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ANTHROPOLOGY

BIOARCHAEOLOGICAL STUDY OF A HUMAN SKELETON WITH TREPANATION DISCOVERED IN A 17TH–19TH CENTURY NECROPOLIS OF IAŞI (ROMANIA)

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This work is focused on a case of trepanation reported in a skeletal sample found in a necropolis from Iași (Romania). According to the discovered coins, the time limits of necropolis use are set between the 17th and 19th centuries.

In the study, the classical paleoanthropological and paleopathological methods, stereomicroscopy, dental wear, nonmetric dental traits were applied.

The skeleton under analysis belonged to an adult male of 35–40 years (middle adult). The preservation status of the skeleton is satisfactory. At the level of the skull (on the parietal bones), two perforations were identified, diagnosed as trepanations. The craniotomy was realized *intra-vitam*, most probably for medical/ therapeutic purposes. Tripartite Inca bone was reported on the lambdoid suture.

Dentition is characterized by moderately advanced predominant wear and *ante-mortem* microfractures in both anterior and posterior teeth.

The particularities of this individual are defined by the supernumerary roots and the asymmetry of traits in the second upper incisor.

Supragingival and subgingival dental calculus (moderate amount) is present at the level of the lower first and second incisors (I_1, I_2) (labial and lingual surface). At the level of the postcranial skeleton, perforation of the sternum (sternal foramina) and Schmorll's nodule in three thoracic and two lumbar vertebrae were reported.

Keywords: bioarchaeological study, human skeleton, trepanation, 17th–19th centuries, Iași (Romania)

1. INTRODUCTION

Archaeological research in the Historical Center – "Curtea Domnească" site of Iași, point: by-street "Sf. Atanasie", no. 1A (Iaşi, Romania) (Fig. 1/a,b), developed between 2019 and 2023, under the scientific coordination of archaeologist PhD George Bilavschi, confirmed the existence of a burial necropolis (Fig. 2), located between the “Vulpe” and the “Sf. Atanasie and Chiril” churches. Based on the information provided by archaeologists, the skeletons were dated to the 17th–19th centuries.

More than 750 archaeological complexes and contexts have been identified, including about 650 funerary complexes, which preserved whole or partial skeletons, either in their natural anatomical position or in a secondary position, as a result of subsequent interventions.

The anthropological study of this sample has not been finalized nor published.

In this study, a case of double trepanation is reported. The skeleton was discovered in the Cx243 complex (grave) (Fig. 2).

The complex Cx243 (grave, pit) – adult, lying on back; head facing upwards; arms placed beside the body; overlapped in the area of the pelvis and right femur by another destroyed funerary complex (Cx253) from which ribs, vertebrae, fragments of the pelvis as well as bones of the left forearm were recovered, in a natural anatomical connection; orientation south-north (with the head towards the south); preserved dimensions of the pit: 0.60 × 1.54 m; –1.35–1.44 m.

Cranial trepanation is an invasive procedure, performed *intra-vitam* or *post-mortem* with specific tools and techniques, resulting in skull opening and, most often, detachment of a bone fragment. Trepanation has been practised in many ancient cultures, dating as far back as the Late Paleolithic to this century, and it has been detected in locations widespread in every part of the world. Being an extremely aggressive intervention on the human body, trepanation (craniotomy, in medical terms) is made with different purposes: medical, symbolic, or magical-religious [1].

Medical trepanations were performed to improve the health of those suffering from convulsions, migraines, epilepsy, hydrocephalus, delirium, hallucinations or even melancholy [2]. Symbolic trepanations were also performed *intra-vitam*, only that, unlike the therapeutic ones, they were incomplete (the cranial box was not opened, but only the *tabula externa ossis cranii* was scraped, up to the diploë) and had a supposed ritual purpose [3]. Symbolic trepanation, mostly circular, was generally performed on the skulls of individuals over 20 years, on the frontal or parietal bone, at the *bregma* cranial point or in its proximity, or next to the cranial sutures (coronary, sagittal, lambdoid). Some authors considered that the presence of the symbolic trepanation marked the transition to the age of maturity, emphasized the status or social rank in the community or highlighted a certain degree of initiation. As for the trepanations carried out for magical-religious (cultural-religious) purposes, they were carried out *post-mortem*, most of the time to take the bone rings worn as amulets, which, it was believed, accumulated the attributes of those who had passed into the world of beyond [4]. This category also includes trepanations performed with the aim of driving away evil spirits, or of obtaining bone fragments that were further transformed into a powder used as an ingredient in healing potions [1].

