave of a 25-29 years old female. Rectangular grave pit (280cm x 120 cm x 115 cm). Orientation NE-SW, coffin burial. Horse skull was found at a depth of 70 cm. The grave was disturbed, the human skeleton did not lay in its original position. In addition to the human bones, bones of a large ruminant (probably cattle) have been found in the grave. Grave goods: 1. ceramic vessel. 2. iron knife. 3–6. iron buckles.

This individual belonging to the Transtisza group shows an admixed genomic profile with a major Eastern Steppe component (~70%) and a second source that best matches Iron Age Kazakh steppe / Altai source, Chandman_IA_3cBCE and IA_SouthernUrals_5cBCE (Fig xviii).

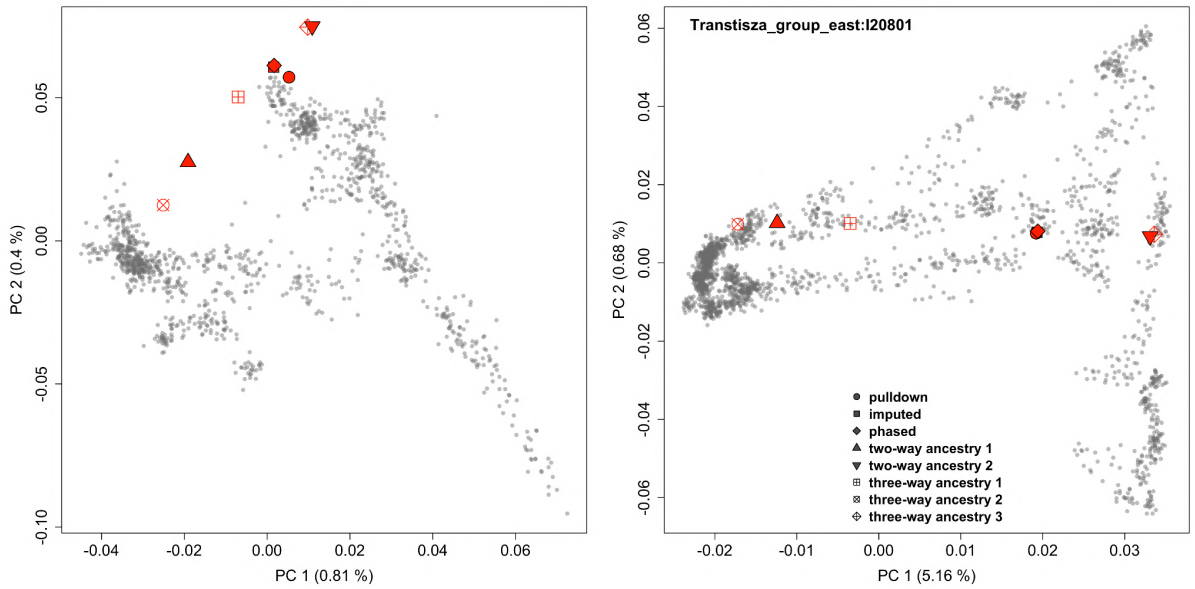

Figure xviii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **I20800 - Feature 18/Str. 18**

Grave of a 25-34 years old male. Rectangular grave pit (240cm x 180cm x 118cm). A horse skull and limb bones were found at a depth of 12 cm. The human skeleton lay at a depth of 118 cm in extended position. The bones are well-preserved, undisturbed. Grave goods: 1. hand-shaped ceramic vessel. 2. antler comb. 3. honing stone. 4. iron buckle. 5. spindle whorl. 6. animal bones at the SW wall.
This individual belonging to the Transtisza group shows an admixed genomic profile with a 40% Eastern Steppe component and a 60% source that best matches a preceding local Carpathian Basin group (Fig xix).

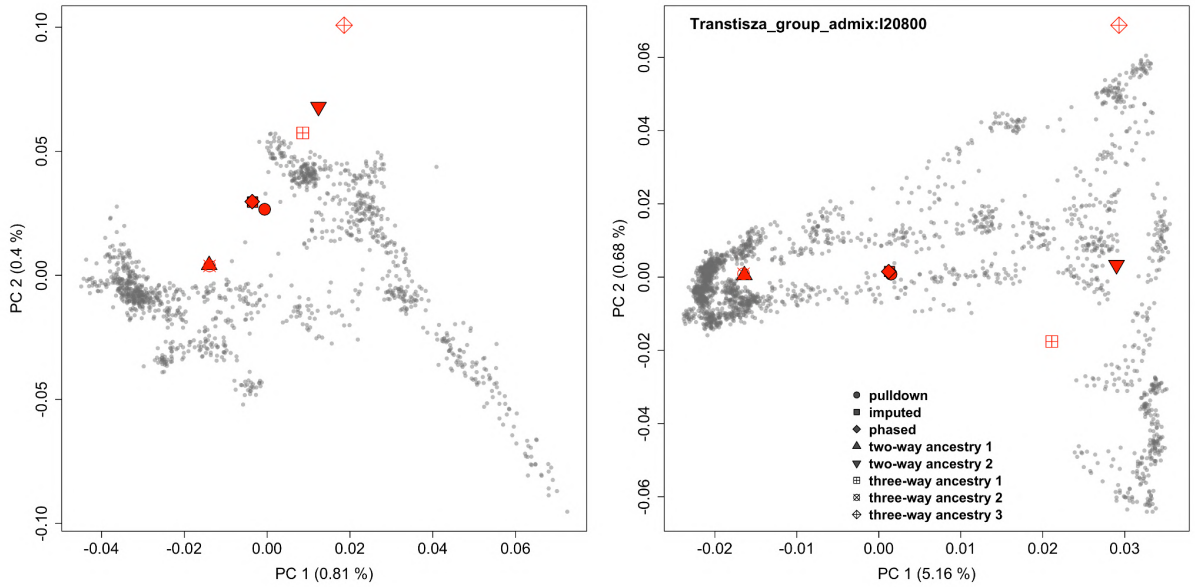

Figure xix. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

Hajdúböszörmény, Homokbánya IV (Hajdú-Bihar county, Hungary)

The Hajdúböszörmény, Homokbánya site IV was excavated in 2005 by Viktória Kisjuhász and Szabolcs Czifra. An area of 6551 m2 was uncovered prior to opening a sand mine in 2005, which yielded 165 archaeological features from the prehistoric, Sarmatian, Avar periods, and the Middle Ages. The outstanding result of the fieldwork is the discovery of the Avar cemetery with 110 inhumation burials. The eastern boundary of the necropolis was completely determined during the excavation, and partly the western expansion was also documented by trial trenches. Further graves are expected to be found only north to the excavated area. Graves were aligned into rows, and the majority of them were N-S oriented. In some cases, even the imprint of coffins could be detected. Men were usually buried with their iron knives and belts. Glass beads belonging to a necklace, one or two spindle whorls and occasionally an iron knife were buried with the women. Meat grave goods are characteristic of both male and female burials. The cemetery was in use from ca. 600 AD to the first half of the 9th century. The anthropological analysis was carried out by Antónia Marcsik.

- **I16744 - Grave 166**

Inhumation burial of an adult buried in supine position. Rectangular grave pit. Orientation: N-S. The skeleton is well preserved. Grave goods: Parts of an earring were found under the skull: a large gilded silver bead (measuring 1,4x1,2 cm), a golden bead made up similarly as the previous one (diameter: 0,8 cm) and a grooved silver cylinder.
Chronology: first half of the 7th century.
This late Avar period individual shows an admixed genomic profile best with (~40%) of eastern influx although we could not obtain a working model for this individual (Fig xx).

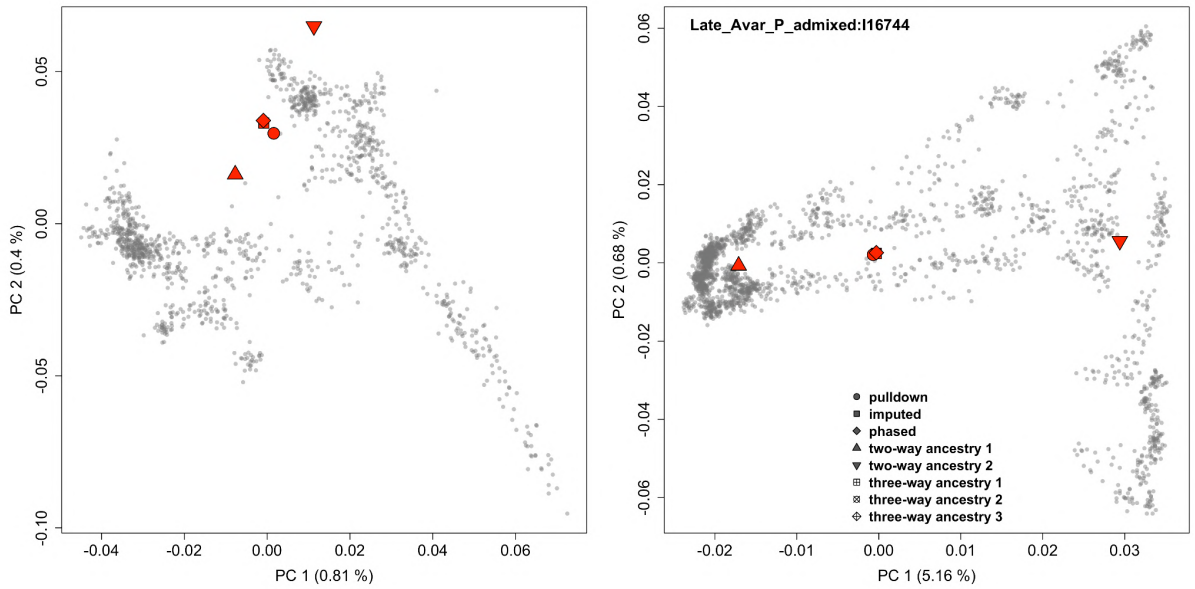

Figure xx. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

Hajdúnánás, Fürj-halom-dűlő 2 (Hajdú-Bihar County, Hungary)

The Hajdúnánás-Fürj-halom-dűlő site (M3 motorway Site 40/A) was excavated in 2005 by Gábor Szabó from the Institute of Archaeological Sciences, Eötvös Loránd University. The site was archaeologically evaluated by Eszter Tutkovics in her MA thesis (Tutkovics 2012); the anthropological analysis was carried out by Tamás Hajdu and Zsolt Bernert.
The site is located in the Transtisza region, about 200 km east from the Roman (Pannonian) limes, in the territory that once was the Sarmatian Barbaricum. An area of approximately 0.5 hectare was uncovered along the planned track of the M3 Motorway. The site yielded 38 inhumation graves – part of a larger cemetery – from the 4-5th centuries. The burial customs are in accordance with the usual Sarmatian rites in the Carpathian Basin: the graves were orientated south-north, the deceased were laying in shallow, rectangular pits (in 23 cases in a coffin), and 11 of the 38 burials were enclosed by circular ditches. The graves formed east-west oriented rows. A large amount (approximately three quarters) of the graves were disturbed in ancient times, which is also a typical phenomenon in Sarmatian period burial places. The grave goods included ceramic vessels, some tools (iron knives and spindle whorls), clothing accessories and jewels (belt buckles, earrings, brooches, pendants, and beads sewn on the cloths or worn in the neck). Some of the buried items reveal cultural connections with the late phase of the eastern European Černjachov/Sântana de Mureș culture. The Hajdúnánás cemetery can be dated to the end of the 4th and the beginning of the 5th century.

Most of the skeletons were in bad, fragmentary conditions. Despite this, 13 adult and mature females, 11 adult and mature males, and 10 sub-adult individuals of different ages could be identified during the anthropological examination.

The sampling strategy was elaborated according to the condition of the skeletons/skulls and the diversity of the material. The samples represent both males and females, graves with and without circular ditches or coffins, richly-furnished burials and graves with modest grave goods.

- **A181021 - Feature 3/Str. 3**

Grave of a female (25-34 years old). Rectangular grave pit surrounded by a circular ditch. Bronze brooch and beads around the ankles were found in the grave.
The genomic profile of this individual matches the one of the other individuals from this site and period (LS_P_Transtisza_4−5c) that overall matches the ancestry of the Szolad_others_6c group (Fig xxi).

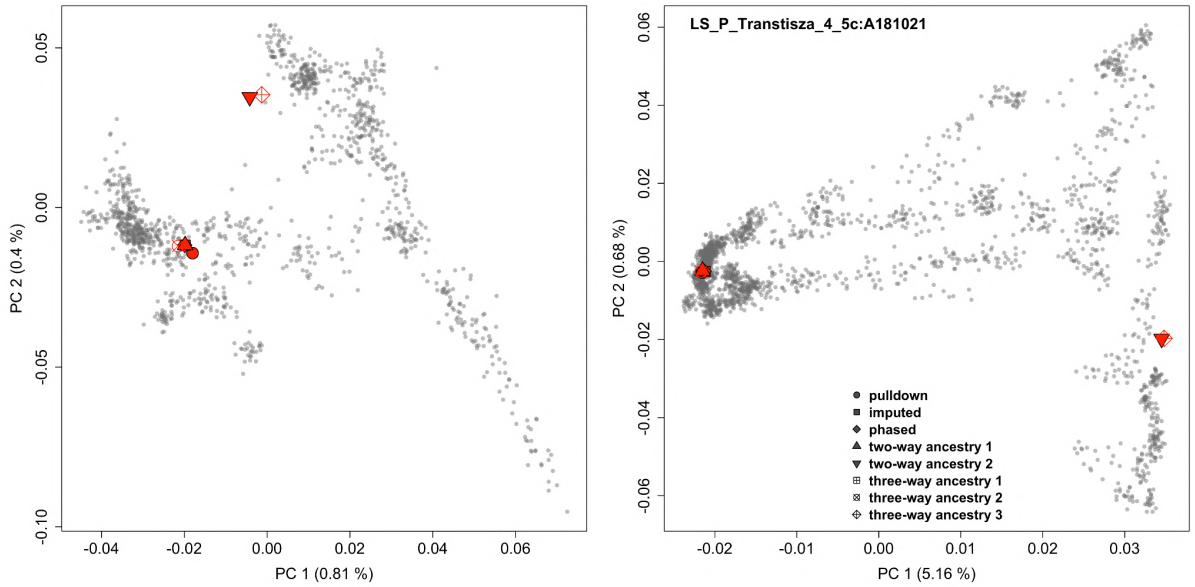

Figure xxi. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A181022 - Feature 9/Str. 12**

Grave of a female (25-29 years old), surrounded by a circular ditch and with a coffin. Grave goods: bronze earrings, glass bead, silver brooch, two ceramic vessels, Roman bronze coin.
The genomic profile of this individual matches the one of the other individuals from this site and period (LS_P_Transtisza_4−5c) that overall matches the ancestry of the Szolad_others_6c group (Fig xxii).

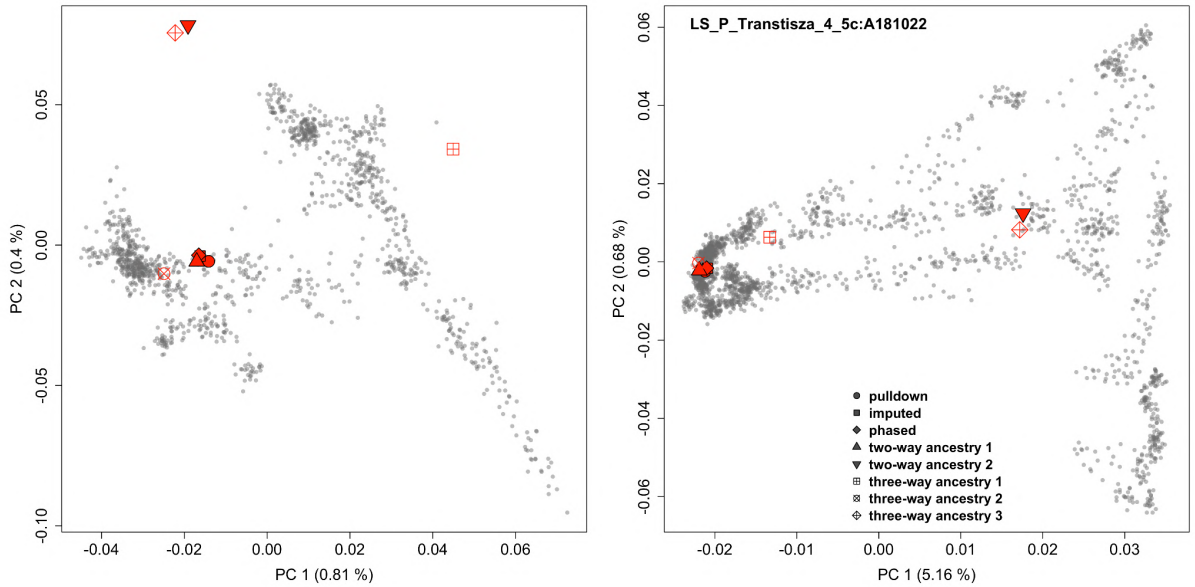

Figure xxii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A181023 - Feature 18/Str. 35**

Grave of a male (45-54 years old). Grave goods: iron brooch, iron belt buckle, ceramic vessel.
The genomic profile of this individual matches the one of the other individuals from this site and period (LS_P_Transtisza_4−5c) that overall matches the ancestry of the Szolad_others_6c group (Fig xxiii).

