Direct dating of the “Gravettian” Balla child's skeleton from Bükk Mountains (Hungary): unexpected results

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Keywords:
Upper Palaeolithic
Modern Homo sapiens

Introduction

Human remains assigned to the Upper Palaeolithic of Hungary are scarce and originate from old excavations in the Bükk and Buda Mountains of Northern Hungary. Most have provided only fragmentary human remains. The exception is the Balla Cave (Bükk Mountains), in which a virtually complete child’s skeleton was recovered in 1909. The Balla child was assigned to Homo sapiens from the “Upper Diluvium” by Hillebrand (1911: 530) and dated to the Magdalenian (Kadić, 1934: 72; Hillebrand, 1935: 13). Gábori and Gábori (1957) later proposed the denomination “Gravettian” for all Magdalenian assemblages of Hungary on the basis of similarities with the Gravettian of Central and Eastern Europe. The Balla specimen was generally accepted as part of the diagnostic late Upper Palaeolithic modern human sample from Central Europe (e.g., Thoma, 1971; Trinkaus, 2002, 2007). Yet, there has been little attention paid to the child’s skeleton (Tillier et al., 2006) and uncertainties continue regarding its chronological position.

In the last decade, several efforts have been made to obtain reliable dates for human remains attributed to Upper Palaeolithic archaeological contexts (e.g., Smith et al., 1999; Henry-Gambier, 2002; Svoboda et al., 2002; Trinkaus et al., 2003; Wild et al., 2005). Direct radiocarbon dating of modern human skeletal remains led to numerous discoveries of intrusive specimens of Holocene age (e.g., Terberger et al., 2001; Conard et al., 2004). We present here the results of direct radiocarbon dating of the Balla child which was conducted to clarify both the chronological position and phylogenetic assignment of the specimen.

Historical background of the discovery

Balla Cave is located at 543 m above sea level at the back of the Balla Mountain near the village of Répáshuta (Fig. 1). During a sounding directed by Jenő (Eugen) Hillebrand in 1909, a few cranial elements and long bones of a child were discovered by workers within a yellow clay layer rich in arctic microfauna. Hillebrand (1911: 519) excavated the rest of the remains and noticed that the child lay on its left side with most of the bones in anatomical position. According to the author, such a condition and the lack of rodent or carnivore gnawing on the bones suggested an intentional burial, although there were no archaeological traces associated with the body. Mihály (Michael) Lennsék made the first inventory of the human remains (quoted by Hillebrand, 1911: 520) and mentioned the lack of the pelvis, as well as hand and foot bones.

The body was located approximately 30 cm below the surface (Fig. 2). Although lithic artefacts were directly associated with the human remains (Hillebrand, 1911: 519), the presence of a few flint blades recovered later in the same layer and foliate tools considered as Solutrean in the deepest layer (in the back of the cave), the human remains were suggested to be “Magdalenian” (Kadić, 1934: 72; Hillebrand, 1935: 13). Later, the nature of the lithic assemblages led Vértes (1965: 208–209) to place Balla among the sites related to the Pilszántói culture, also called “Cave Gravettian.” On the top of the layer containing the human remains, a distinct yellow stratigraphic horizon was identified as the Pleistocene-Holocene transition.

The microfauna was assigned to the late Pleistocene through biostatigraphic comparison to data collected by Kadić (1934) in the Puskaporos rockshelter. The macrofaunal assemblage of Balla Cave was attributed to a post-glacial period, because of the absence of lemmings and the low percentage of reindeer (Mottl, 1941: 19–20, 24–25). In fact, it appears that the faunal sample tested was a mixture of several levels and, among them, one indicated a late Pleistocene period (“Pilszántói and Palánkian substages,” according to Jánossy (1986: 154) or “Pilszántói and Bajótian substages” (Vörös, 2000: 195, 200)).
Mountains, hard grey

The developmental stage documented by the Balla specimen falls in

The child's skeleton

The Balla child is housed in the anthropological collections of the Hungarian National History Museum in Budapest (numbered 68147-5). A re-examination was done to provide an inventory of the skeletal and dental elements preserved, and to evaluate the anatomical pattern of the specimen. The cranial lacks the occipital bone and most of its midfacial area (zygomatic bones are partly preserved). The mandible is complete. Most of the axial remains are missing (except two thoracic vertebral bodies and six rib fragments), but several elements of the upper and lower limbs are preserved (right clavicle; left incomplete scapula; complete left humerus, radius, and ulna; fragmentary right humerus; both femora; and the left tibia).

