Title: "Investigation of a Historical Crime Scene" - A Comprehensive Study of an Unusual Burial in the Calvinist Church of Sóly, Hungary

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Abstract

A rescue excavation in the Chapel of the Presbyterian Church of Sóly, explored a grave of two men in an unusual position among 20 other child burials in 2008-2009. The burial is dated to the early modern (16-17th century AD) Period. The 45-50-year-old males showed signs of poor health condition and both had healed fractures and perimortem sharp force traumas including also injuries due to decapitation. Craniometric and morphological features suggested the two men of non-Hungarian origin but show similar characteristics to incoming populations from South Slavic areas during the Ottoman Period of Hungary (16-17th centuries). Strontium and oxygen isotope analyses were conducted, with O isotope ratios suggested that Skeleton 12 had a non-local childhood, with a ratio consistent with an origin further east in Europe. The ratio of the sample from Skeleton 11 was consistent with a local origin but also with a wide range of other places in Central and Eastern Europe. The two men are inferred to be non-local victims of murder or extra-judicial punishment and exemplify the high level of local conflicts in this troubled Period of Hungarian history.

Highlights

- Interpretation of an unusual burial of two males by merging data from the archaeological context with physical and forensic anthropological methods.
- Detected antemortem and perimortem traumas were evaluated to explore the possible causes and circumstances of the violent death of the individuals.
- Non-local origin was suggested based on craniometrical and morphological features supported by O isotope results for one individual.
- By merging our findings into bioarchaeological and historical context we could illustrate the nature of interpersonal violence in 16-17th century Ottoman Hungary.

Keywords

Weapon trauma, Ottoman Period, Hungary, strontium isotopes, oxygen isotopes

Introduction

Interpersonal violence in modern societies is a main subject of forensic anthropology and pathology and the most popular role of a forensic pathologist is in the investigation of cases of suspicious death many of which are caused by trauma (Skhrum and Ramsay, 2007). Violence in past societies often manifest on archaeological human skeletons but the interpretation of the causes of violence and the identification of the victims are difficult topics to tackle. Also, the analytical methods of the two fields of anthropology do not consciously meet. In this paper we attempt to examine how far we can get in the interpretation of one particular case of past violence.

The Hungarian Field Service for Cultural Heritage undertook excavations in the Presbyterian Church of Sóly in 2008-2009 prior to the renewal of the floor inside the building. Among 20 child burials, a grave containing two adult males was found. Due to lack of artefacts in the excavated context, the exact dating of the burial was a primary problem, thus dating the burial could be based only on the stratigraphic analysis. A later grave group was created in the church building during a short period, and 12 burials (13 individuals) from the nave belong to this period, including the burial of the two men. Their burial pit was cut into a burnt floor surface which is related to an abandonment deposit. These features probably formed when the church was damaged, and unused. According to an account from 1762, this phase can be dated to the early modern period (16-17th century) since at this time the area of Sóly was abandoned and the chapel was used as a sheepfold (Koppány 1989). This double grave therefore could be assigned to the period of the Ottoman occupation between the 16th-17th centuries (Rácz, 2004, Rácz, 2011).

Historically, the latter part of this time scale included the Ottoman invasion in Hungary from AD 1541 to 1699. The Ottoman Empire expanded its borders by invading the central and southern territories of the medieval Kingdom of Hungary. Villages and smaller country towns were partly or entirely deserted, as their tenants moved from the invaded areas to larger and safer towns. This depopulation was followed by settlement by varied groups of Balkan origin (Wicker, 2008).

Previous anthropological analyses of contemporary human remains demonstrated that metric and morphological cranial characteristics can clearly differentiate the incoming populations from ethnic Hungarians buried in late medieval cemeteries, despite a trend to brachycephalisation in this time Period (Allen and von Cramon-Taubadel, 2017; Molnár et al., 2008; Lovász, 2015). The settlers included both pastoral and military groups (Wicker, 2008). Palaeopathological analyses demonstrate that these populations had very poor health with a high incidence of traumatic injuries, findings which are indicative of the troubled times (Molnár et al., 2008; Lovász, 2015).

The aims of this study are thus (a) to identify the geographic and population origins of the two men from Sóly using bioarchaeological and stable isotope analysis, and (b) to employ an integrated forensic and ethnoarchaeological approach to create an osteobiography for these individuals and interpret the violence they experienced. We hope that our work illustrates how such an integrated approach can enhance our understanding of violence in the past.

Materials

Sóly is located in the western part of Hungary, north of Lake Balaton in Veszprém County (Fig. 1). It is first mentioned in a charter of AD 1009, which mentions a chapel dedicated to Saint Stephen the Martyr (Szentpétery, 1923), though the earliest surviving architectural evidence is from the 13th century. At some point during the Ottoman occupation (16-17th century) it went out of religious use and (Koppány, 1989) and only after this period was given to the Calvinist community, and was subsequently rebuilt around AD 1725 (Rácz, 2011).