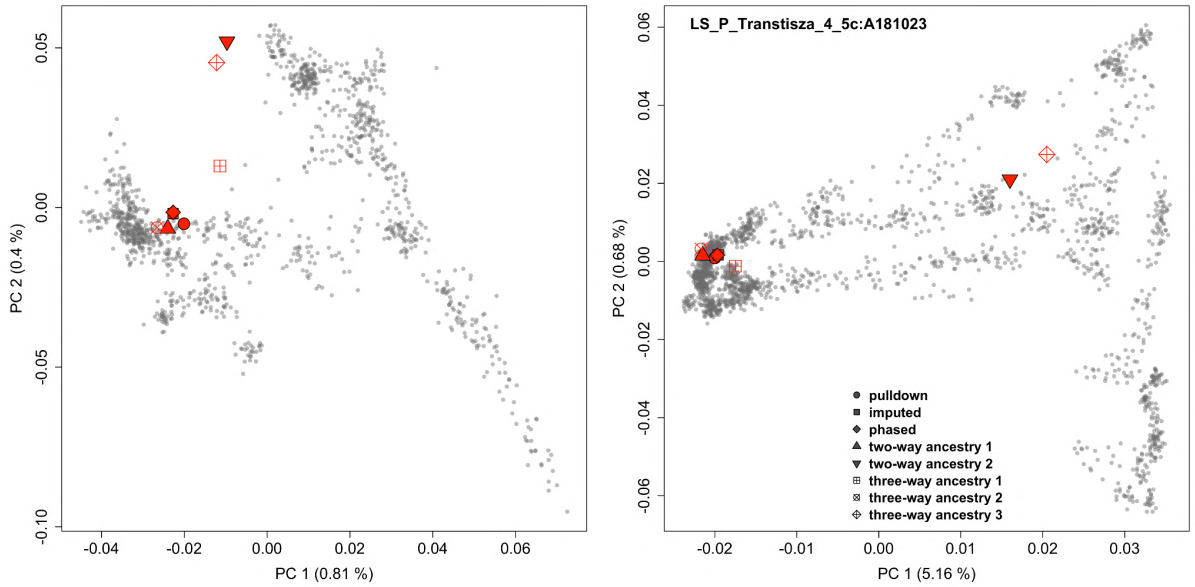

Figure xxiii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A181024 - Feature 23/Str. 41**

Grave of a female (20-24 years old). Rectangular grave pit surrounded by a circular ditch with a coffin. Grave goods: bronze earrings, pendant made from a Roman silver coin, beads, silver brooch, ceramic vessel.
The genomic profile of this individual matches the one of the other individuals from this site and period (LS_P_Transtisza_4−5c) that overall matches the ancestry of the Szolad_others_6c group (Fig xxiv).

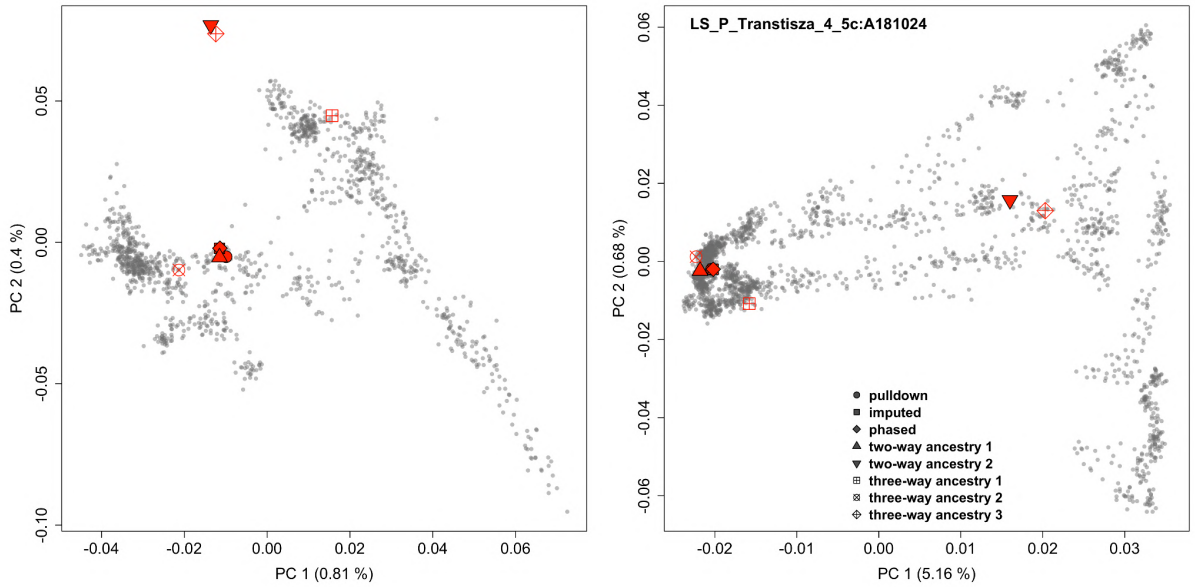

Figure xxiv. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A181025 - Feature 27/Str. 46**

Grave of a male (40-44 years old). Grave surrounded by a circular ditch. An iron buckle and a fragmented iron brooch (?) were found as grave goods.
The genomic profile of this individual matches the one of the other individuals from this site and period (LS_P_Transtisza_4−5c) that overall matches the ancestry of the Szolad_others_6c group (Fig xxv).

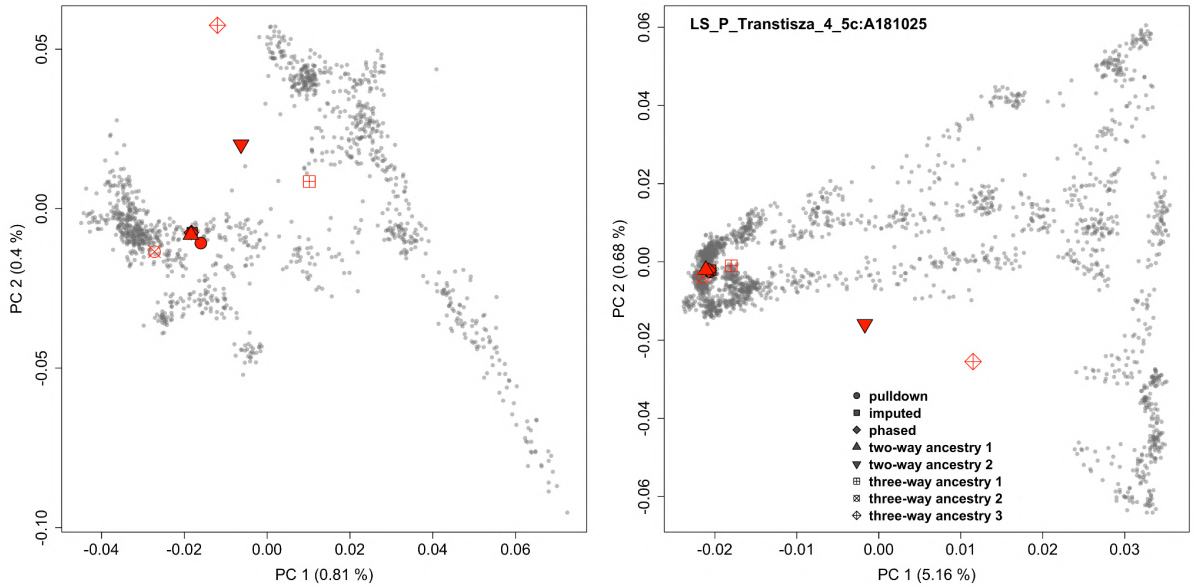

Figure xxv. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A181026 - Feature 36/Str. 64**

Grave of a female (22-24 years old). Grave with coffin. Grave goods: bronze earring, 2 bronze brooches, Roman silver coin, ceramic vessel, choral beads around the neck, the wrists, and the ankles.

The genomic profile of this individual matches the one of the other individuals from this site and period (LS_P_Transtisza_4−5c) that overall matches the ancestry of the Szolad_others_6c group (Fig xxvi).

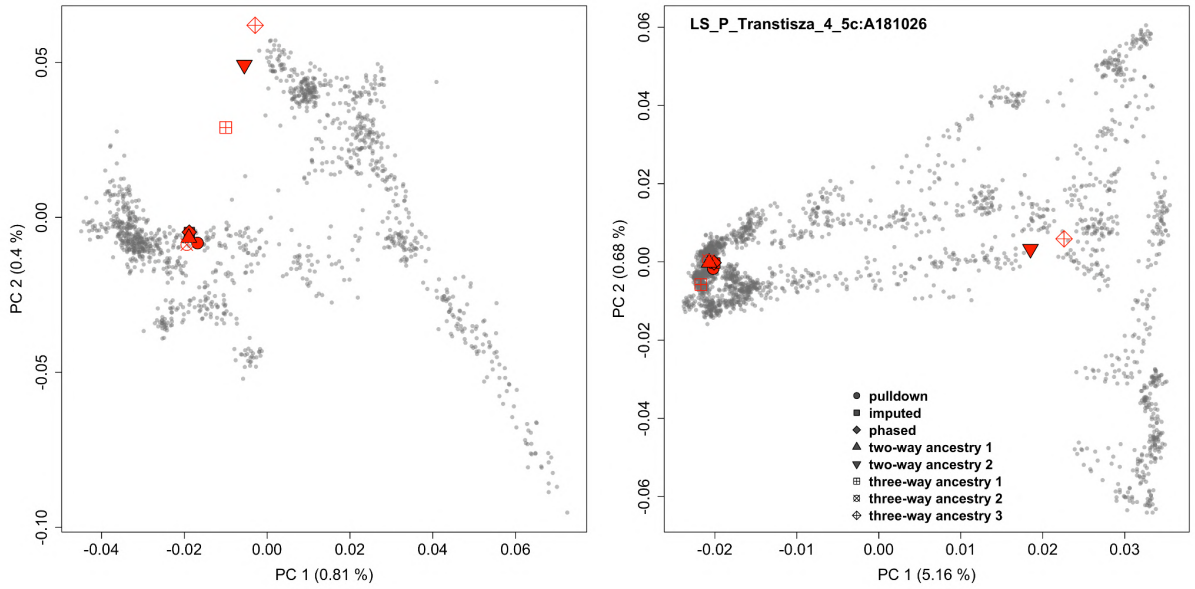

Figure xxvi. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A181027 - Feature 43/Str. 74**

Grave of a female (30-39 years old). Grave goods: bronze brooch and bronze coin. The genomic profile of this individual is outlier with respect to the other individuals from this site and period and instead matches the ancestry of the Longobard period Szolad_south_6c group (Fig xxvii).

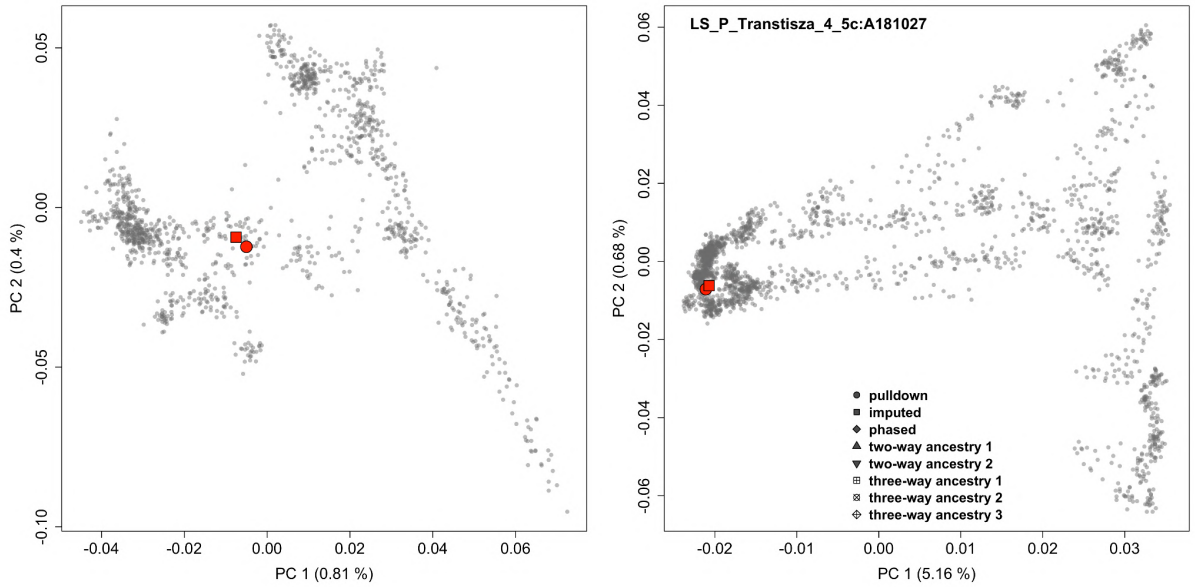

Figure xxii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A181028 - Feature 44/Str. 75**

Grave of a male (50-59 years old). Grave with coffin. Pendant from a false coin and ceramic vessel.

The genomic profile of this individual matches the one of the other individuals from this site and period (LS_P_Transtisza_4−5c) that overall matches the ancestry of the Szolad_others_6c group (Fig xxiii).

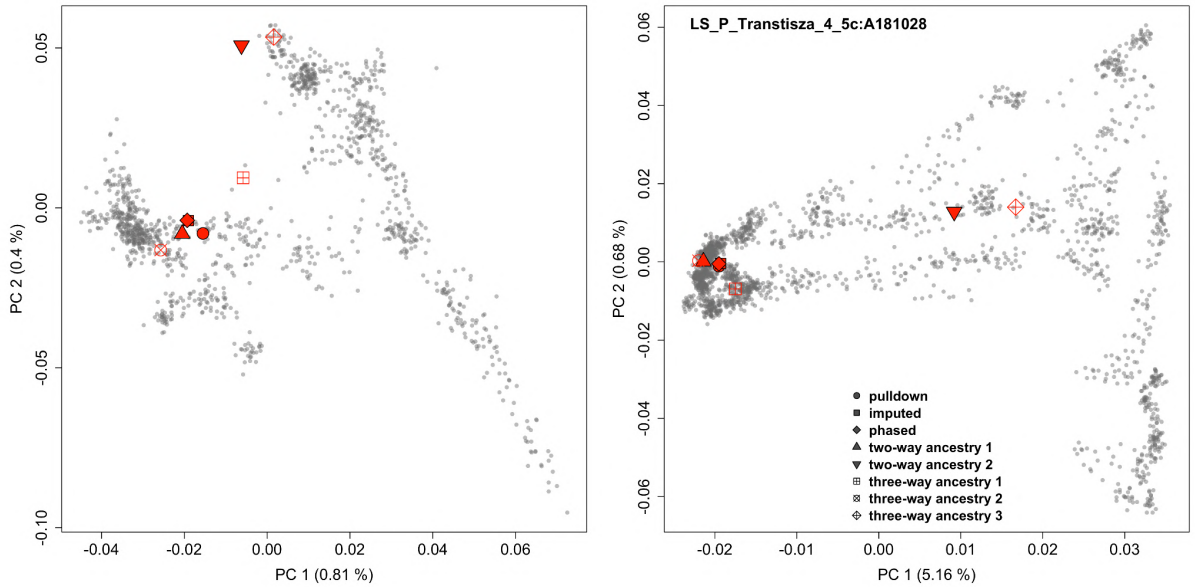

Figure xxiii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual

Kecskemét, Mindszenti-dűlő II, Mercedes RL12 (Bács-Kiskun county, Hungary)

A 5th-century cemetery has been unearthed between October-November of 2017 during the rescue excavations connected to the construction of an automobile factory at Kecskemét, Mindszenti-dűlő II. Mercedes RL12 site (46°52'04.74"N; 19°43'19.27"E). The cemetery consisted of 22 burials organized in three rows. Ten burials were surrounded by circular ditches – the NW-SE oriented graves were placed in the middle of the enclosed areas. The depth of the ditches varied widely, it is possible that they indicate burial mounds of different sizes. Six graves did not have such a circular ditch, while six other graves were placed inside the ditches of other burials.

All but three burials show the signs (secondary digs on the pelvis-chest area in most cases) of contemporaneous disturbance that affected both the skeletal and the archaeological material. Two of the three undisturbed graves did not contain any artefacts, and only one pottery came to light from the third. Most disturbed burials only contained bone and iron fragments. Only two were exceptions: Grave Str. 3817 contained an iron spearhead, a glass vessel and fragments of a high-quality jug with burnished decoration; and in Grave Str. 810 more than 240 beads made of carnelian, coral and chalcedony were found. Both burials had deep circular ditches, suggesting a larger burial mound. From grave Str. 3833 a well-preserved bone/antler comb came to light.

Beside the burials the remains of two hearths and three other ditches/trenches – probably connected to later - Avar - period settlement structures – were also discovered.

- **A181013 - Str. 3810**

Grave of a 25-34 years old female. The genomic profile of this individual matches the one of the other individuals from this site and period that overall matches the ancestry of the Transtisza Sarmatians or Szolad_others_6c with small (~5%) contribution from an Eastern Steppe source (Fig xxix).

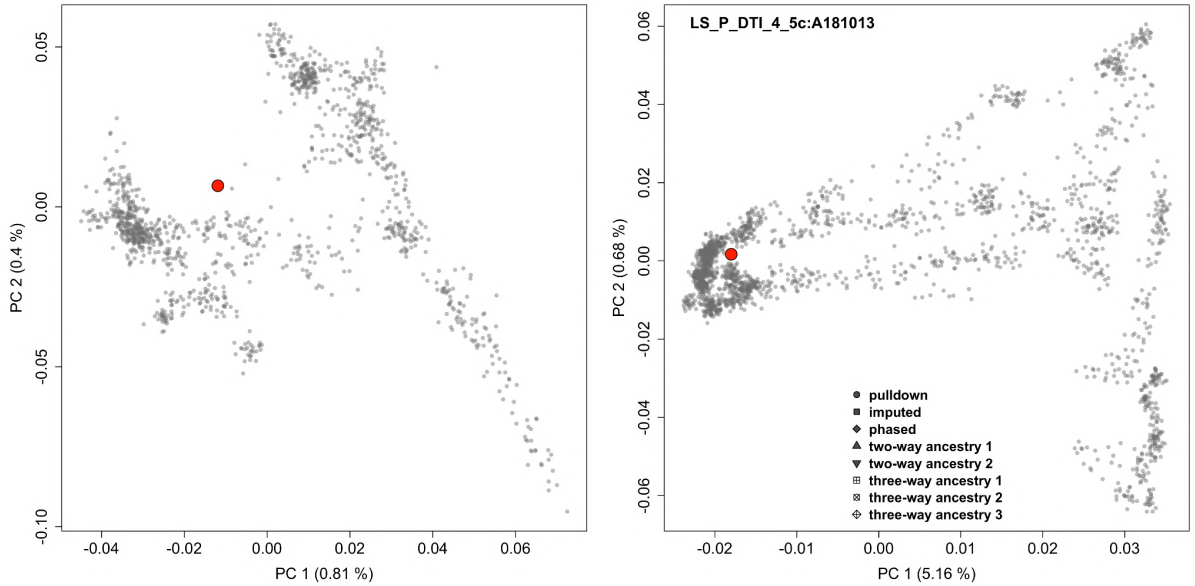

Figure xxix. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A181014 - Str. 3812**

Grave of a 45-54 years old male.

The genomic profile of this individual matches the one of the other individuals from this site and period that overall matches the ancestry of the Transtisza Sarmatians or Szolad_others_6c with small (~5%) contribution from an Eastern Steppe source (Fig xxx). A181014 (male; mtHap=K1a4a1; y-chrHap=I2a2a1b) has a first degree relation (full brother) with A181019 (male; mtHap=K1a4a1; y-chrHap=I2a2a1b).