The mandibular deciduous teeth were either erupting (di and dm1), or unerupted (dc and dm2). Remnants of a metopic suture are present and the tympanic plate is fully developed, but the anterior fontanelle (enlarged post-mortem) was probably still open. The age estimation matching the dental development and various indications of skeletal age with modern human standards indicate that the Balla child died at an age of circa 1 year.

The Balla cranium appears narrow (Fig. 3) and long; its narrowness is accentuated by post-mortem distortion that reduced space for the basilar part of the occipital bone. The overall cranial shape is similar to that of European modern children (well-developed frontal eminences, vault relatively high but narrow and parallel-sided) and the mandible exhibits a fully modern chin. The postcranial skeleton appears rather gracile, with no indications of marked muscular attachments. The degree of completeness of the long bones permits assessments of limb segment proportions using intermetaphyseal lengths (claviculo-humeral index: 51.2; brachial index: 76.4; crural index: 83.6). Anatomically modern, the Balla child skeleton displays no significant traits that align it specifically to either late Upper Paleolithic or Holocene humans. Bartucz (1940: 54) has suggested that the Balla craniofacial morphology resembled the morphology of the Hungarian Neolithic population compared to that of the Neanderthal Sub-lyuk child from the Bükk Mountains.

As we mentioned before, other early modern humans from Hungary were very fragmentary and found in different archaeological contexts. Moreover, except for an isolated tooth found at Istállóskő, they consist of adult remains in Görömbső-Tapolca and Remete Felső (Tilliér et al., 2005, 2006). For a comparative study, the closest immature specimens in space and time would be those originating from Předmostí in the Czech Republic (Matiegka, 1934, 1938; Velemínská and Brůzek, 2008) and the three Krems-Wachtberg infant burials from Eastern Austria (Einwögerer et al., 2006).

The developmental stage documented by the Balla specimen falls in between those represented at Krems-Wachtberg and at Předmostí. In this context, it would be rather important to document the anatomical characters of the Balla specimen by a detailed study, as most of the Předmostí fossil remains did not survive the 1945 fire at Mikulov castle1 and the recent Austrian discoveries are still unpublished. As the Balla specimen has no secure and diagnostic archaeological association, the assessment of whether it is indeed Upper Palaeolithic in age (and Gravettian) becomes central to understanding the ontogenetic variation of early modern humans in Central Europe.

Previous radiocarbon dates from Balla

Previous attempts to radiocarbon date animal bones and charcoal from Balla were made in 1965 by Vértes, in order to determine the age of the Széletian lithic assemblage found in the cave (Geyh et al., 1969: 9–10). The results were published by the Gröningen Laboratory (Vogel and Waterbolk, 1972: 63). The first date by Vértes (GrN-4660), deriving from charcoal mixed with bone and sand, gave an age of 22,300 ± 180 BP; but Vogel and Waterbolk (1972) mentioned that the poorly preserved charcoal might have affected the determination. A second date on bone (GrN-4661), 20,000 ± 190 BP, appeared compatible with the first.

These dates were incompatible with those reported by Gröningen (Vogel and Waterbolk, 1972: 62) that placed the Széletian period between 43,000 ± 1100 BP (GrN-6058) and 32,620 ± 400 BP (GrN-5130). This discrepancy in the data sets led Vértes to suggest that the former might date the Balla child itself (Geyh et al., 1969: 9–10). As a consequence of this statement, the Balla child’s skeleton was later suggested to date to about 20 ka (Thoma, 1971: 224). Vogel and Waterbolk (1972: 64) suggested also that the stratigraphic assignment may be wrong because the dates of Balla were close to those obtained for the Gravettian site of Ságvár (about 18 ka BP).

However, Vértes provided no exact provenience of the bone samples (Fig. 2) used for radiocarbon dating. Nor was any sound evidence provided that these were contemporary with the child’s remains. It therefore seems appropriate to confirm their age by a direct dating of the Balla skeleton.

Direct dating of the skeleton

A small piece of rib was cut and carefully cleaned with acetone and distilled water in an ultrasound bath. The sample was then ground and sieved to obtain a powder of 0.7 mm grain size. About 5 mg of this powder were analysed in a CHN elemental analyser as a proxy for collagen preservation and extraneous contamination (Bocherens et al., 2005). Collagen was extracted according to the protocol described by Bocherens et al. (1997). Determination of carbon and nitrogen amounts in the extracted residue was performed simultaneously with the isotopic determination, using a CHN analyser connected to a mass spectrometer. The isotopic ratios are expressed for carbon as $\delta^{13}C$ vs V-PDB (a marine carbonate) and for nitrogen as $\delta^{15}N$ vs atmospheric N2: $\delta = ([R_{sample}/R_{standard} - 1] \times 1000)_{\%}$, where X stands for $^{13}C$ or $^{15}N$ and R stands for $^{13}C/^{12}C$ or $^{15}N/^{14}N$, respectively. The isotopic measurements were performed at the Institut des Sciences de l’Évolution (Univ. Montpellier 2, France), with an analytical precision of 0.1‰ and 0.2‰ for $\delta^{13}C$ and $\delta^{15}N$, respectively. Radiocarbon dating was performed using AMS (accelerator mass spectrometry)