The first case of prehistoric trepanation reported is that of the Neolithic skull from Cuzco-Peru, observed and analyzed by anthropologist E.G. Squier, while visiting Peru, between the years 1863–1865 [5]. Later, Broca (1876) highlighted several trepanated skulls from the French Neolithic. In the locality of Lozere, between 1873–1884, 167 trepanated skulls were discovered [6]. As far as the spread is concerned, from the existing data we know that, in ancient times, the practice of trepanation was present over four continents. There are several thousand discoveries related to trepanation and, probably due to the more intense and numerous studies carried out on the territory of Europe, they seem to be more frequent on this continent [7,8].

In Romania, the scientific study of trepanation began in the 19th century, closely following the structuring and consolidation of anthropology as an independent science, a process initiated at the end of that century. We mention only a few of the important works signed by the authors concerned over the time with practising trepanation based on the discoveries made on the territory of Romania: Necrasov [9,10], Necrasov and Cristescu [11], Necrasov *et al*., [12], Botezatu *et al*., [13], Miu [14], Comşa [15], Nicolaescu-Plopşor [16], Floru and Nicolaescu-Plopşor [17], Moldovan [18], Rusu and Bologa [19], Rusu [20], Bologa [21], Bologa and Rusu [22], Bologa and Lenghel [23], Dunăre [24,25], Crişan [26,27], Arseni and Ciurea [28] and Bercuş [29].

Fig. 1. a, b. Location of the necropolis (Iași County, Romania); c. Detail of location (Map Source: Google Earth Pro)

Fig. 2. “Sf. Atanasie” necropolis, no. 1A (Iași city); positioning of Cx243 (Skeleton Cx243) within the necropolis; (Photo: archaeologist PhD George Bilavschi)

2. MATERIAL AND METHODS

The preservation status of the skeleton examined in this study (codified as Cx243) originated from graves (complex – Cx243) is satisfactory [30]. Age at death was estimated by a combination of several criteria: pubic symphysis degeneration and sacro-iliac surface transformation [31]; changes in the spongy tissue from humeral and femoral epiphyses; morphology of the rib sternal end; dental attrition [5,32]; cranial suture obliteration [33]. Estimation of sex was based on the following aspects: mandible robustness, teeth shape and size [34]; pelvis characteristics [35]; skeleton’s massiveness and robustness [33].

We used the main measurements and indices according to Martin and Saller [36], while morphometrical evaluation was made using the dimorphic scales of Alexeev and Debetz [37]. The morphological observations were registered and analyzed with the methods recommended by Broca, Eickstedt and Olivier [38–40]. Stature was estimated from the dimensions of the long bones of the lower limb. The dimensional scales proposed by Manouvrier, Breitinger, Bach, Trotter and Gleser [41–44] were also employed. Framing of the stature in the appropriate sex category was made by Martin and Saler [36]. The study of bone lesions was carried out macroscopically and stereomicroscopically. Paleopathological literature was also consulted [1,7].

The teeth were prepared for stereomicroscopicall examination, all surfaced being examined and digitized using a Carl Zeiss Stemi 305 with an attached camera. Dental observations included *ante-mortem* teeth lost, *post-mortem* teeth lost, occlusal/ incisal macrowear and atypical dental wear (*i.e.*, *ante-mortem* chipping). Macrowear evaluation was based on the scoring systems proposed by Smith [45] and Scott [46]. The dental material was grouped into three categories, according with de degree of wear: with invisible or very small wear facets, teeth with moderately advanced wear facets and teeth with highly advanced wear facets [47,48]. *Ante-mortem* chipping is produced as a result of a bite force pressure between antagonist teeth that exceeds the strength of enamel [49,50,51] and is characterized by smooth edges and color similarity of the affected area with the rest of the dental crown [52].

Non-metric traits are dental anatomical variations representing phenotypic expressions of the dental enamel that result from morphogenesis processes and are regulated by the individual genome. They are stable in time and have a high state of preservation, compared to the bone material [53]. They can be positive structures, such as accessory cusps, tubercles or crests or negative like grooves, but some other characteristics like variation on the number, position and size of cusps and roots are also considered non-metric traits.