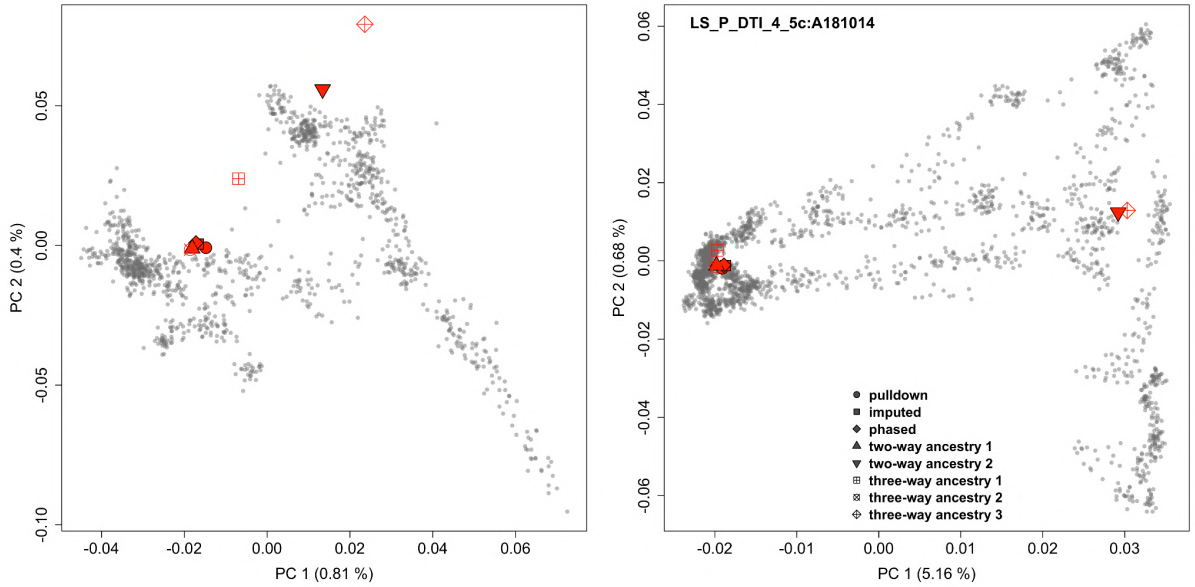

Figure xxx. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A181015 - Str. 3817**

Grave of a 45-59 years old male.

The genomic profile of this individual matches the one of the other individuals from this site and period that overall matches the ancestry of the Transtisza Sarmatians or Szolad_others_6c with small (~5%) contribution from an Eastern Steppe source (Fig xxxi). A181015 (male; mtHap=U2e1h; y-chrHap=I1a2a1a1) has a second degree relation with A181016 (male; mtHap=H1cf; y-chrHap=I1a2a1a1) and a second to third degree relation with A181017 (male; mtHap=H7; y-chrHap=I1a).

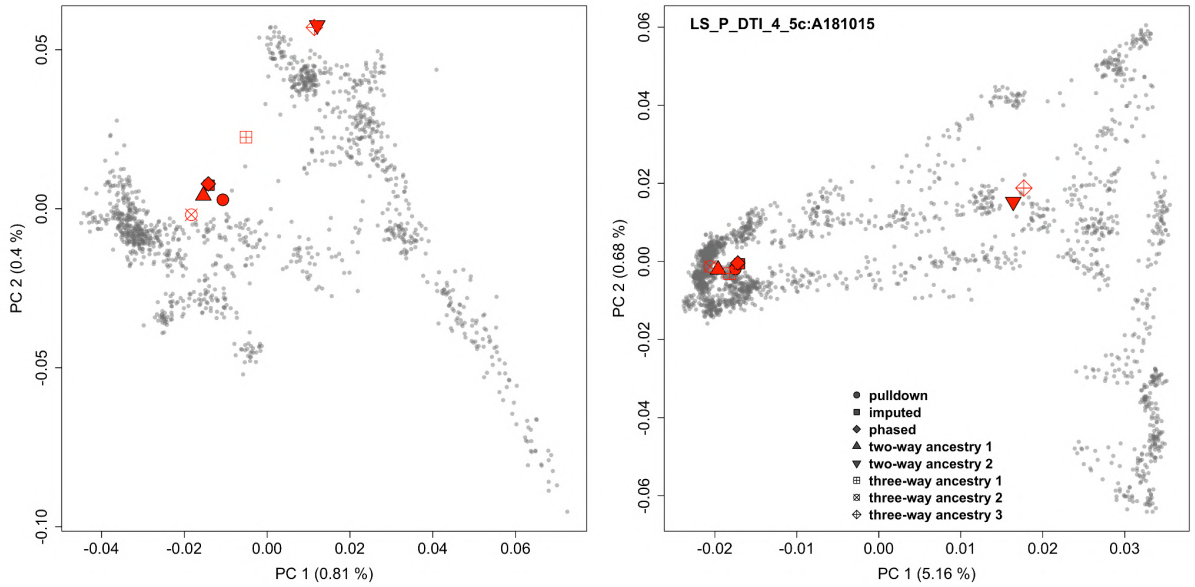

Figure xxxi. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A181016 - Str. 3826**

Grave of a 35-49 years old male.

The genomic profile of this individual matches the one of the other individuals from this site and period that overall matches the ancestry of the Transtisza Sarmatians or Szolad_others_6c with small (~5%) contribution from an Eastern Steppe source (Fig xxxii). A181016 (male; mtHap=H1cf; y-chrHap=I1a2a1a) has a second degree relation with A181015 (male; mtHap=U2e1h; y-chrHap=I1a2a1a1) and a third degree with A181017 (male; mtHap=H7; y-chrHap=I1a).

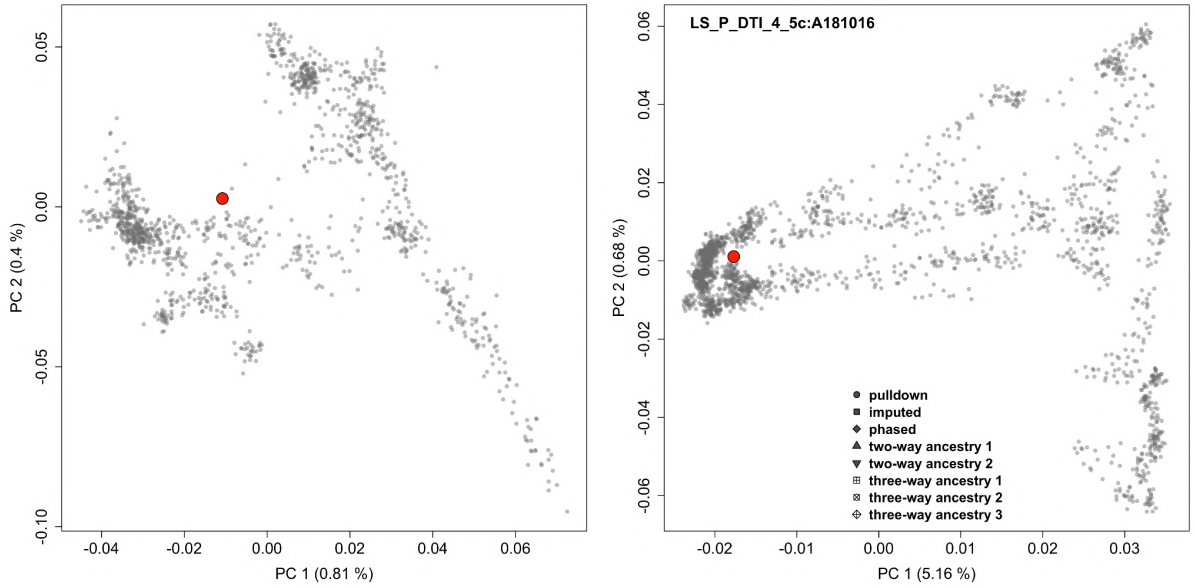

Figure xxxii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-

way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A181017 - Str. 3829**

Grave of a 25-29 years old male.
The genomic profile of this individual matches the one of the other individuals from this site and period that overall matches the ancestry of the Transtisza Sarmatians or Szolad_others_6c with small (~5%) contribution from an Eastern Steppe source (Fig xxxiii). A181017 (male; mtHap=H7; y-chrHap=I1a) has a third degree relation with A181016 (male; mtHap=H1cf; y-chrHap=I1a2a1a) and a second to third degree with A181015 (male; mtHap=U2e1h; y-chrHap=I1a2a1a1).

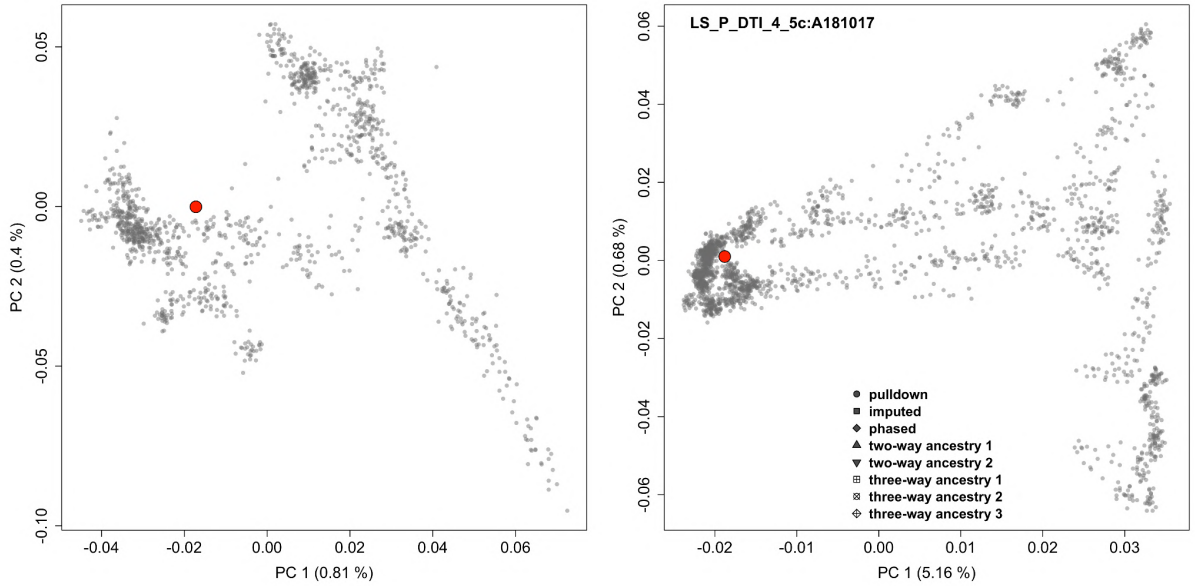

Figure xxxiii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A181018 - Str. 3830**

Grave of a 35-49 years old female. The genomic profile of this individual is outlier with respect to the one of the other individuals from this site and period and instead matches the ancestry of the Longobard period Szolad_north_6c group (Fig xxxiv).

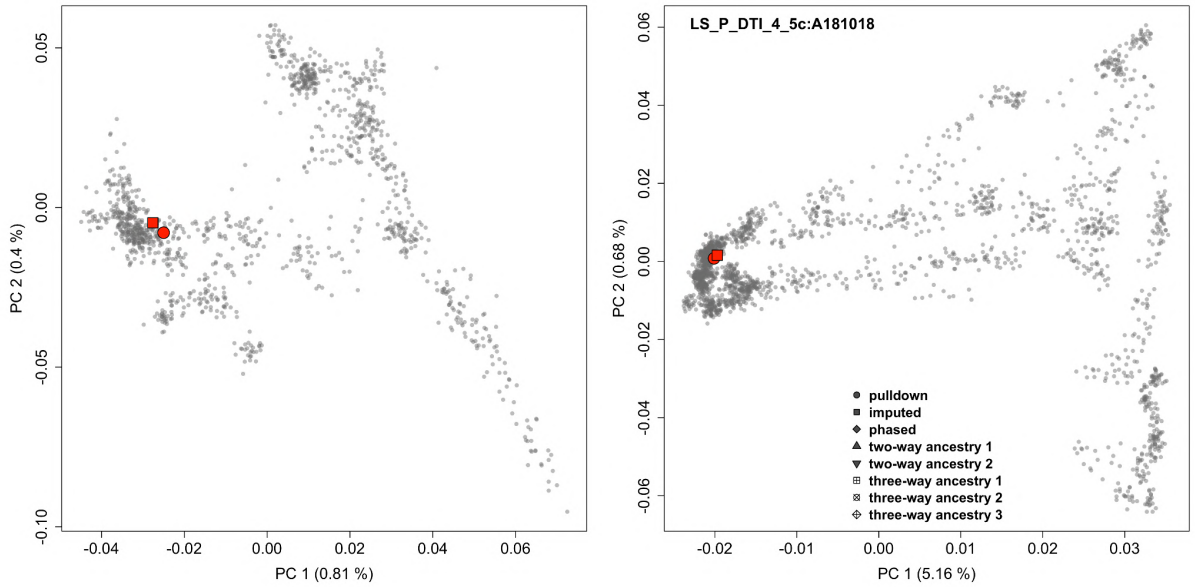

Figure xxxiv. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A181019 - Str. 3831**

Grave of a 15-17 years old male.

The genomic profile of this individual matches the one of the other individuals from this site and period that overall matches the ancestry of the Transtisza Sarmatians or Szolad_others_6c with small (~5%) contribution from an Eastern Steppe source (Fig xxxv). A181019 (male; mtHap=K1a4a1; y-chrHap=I2a2a1b) has a first degree relation (full brother) with A181014 (male; mtHap=K1a4a1; y-chrHap=I2a2a1b).

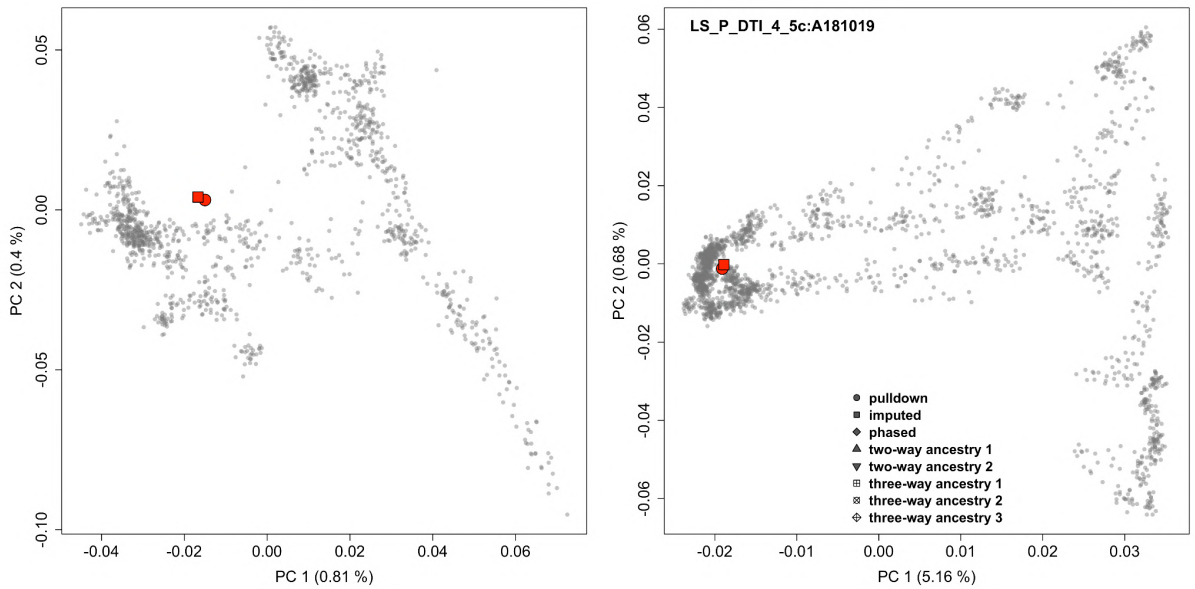

Figure xxxv. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-

way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A181020 - Str. 3836**

Grave of a 30-49 years old male.
The genomic profile of this individual matches the one of the other individuals from this site and period that overall matches the ancestry of the Transtisza Sarmatians or Szolad_others_6c with small (~5%) contribution from an Eastern Steppe source (Fig xxxvi).

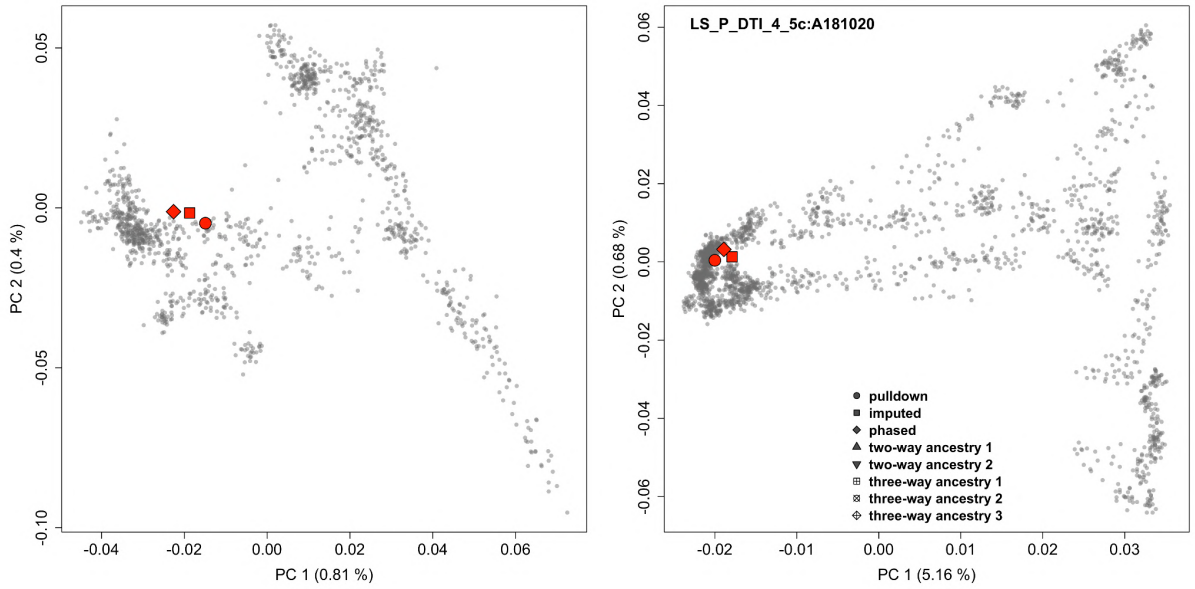

Figure xxxvi. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

Kecskemét, Sallai út (Bács-Kiskun county, Hungary)

A richly furnished, mid-7th-century grave excavated in 1973 was described in Csáky et al. 2020.