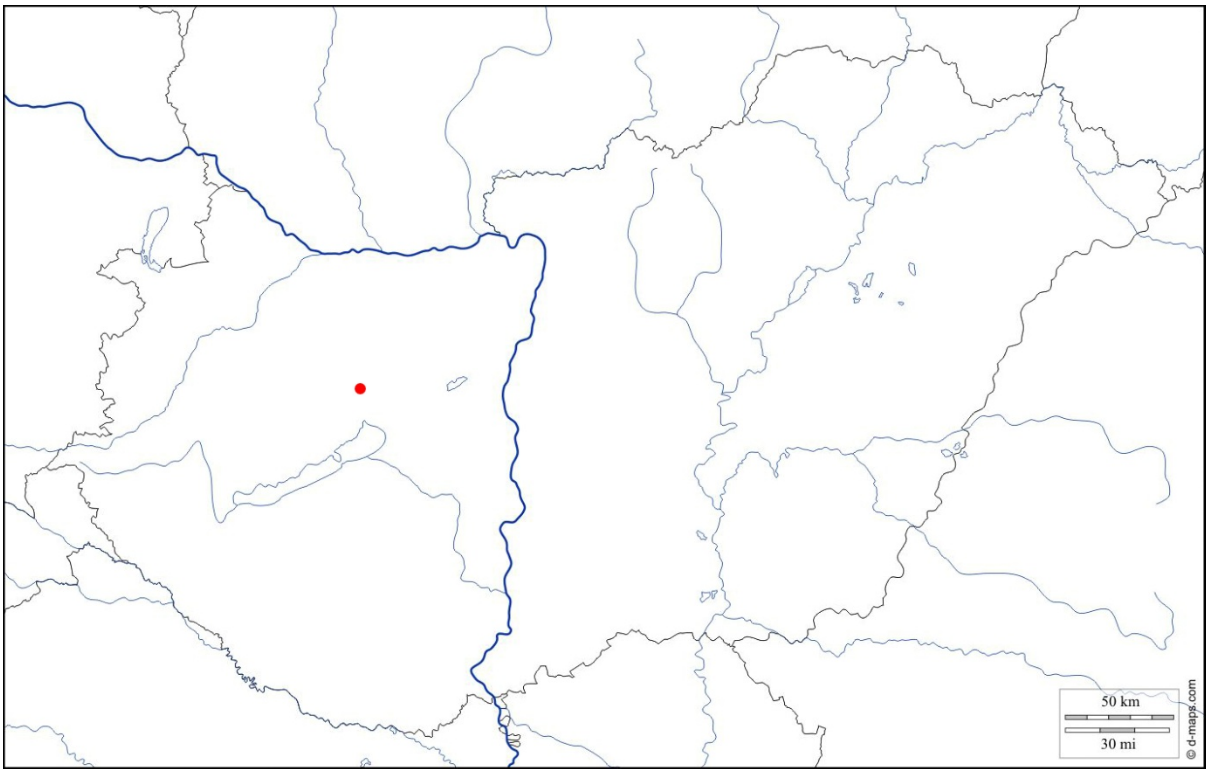

Fig. 1: The location of Sóly in western Hungary.

The church is situated on a raised area in a river flood-plain but the adjacent area is unsuitable for burials due to waterlogging. Hence the excavation found no evidence for an external cemetery, but only burials within the chapel. A total of 22 individuals were buried inside the church in two main burial phases. The first phase is probably related to an earlier building (11-13th centuries AD), whose foundations were excavated on the north side of the church. The second phase is associated with the 13th century building which still stands, and continues until the late 17th century. The burials of both phases are exceptional since they are all children, apart from skeletons 11 and 12 which are the subject of this paper. The other members of the local community must have used a different area as a cemetery. Similar practice is only known in medieval Hungary at the cemetery of Telekfalva, in Transylvania (Nyárádi and Sófalvi, 2009).

The double grave is aligned west-east and therefore does not represent the typical Christian ritual, unlike all the other skeletons which are in single graves and aligned east-west. Skeleton 12 was lying in a supine position, with the right arm extended to the right, and the left bent to the pelvis, while Skeleton 11 was lying in a flexed position on its left side, face down, and partly lying on top of the right side of Skeleton 12 (Fig. 2). The single grave-cut and close association of the two undisturbed skeletons indicates that they were buried simultaneously.

Fig. 2: Skeletons 11 and 12 showing their unusual disposition.

Methods

Skeletal analysis

Preservation and completeness of the skeletons was assessed following Buikstra and Ubelaker (1994). Sex assessment is based on the methodology proposed by Brickley and McKinley (2004). Age at death was estimated using the changes of the pubic symphysis (Brooks and Suchey, 1990), of the auricular surface of the ilium (Lovejoy et al., 1985), and of the sternal end of the ribs (İsçan et al., 1984). For analysis of the ancestral background cranial metrics and indices were used to express the skull shape following Bass (2005) and White et al. (2012). Stature was estimated based on the formula referring to both sexes elaborated by Sjøvold (1990).

Sharp force traumas were macroscopically analysed and recorded by location, and their morphological characteristics, such as edges, cross-sections, and surfaces (Wenham, 1989). Their angle and striation were used to determine the direction of the blow (Boylston, 2000, Kjellström, 2005). The skeletal materials are currently curated by the Laczkó Dezső Museum, Veszprém.

Isotope analysis

Strontium and oxygen isotope analysis was performed on four teeth, two from the individuals of interest, Skeleton 11 and Skeleton 12, and two from controls of presumed local origin, a child (Skeleton 13) and a deer.

Sampling and analysis followed the methods given in Mitchell and Millard (2009), which may be summarised as follows. Each tooth was sectioned using a flexible diamond coated cutting disc, and enamel separated. The crown and cut surfaces of the enamel were abraded from the surface to a depth of ~100µm using a tungsten carbide dental burr and the removed material discarded. Any adhering dentine was removed using the burr and the resulting core enamel isolated for strontium and oxygen isotope analysis.