Evaluation of dental traits and scores was based on the Arizona State University Dental Anthropology System (ASUDAS) [54].

3. RESULTS AND DISCUSSION

Preservation status. Skeleton Cx243, well preserved but incomplete, belonged to an adult male of 35-40 years. *The skull* is approximately complete (missing fragments from the facial massive). From the postcranial skeleton, there are present: the humeri, radius, cubitus, scapulae (incomplete), coxal bones (fragments), sacrum bone (fragments), costal fragments, sternum, 11 dorsal vertebrae and three lumbar vertebrae.

Morphometrical data. The cranial dimensions and indices are listed in Table 1. The longitudinal diameter (g-op) of the neurocranium offers a large size; the transversal one (eu-eu) presents a very large size, its report giving a cranial index of mezobrahycranic type. The forehead is moderately blunt. The minimum diameter of the forehead (ft-ft) is very large. The maximum frontal width (co-co) offers a very large size, meaning an eurimetopic frontal-parietal index, therefore indicating a spherical contour of the forehead, with diverging margins from the parietals. Regarding the degree of occipital curvature, the skull presents a bulgy and short occipital. The width of the occipital (ast-ast) belongs to the big-sized category. The parietal-occipital index is medium-sized. The shape of the neurocranium in *norma verticalis* is ovoid, in *norma occipitalis* being the one of "house". The cranial bone relief is marked. The development of the glabellar relief indicates 3^{rd} degree, and the supraorbital – 2^{nd} degree. The external occipital protuberance indicates 1^{st}–2^{nd} degree, and the development of the mastoid apophysis indicates 3^{rd} degree.

The face is incomplete. The mandible, with a hight and thick horizontal ramus ($69_{(1)}$: 36.5 mm; $69_{(3)}$: 13.5 mm) presents a medium robustness index ($69_{(3)}/69_{(1)}$: 36.98 i.u.); the mentum, with a pyramidal shape, is marked, the gonions, slightly outlined, are in the same plane as the ramus; dentition is slightly eroded (1^{st}–2^{nd} degree).

Postcranial skeleton is of medium robustness; the humeri, based on the section indexes, belong to the eurybrachic type (right bone – 86 i.u. and left bone – 88 i.u.);

Stature, estimated by considering the length of the humerus, cubitus and radius, is about 168 cm, a value that falls in the over middle category for males.

Table 1

Skeleton Cx243 (♂, 35–40 year-old): cranial dimensions (mm) and indices

Martin No.	**Dimensions**	**Value (mm)**
1	g-op (maximum cranial length)	197
8	eu-eu (maximum cranial breadth)	150
9	ft-ft (minimum frontal breadth)	106.5
10	co-co (maximum frontal breadth)	134.5
12	ast-ast (maximum occipital breadth)	112
20	po-b (height of the calotte);	122
43	fmt-fmt (upper facial breadth)	113
$43_{(1)}$	fmo-fmo (internal biorbital breadth)	106
47	n-gn (the total height of the face)	118
48	n-pr (the upper height of the face)	68
51	mf-ek (the width of the orbit)	38.5
52	the height of the orbit	31.5
$69_{(1)}$	height at the g.m.level	36.5
$69_{(3)}$	thickness at the g.m. level	13.5
	Indices	**Value**
8/1	Cranial index	76.14
20/1	Auricular-longitudinal index	61.92
20/8	Auricular-transversal index	81.33
9/10	Frontal-transversal index	79.18
9/8	Frontal-parietal index	71.00
12/8	Parietal-occipital index	74.66
9/43	Frontal-parietal index	94.24
52/51	Orbital index	81.81
54/55	Nasal index	54.16
$69_3/69_1$	Mandible robustness index	36.98

Trepanation. Two perforations were identified on the parietal bones, diagnosed as trepanations. The craniotomy was realized *intra-vitam*, most probably for medical/ therapeutic purposes. Both openings of the skull are approximately oval; one is located on the right parietal near the temporal, having 78/49 mm (Fig. 3/a); the other is located on the left parietal near the sagittal suture, of 52/26 mm (Fig. 3/b); they were probably made by the scraping method with a flat implement used in a rotary movement on the bone surface, which was eroded to the formation of complete holes. Our analysis shows that in both perforations there was an osseous regeneration, which means that the individual survived for a time after the operation (Fig. 3/a,b; Fig. 4/a,b,c,d,e). A tripartite Inca bone or Interparietal bones were located about the lambda (Fig. 3/b). The presence of interparietal bones or Inca bones is multifactorial.