- **A1823 - solitary grave**

This sample originates from an adult male, who was buried with a ring-pommel sword and decorated belt. The genomic profile of this individual matches the other elite related individuals from the early Avar period in the DTI region harbouring 90-98% of Eastern Steppe ancestry source AR_Xianbei_P_2c (Fig xxxvii).

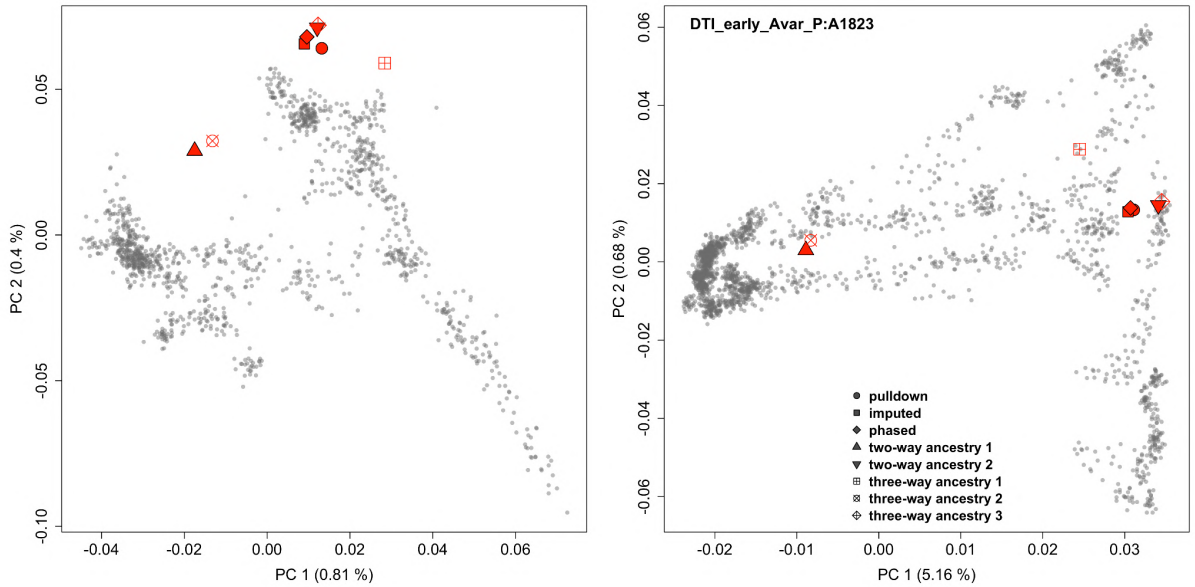

Figure xxxvii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

Kölked, Feketekapu (Baranya county, Hungary)

At this site a large Avar period settlement and cemetery were unearthed in several archaeological excavation campaigns between 1972 and 1999. Owing to the planned excavation series led by Attila Kiss, 80% of the cemetery "A" and almost entirely the cemetery "B" were unearthed (Kiss 1996, 2001). It was founded at the end of the 6th century and remained in use until the end of the 8th century, the end of the Avar period in this region. The anthropological analysis of human bones was performed by Tamás Szeniczey (Szeniczey 2019).

The Kölked-Feketekapu settlement was made up of separate plots with large above-ground houses enclosed by fences and ditches, representing a unique spatial layout in the early Avar period. A total of 174 sunken-floored houses, 160 pits, 131 open-air ovens, 80 ditches, five wells and four above-ground buildings were uncovered. The settlement's households – economic units – were made up of large manor-house-like residences associated with two-to-five sunken-floored buildings beside them (Hajnal 2009, 91-116.). The seventh-century buildings at Kölked were used not only as dwellings, but also as cellars, storage facilities, weaving houses and workshops. The good-quality amphorae, jugs and oil lamps in the ceramic material reflect the special demands of the elite family and its wide-ranging supra-regional connections (Hajnal 2003, 177-209; Hajnal 2005, 437-480.)

The structure of the cemeteries A and B in Kölked is determined by the fact that they are divided into 17 smaller and larger grave groups ('A' + 'B' groups I-XVI). Almost the entire cemetery, 1343 graves were unearthed, laid several groups (communities), in cemeteries on the outskirts of the settlement and inside as well. The early cemetery shows cultural diversity, local, Western Merovingian, late antique and early Byzantine and eastern nomadic elements, the late cemetery shows the characteristic material of the middle and late Avar periods. This unification of the Avar culture around the middle or in the second half of the 7th century can be seen in the entire Avar Empire.

The extent of the excavation and the quality of the finds in Kölked – the graves and houses of the members of the elite, whose burial customs showed different character as the DTI elite. In the late 6th and early 7th centuries the former Pannonia experienced extraordinary mobility of the population and strong cultural influences from all sides, especially from the Byzantine Balkans, from the Alps-Adriatic region, from the western Merovingian world and the eastern Eurasian steppe.

The pursuit of Western Merovingian fashion is striking in the early phase of the cemetery: foreign shapes and patterns are placed on the suspended belts of women who wrapped their legs with a leather strap. The men also wore Merovingian type belts and arms (sword, spear, shield). A similar influence is observable in the decoration and technology of jewellery and dress accessories. However, local peculiarities already appear: following Avar tradition, men also wear strap ends, but these also have a local flavour. There is a significant increase in the amount of early Byzantine jewellery.

The high proportion of weapon burials in the cemetery makes it probable that part of the population of Kölked cemeteries belonged to the military retinue of noble families and could not only control contemporary trade along the former Roman roads, but also took part in the Avars 'Balkan' and 'Italian' campaigns under their own leaders.
Attila Kiss connected the population of the "A" cemetery to the Gepids due to the strong Germanic nature of the archaeological finds. However, archaeological methods cannot prove

the hypothesized Gepid identity, especially considering that the remains of the Longobard-era population in the area should also be considered. The biodistance analysis based on cranial metric traits supported the biological influence of the Longobard-era population.
In the second chronological phase of the "A" cemetery in Kölked, a group showing strong cultural connections to the steppe appeared.

- **A1824 - A cemetery, Grave 107**

The costume and weapons of the adult male shows connections to the eastern steppe tradition, while his Byzantine belt was a prominent element of the social display of the Avar-period elite (Kiss 1996).

Grave goods were the following: Straight, narrow-edged iron sword. Deltoid-shaped rhombus on the handle with fan-shaped decoration. On the blade are wood remains of the case. For the wooden case belonged 2 pcs P-shaped, II. a hanging ear decorated with second animal style ornamentation and decorated with 2-2 beaded glass beads. Probably the 3 small cast bronze buckles also served to suspend the sword.

Cast bronze buckle with oval bronze ring and short body; a double-leaf large belt end made of silver plate; 5 shield - shaped, dot - comma ornate belts with tendrils in the middle; a flint; 15 three-leaf iron arrowheads; narrow-plate riveted archbones; an iron spear; a dark gray high speed disc bottle; a bone quiver.

See main text for genetic description (Fig xxxviii).

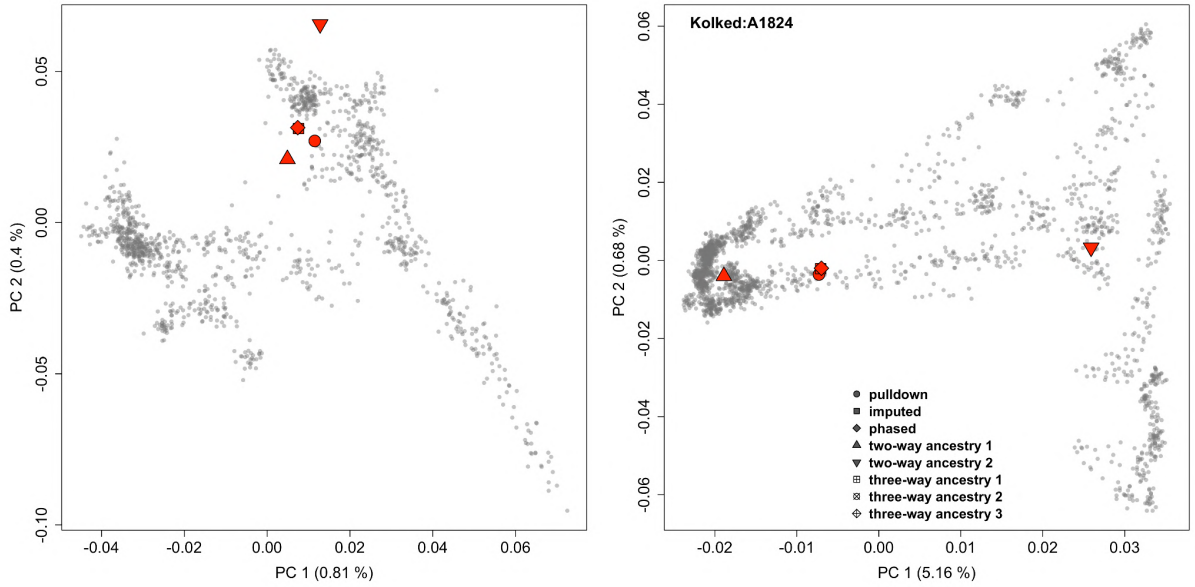

Figure xxxviii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A1825 - A cemetery, Grave 108**

As described in Vida 2018: '*Grave 108 of the early Avar-period cemetery at Kölked (Kom. Baranya / H; figs 1-2) contained the burial of a roughly 40-year-old woman. Her carefully selected jewellery, costume accessories and the other articles deposited in her grave bespoke a high-ranking individual of prominent social position 5. Her cap or headdress was secured with two large, spatulate-headed silver stylus pins (13 and 14 cm long, respectively) that were found on either side of the head, immediately beside the cheekbones. She wore a pair of genuine Byzantine gold crescentic earrings decorated with peacocks and granulation. The disc brooch fastening her cloak lay on the left side of the chest. The silver tweezers on the left hip and the silver tube (perhaps the handle of a cosmetic brush) by the lower arm were probably part of a toiletry set kept in a pouch. The bronze chain by the left thigh and the iron knife by the left hand had probably been suspended from the belt. The two bronze buckles by the middle part of the left leg and the small strap-ends by the right leg were no doubt the adornments of a Merovingian-type leg binding (Wadenbindengarnitur). The iron folding chair with metal wire inlay set in the lower right corner of the grave pit is again a reflection of the deceased's high status. The food or drink offerings for the journey to the otherworld were placed in the pear-shaped grey mug behind the skull.*'

See main text for genetic description (Fig xxxix).

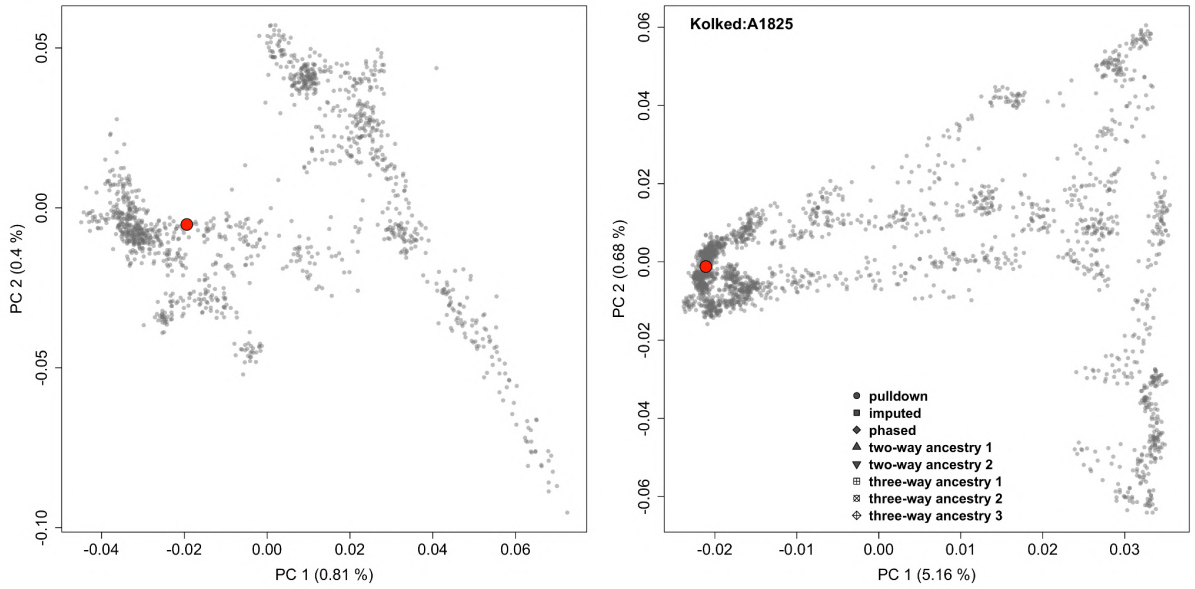

Figure xxxix. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

A relationship between the man and the woman can only be shown on the basis of their relatively large graves, which are close to each other, and not on an archaeological basis. Based on its finds Grave 107 is a characteristic early Avar grave with steppe features, quite protruding from the Meroving-like finds of the Kölked cemetery, which is also reflected in the type and the combination of weapons.

Kövegy, Nagy-földek (Csongrád-Csanád County, Hungary)

The site of Kövegy, Nagy-földek, M43/49 was excavated by András Benedek (Móra Ferenc Museum, Szeged) in 2010-2011. The archaeological data of the site was summed up and evaluated by András Benedek and Antónia Marcsik in 2017 (Benedek–Marcsik 2017), the anthropological analysis was carried out by Antónia Marcsik in 2014. The cemetery was excavated during the construction of the M43 motorway, along the Tisza – Körös – Maros rivers, in an area of 4093 sq metres. On the axis of the site 17 graves of an early Avar period cemetery, a sacrificial pit and two storage pits were found.
Based on the observed features of the burial characteristics, the excavated graves could clearly be assigned to the early Avar period. A previously undocumented burial habit could be observed in the cemetery, namely two shaft graves and two graves with niches dug from the end of the grave pit were surrounded by a circular ditch and presumably, within that a mound was raised. These “ditch-mound” burials in the early Avar period were previously unknown in the Carpathian Basin.

- **I16750 - Feature 28/Str. 41**

Shaft grave of a male (50-59-year-old). Orientation: SW–NE. L: 237 cm, W: 90 cm, D: 74–79 cm. Well-preserved skeleton. No burial goods were found in the grave. This individual belonging to the Transtisza group shows a higher affinity towards Mediterranean populations clustering with present-day Sicilians and Maltese, and plot at the very end of the Szolad_south_6c genetic cluster (Fig xl).

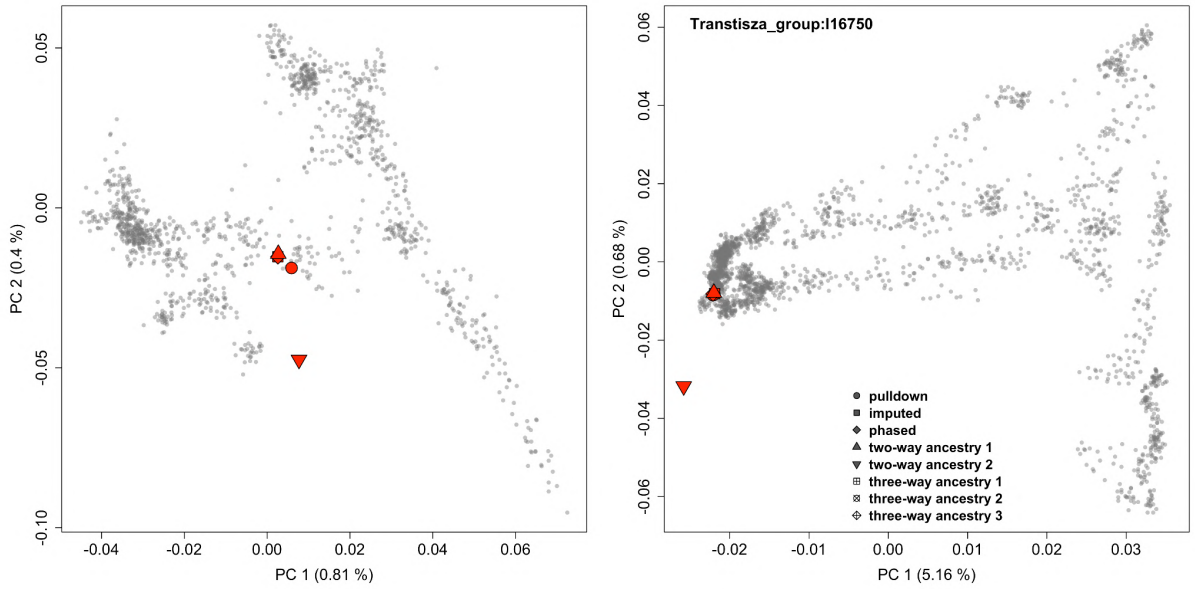

Figure xl. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

Kunbábony (Bács-Kiskun county, Hungary)

As of today, the richest Avar period burial - dated to the early/mid-7th century - came to light at Kunbábony in 1971. The detailed description of the archaeological context is presented in Csáky et al. 2020 and radiocarbon dated in Stadler et al. 2005.

- **A1802 - Grave 1**

This sample comes from grave 1 of this site. The 45-50 years old male uncovered in this grave had the richest burial assemblage from the early Avar period with 155 preserved artefacts; he was probably a member of the highest social rank. He was interpreted by the excavators as the Avar qagan. Although he was buried with prestigious artefacts, but it is debatable whether the burial contained proper *insigniae*. The genomic profile of this individual matches the other elite related individuals from the early Avar period in the DTI harboring 90-98% of Eastern Steppe ancestry source AR_Xianbei_P_2c (Fig xli).