Enamel samples of ~20-175mg were cleaned in deionised water and dissolved in 16M HNO_3. Strontium was extracted following the procedures of Charlier et al. (2006) as a fraction eluted from a column of Sr-Spec (Eichrom). Procedural Sr blanks were <0.7ng. $^{87}Sr/^{86}Sr$ ratios were measured using a ThermoFinnigan Multi-collector ICP Mass Spectrometer (MC-ICP-MS) in the Northern Centre for Isotopic and Elemental Tracing at Durham University. Reproducibility of the standard NBS987 during analysis was 0.710271±0.000006 (2SD, n=6).

Sub-samples of 10-20 mg enamel were prepared for isotope analysis using a modified version of the method of Dettman et al. (2001). Each sample was dissolved in 2M HF and 2M HNO_3, calcium precipitated as CaF_2 and the solution was centrifuged. The decanted solution was diluted and KOH and NH_3OH were added to bring it near to neutral pH. Then 2M AgNO3 was added and fine-grained silver phosphate (Ag_3PO_4) was precipitated. The precipitate was separated by centrifuging, was washed to remove excess silver ions and lyophilised. $\delta^{18}O$ measurements on the resulting yellow-brown Ag_3PO_4 precipitate were carried out using Continuous Flow Isotope Ratio Mass Spectrometry (CF-IRMS) in the Northern Centre for Isotopic and Elemental Tracing. The instrumentation comprised a TC/EA (high temperature elemental analyser) coupled to a Delta Plus XL isotope ratio mass spectrometer via a ConFlo III interface (Thermo Finnigan). Mean reproducibility on batch controls was 0.21‰ (1σ, n=12). All samples in the batch were analysed in triplicate, with a mean reproducibility of 0.16‰.

Results

Skeletal analysis

Skeleton 11 is a male of 45-55 years. According to the cranial index his skull is in the shorter brachycephalic range (Fig. 3, Table 1). The estimated stature based on the maximum length of the left femur is 165 cm.

Fig. 3: The skull of Skeleton 11.

Table 1 Craniometric data and indices of Skeleton 11 and 12.

Martin No.	Skeleton 11	Skeleton 12
1	176	173
5	(102)	96
8	142	152
9	96	102
10	124	139
17	(149)	137
40	-	90
45	-	-
46	103	88
47	-	-
48	-	-
51	43	42
52	34	36
54	27	25
55	54	56
62	53	45
63	72	66
65	-	125
66	107	104
69	-	36
70	76	66
71	35	27
8:1	80.68	87.86
17:1	84.66	79.19
17:8	104.93	90.13
20:1	-	-
20:8	-	-
9:8	67.61	67.11
47:45	-	-
48:45	-	-
52:51	79.07	85.71
54:55	49.07	44.64
63:62	135.85	146.67

Skeleton 12 is a male of 45-55 years old. His skull is also short, very wide and high, with a wide forehead, which has a very wide maximum breadth. The cranial index places it in the very short hyperbrachycephalic range (Fig. 4, Table 1). The estimated stature based on the maximum length of the left femur is 176 cm.

Fig. 4: The skull of Skeleton 12

Both skeletons demonstrate poor health, with some shared pathologies. These shared conditions include osteoarthritis (OA), subperiosteal new bone formation, and degenerative changes of the spine (spondylosis deformans, spondylarthrosis). Skeleton 11 exhibits severe OA of the right hip with eburnation on both the flattened femoral head and the surface of the acetabulum. The aetiology of OA is multifactorial, but the most significant factors can be identified as age and high levels of physical activity (Jurmain, 1999; Waldron, 2009) which both lead to mechanical stress on the joints. Both skeletons show severe and diffuse subperiosteal new bone formation on the long bones, as a sign of non-specific infection but we also cannot exclude severe metabolic disorder as a possible cause. This occurred on the radiuses, on the right femur, on the tibias and fibulas on Skeleton11. On Skeleton 12 only the femurs were affected. In addition, Skeleton 11 has a developmental defect, spina bifida, and a non-metric variation, os acromiale, which also can develop at younger ages as a result of intensive physical activity of the shoulder joint (Stirland, 1996; Case et al. 2006; Fiorato et al., 2007).

Skeleton 12 has a pseudojoint between the right fourth and fifth metacarpals. Their articulation moved slightly distally, probably due to dislocation (Lovell, 1997). Skeleton 12 also presents a rare example of DISH (Roberts and Manchester, 2010). On this skeleton bony ankylosis affects the ninth through the twelfth thoracic vertebral segments. The irregular ligament calcification of the anterior ligaments on the right side of the spine caused ankylosis of the vertebral bodies. The intervertebral disk space and the apophyseal joints are not involved. Ossification of extra-spinal location entheses and ligaments (eg. patella, sternum) are also present. These symptoms probably constitute a rare example of DISH (Roberts and Manchester 2010, Waldron 2008). Their dentition indicates poor dental health. Both individuals lost 13 teeth antemortem, had caries, abscesses and severe calculus deposition and displayed severe attrition.

Antemortem injuries

Skeleton 11 displays blunt force trauma on the right parietal near the lambdoid suture (Fig. 5a). The left one is deeper and rounded; the right is oval and shallow. The ectocranial surface is roughened and porotic around the injuries, indicating that they probably resulted in infection or haematoma. A fracture on the left second rib was healed with a slight dislocation.