Fig. 3. Complex Cx243 – grave; Skeleton Cx243 – ♂, 35–40 year-old:
a – Macroscopic view of the opening in the right parietal bone;
b – Macroscopic view of the opening in the left parietal bone

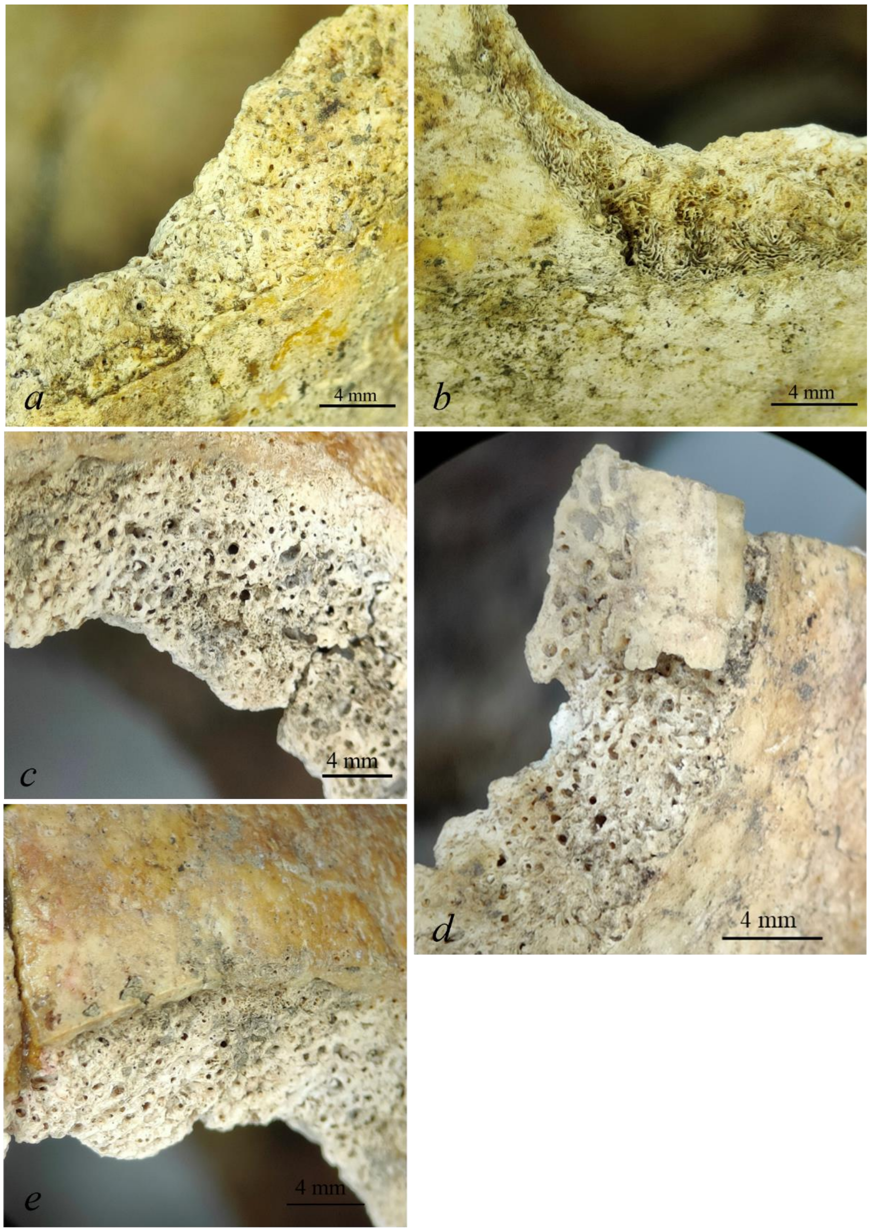

Fig. 4. Stereomicroscopic view – detailed images of the two opening margins:
a, b, c, d – right opening; e – left opening

