Memoirs of the Scientific Sections of the Romanian Academy
Tome XLVI, 2023

ANTHROPOLOGY

DENTAL ENAMEL HYPOPLASIA IN THE SKELETAL SERIES EXHUMED FROM THE "OVIDENIA" CHURCH IN IAŞI (16TH–17TH CENTURIES)

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The study is discussing dental enamel hypoplasia, identifed in a sample of human skeletons discovered in 2021 at the "Ovidenia" Church in Iași (Iași County, Romania).

The unearthed osteological material is mostly derived from inhumation tombs and reburials and includes 114 skeletons: 43 adults (25 ♂ and 18 ♀), 33 children *(infans I, infans II)* and 38 indeterminable. According to the information provided by archaeological investigations, the skeletons date between the late 16th century and early 17th century. Enamel hypoplasia is a developmental anomaly caused by perturbations of amelogenesis, representing a nonspecific indicator of health or/and nutritional status in human populations; it is a response of the human body to physiological stress.

Dental enamel hypoplasia has been widely used for the investigation of growth disruptions in past populations, as it provides a permanent record of disturbances occurring during individual development.

In this paper, enamel hypoplasia was observed in two male (aged between 25-45 years) and three female (aged between 30-60 years) subjects. The identified enamel hypoplasia is of linear transversal type, on incisive, canine, premolar and molar teeth, located on the labial and buccal surface of the crowns, with a moderate degree of severity.

Keywords: dental enamel hypoplasia, human skeletons, 16th -17th centuries, "Ovidenia" Church in Iași (Romania)

1. INTRODUCTION

During the archaeological rehabilitation excavations conducted in 2021 at the "Ovidenia" Church in Iași (Iași County, Romania) (Fig. 1), several skeletons were discovered.

The osteological material found in seven archaeological units of different dimensions was dug in specific areas of the church, both in the interior (Units 1, 2, 5, 6, and 7) and exterior (Units 3 and 4) areas (Fig. 2). Based on the information provided by archaeologists, the skeletons dated to the 16th–17th centuries.

An interesting aspect aspect of the archaeological research at "Vovidenia" Church refers to the funerary discoveries: graves and reburials. Most graves discovered within the excavation units predate the construction of the current church and were most likely in connection to an older one, situated in the same area. The construction of the "Vovidenia" Church disturbed many such graves, as shown by the numerous reburials of human remains along the foundation [1].

Only one burial, found in Unit 4, can be attributed to the "Vovidenia" necropolis. The skeleton that belonged (according to the funerary stone) to Maria Schilet was not included in the study and will be subjected to further multidisciplinary research [1].

The osteological samples discovered belonged to 114 individuals (graves and reburials): 43 adults, 33 children and 38 indeterminable.

The anthropological study of this sample has not been finalized nor published. We mention that only the human remains discovered in Unit 1 were studied by Groza *et al.* [2] in terms of biometry, sex and age at death estimation pathologies, abnormalities and non-metric traits.

Dental remains, the hardest and most chemically stable tissues in the organism [3], provide valuable information about population's state of health and nutrition [4]. In skeletal studies of human populations, the teeth show considerable potential, since they can provide much information about the age at death, diet, diseases, health status, genetic affiliation, as well as about the socio-economic status, migrations and behavior of past people [5].

The present paper focuses on linear enamel hypoplasia (LEH), which was identified in five human skeletons.

Dental enamel hypoplasia is a surface defect of the tooth crown due to physiological insults during amelogenesis [6]. It develops as a consequence of an impairment of enamel matrix secretion, appearing as a deficiency in the thickness of enamel [6,7]. Hypoplastic defects vary greatly in their macroscopic appearance, depending on the intensity and duration of the insult and the corresponding reaction of the secretory structure; number of secretory ameloblasts affected by the insult; position of the affected ameloblasts along the corono-cervical tooth axis and the corresponding time elapsed from entering into the secretory stage, and the species- and tooth-specific geometry of crown growth [7,8].

Three primary types of enamel hypoplasia are defined: pit, linear and plane. Among these types, linear enamel hypoplasia (LEH) is most observed [9]. LEH is characterized by horizontal lines of decreased enamel thickness on the external surface of the tooth crown. Another type, called cuspal enamel hypoplasia, was recently reported [10]. Once hypoplasia occurs, it remains on the enamel surface

for the rest of individual's life unless it is worn away. Furthermore, it is also possible to estimate the ages at which enamel disturbances took place from the location of the defects on the tooth crown [11].