Skeleton 12 exhibits healed injuries on the postcranial skeleton. There are fractures on the right 4th to 7th ribs (Fig. 5b). These are in line and were limited to the middle or posterior portions of the shafts. On the 5th and 6th appeared two fracture lines causing serious angulations on the shafts which suggest that they are originated from a blunt force trauma and that pushed the mid parts of their shafts toward the lung. All these fractures healed with severe dislocation. On one of these ribs there was a partially healed fracture, showing that these injuries were not completely healed at the time of the death. Skeleton 12 also displays an oblique fracture of the right scapula blade with notable anterior-posterior dislocation and partial non-union (Fig. 5c). There are oval holes with sharp edges in the infraspinous fossa and the medial part of the scapula blade bent dorsally. These perforations probably indicate incomplete healing of a comminuted fracture. Dislocation of the scapula probably also led to immobility or abnormal posture of the shoulder. Such injury was most likely caused by a direct force such as falling onto the shoulder or blunt force trauma (Blondiaux et al., 2012). The injured 4-7th ribs which are located at the area of the fractured scapula show a similar healing stage. This may mean that the injury of the scapula and the ribs could be linked to a single traumatic event, most probably direct trauma with a high kinetic force. Finally, there was a cutmark (c. 11.7×2.72 mm) on the anterior surface of the medial condyle of the femur, though the edges were still clear, they were rounded indicating also incomplete healing just as with the fractures (Fig. 5d).

Fig. 5: Antemortem injuries. (a) blunt force injuries on the right parietal of Skeleton 11; (b) fractured rib of Skeleton 12; (c) fracture of the right scapula of Skeleton 12 (d) cutmark on the femur of Skeleton 12.

Perimortem injuries

Skeleton 11 exhibited three sharp force traumas on the skull from differing directions. The most characteristic is a sharp horizontal cut on the squama of the occipital bone with well-defined edges and smooth surface, close to the inferior nuchal line (Fig. 6a). The morphology of the cut indicates a blow from above and the right. A second blow detached the apex of the right mastoid process and cut the surface medially from there (Fig. 6b). The cut is also sharp, exposing the trabecular structure of the bone. The third is a superficial cut superior to the mastoid.

Fig. 6: Sharp force traumas to the skull of Skeleton 11. (a) horizontal cut on the occipital bone; (b) cut on the skull surface (A) and through the apex of the right mastoid process (B).

On the cervical spine of Skeleton 11, sharp force traumas also damaged the atlas and the axis (Fig. 7a). On the right (Fig. 7a), the weapon cut the superior surface of the anterior arch of the atlas, its right superior articular facet, the surface of the odontoid apophysis of the axis, and exposed the trabecular layer in an oblique manner. Finally, it went through the posterior arch of the atlas, where the surface is roughened rather than smooth and sharp. The cutmark on the left (Fig. 7a) is inferior to the superior articular facet of the atlas. A line drawn through these cuts demonstrates the different angulations on the two sides of the atlas (Fig. 7a). This difference is also visible in a different view (Fig. 7b).

A cut was also found on the right ramus of the mandible below the caput and penetrating 2 mm into the bone (Fig. 7c).

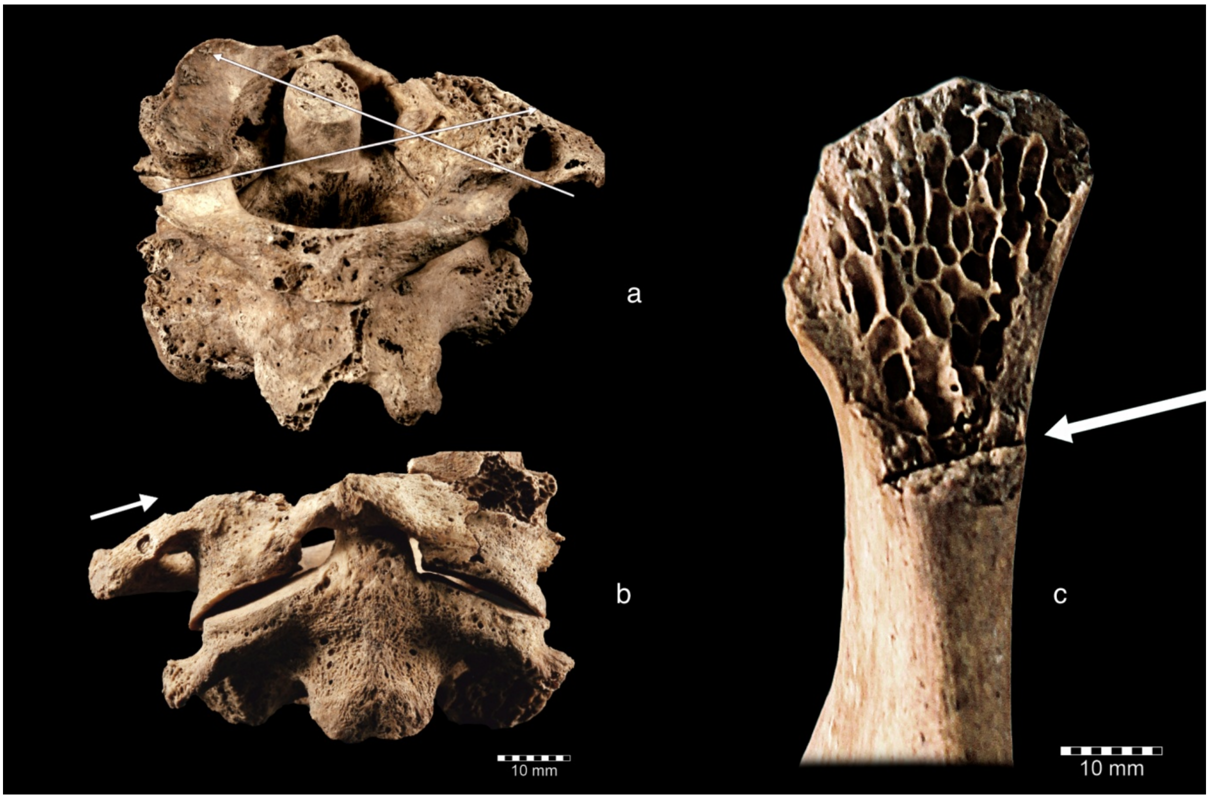

Fig. 7: Sharp force traumas to the spine of Skeleton 11 (a) on the atlas and the axis; (b) alternative view of the atlas and axis; (c) on the right ramus of the mandible.