Dental features. The dentition of the Cx243 skeleton was incomplete. No *ante-mortem* tooth lost was registered, but some teeth were noticed as *post-mortem lost* – the first maxillary incisors (right I^1 and left I^1) and the right second maxillary incisor (I^2), as well as the second and third maxillary left molar teeth (M^2, M^3) which were missing along the bone structure (Fig. 5). The scoring system showed that two grades of wear were identified in the Cx243 skeleton dentition (*i.e.*, moderately advanced wear and advanced wear). All mandibular teeth, except for the M_1 mandibular molars, showed moderately advanced wear, with scores between 3–4 (Smith scale) for incisors (I), canines (C) and premolars (P), scores between 12–17 (Scott scale) for the molar teeth (Fig. 5). As expected, the M_1 mandibular molars exhibit an advanced occlusal wear (Scott scores: 23, 26). In the maxillary teeth, only the first right M^1 molar exhibits advanced wear, while the rest of the maxillary teeth show moderately advanced wear.

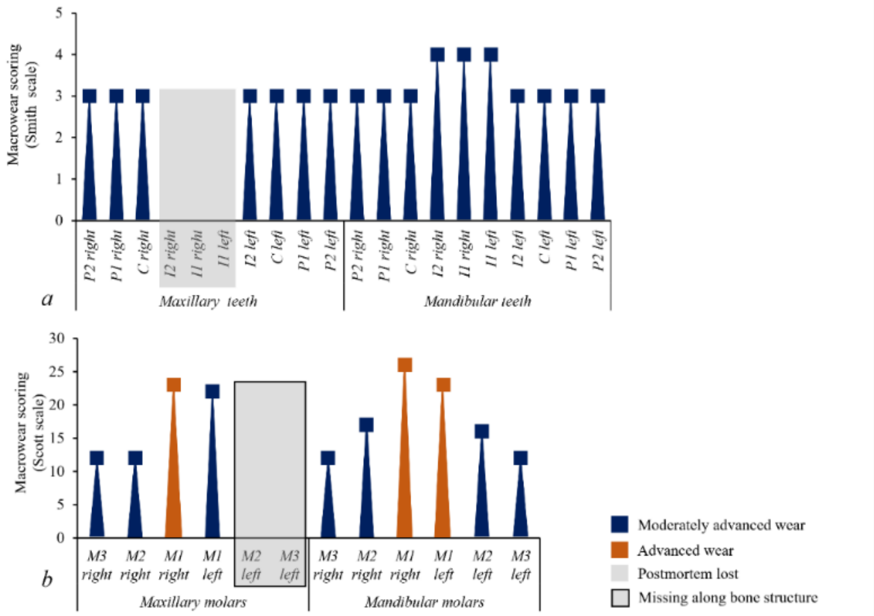

Fig. 5. Dental macrowear scores for: *a* – incisors (I), canines (C), premolars (P); *b* – molars (M)

During microscopical inspection, several microfractures produced during the individual life were identified. Chipping was identified in both anterior (Fig. 6/a, b, c, d, f) and posterior teeth (Fig. 6/e). All mandibular incisors reveal several areas (incisal angle) with chipping on of the more pronounced on the first incisors (Fig. 6/b, c), comparatively with the second ones (Fig. 6/a,d). The mandibular left canine (C) and the maxillary first left molar (M^1) also revealed enamel microfractures (Fig. 6/e, f).