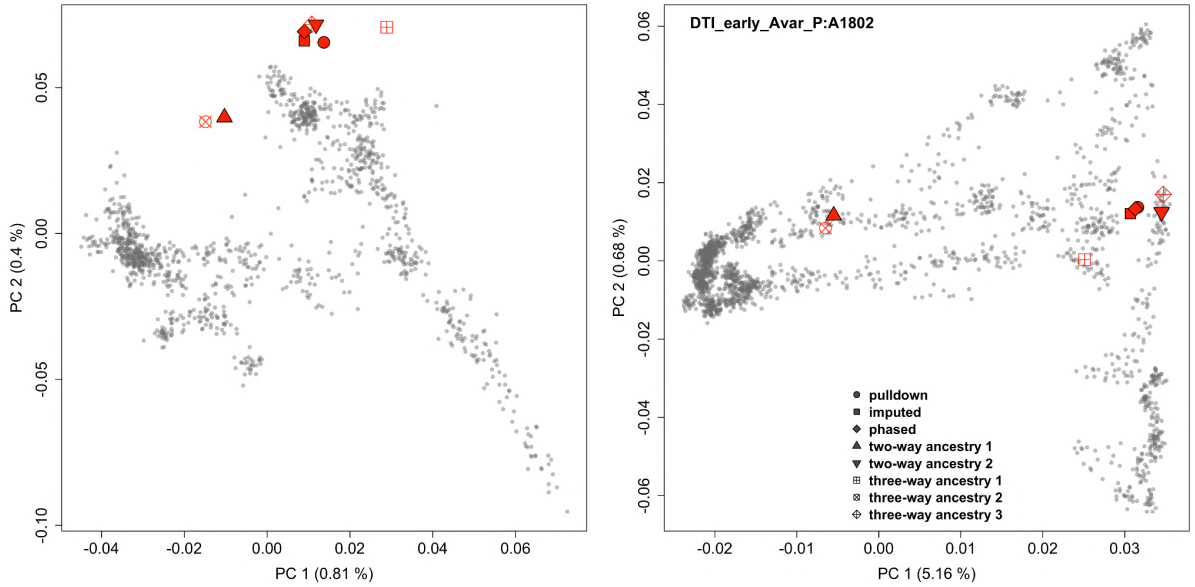

Figure xli. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

Kunpeszér, Felsőpeszéri út (Bács-Kiskun county, Hungary)

27 Avar period graves dated to the early/mid-7th century were excavated at this site in 1982 and 1984. The detailed archaeological context of the samples is presented in Csáky et al. 2020.

- **A1816 - Grave 5**

This sample originates from an adult female, who wore a gold earring**.** The genomic profile of this individual matches the other elite related individuals from the early Avar period in the DTI region harboring 90-98% of Eastern Steppe ancestry source AR_Xianbei_P_2c (Fig xlii).

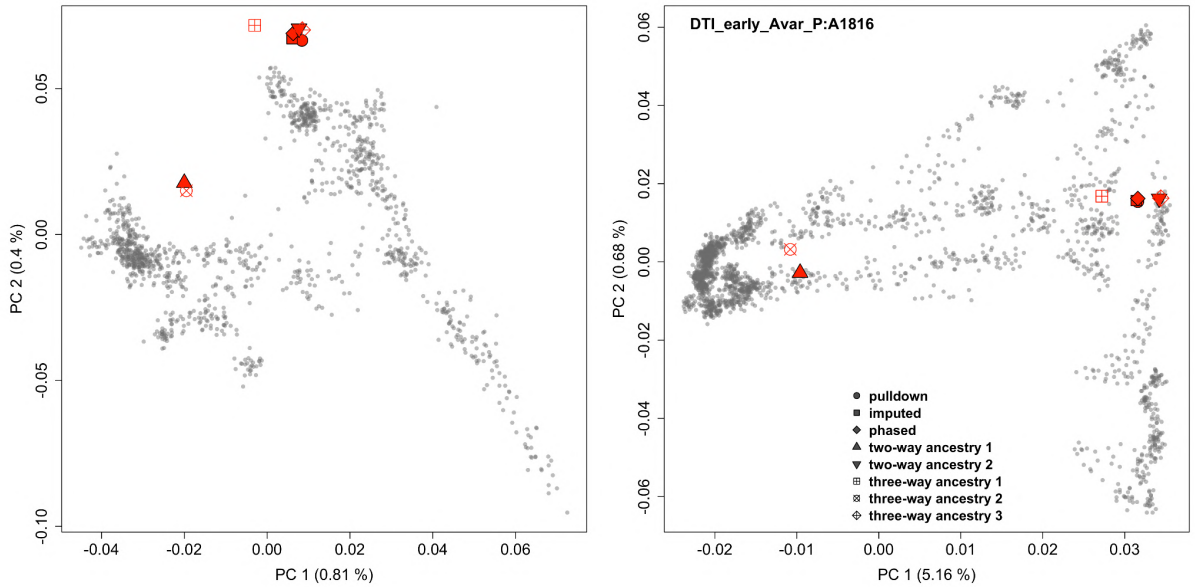

Figure xlii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A1817 - Grave 4**

This sample comes from a child burial without any grave goods. The genomic profile of this early Avar period in the DTI individual retrieved in an elite site, is outlier respect to the other elite related individuals from same site, region and period harbouring only ~50% of the Eastern Steppe ancestry source matching AR_Xianbei_P_2c and ~50% of local Carpathian Basin source matching Szolad_south_6c (Fig xliii).

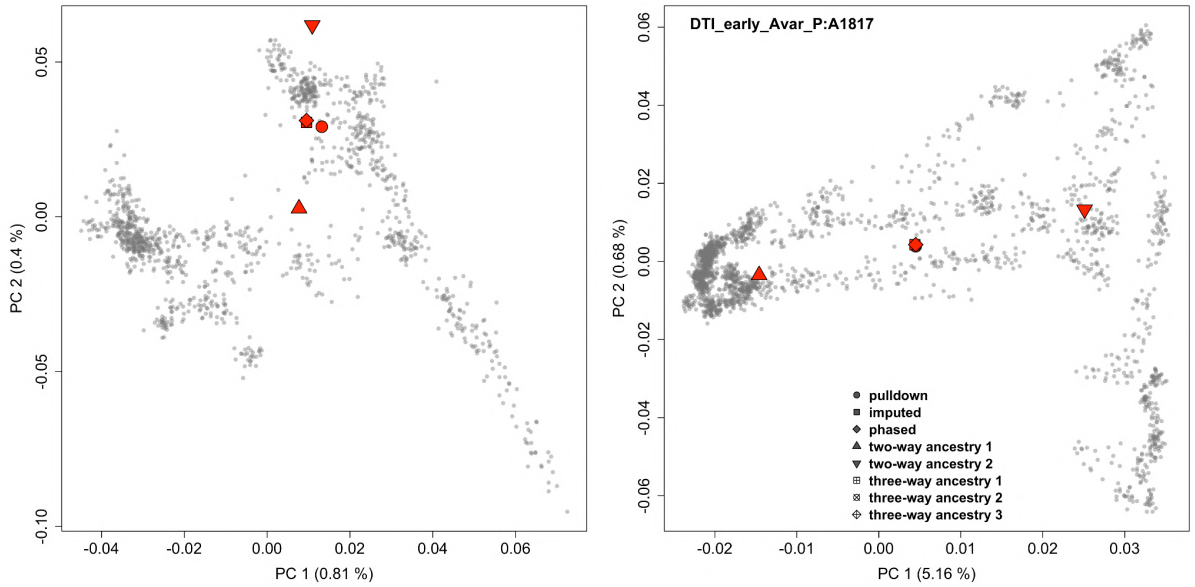

Figure xliii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A1818 - Grave 27**

This sample belongs to a female, who had a richly furnished grave with silver decorated artefacts. The genomic profile of this individual matches the other elite related individuals from the early Avar period in the DTI region harboring 90-98% of Eastern Steppe ancestry source AR_Xianbei_P_2c (Fig xliv).

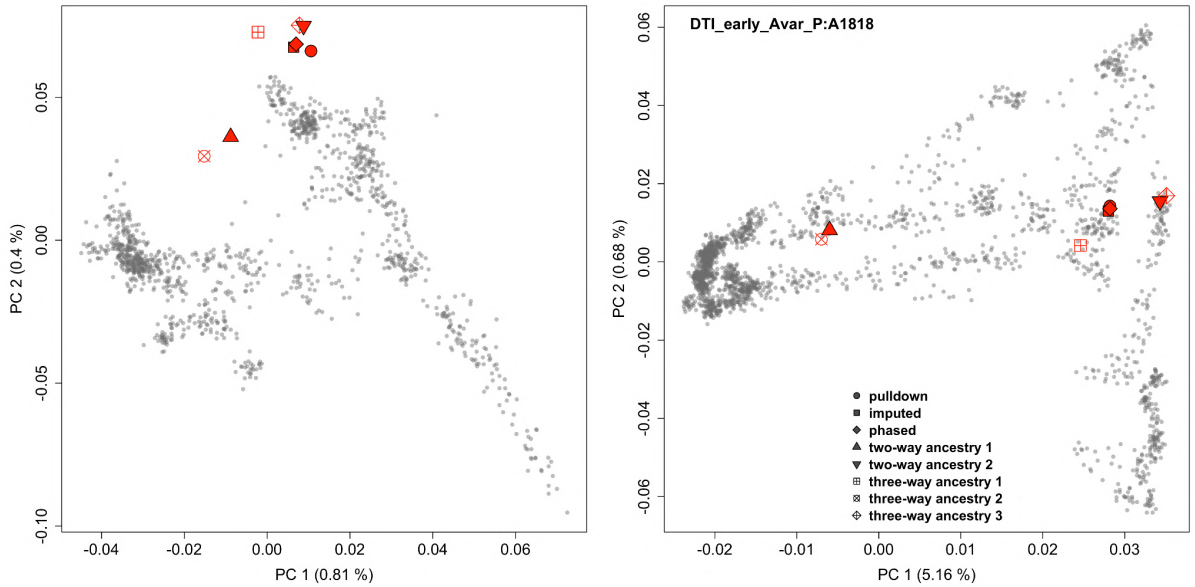

Figure xliv. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A1820 - Grave 9**

This sample originates from a mature-senile male buried with rich grave goods (sword, bow and decorated belt). The genomic profile of this individual matches the other elite related individuals from the early Avar period in the DTI region harboring 90-98% of Eastern Steppe ancestry source AR_Xianbei_P_2c (Fig xlv).

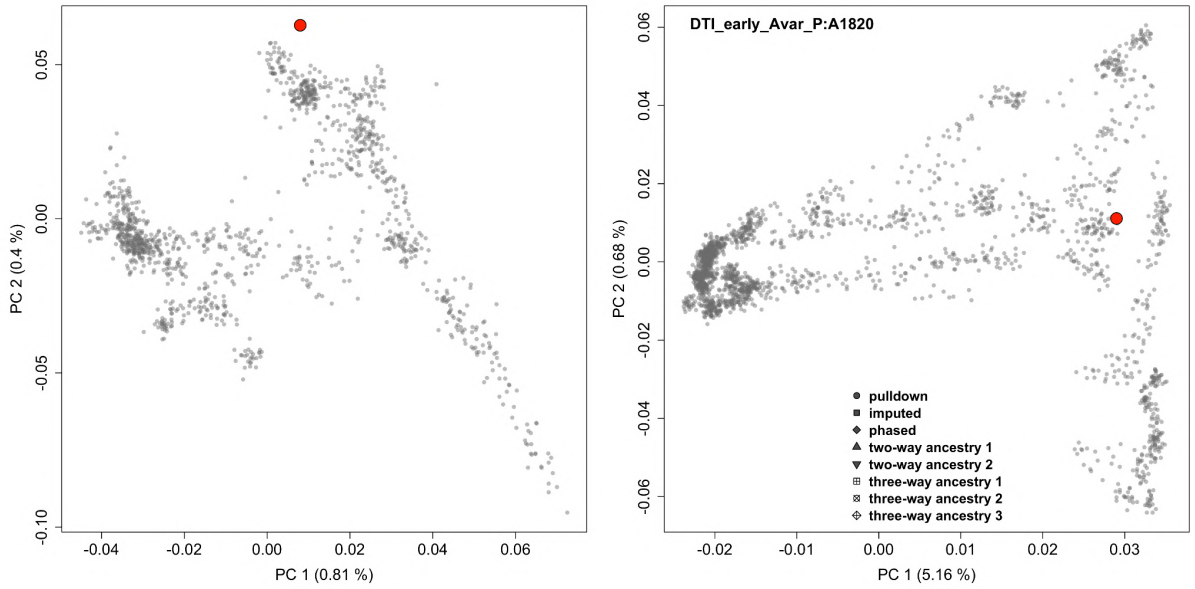

Figure xlv. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A1821 - Grave 3**

This sample comes from an elderly (mature-senlile) male who was buried with exceptionally rich grave goods like gold-plated sword and belt. The human sample was radiocarbon dated (Sigma2 95.4% probability 430AD-650AD; Balogh 2011).

The genomic profile of this individual matches the other elite related individuals from the early Avar period in the DTI region harboring 90-98% of Eastern Steppe ancestry source AR_Xianbei_P_2c (Fig xlvi).

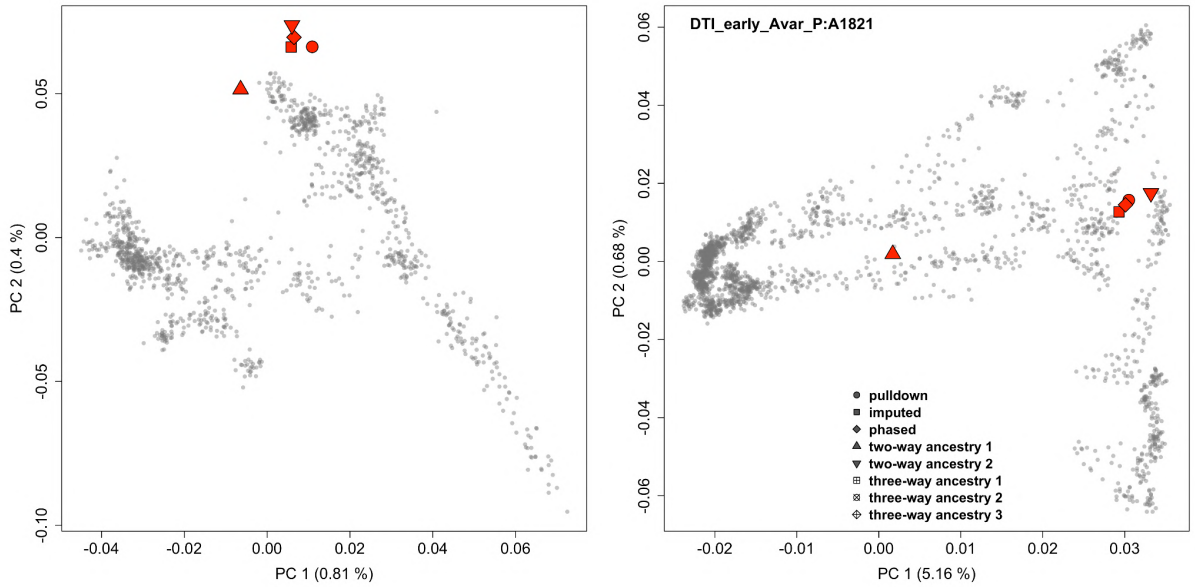

Figure xlvi. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A1822 - Grave 8**

This sample originates from a richly furnished grave of an adult male (sword, bow and multiple elements of a decorated belt made of precious metals were found). The genomic profile of this individual matches the other elite related individuals from the early Avar period in the DTI region harbouring 90-98% of Eastern Steppe ancestry source AR_Xianbei_P_2c (Fig xlvii).

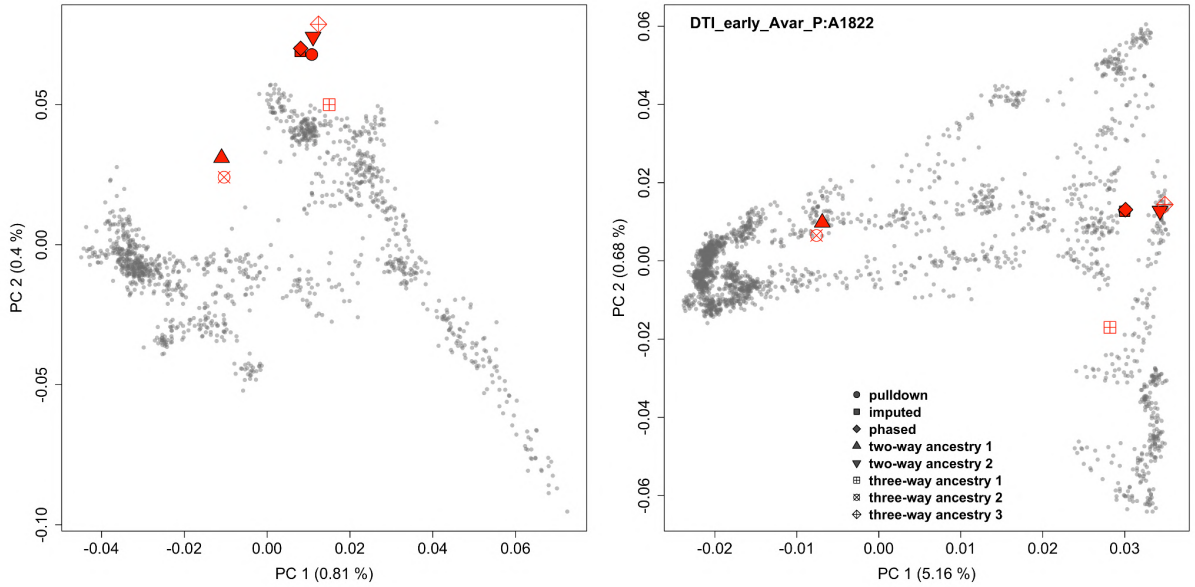

Figure xlvii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

Kunszállás, Fülöpjakab (Bács-Kiskun county, Hungary)

This cemetery dated to the 7-8th centuries was excavated between 1967-1979, and has been previously presented in the Csáky et al. 2020 study.

- **A1809 - Grave 51**

This sample originates from the grave of a maturus female. She was buried with sheep meat (bones) and wore some beads. The genomic profile of this individual matches the other elite related individuals from the late Avar period in the DTI harboring 60-80% of Eastern Steppe ancestry source AR_Xianbei_P_2c and a 40-20% of North_Caucasus_7c-like source (Fig xlviii).