Many studies have utilised linear enamel hypoplasia (LEH) to understand the health status of various human populations and their surrounding biocultural environments in the past or present times. Some studies investigated the chronological changes in the patterns of LEH occurrence in a certain population, often associated with changes in subsistence [12–14] or contacts with another population [15,16]. Another point of debate is the relationship between linear enamel hypoplasia formation and the socio-economic conditions [17,18]. Therefore, enamel hypoplasia represents a useful indicator of systemic stress and health status in past and present people [11].

Fig. 1. a. Location of the "Vovidenia" Church in Iași (Iași County, Romania); b. Detail of location (Map Source: Google Earth Pro) [19].

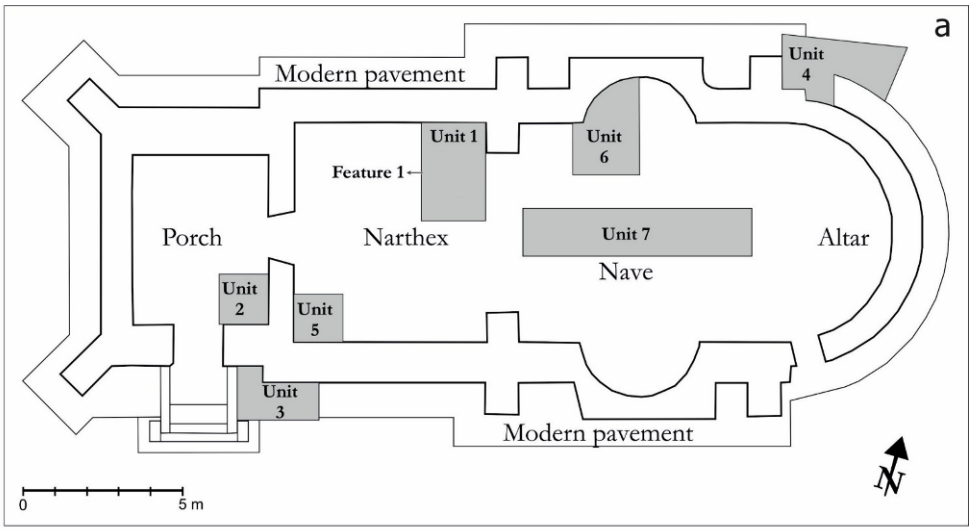

Fig. 2. General plan of "Vovidenia" Church and location of the archaeological units [2].

2. MATERIAL AND METHODS

The osteological sample consists of 114 skeletons coming from both inhumation tombs and reburials, exhumed from the "Vovidenia" Church of Iași. The preservation status of the skeletons is approximately satisfactory in some cases [20]. Study of the osteological sample was preceded by a process of marking and bone restoration, to allow the estimation of the age at death and sex evaluation.

Age at death for the 20–x years group was estimated by a combination of several criteria: pubic symphysis degeneration and sacro-iliac surface transformation [21]; changes in the spongy tissue from humeral and femoral epiphyses; involutions in skeleton; morphology of the rib sternal end; pathology specific to old age [22,23]; dental attrition [24,25]; cranial suture obliteration [26].

Determination of sex for the subjects over 20 years was based on the following aspects: shape and degree of forehead inclination; size of mastoid apophysis; mandible robustness, teeth shape and size [27]; pelvis characteristics [28–30]; development of bone relief for muscle insertions and size of the joint surfaces; skeleton's massiveness and robustness [23,26].

Estimation of age at death in the case of subjects under 20 years was based on the methodology suggested by Ubelaker, Fazekas and Kosa, Schaefer *et al.*, [23,31,32].

In this paper, we focused only on the individuals in whom teeth were available.

The enamel hypoplasia is evaluated by macroscopic observations. Some of the osteological and dental material was poorly preserved, most of the teeth being lost antemortem or *postmortem.* Only 33 people had their teeth present.

The teeth, found in the alveoli or *postmortem* fallen from the alveoli, were cleaned using a soft brush, to eliminate the sediments that would have impeded visual inspection.

Enamel hypoplasia was analysed according to the *Index of developmental defects of enamel* (DDE Index), but other registration methods have been also considered. The severity degree was established according to the method proposed by King, Hillson and Humphrey [9].

The degree of tooth wear/ attrition was estimated according to the method proposed by Smith and Knight [33]. Dental wear causes decrease in crown length – a variable used in the regression equation to calculate the age at which the hypoplastic line was formed.