From the medial angulation and direction of the cut to the ramus, this appears to be the same blow that cut the mastoid and penetrated the right part of the atlas. The blow stopped in the mandible and the caput probably broke off when the weapon was withdrawn. However, this blow appears not to have damaged the base of the skull, which could only happen if the head was straight or downward. CT imaging was used to analyse whether the cuts on the first vertebrae with different angles could be delivered from one direction (Fig. 8).

a) If the head was upward, the angulations would not match, but also the mastoid and the mandible would be in a higher position than the atlas, so it would not be possible to damage all of them with a single blow.

b) If the head was facing down: the blow could penetrate through all the relevant bones at once, but they still would have different angles to those observed.

c) If the head was flexed to the left and downward, the directions of the various cuts would match, including the medially sloping cut on the mandible matching with the cut on the left side of the atlas (Fig. 8).

The injuries therefore suggest that Skeleton 11 was decapitated from behind, whilst the head was bowed to the left. From the position of the head and from the direction of this cutmark we can suggest that the man was kneeling at the time of the blow and fell to the left which could also explain his crouching position in the grave. Since he was lying on Skeleton 12, this also means that the other individual was already lying in the grave.

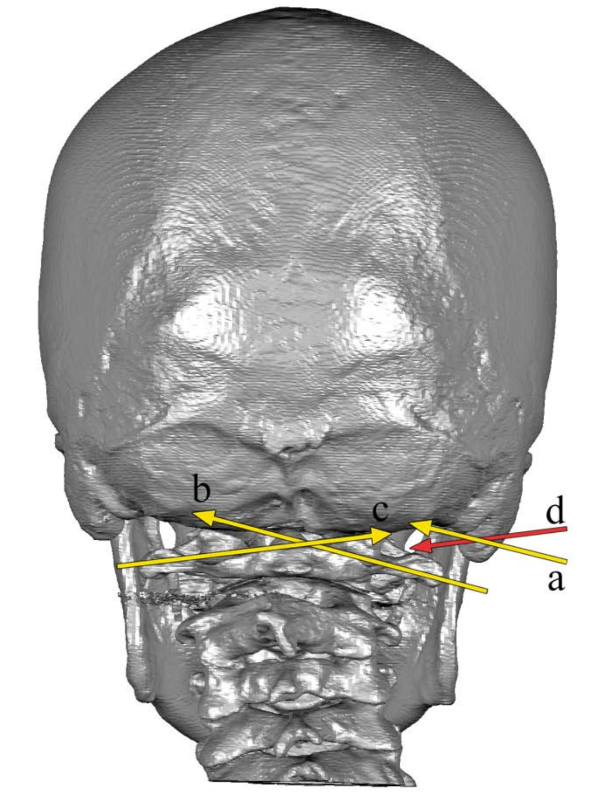

Fig. 8: CT image of cuts (a) at the mastoid; (b, c) two on the atlas and (d) one on the mandible (Kustár et al., 2013).

The cut to the occipital can be inferred to be unrelated to the those on the other parts of the skull and the spine, since this blow would have ended somewhere in the region of the posterior of the 3^{rd} to 5^{th} cervical vertebrae, but there was no bone injury here, and thus it must have only damaged the soft tissue.

On Skeleton 12, a gaping wound on the left parietal bone starts on the right of the frontal bone and ends on the left parietal bone (Fig. 9a). The cut is oblique, with the ends bending slightly anteriorly, and it has clear edges. It runs through both tables of the skull and cracking lines are originating at both end of the injury. On the anterior side of the cut wider pieces of bone flaked off, on the left side less wide flaking is observed, caused by bone failure in tension along the inner table due to compressive forces following the external penetration of the weapon (Boylston, 2000). The edges of the wound are sharp and well-defined with no evidence of healing. The posterior edge bevels outwards and the opposite side shows flaking and roughening. Sharp force traumas often remove an approximately semi-circular piece of bone or cause fractures or flaking on the opposite side to the entry point, because of the expansive forces of the blow (Boylston, 2000). The presence of fracture lines, radiating from the termini of the sharp force trauma, are more common in axe wounds than sword cuts, since the wedge shape of an axe blade splits the cranium open further than the initial cut. The pointed anterior end of the trauma indicates the exit defect from the blade (Wenham, 1989). Thus it can be deduced that the blow came from behind and from the left, and the assailant may have been positioned over the victim and delivered the blow from above. There is also a thin cut on the frontal bone which is vertical and only superficial (Fig. 9a), which parallels the fracture line on the frontal bone from the other more intense blow. Unlike the other wound, here the left edge is sharp, while on the right small flecks of bone detached from the outer table of the skull. The anterior pointed end of this superficial cut suggests that the blow came from also behind.

Fig. 9: Perimortem injuries on Skeleton 12 (a) the posterior of the skull; (b) the second cervical vertebra; (c) the mandible.

Just as with Skeleton 11, Skeleton 12 shows evidence for decapitation with a cut on the right inferior part of the axis vertebra (Fig. 9b) parallel to one on the right gonial angle of the mandible (Fig. 9c). The cut on the mandible has a smooth surface. A small piece of bone has broken off at the anterior edge of the cut, probably due to straining forces. The cut on the axis is angled (cranial to caudal) to the left. It cut the odontoid process of the axis, cut just below the right superior articular facet, penetrated the right side of the vertebral body and sliced off the posterior arch. Thus this blow probably came from behind and the right.