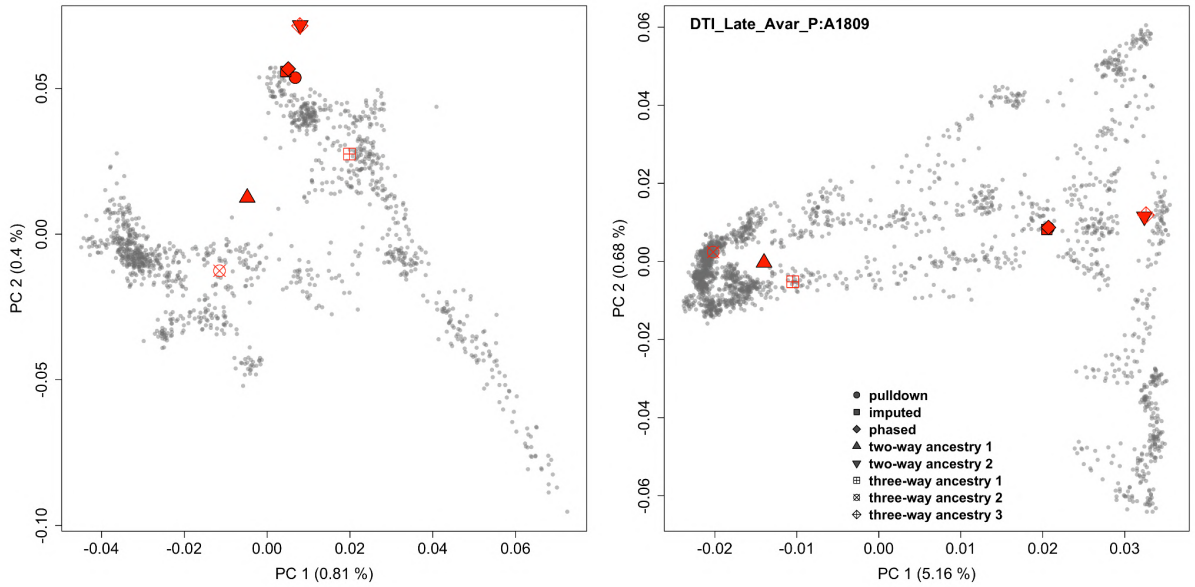

Figure xlviii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A1810 - Grave 14**

This sample originates from the grave of an adult female. Sheep meat was placed into her grave. The genomic profile of this individual matches the other elite related individuals from the late Avar period in the DTI harboring 80% of Eastern Steppe ancestry source AR_Xianbei_P_2c but unlike the majority of DTI late Avar period individuals the the remaining 20% matches different local Carpathian Basin sources (Fig xlix).

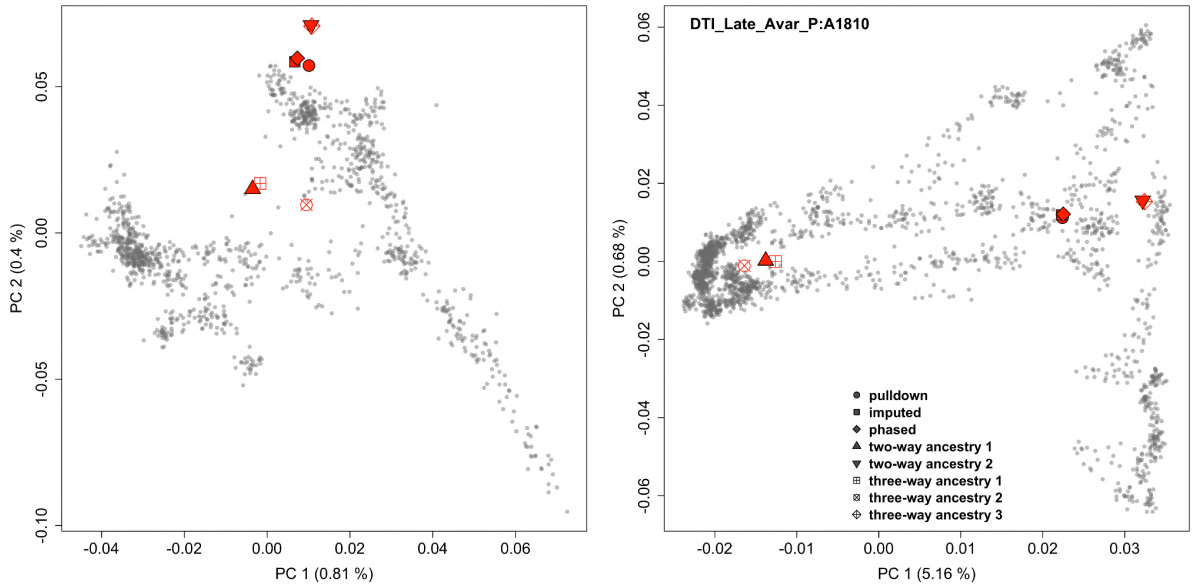

Figure xlix. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A1811 - Grave 30**

This sample was taken from the grave of an elderly female, whose burial contained sheep or goat bones. The genomic profile of this middle Avar period DTI individual matches the other elite related individuals from the early Avar period in the DTI harboring 90-98% of Eastern Steppe ancestry source AR_Xianbei_P_2c (Fig l).

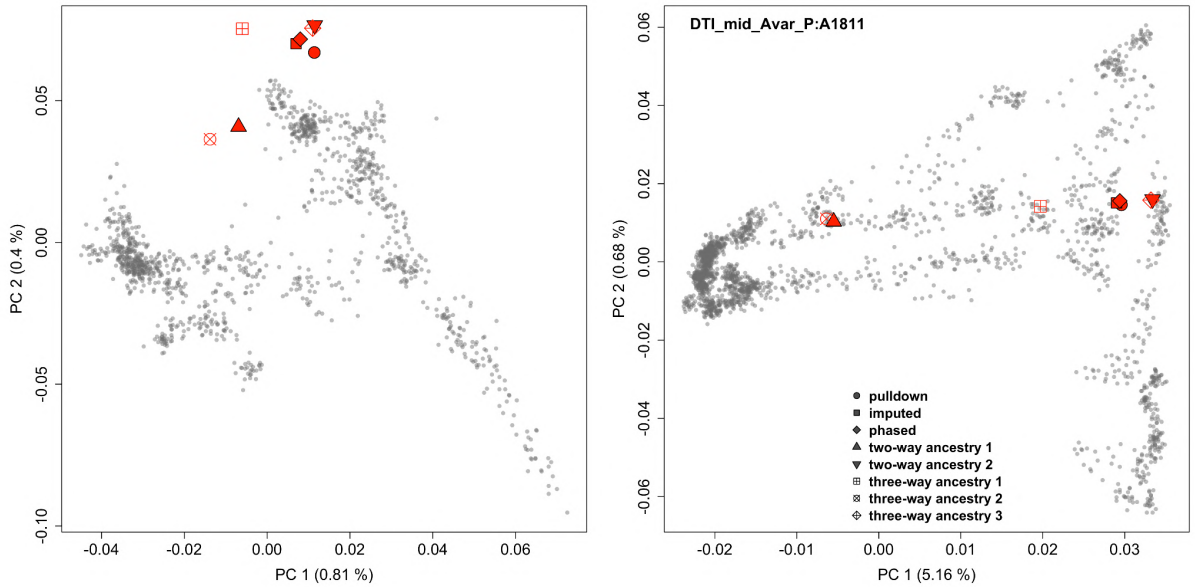

Figure l. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A1812 - Grave 32**

This sample originates from a richly furnished grave of a male individual buried with: gold earrings, golden hair clips, gold-foiled strap-ends with interlace patterns made of silver and a sword decorated with gold plates. The genomic profile of this middle Avar period DTI individual matches the other elite related individuals from the early Avar period in the DTI harboring 90-98% of Eastern Steppe ancestry source AR_Xianbei_P_2c (Fig li).

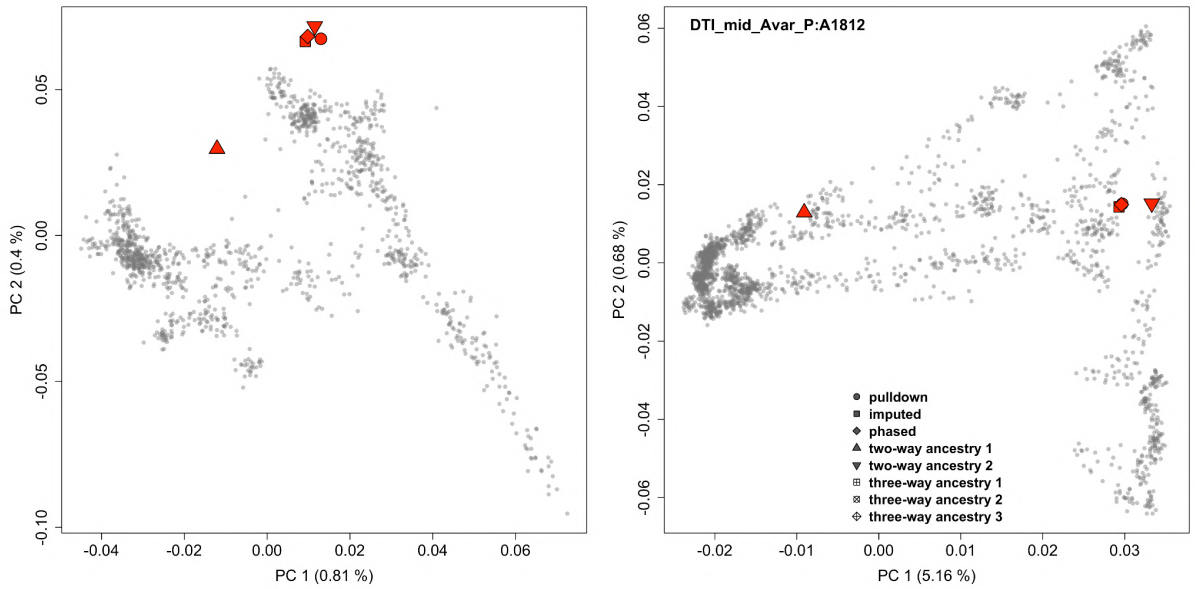

Figure li. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A1813 - Grave 28**

This sample originates from the grave of a young adult male buried with: pottery, goat/sheep bones and an iron knife. The genomic profile of this individual matches the other elite related individuals from the late Avar period in the DTI harboring 60-80% of Eastern Steppe ancestry source AR_Xianbei_P_2c and a 40-20% of North_Caucasus_7c-like source (Fig lii).

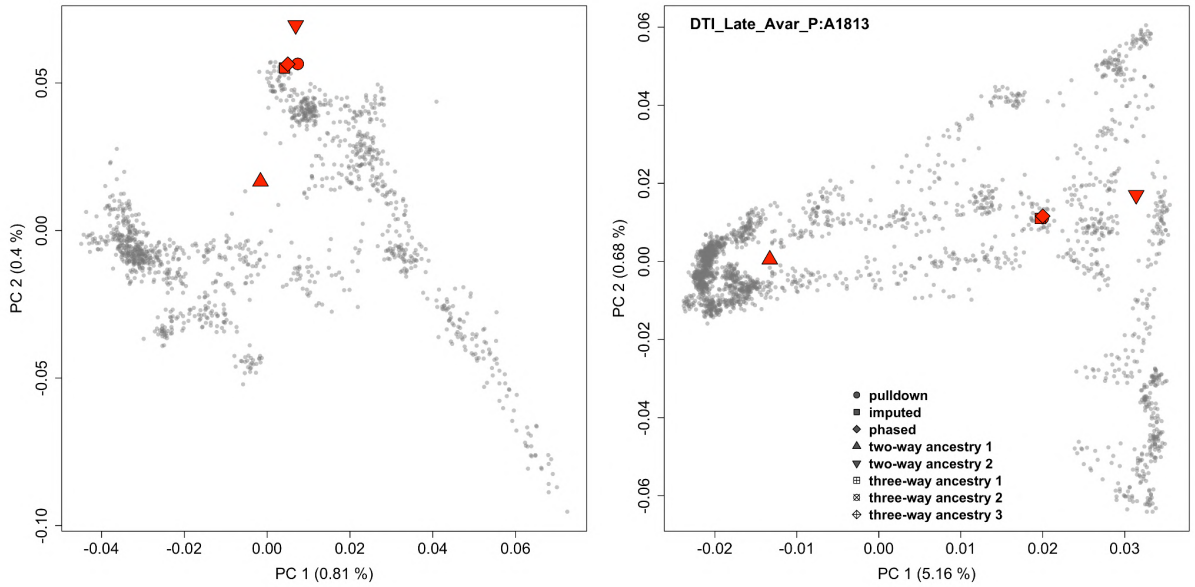

Figure lii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A1814 - Grave 59**

Sample of a male individual from a richly furnished grave (with a gold-foiled bronze belt). The genomic profile of this individual matches the other elite related individuals from the late Avar period in the DTI harboring 60-80% of Eastern Steppe ancestry source AR_Xianbei_P_2c and a 40-20% of North_Caucasus_7c-like source (Fig liii).

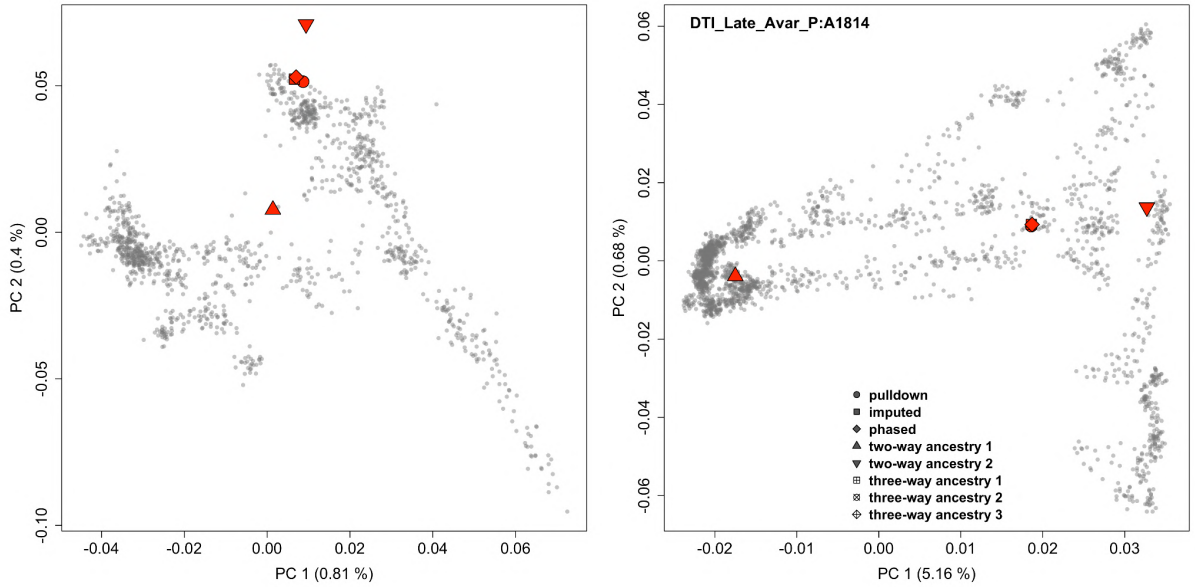

Figure liii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A1815 - Grave 52**

This sample of a male individual, whose grave was richly furnished (with gold-foiled cast bronze belt set with griffin and floral ornament). The genomic profile of this individual matches the other elite related individuals from the late Avar period in the DTI harboring 60-80% of Eastern Steppe ancestry source AR_Xianbei_P_2c and a 40-20% of North_Caucasus_7c-like source (Fig liv).

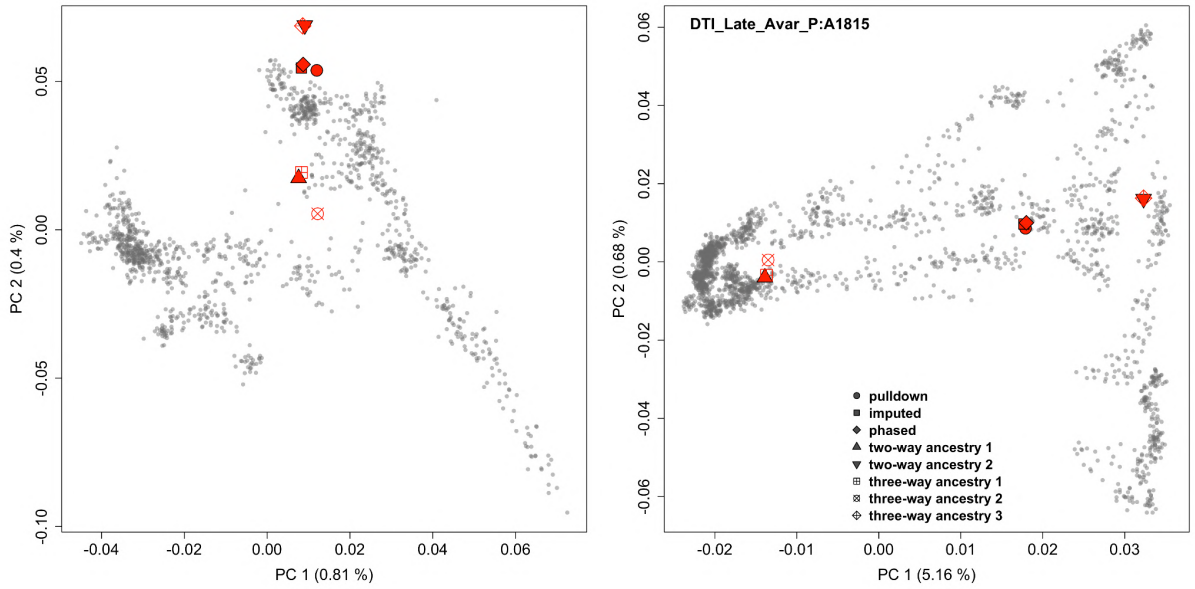

Figure liv. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

Kinship at Kunszállás

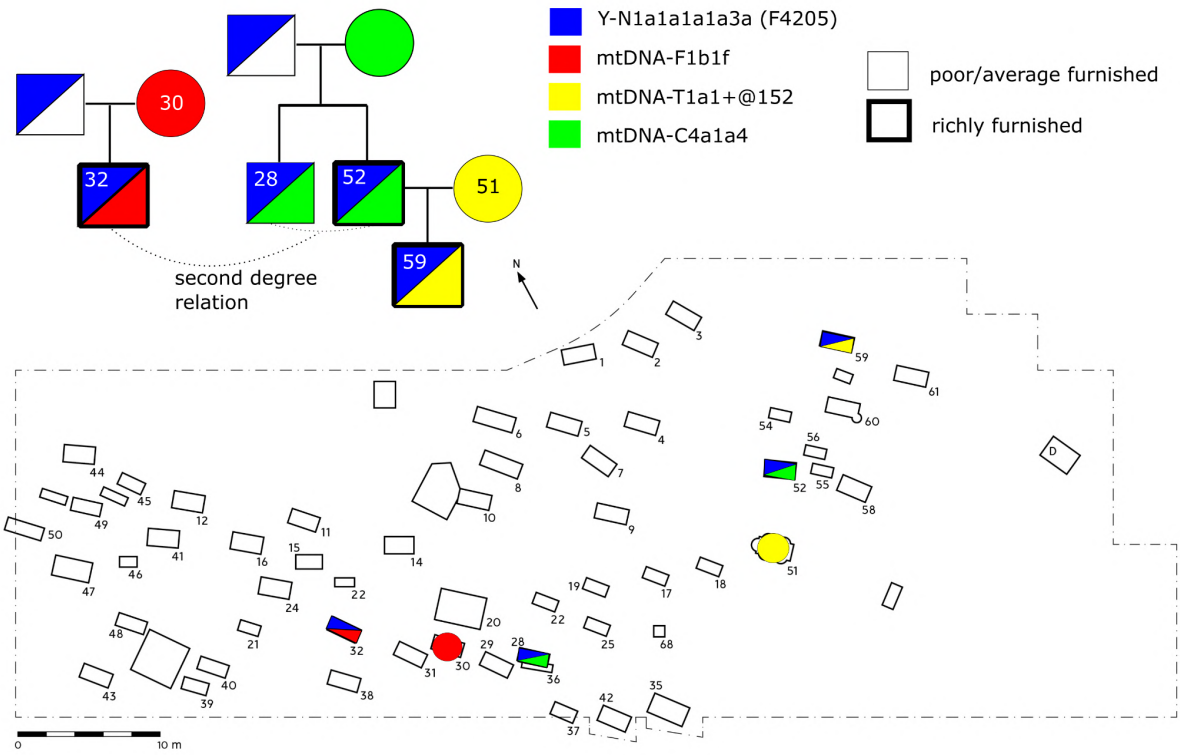

Figure lv. Pedigree of the related individuals found at Kunszállás and their respective position in the cemetery. The pedigree was reconstructed based on the information of degrees of genetic relatedness (Fig. S4), sharing/non sharing of uniparental haplotypes and mitogenome sequences and if informative the estimated skeletal age of the individuals.