Recording of the hypoplasia type has considered four main categories, namely: pits, horizontal ditches, vertical ditches, and areas wholly devoid of enamel [34]. Localization of enamel hypoplasia was observed on two anatomic dental surfaces: labial and buccal. On the crown of each tooth, it was established whether the hypoplasic defect is singular or multiple, well-delimited or diffuse [34]. Estimation of the age at which the hypoplasic defect first appeared was

based on the method proposed by Goodman, Armelagos and Rose [35]. For each hypoplasic tooth, the digital caliper (calibrated to the nearest 0.01 mm) was used for measuring the following parameters: distance between the cement-enamel junction and the center of the hypoplasic defect; distance between the cement-enamel junction and the occlusal margin. The obtained values have been subsequently introduced in the regression equation: Age at formation = age at crown completion – [(years of formation/ crown height) x defect height (from CEJ)]. The result should be reported as "0" (absent), "1" (small amount), "2" (moderate amount), "3" (large amount) [24].

3. RESULTS AND DISCUSSION

Out of the total number of 114 human skeletons exhumed from the "Vovidenia" Church of Iași, 34 subjects were determined to be subadults (*infans I, infans II* and *juvenis*), and 42 subjects (25♂ and 17♀) were over 20 years old (*adultus, maturus, senilis*). 38 skeletons were very fragmented, so that a correct determination was impossible. The demographic study indicates a mortality of approximately 30% for the subjects aged less than 20 years, of whom 28.94%, consequently an important percentage, is associated with children aged 0–14 years. In the subjects past the age of 20, the highest death rate corresponds to the maturity stage (approximately 28%), whereas, for the adult stage, the mortality index is approximately 4%.

In the age interval 60-x years we recorded a death rate of 4.39%. As to death frequency in the two genders, we signaled a slightly higher prevalence in adult females compared to males (2.63% *vs* 1.75%). On the other hand, in the mature stage, the male mortality rate is higher than the female rate (15.79% *vs* 12.28%). The indeterminable skeletons represent 33.33% of the total analyzed skeletons.

The teeth of 33 subjects were analyzed, but only in five cases linear enamel hypoplasia (LEH) was identified (two belonged to males: aged between 25–5 years and three belonged to females: aged between 30–60 years).

"Unit 1/ Feature 1" (Reburial) – Skeleton R1 was attributed to a female of 35–40 years. The dental wear is reduced, of attrition type – degree 1 towards 2. No dental caries was found.

In this case, the enamel hypoplasia is of linear horizontal type (moderate amount). At the level of the right canines (C) (labial surface) on the maxillary and the mandible, linear enamel hypoplasia (LEH) is present. As to the age interval within which the hypoplastic lines had been formed, it was calculated as being around 1.5 and 3 years.

The supragingival dental calculus (a moderate amount – 2) was identified on the buccal surface – in the lower right premolars (P_1, P_2), and the right canine (labial surface) on the maxillary (Fig. 3). Regarding dental calculus, it appears as a

mineralized plaque composed primarily of calcium phosphate. Depending on its localization, on either tooth crown or exposed roots, there are two forms of calculus: supragingival and subgingival [36]. Dental calculus appears most frequently on the teeth located closest to the salivary glands (especially mandibular incisors and maxillary molars) [3]. Dental calculus should be reported as "0" (absent), "1" (small amount), "2" (moderate amount), "3" (large amount) [24].

"Unit 1/ Feature 1" (Reburial) – Skeleton R4. Poorly preserved, it belongs to a mature female (55-60 years old). Dentition (teeth in alveoli – at the level of the maxillary) shows accentuate abrasion (3^{rd}-4^{th} degree). The mandible is missing. The linear enamel hypoplasia (LEH – moderate amount) is present in the upper right first molar (M^1) (buccal surface) (Fig. 4). As to the age interval within which the hypoplastic lines had been formed, it was calculated as being around 2 and 3 years.

Supragingival dental calculus (moderate amount – 2) is present at the level of the upper left first molar (M^1) on the buccal and occlusal surface. The upper right second incisor (I^2), the left first premolar (P^1) and the right second premolar (P^2) are present as radicular remains.

Dental attrition includes two prime components: occlusal attrition resulting from the contact between the biting surfaces of the upper and lower teeth, and interproximal attrition, a consequence of the slight movement produced between adjacent teeth in the same jaw [37,38]. Variations in the consistency of food, food preparation methods, and grit contained in food produce dental abrasion patterns, which is consistent with the well-documented patterns of attrition that reflect the biomechanics of mastication. Five degrees of dental abrasion established by Périer are used to highlight the disappearance of enamel and dentine [39]. The fifth degree is represented by pronounced abrasion, leading to the disappearance of the crown, which makes visible the pulp chamber. This is how radicular remains result.