Both skeletons exhibit also postcranial perimortem sharp force traumas. These include one to the right proximal epiphysis of the right humerus of Skeleton 11 (Fig. 10a), and one to the right acromial process of Skeleton 12 (Fig. 10b). The former is narrow, on the lateral side of the head of the humerus, starting at the greater tuberculum superiorly and ending superior to the intertubercular sulcus (c. 23.1 x 0.2 mm). The injury of Skeleton 12 slopes medially and anteriorly, with a smooth surface. The acromial extremity of the clavicle is also missing but post-mortem damage prevents assessment of whether there was also a cut mark here.

Fig. 10: Postcranial perimortem injuries (a) the right humerus of Skeleton 11, (b) the right acromial process of Skeleton 12.

Isotope analysis

The strontium isotope results (Table 2) show that the deer (0.7100) is slightly higher than the humans, with the humans showing some variation (0.7095, 0.7096, 0.7098). Sóly lies in a region of varied geology (Sheet Székesfehérvár of the 1:100,000 geological map series of Hungary), with loess and various Triassic limestone sediments within 5 km, and an even greater variety within the region of Lake Balaton. Fig. 11 collates previous studies within the region around Lake Balaton, and in the east of Hungary, for comparison with the results from Sóly. Fig. 11 demonstrates that all four samples from Sóly fall within the range previously seen from the Lake Balaton region, as well as within that found in the East Hungarian Plain. The strontium isotope ratios of humans and deer are, on the evidence we have, consistent with a local origin, but also with origins in wide range of non-local places.

Individual	**Tooth**	**$\delta^{18}O_P$ (‰ VSMOW)**	**$^{87}Sr/^{86}Sr$**	**$\delta^{18}O_W$ (‰ VSMOW)**
Deer	M2	16.2	0.710016 (10)	-8.2±0.6
Skeleton 11	upper left M3	17.4	0.709835 (11)	-6.9±0.6
Skeleton 12	upper left PM2	14.8	0.709538 (11)	-10.9±0.6
Skeleton 13	upper right PM2	16.8	0.709602 (11)	-7.8±0.6

Table 2: Isotope samples and results. $^{87}Sr/^{86}Sr$ values are reported with the uncertainty in the final digits in parentheses. $\delta^{18}O_W$ (drinking water) values were computed using the equation of D'Angela and Longinelli (1990) for deer and equation 6 of Daux et al. (2008) for humans.