Petőfiszállás (Bács-Kiskun county, Hungary)

The detailed description of this exceptionally rich, mid-7th-century solitary grave is found in Csáky et al. 2020.

- **A1819 - solitary grave**

This sample originates from a 40-45 years old male buried with a sword covered with gold plates and two belt sets. The genomic profile of this individual matches the other elite related individuals from the early Avar period in the DTI region harboring 90-98% of Eastern Steppe ancestry source AR_Xianbei_P_2c (Fig lvi)

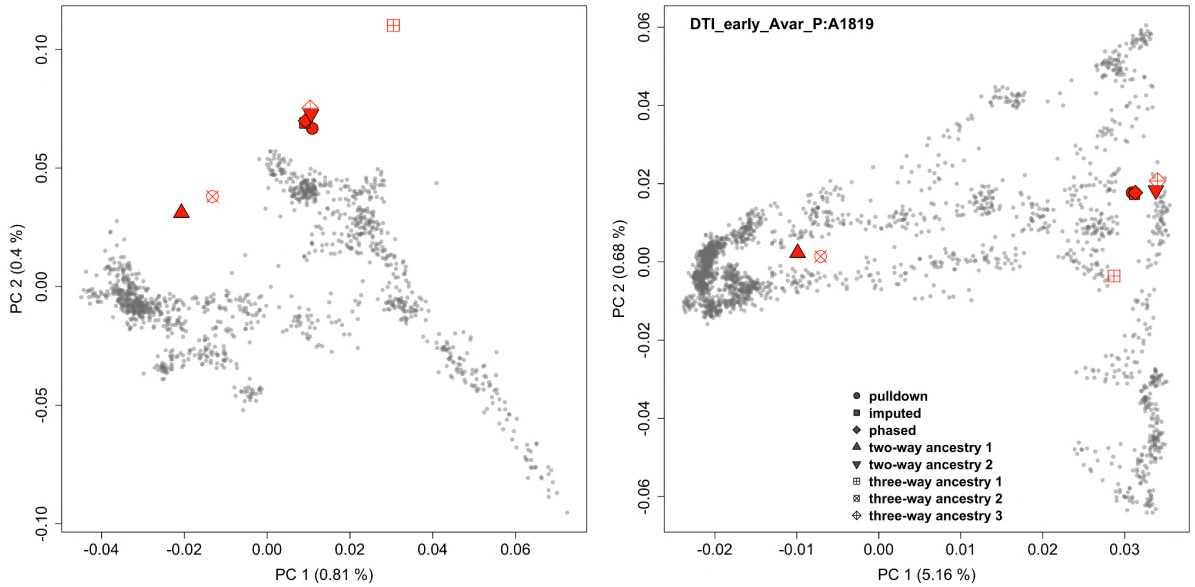

Figure lvi. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

Szalkszentmárton, Táborállás (Bács-Kiskun county, Hungary)

This site lay on a strategic position, which served as a crossing of the Danube from the Bronze Age onward and during the Roman and Late Roman period (*Intercisa*) as well. The early-7th-century site was excavated in 2015 and the archeological context of the grave is presented in detail in Csáky et al. 2020.

- **A1808 - Grave 1**

This sample originates from a grave of an adult male, which was richly furnished: skin, skull and lower legs of his harnessed horse, two belt sets, and a ring-pommel sword. He had a pit burial with a niche on the west side. The high-ranking man from Grave 1 was probably responsible for the control and protection of the river crossing. This individual shows similar characteristics to the Transtisza group (i.e. it is a niche grave partial horse burial found in the DTI region) and shows an admixed genomic profile with a major Eastern Steppe component (~70%) and both a Carpathian Basin and a Kazakh-to-Pontic steppe source (Fig lvii).

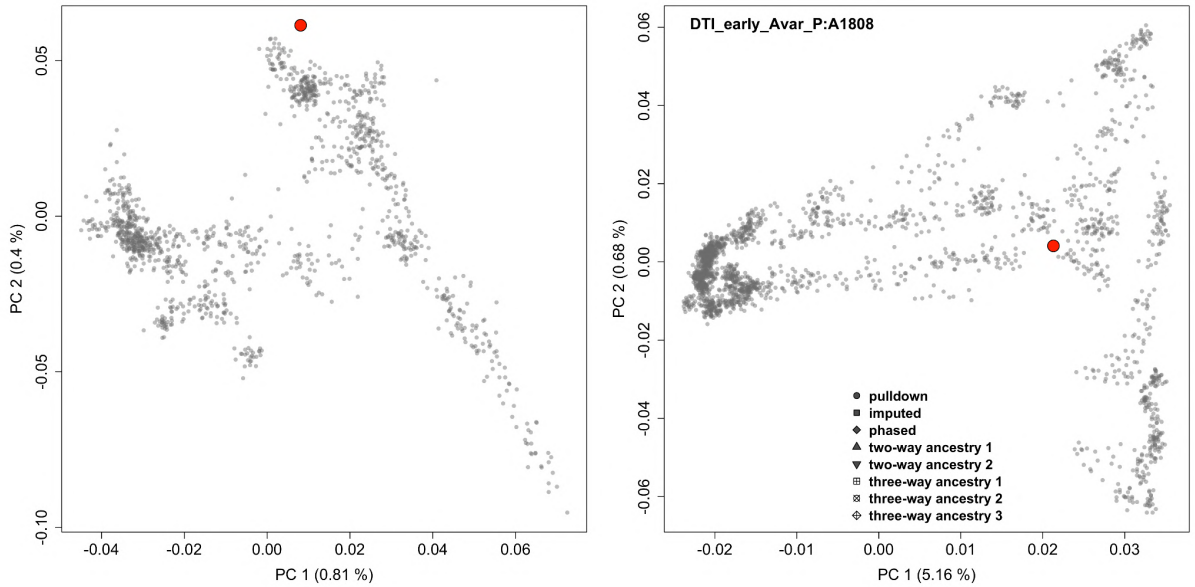

Figure lvii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

Szarvas, Kovács-halom, Site 8/1 (Békés county, Hungary)

The mid-7th-century graves excavated in 2015 from this site have been described in detail in Csáky et al. 2020. They belong to the Transtisza group.

- **A1804 - Grave 24**

This sample originates from a grave of an adult male, possessing a belt with pressed mounts. This individual belonging to the Transtisza group shows an admixed genomic profile with a major Eastern Steppe component (~60%) and both a Carpathian Basin and a Kazakh-to-Pontic steppe source (Fig lviii).

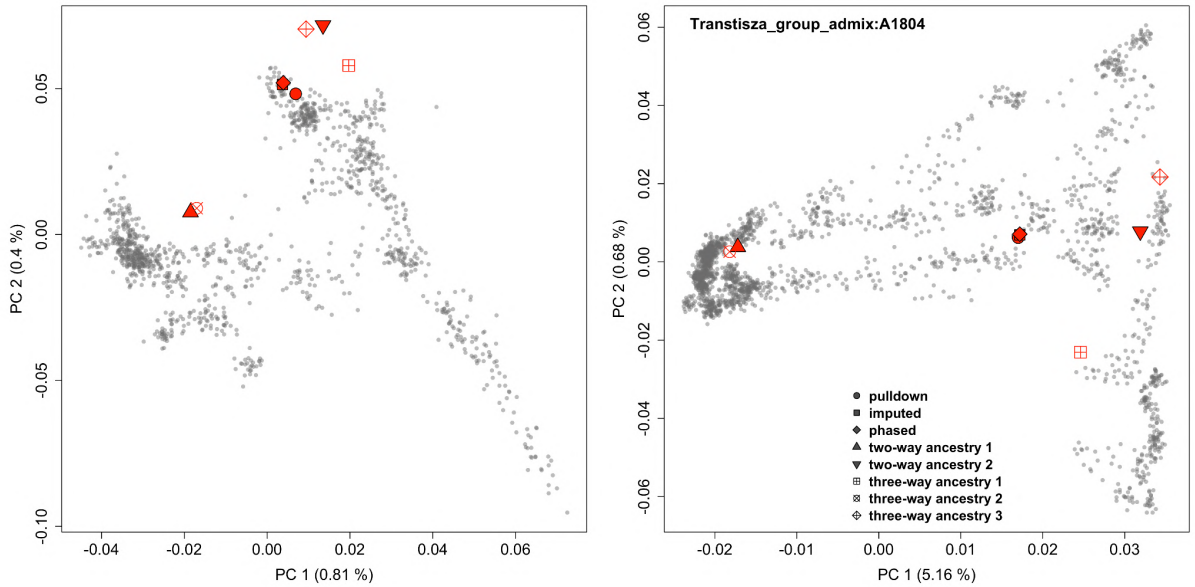

Figure lviii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A1805 - Grave 25**

This sample originates from the grave of an adult female. Her burial contained a decorated harness, she had a gold plate in her mouth and parts of a goat were placed into her grave. This individual belonging to the Transtisza group shows an admixed genomic profile with a major Eastern Steppe component (~60%) and a combination of Carpathian Basin and a Kazakh-to-Pontic steppe source provided fitting models (Fig lix).

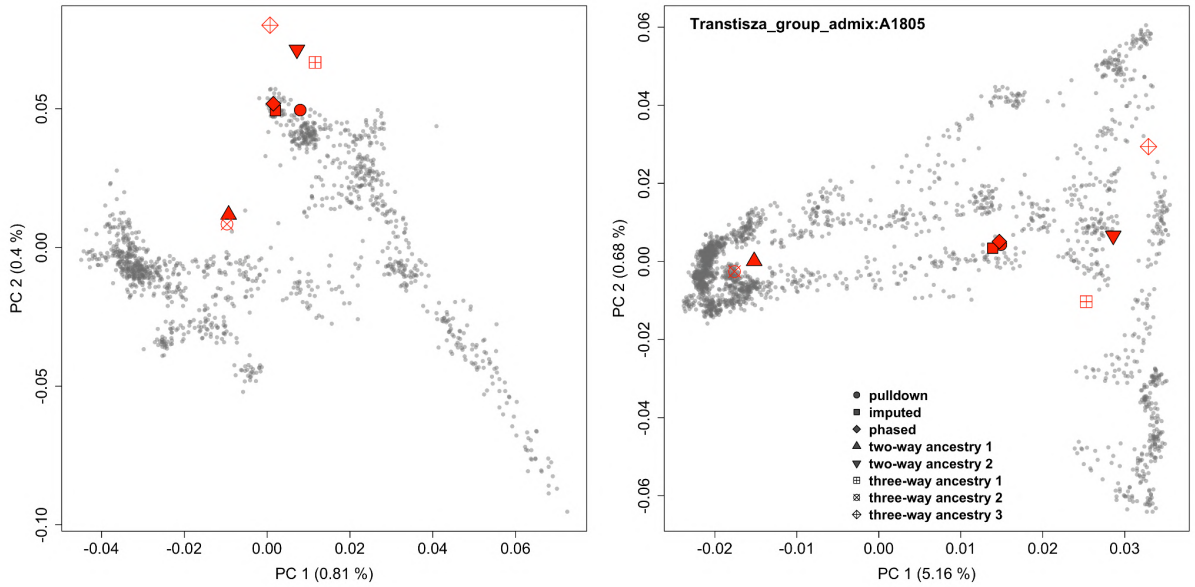

Figure lix. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A1806 - Grave 33**

This sample comes from the poorly furnished grave (no. 33) of an adult female. The genomic profile of this individual belonging to the Transtisza group matches the eastern profile of the early Avar period DTI elite (Fig lx).

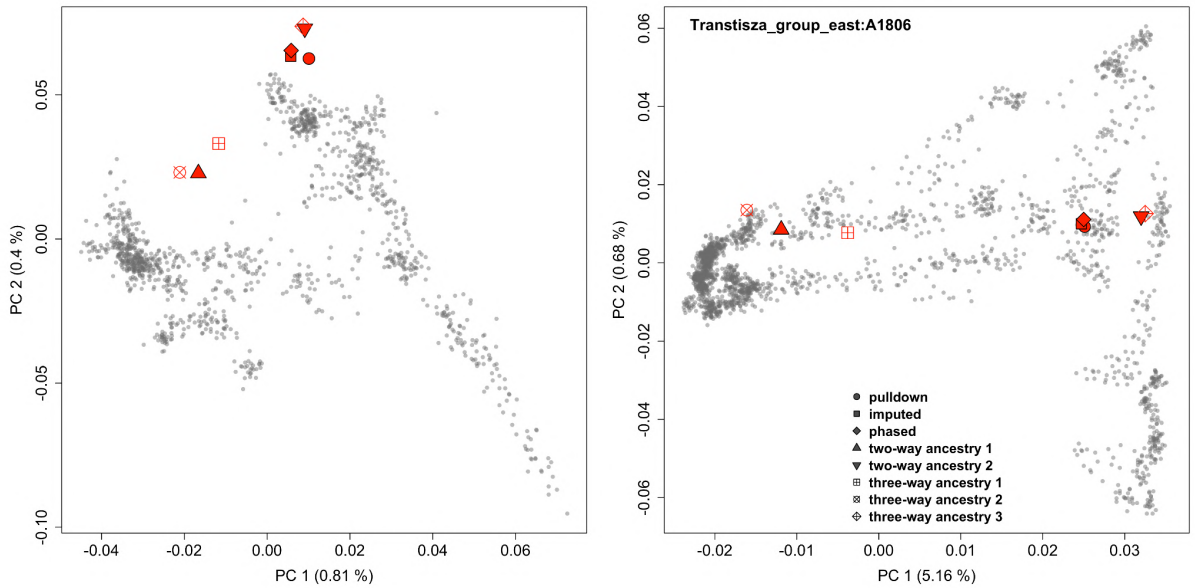

Figure lx. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **A1807 - Grave 40**

This sample originates from a grave of a juvenile male. The grave contained a decorated horse harness and gold sheet placed in his mouth. This individual belonging to the Transtisza group shows an admixed genomic profile with a ~40% Eastern Steppe component and ~60% of a component matching the IA_PonticSteppe_4cBCE group (Fig lxi).

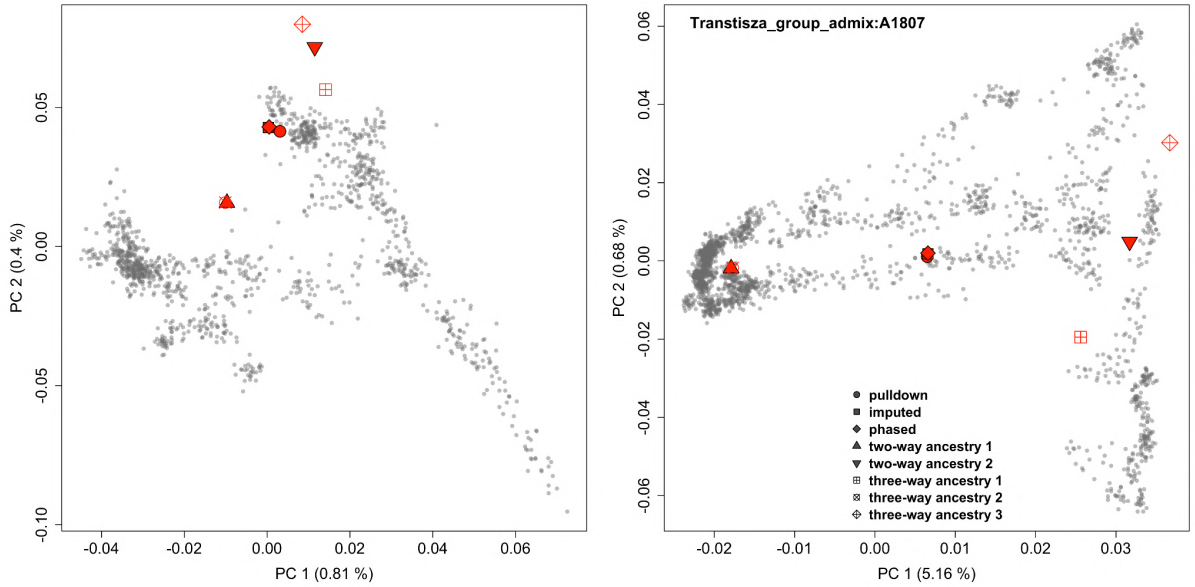

Figure lxi. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

Tiszapüspöki, Holt-Tisza-part (Jász-Nagykun-Szolnok county, Hungary)

The Damjanich János Museum (Szolnok) carried out rescue excavations, led by Judit Tárnoki and Zoltán Polgár, in 2014 and 2015 on the route of the M4 motorway, on the southern border of Tiszapüspöki. The Site 17 is located on the banks of a former Tisza riverbed, today the Szajol backwater. During the excavation, a total of 3858 objects from different eras (Neolithic, Bronze Age, Sarmatian period, Avar period, Árpádian Age) were excavated on 116 thousand square meters. The large-scale site was divided into Surfaces 'A', 'B', and 'C' during the excavations. A small Avar cemetery was also found on Site 17/A and 17/C (Kovács & Tárnoki 2018).
Nine graves of a larger cemetery were excavated on Site 17/A. The graves can be dated to the early Avar period. Their characteristic burial rite, found here in four cases, is that partial animals (skin, skull and legs of sheeps and cattles) covered the coffins.
On Site 17/C, a small Avar cemetery consisting of seven graves was completely excavated. At a considerable distance from the cemetery (about 200 meters) a solitary grave of a female was found (obj. no. 1128, str. no. 1169). In this case, the deceased was also covered with animal skin, because above the skeleton (or above the coffin) the skull and limb bones of a sheep or goat were found. The anthropological analysis was carried out by Tamás Hajdu and Antónia Marcsik.