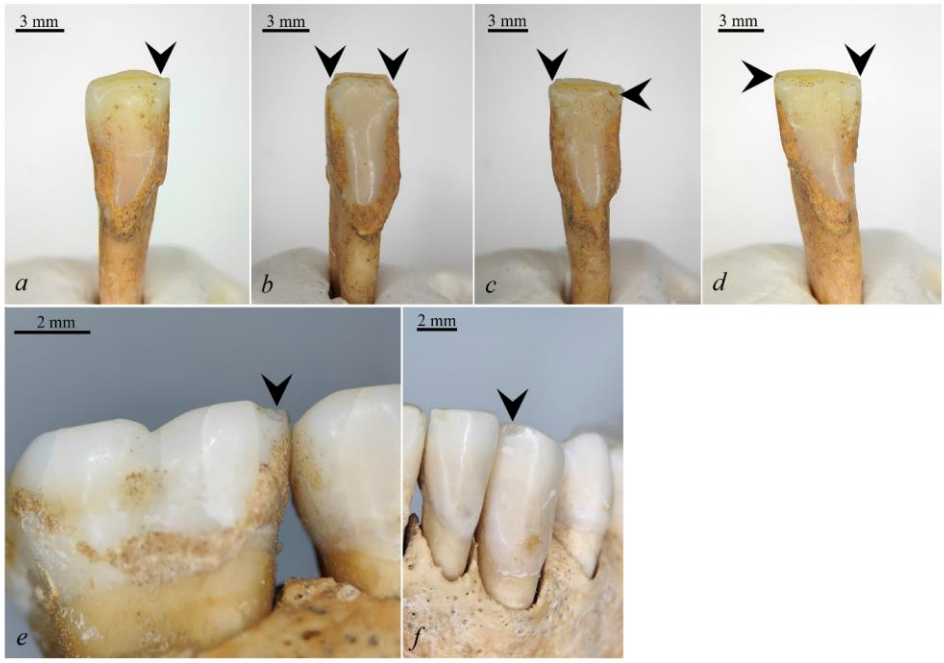

Fig. 6. Dental chipping in the Cx243 skeleton: a – mandibular second left incisor I_2 (lingual view); b – mandibular first left incisor I_1 (lingual view); c – mandibular first right incisor I_1 (lingual view); d – mandibular second right incisor I_2 (lingual view); e – maxillary first left molar M^1 (buccal view); f – mandibular left canine (buccal view)

Dental wear refers to the loss of dental hard tissues and it is not a result of dental pathologies or trauma [55-57]. Dental macrowear is a cumulative, multifactored process, being also influenced by age [49,55,57]. The study of dental wear may be used as an indirect approach to reconstructing past diets dietary, revealing information regarding food particles physical properties, exogenous abrasives, and food processing [58]. Our scoring results show that the M 243 individual is characterized by a moderately advanced and advanced dental macrowear. Also, a special type of wear – chipping – was identified, especially in the anterior mandibular teeth. According to the literature [59,60], chipping in the anterior teeth can be more suggestive in daily activities (*e.g.*, crafts, housework). On maxillary M1 dental crown, chipping was also identified. This type of wear on the posterior teeth can be linked to a masticatory activity of food contaminants and ingestion of hard food [59].

Each tooth of the specimen was analyzed to identify non-metric dental characteristics.

The upper teeth. Central incisors could not be scored for any non-metric trait. Instead, we signal an asymmetry at the level of the lateral incisors.

The right lateral incisor exhibits *interruption grooves* and *tuberculum* dentale (Fig. 7/a). This interruption groove has distinct depressions or grooves that interrupt the normal course of the mesial or distal marginal ridges or even the basal cingulum. Classification of the trait, made in accordance with Turner and Scott [54,61], places this trait in the category "*med*" *i.e*., groove on medial aspect of basal cingulum.

Tuberculum dentale is a cingular projection on the lingual surface of the upper anterior teeth, relatively common in human populations. It typically takes the form of ridges and/or tubercles. The expression of the dental tubercle on this incisor is of the slight ridge type (score 1) (Fig. 7/b).

Premolars also present a typical morphology in terms of accessory cusps or ridges.

The upper molars also have a typical morphology, with 4 cusps. In UM1, we cannot detail due to the degree of wear, instead we note for LM2 and LM3 a reduced hypocone in size, assuming a normal ovate shape, alongwith a distinct free apex (score 3 according ASUDAS).

The metaconule, or cusp 5, does not appear on any molars, none of the upper molars exhibiting the parastyle or trait of Carabelli.

An exception in the number of roots was noticed. In UM2, an atypical number of roots were quantified: 3 roots with a free apex, and the 4th reduced root also with a free apex.

Lower teeth. The anterior teeth (incisors and canines) tend to have a simple morphology, without any observed non-metric traits of their level. Also, premolars are of typical anatomy.

The hypoconulid is usually present on LM1 in most human populations, but it is highly variable in terms of presence and size on LM2. It is also variable on LM3.