At the level of the upper left second incisor (I^2) and upper left canine, a radicular cyst is present (Fig. 4). Radicular cyst results from the infection of the pulp cavity and the root canal of an erupted tooth. It starts as an apical abscess or granuloma and secondarily acquires an epithelial lining from the remnants of the epithelial sheath of the dental root [40].

"Unit 4/ Feature 27" (Reburial) – Skeleton R1 belongs to a mature male of 40–45 years.

The mandible is missing. Dentition at the level of the maxillary shows 3^{rd} degree abrasion. The linear enamel hypoplasia (LEH) was identified on upper canines (C) on the labial surface (Fig. 5).

The severity degree of enamel hypoplasia is moderate. The affected teeth show multiple, diffuse hypoplasia lines on the labial surfaces. The age interval within which the hypoplasia lines appeared in this subject ranges between 2.5 and 3 years.

The supragingival dental calculus was moderately deposited on the buccal and labial surface of the upper right second premolar (P^2), first molar (M^1) and canines (C) (Fig. 5).

"Unit 4/ Feature 27" (Reburial) – Skeleton R6.

Poorly preserved, this skeleton was attributed to a female of 35–40 years. The maxillary is missing and isolated teeth are not present. Dental wear is reduced, of atrition type – degree 1 towards 2.

Enamel hypoplasia is of linear horizontal type, being identified on the lower right canine (C) – labial surface (Fig. 6). The rest of teeth are apparently normal. The severity degree of enamel hypoplasia is moderate. The linear defects are superficial, not having reached the dentine layer. The age interval in which the hypoplasia lines appeared in this subject ranges between 2 and 3 years.

Dental caries (1st-2nd degree) affected the lower left first and second molars (M_1, M_2) and the lower right canine and second molar (M_2). Different types of caries have been identified: interproximal, cervical and root caries (Fig. 6).

The dental caries has a multifactor etiology, presenting various degrees of gravity, from opaque stains to large cavities affecting the teeth [3]. Specialized literature indicates that the main factors influencing dental caries are: environmental factors (oligoelements present in food and water), pathogenic agents (bacteria causing the disease), exogenous factors (diet, oral hygiene) and endogenous factors (teeth shape and structure) [41].

"Unit 6/ Feature 41" (Grave). This well-preserved skeleton belonged to an adult male (25-30 years).

The facial skeleton is almost complete and most of the teeth are present in the alveoli. Dental wear is of attrition type, degree 1. Enamel hypoplasia of linear horizontal type is present on the labial surface of the upper right second incisor (I^2 - isolated tooth) (Fig. 7/a). The severity of hypoplasia is low. The affected tooth shows a line of diffuse hypoplasia. The age interval at which the acute physiological stress was manifested ranges between 2 and 3.5 years.

In this case, dental caries affected the upper left first incisor (I^1) (1st degree), first premolar (P^1) (2nd degree) (Fig. 7/b) and lower left second molar (M_2) (2nd degree) (Fig. 7/c).

4. CONCLUSIONS

Following the analysis of the osteological series (16th – 17th centuries) exhumed in 2021 from the "Vovidenia" Church of Iași, we identified 114 skeletons whereof 33 belonged to children (28.94%), one to an adolescent (0.88%), five to adults (4.39%), 32 to matures (28.07%) and only five to elders (4.39%). A number of 38 skeletons (33.33%) were very fragmented, so that a correct determination was impossible.

The high number of children skeletons (0-14 years) indicates a hight frequency of these age categories, which shows that an important part of the population died before reaching adulthood.

Dental enamel hypoplasia was identified in only five of the 33 subjects (where teeth were present): two males - aged between 25–45 years and three females – aged between 30-60 years. In all five cases, hypoplasia defects are of linear horizontal type, being localized on the labial and buccal surfaces of the maxillary and mandibular teeth (*i.e.*, incisors, canine, premolars and molars), most of them in the median third of the crown. On almost all dental crowns affected with hypoplasia, a well-delimited defect and several diffuse lines can be observed, suggesting that, at young ages, the subjects have suffered some physiological disorders. The severity extent of hypoplasia is a moderate one in the majority of cases. The dental enamel hypoplasia present in our sample as a nonspecific indicator of health or/and nutritional status in human populations can suggest a biological fragility in response to some stress factors. At the dentition level of the five analysed subjects, supragingival calculus (three cases), dental caries (two cases) and radicular cyst (one case) are also reported.

The results obtained for a relatively small medieval community of Iași illustrate a good adaptation to environmental stressors, possible episodes of malnutrition or diseases suffered during early childhood being recovered during the growth and development processes.