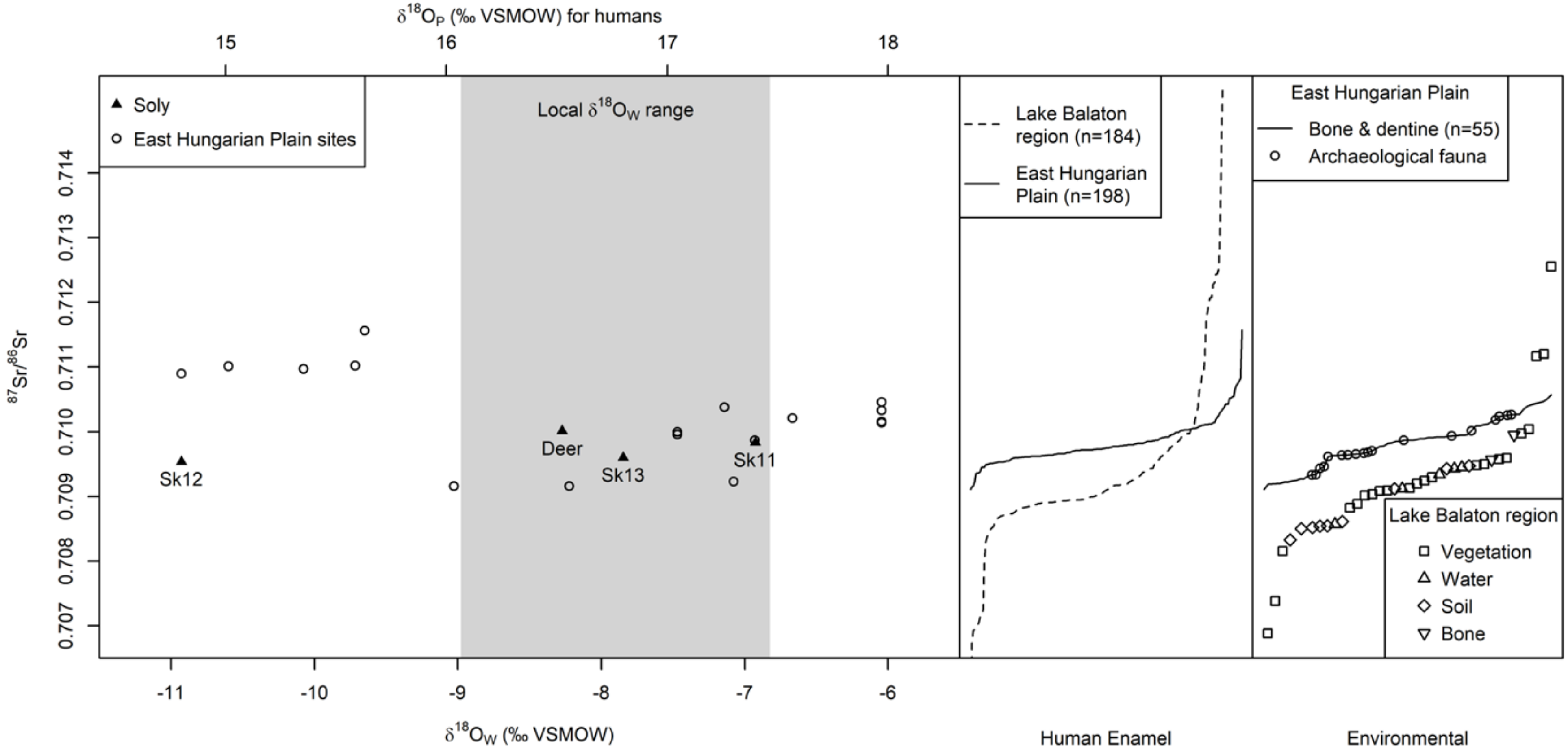

Fig. 11: Comparison of isotope results from Sóly with other sites from Hungary. From the Lake Balaton region these data comprise human enamel samples from Migration Period (Alt et al., 2014), Roman (Heinrich-Tamáska and Schweissing, 2011) and Neolithic individuals (Whittle et al., 2013), together with vegetation, soil, water and archaeological human bone as indicators of the local environment (Alt et al., 2014). In the East Hungarian Plain, there are likewise human enamel samples from the Neolithic (Whittle et al., 2013), Neolithic and Copper Age (Giblin et

al., 2013) and Copper and Bronze Ages (Gerling, 2015), with environmental data from human bone and dentine, and archaeological faunal remains (Giblin et al., 2009; Gerling, 2015). Cumulative distribution curves are used for large datasets and smaller datasets are plotted as individual points. Carbonate oxygen isotope data from Gerling (2015) was converted to $\delta^{18}O_P$ using the equation of Chenery et al. (2012). The grey band represents the 95% credible range of values given the uncertainty on the predicted precipitation value and the uncertainty of the calibration to drinking water.

Sóly is located at latitude 47.13, longitude 18.03 and at an elevation of approximately 163 m above sea-level (data from Google Earth). Using the Online Isotopes in Precipitation Calculator (Bowen and Revenaugh, 2003) the predicted $\delta^{18}O$ of local precipitation is 7.9±0.2‰ VSMOW. The measured $\delta^{18}O$ of the enamel phosphate can be calibrated to drinking water values for comparison with this, for humans using equation 6 of Daux et al. (2008), and for deer using the equation of D'Angela and Longinelli (1990). The deer, with a calibrated value of -8.3±0.6 ‰ and the presumed local child with a value of -7.8±0.6 ‰ are both within error of the predicted local value. Skeleton 11, at -6.9±0.6 ‰, whilst appearing somewhat different is not statistically significantly different (using the test of Ward and Wilson (1978), test statistic=2.6, p=0.11), whilst Skeleton 12 at -10.9±0.6 ‰ is very different (test statistic=22.1, p<0.0001). Fig. 11 plots the data from Sóly with the limited other $\delta^{18}O$ data from archaeological sites in Hungary, from Copper and Bronze Age sites on the East Hungarian Plain (Gerling, 2015). On the basis of the oxygen isotopes alone, only Skeleton 12 can be identified as non-local, as this individual spent his childhood in an area with much more depleted drinking water than Sóly. Gerling (2015) interpreted the individuals with similar $\delta^{18}O_W$ values as migrants. Oxygen isotope maps of precipitation in Europe (Bowen and Revenaugh, 2003) show that there are areas of the Alps and Carpathians which are possible places of origin, as well as areas much further east or north of Hungary.

Discussion

Why are these two individuals buried together within the chapel with only children and not in a public cemetery? Since one or two blows would suffice to incapacitate or to kill, more than one blow to the head raises the question why they have been clubbed or hacked many times? If we summarize the paleopathological results can we find any relation between them and reconstruct the circumstances of their death?

The starting point of our interpretation is finding the main similarities between the two individuals which can help to find clues which can further indicate a close association at the time of death. Firstly, both men were at an advanced age, their osteoarthritic changes suggest high physical activity during their life. Both of them reflected poor health conditions with active chronic infection but most interestingly both had several ante- and perimortem morphologically similar injuries. The location, severity and morphology of sharp force traumas can help to assess the context of such injuries, but usually sharp force traumas cannot be interpreted without comparison to other archaeological and clinical samples (Boylston, 2000).

However, modern patterns of interpersonal violence cannot be used simplistically for palaeotrauma studies, since culture may influence the location of injuries (Walker, 2001). Three strands of evidence reported above allow interpretation of the timing and nature of events at Sóly: perimortem trauma, antemortem trauma and place of origin.

The morphology of the perimortem cutmarks on their skeleton suggests that they resulted from vertical forces applied by heavy instruments with long sharp edges, leading to V-shaped notches and penetrating through the interior bone structure (Boylston, 2000) and the morphology of the cuts implies also that the blade of the weapon had limited lateral movement (Walker and Long, 1977).

Unfortunately, the lack of interconnecting fracture lines prevents determination of the sequence of wounds. The large wounds on the crania of were probably all delivered from above. The decapitation wounds for both men came from behind and from the right. According to Ingelmark (1939) multiple sharp force traumas located in the same region are an indication of deliberate and well-aimed blows. The pattern of wounds therefore suggests that they resulted from a final execution. However, if this was an execution it was either made in a hurry, or the executioner did not have much experience, since the nature of the cuts shows a lack of precision, and the juxtaposition of skulls and torsos in the grave implies that the heads were not completely severed.