The *cusp number* on the lower molars (LM1-LM2-LM3) most often follows the 5–4–5 formula (Scott, 2017), and what we notice is that, in the analyzed individual, the formula for the number of cusps is 4-4-5. We notice a reduced entoconid at LM2 (Fig. 7/c).

The *anterior fovea* is a polymorphic trait expressed on the mesial aspect of the trigonid of the lower molars. It could not be visualized in LM1 and LM2, due to the degree of tooth wear, instead we estimate an expression score of 0–1 for LM3: at most a weak ridge connects the mesial faces of the protoconid and metaconid cusps, making a faint groove [54].

The *groove pattern* is defined by how the cusps contact in the lower molar central fossa [54], being determined by the relative sizes of cusps [62]. Dental wear does not allow visualization of the arrangement of the intercuspidal grooves in LM1 and LM2. The pattern of the cusps, the contact between the metaconid and the hypoconid in LM3 correspond to the *y* groove pattern (Fig. 7/c).

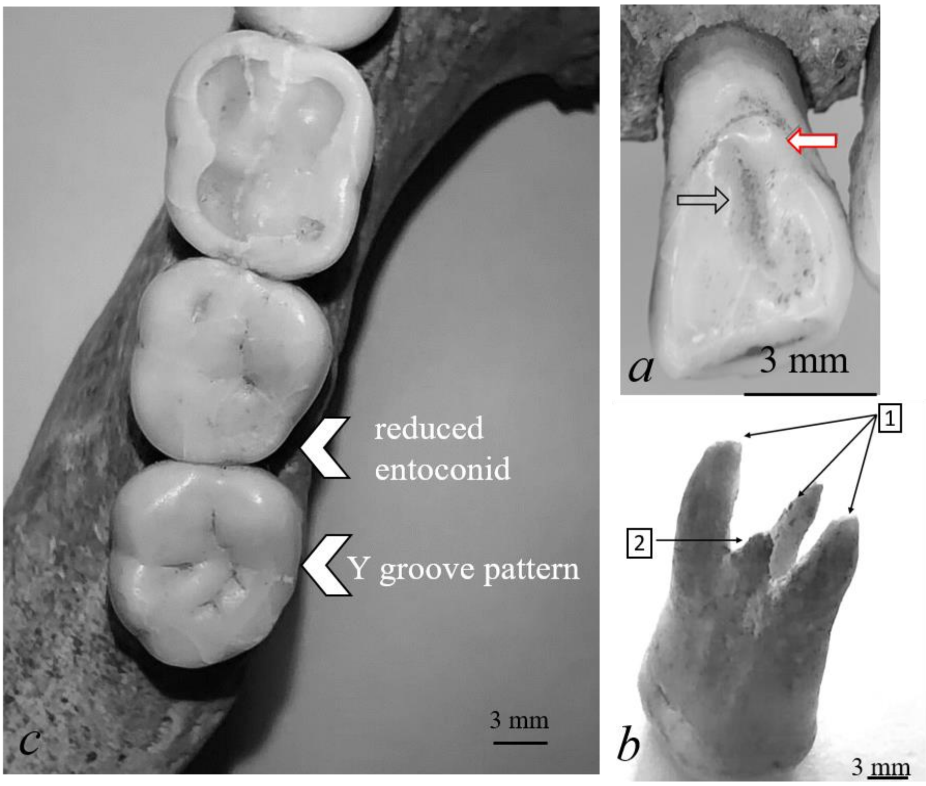

Fig. 7. a – Non-metric traits on right upper incisor (RUI); black arrow – interruption grooves and red arrow – *tuberculum dentale*; b – Roots in LM: 1) three inter-radicular projections separate all three roots; 2) fourth reduced root; c – lower molars – left mandible

Dental calculus or plaque (grey-white mineralized plaque composed primarily of calcium phosphate) is firmly attached to the dental surface. Depending on the positioning on the tooth crowns or exposed roots, dental calculus can be supragingival or subgingival [63]. Calculus should be reported as “0” (absent), “1” (small amount), “2” (moderate amount), “3” (large amount) [5].

Supragingival and subgingival dental calculus (moderate amount – “2”) is present at the level of the mandibular first and second incisors I_1, I_2 (right and left) on the labial and lingual surface (Fig. 8/a,b).