- **I18174 - Feature 197/Str. 202 (Site 17/A)**

Rectangular grave of an adult male (230cm x 80cm x 63cm). Orientation: W–E. Well preserved skeleton in extended position, lying on its back. Above the skeleton sheep bones: the animal skull 13 cm above the human skull, the limb bones next to the grave wall. Grave goods: 1. iron buckle, 2. iron bracelet, 3. iron knife, 4. sheep bones.

This individual belonging to the Transtisza group shows an admixed genomic profile with a ~30% Eastern Steppe component and a ~70% source that best matches a preceding local Carpathian Basin group (Fig lxii).

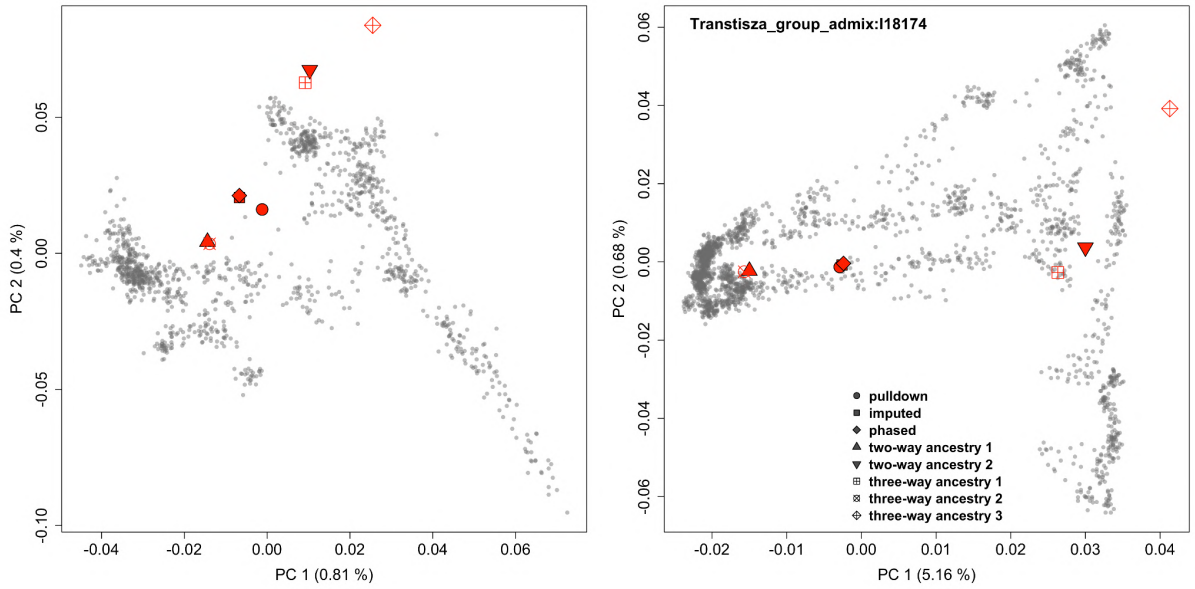

Figure lxii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-

way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **I18184 - Feature 247/Str. 257 (Site 17/A)**

Rectangular grave of an adult male (230cm x 95cm x 56cm). Orientation: NE–SW. The upper body of the skeleton lies to the right, its arms bent under the skull. Legs straight from waist down. Grave good: 1. D-shaped silver buckle.

This individual belonging to the Transtisza group shows a genomic profile that best matches a preceding local Carpathian Basin group, Szolad_others_6c (Fig lxiii).

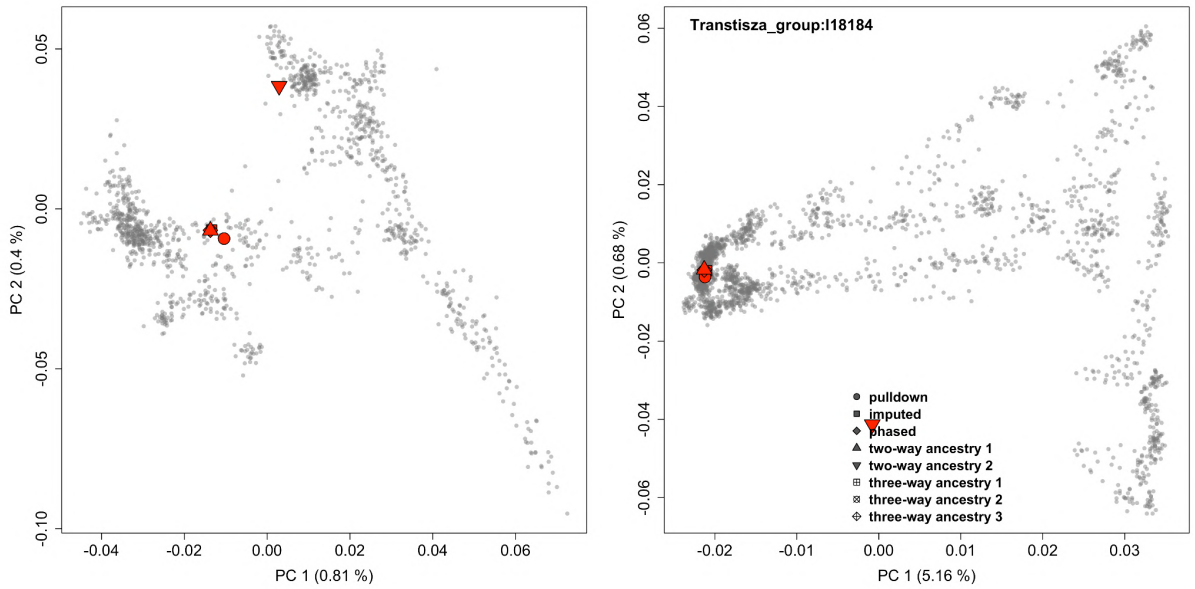

Figure lxiii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **I18185 - Feature 1128/Str. 1169 (Site 17/C)**

Rectangular grave of an adult female (200 cm x 86 cm x 50 cm). Orientation: W–E. The skeleton lies on its back, in an extended position. Well preserved bones. Grave goods: 1. hand-shaped vessel, 2. animal skull and limb bones (goat or sheep) above the left pelvis.

This individual belonging to the Transtisza group shows a higher affinity towards Mediterranean populations clustering with present-day Sicilians and Maltese, and plot at the very end of the Szolad_south_6c genetic cluster (Fig lxiv).

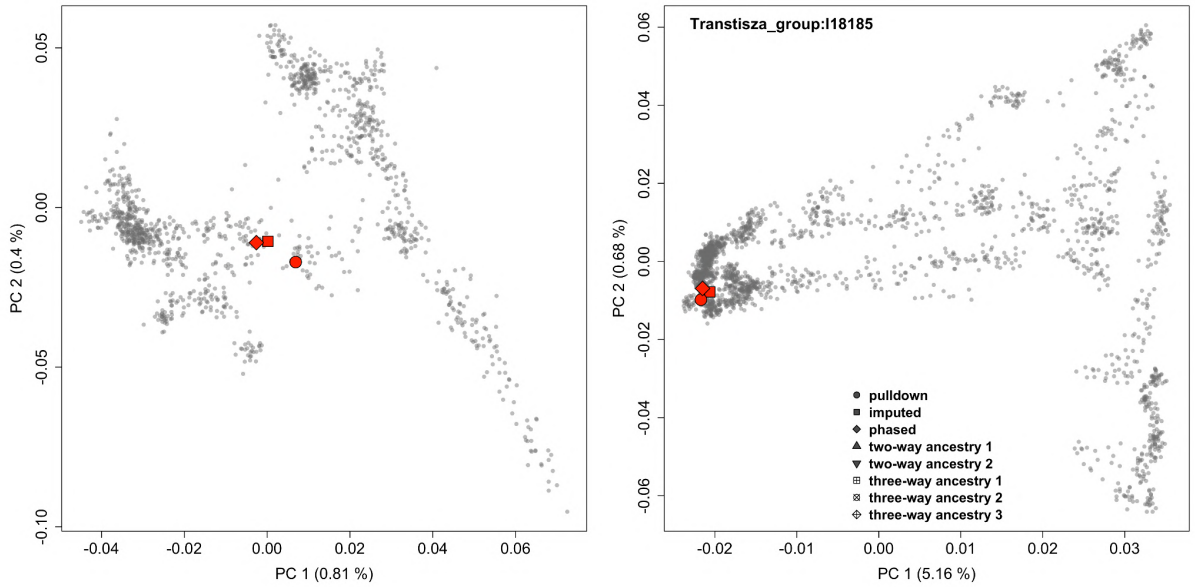

Figure lxiv. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

Visonta, Nagycsapás (Heves county, Hungary)

At the Visonta-Nagycsapás site Árpád Nagy (Dobó István Castle Museum, Eger) conducted an archeological excavation between 1969 and 1972. 102 graves were found, but the cemetery may have originally been twice that size. The site belongs to the Mátra region; it was used from the last third of the 7th century to the beginning of the 9th century. The anthropological analysis of human bones was performed by Tamás Szeniczey. The archaeological material is unpublished.

The cemetery fits well with the sites found in the region, and shows connections with the northern part of the Carpathian Basin in terms of object types and burial customs. Only few artefacts have been placed in the graves, these are finds typical of the late Avar period: bronze cast belt sets, earrings, beads, and iron objects (knives, belt buckles).

- **I16753 - Grave 34**

Inhumation burial of a 20-25-year-old male. Grave goods: iron knife, iron buckle, and animal bones.
This late Avar period individual shows a genomic profile best matching the preceding local Carpathian Basin groups, Szolad_south_6c (~98%), with ~2% of admixture with eastern sources (Fig lxv).

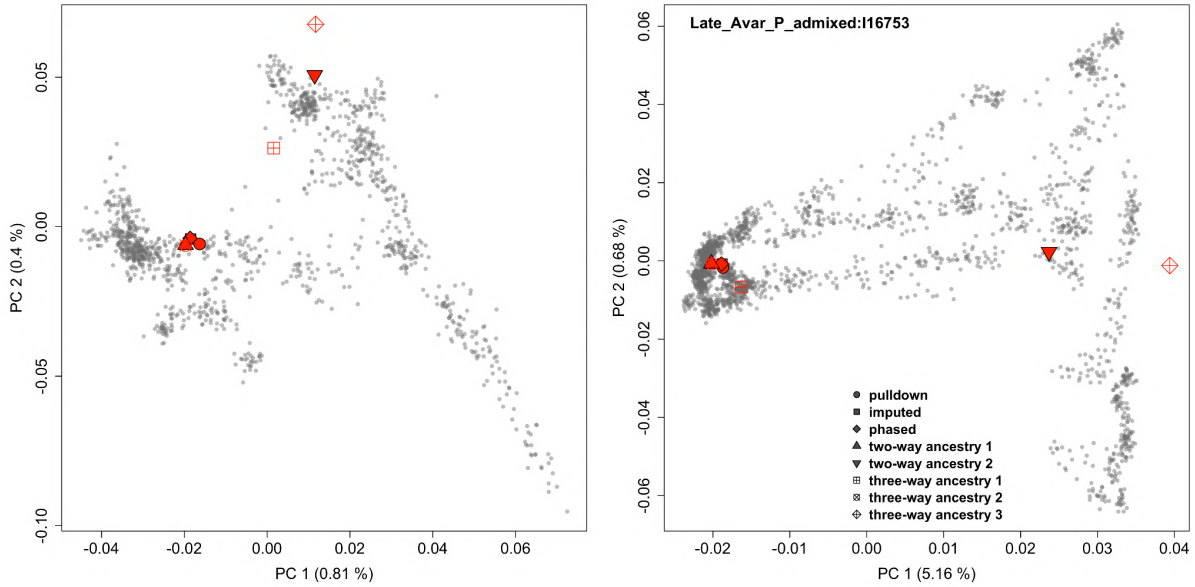

Figure lxv. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **I16752 - Grave 56**

Inhumation burial of a 17-19-year-old individual. Grave goods: fragment of a bronze earring and iron rings.
This late Avar period individual shows a genomic profile best matching the preceding local Carpathian Basin groups, Szolad_others_6c (~95%), with ~5% of admixture with eastern sources (Fig lxvi).

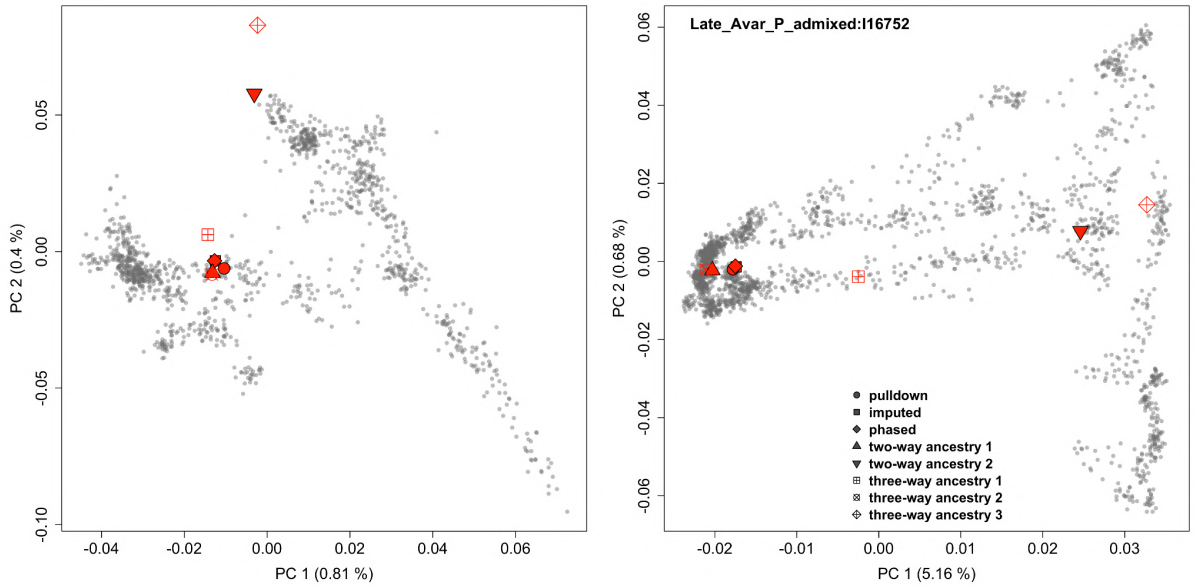

Figure lxvi. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

- **I16751 - Grave 102**

Inhumation burial of a 20-25-year-old female.

This late Avar period individual presents a genomic profile best matching the preceding local Carpathian Basin groups, Szolad_south_6c (~97%), with ~3% of admixture with eastern sources (Fig lxvii).

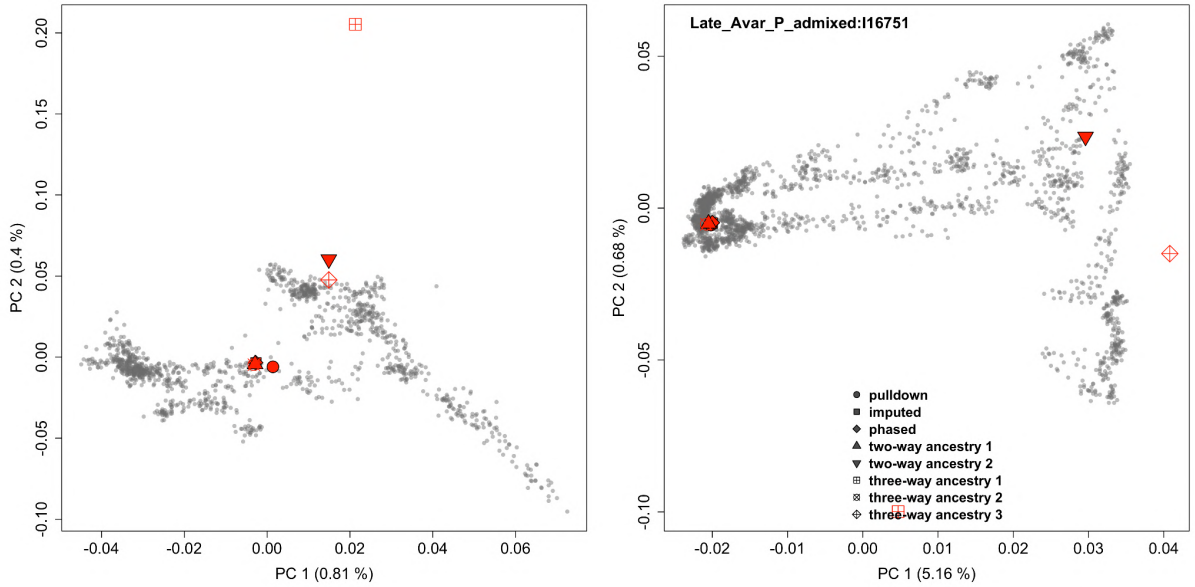

Figure lxvii. West Eurasian (left) and Eurasian (right) PCAs showing the position of the individual according to the basic random pseudohaploid call (pulldown) and its position after imputation, phasing and local ancestry analyses performed with Mosaic testing two- and three-way ancestries. The results of imputation, phasing and local ancestry analyses are present only if they were successful for the individual.

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