1 In fact, two fragmentary adult mandibles, Předmostí 21 and 26, were recently recovered from Museum collections (Svolboda, 2008).
Results and discussion

The results are presented in Table 1. The nitrogen and carbon content of whole bone were 4.5% and 14.4%, respectively. Extraction yield was 153.1 mg collagen per gram sample. Carbon and nitrogen amounts of the extraction product were 41.0% and 15.0%, respectively, with an atomic C/N ratio of 3.2. Such results indicate excellent collagen preservation and unaltered stable and radioactive isotopic values. The isotopic signature was $-19.3^{\%}_{oo}$ and $14.7^{\%}_{oo}$ for $\delta^{13}C$ and $\delta^{15}N$ values, respectively. By comparison with isotopic data from roughly contemporaneous humans from the Iron Gates along the Danube River, such $\delta^{13}C$ and $\delta^{15}N$ values indicate a significant amount of freshwater resources in the diet (e.g., Bonsall et al., 1997; Boric’ et al., 2004). The uncalibrated radiocarbon age was 6660 $\pm$ 50 BP. Calibrated ages using calib.5 software for terrestrial samples (Reimer et al., 2004) yield ages from 5659 to 5549 BP (one sigma), and from 5659 to 5490 BP (two sigma). However, these ranges could be a few centuries younger if the child’s diet included significant amounts of freshwater resources, as suggested by the C and N isotopic values.

Direct dating performed on the Balla child’s skeleton is compatible with an early Neolithic time period of Central Europe (Hertelendi et al., 1995). Given the uncertainty regarding the context of the discovery (see above), we consider our results to be a reliable age estimate for the Balla skeleton. Unfortunately, ceramics and fauna from the Holocene archaeological deposits of Balla Cave were never studied and the assemblages could not be relocated (Korek and Patay, 1958: 12). Other Neolithic archaeological remains from the Bükk Mountains are dated to between 5260 and 4880 cal BP (Hertelendi et al., 1995). The oldest date from the early Neolithic site of Füzesabony-Gubakút is 6600 $\pm$ 55 BP (Domboróczki, 2003). Thus, the Balla child may represent the earliest Neolithic human remains from the Bükk Mountains.

Clearly, the Balla child should never again be considered an example of Upper Palaeolithic modern human infants in comparison with young Neanderthal specimens. We join the voices of scholars recommending a systematic re-evaluation of the chronological ages of all questionable Upper Palaeolithic specimens (Gruñ, 2006).

Acknowledgments

This research was supported by the Department of Anthropology of the Hungarian Natural History Museum, the CNRS (LAPP-UMR 5199/PACEA), and the OMLL program directed by F. d’Errico (IPCG-UMR5199/PACEA). Two of us (D. H-G. A-m. T.) thank their Hungarian colleagues for their wonderful hospitality. A-m. Tillier is deeply grateful to B. Arensburg (Sackler Medical School, Tel Aviv University)

Table 1

<table>
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<tr>
<th>Piece</th>
<th>$%$Nbone</th>
<th>$%$Cbone</th>
<th>$%$C coll</th>
<th>Yield mg. g-1</th>
<th>$%$Coll</th>
<th>$%$Ncoll</th>
<th>C/N</th>
<th>$\delta^{13}C (%)$</th>
<th>$\delta^{15}N (%)$</th>
<th>$^{14}C$ Age</th>
<th>Date #</th>
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<td>14.4</td>
<td>2.2</td>
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<td>41.0</td>
<td>15.0</td>
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<td>$-19.3$</td>
<td>$14.7$</td>
<td>6660 $\pm$ 50</td>
<td>GrA 24712</td>
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and J. Jelinek (eds.) (Moravské Museum, Brno) for fruitful discussions. Z. Mester is particularly indebted to L. Domborozczi (István Dobó Castle Museum, Eger) for his help on Hungarian Early Neolithic radiocarbon chronology. Best thanks are also due to D. Drucker and M. Chech for their assistance in the technical aspects of this work.

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