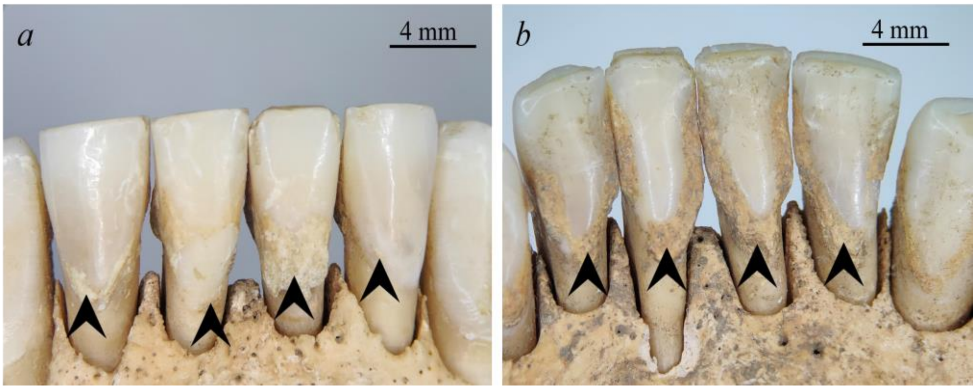

Fig. 8. Supragingival and subgingival dental calculus (moderate amount "2"):
a – mandibular first and second incisor I_1, I_2 (right and left) – labial view;
b – mandibular first and second incisor I_1, I_2 (right and left) – lingual view

Postcranial pathologies/ anomalies. At the level of the postcranial skeleton: Schmorll's nodule in three thoracic and two lumbar vertebrae (Fig. 9) and perforation of the sternum (sternal foramina) were reported (Fig. 10).

Schmorll's nodes are commonly recorded lesions, evidenced by depressions on the upper or lower surfaces of the vertebral bodies. Schmorll's nodes are caused by degeneration of the intervertebral disc, which may protrude through the vertebral surface facing the disc and extend into the vertebral body [33]. This produces a characteristic indentation in the corresponding vertebral body (Fig. 9). Although the specific cause of Schmorll's nodes is unknown, it is likely that they are caused by carrying heavy loads on the back [64]. In addition, different factors, such as trauma or an underlying disease process (for example osteoporosis, a disease in which loss of bone density and deterioration in the organisation of the bone tissue result in increased bone fragility), may weaken the bone structure, thereby increasing the likelihood of the development of Schmorll's nodes [33].

Sternal foramina (SF) constitute congenital midline defects in sternum, caused by incomplete fusion of the multiple sternal ossification centers. Presence of SF was firstly documented in the 17th century. Riolanus (1649) reported that the first description of SF located at the sternal body was made by Massa, while Eustachius (1707) also noted the existence of the anomaly [65].

Sternal foramina have been observed in the manubrium, body and xiphoid processes, however, they appear mainly in the inferior part of the sternum [65].

Fig. 9. Thoracic and lumbar vertebrae with Schmorll's nodules

Fig. 10. Perforation at the level of sternum (sternal foramina)

4. CONCLUSIONS

In the 17^{th}–19^{th} century skeletal sample discovered in the Historical Center – "Curtea Domnească" site of Iași, point: by-street "Sf. Atanasie", no. 1A (Iaşi, Romania), a case of double trepanation was identified – in the skull of an adult male, on the parietal bones. Trepanation was diagnosed and analyzed macroscopically and stereomicroscopically.

Regarding the determinism of the trepanation, examination of the edges of the holes highlights that the intervention had a medical/ therapeutic purpose: to combat internal cranial injuries (convulsions, hematoma or even a brain tumor).

Cx243 dentition is characterized by moderately advanced predominant wear and *ante-mortem* microfractures in both anterior and posterior teeth.

The particularities of this individual are defined by the supernumerary roots and the asymmetry of traits in the second upper incisor (interruption groove and *tuberculum dentale*).

Supragingival and subgingival dental calculus (moderate amount) is present at the level of the mandibular incisors I_1, I_2 on the labial and lingual surface.

At the level of the postcranial skeleton, perforation of the sternum (sternal foramina) and Schmorll's nodule in three thoracic and two lumbar vertebrae were evidenced.

The study provides new evidence regarding the trepanation in the ancient populations of Romania.

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