Neither man showed injuries typical of "face to face" combat (Ingelmark, 1939; Manchester, 1983; Larsen, 1997; Knüsel and Boylston, 2000). It is possible that there were soft tissue injuries without skeletal involvement, but the lack of defence injuries, such as injuries to the forearms (Novak, 2000; Kjellström, 2005) suggests that the men were not defending themselves in a close combat situation. The severe OA in the right hip of Skeleton 11 which probably caused limping and the advanced stage of DISH of Skeleton 12 probably also allowed only limited movements in the extremities.

Given that the two men were killed by violent assault, but their injuries are neither typical for face-to-face combat nor judicial execution, consideration of their antemortem injuries may provide additional clues. During forensic investigations all recent traumas are considered since skeletal trauma is the only direct evidence of violence indicating the decedent's cause of death after the decomposition of soft tissues (Passalacqua and Rainwater 2015). Similar observations in forensic cases, including blunt force trauma to the skull or on the dorsal postcranial skeleton, and subperiosteal reactions due to poor health, have been made on victims of abuse (Martin et al., 2008, 2010). The sharp-force trauma to the right shoulder can also be interpreted as a sign of torture with an intention to immobilize the victims as was shown in a Guatemalan forensic case (Chacón et al., 2008).

The different origin of the two men also helps to explore the possible reasons of their violent death. The skulls of the men from Sóly were brachycephal which is very typical of the late medieval and Ottoman Period (Molnár et al., 2008; Lovász, 2015). Round headedness (broad and high), often accompanied by a flat 'dinaric' occiput and high stature can primarily be found among populations of the Balkan region (Éry and Bernert, 2010). Thus the morphological characters of the skulls of the two men link them more strongly to newcomer populations from the Ottoman Period of Hungary than late medieval ethnic Hungarians.

The craniometric evidence is supplemented by the isotope analyses. The oxygen isotope results clearly indicate that Skeleton 12 had a non-local childhood, with a value consistent with an origin further east in Europe. The value from Skeleton 11 is consistent with a local origin but also with a wide range of other places in central and Eastern Europe. Potential places of origin for Skeleton 12 include regions of the Turkish Empire in the 17th century such as Moldovia and Wallachia, while Skeleton 11 cannot be said to be local or non-local. The isotope analysis therefore does not contradict, and partially supports, the craniometric evidence that the two men are not similar to the Hungarian native population.

Traumatic injuries, decapitation and sharp force traumas often occur in these Ottoman Period cemeteries (Éry, 1982; Molnár et al., 2008; Slaus et al., 2009; Nagy, 2014; Constantinescu et al., 2015). Decapitation was also a common feature of fighting activity in this era. However, differences can be detected in some cases, such as Fonyód-Bézsenypuszta (Bernert and Évinger, 2006) which also close to the border of the Ottoman territory but it is on the opposite side of the Lake Balaton. At Fonyód a pastoral population lived, the so-called vlachs who had also military tasks. Males predominated in this cemetery, especially young adults. Just as at Sóly, there were double burials, but on the outskirts of the cemetery several mass graves of decapitated individuals were also found. The decapitated individuals sometimes were laid in unusual positions, not only in mass graves, but also in single graves, and many of them were buried without their skulls. In contrast to Sóly, the people showing traumatic lesions were buried in the cemetery belonging to the local population. The decapitation procedure differed here. There were accurate blows to the mid-cervical region rather than the cuts to the atlas and the axis at Sóly. The mid-cervical region is thought to be the most frequent position for transverse cuts in case of executions (McWhirr et al., 1982; Aufderheide and Rodriguez-Martin, 1998; Kjellström, 2005). Similarly, a high number of blade injuries were seen in a small group of young males belonging to the Rác cemetery at Perkáta-Nyúli dűlő (László and Paja, 2016). Here, two males had decapitation marks which affected the first two vertebrae, though there were also injuries which suggested face-to face combat (e.g., a defence injury on the forearm). These sites show that decapitation was a typical execution method but also a common part of the fighting technique of the Period. They also testify that violent trauma was very common in these populations which also played a role in military activity.

The death of the men cannot be assigned to judicial executions, but may be the result of an extra-judicial punishment; murder or execution of captured soldiers which often happened in the occupied area. Abuse and capture were not rare in this period since it was practiced by both the Hungarian and Turkish military. There is no major battle event recorded from this area in this period but Lake Balaton was a frontier between the Turkish and Habsburg territory and the north side was often attacked by the Turkish navy. Kidnapping and imprisonment of soldiers was an aim of occasional raids of both Turkish and Hungarian/Habsburg military and usually these prisoners were only released for a high ransom (Végh, 2016). Such a trade was an important source of income for the frontier soldiers who often lacked their military pay for months. To encourage payment the Hungarians were often cruel to their prisoners, as were the Turkish (Székfű, 1928).

As we mentioned before, the chapel was used as a sheepfold during the Ottoman Period (Koppány, 1989), therefore, it might have been a suitable place for the burial of murder victims, or victims of extra-judicial punishment.

Conclusion

The archaeological context lacked information regarding finds and precise dating but our analysis suggests the double burial of the two males at Sóly can be placed into the context of the Ottoman occupation of Hungary in the 16th and 17th centuries, with these men being members of an incoming Balkan population which settled the area at that time. Their pathologies parallel those found in contemporary cemeteries of incoming populations and reflect the disturbed state of this period. The mode of their deaths has similarities with others from this historical context in terms of execution by decapitation, but is unusual in the details showing that the beheading was not conducted by an expert executioner.

In conclusion, the combined application of physical anthropological, forensic and isotope analysis with the historical context was necessary for the final interpretation of the remains from Sóly. With this context, they provide a clear testimony of the conflicts of the early modern period, which not only had consequences for the general political situation, but also had devastating local and personal impacts.

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