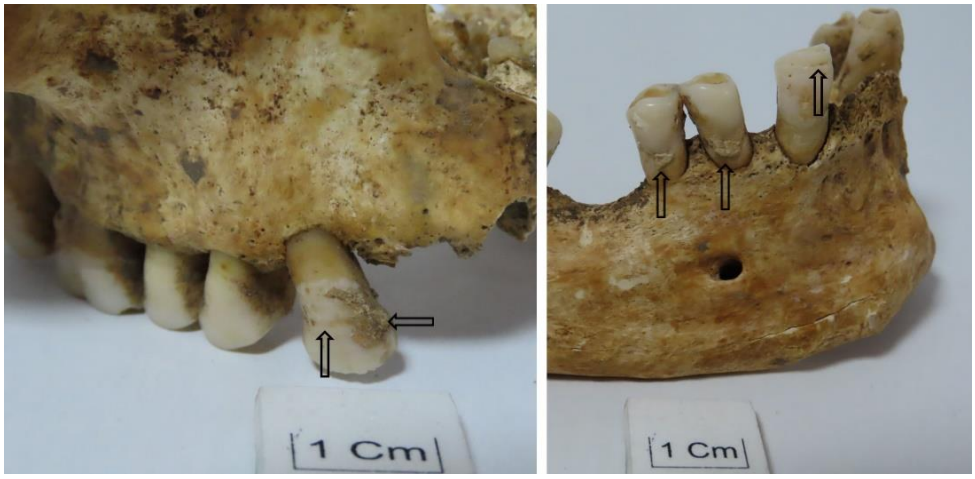

Fig. 3. "Unit 1/ Feature 1" (Reburial) – Skeleton R1, ♀, 35-40 years old: linear enamel hypoplasia (LEH) (moderate amount "2") – upper and lower right canines (labial surface); supragingival dental calculus (moderate amount "2") – on the upper right canine (labial surface) and on the buccal surface of the lower right premolars (P_1, P_2).

Fig. 4. "Unit 1/ Feature 1" (Reburial) - Skeleton R4, ♀, 55–60 years old; maxillary – linear enamel hypoplasia (LEH – moderate amount "2") – right first molar (M^1) (buccal surface); supragingival dental calculus (large amount – 3) – right first molar (M^1) on the buccal and occlusal surface; radicular remains – right second incisor (I^2), left first premolar (P^1), and right second premolar (P^2); radicular cyst at the level of the left second incisor (I^2) and canine.

Fig. 5. "Unit 4/ Feature 27" (Reburial) – Skeleton R1, ♂, 40–45 years old; maxillary - linear enamel hypoplasia (LEH – moderate amount "2") – canines (C) (labial surface); supragingival dental calculus (moderate amount "2") – right second premolar (P^2), first molar (M^1) and canines (C) on the buccal and labial surface.

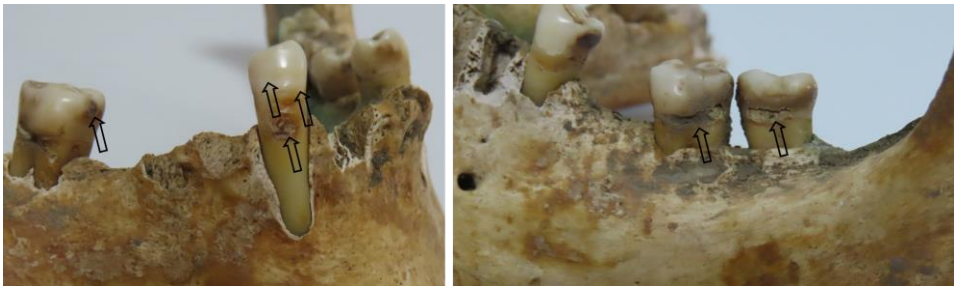

Fig. 6. "Unit 4/ Feature 27" (Reburial) - Skeleton R6, ♀, 35–40 years old; mandible – linear enamel hypoplasia (LEH – moderate amount "2") – right canines (C) (labial surface); dental caries (1^{st}-2^{nd} degree) – the left first and second molars (M_1, M_2) and the right canine and second molar (M_2).

Fig. 7. "Unit 6/ Feature 41" (Grave), ♂, 25–30 years old; a. linear enamel hypoplasia (LEH – small amount "1") – upper second left incisor (I^2) (labial surface); b. maxillary – dental caries in the left first incisor (I^1) (1^{st} degree), first premolar (P^1) (2^{nd} degree); c. mandible – dental caries in the left second molar (M_2) (2^{nd} degree).

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