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# ON THE ASSOCIATION OF HARRIS LINES, ENAMEL HYPOPLASIA AND POROTIC HYPEROSTOSIS

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RESUME

*Les lignes de Harris, l'hypoplasie de l'émail et l'hyperostose porotique sont les classiques indicateurs des conditions de santé parmi les populations préhistoriques.*
*L'association de ces trois facteurs a été étudiée lors d'un examen paléoanthropologique, portant sur un échantillon de 128 squelettes. Ce matériel provenait des fouilles de la grande plaine de Hongrie et était datable du 8ème au 10ème siècle. Aucune association significative de ces trois facteurs n'a été trouvée. Ceci est imputable aux variations d'étiologie.*

*Mots-clés : Ligne de Harris, hypoplasie de l'émail, hyperostose porotique, squelettes d'époques historiques*

## INTRODUCTION

In the examination of the skeletons of past human populations, the various aspects of the pathological changes provide useful information about their living circumstances and may be indicators of their health conditions. Such indicators include Harris Lines, enamel hypoplasia and porotic hyperostosis, among others. As the etiology of Harris lines partially overlaps with that of enamel hypoplasia/temporary interruption of the growth process due to disease, malnutrition, starvation, or other metabolic insult ; McHenry and Schulz 1976, Maat 1984, the possibility of their regular co-occurrence has come into prominence in research.

Porotic hyperostosis yields also good evidence of the degree of nutritional stress. As its etiology the iron deficiency anemia is stated as the main factors (Roosevelt, 1984), but Janssens (1981) pointed out the lack of folic acid may arise due to the drinking of goat's milk. In an early Bronze Age material Smrcka et al (1989) supposed the lack of folic acid and iron as the responsible factors for cribra orbitalia. Thus, the etiology of porotic hyperostosis is connected with the etiology of Harris linesz and enamel hyperostosis only in a wider sense. In spite of this, it seems important to record its occurrence in individuals displaying enamel hypoplasia and/or Harris lines.

## MATERIAL AND METHODS

In a complex paleoanthropological investigation, the association of Harris lines, enamel hypoplasia and porotic hyperostosis was studied. The materiel was excavated on the Great Plain in Hungary, at Belmegyer (8th century) and Algyö (10th century) (in elaboration). The samples involved a total of 128 individual skeletons, but only those specimens (N = 115) with tibia, teeth orbit and skull vault in a well-preserved condition were included in the study.

A longitudinal section was made from the distal half of the tibia for the examination of Harris lines. The ages at which the Harris lines formed were estimated by the method of Wells (1961) and Allison et al (1974). Only those lines which extended at least halfway across the shaft were recorded.

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For enamel hypoplasia, permanent teeth were included ; thus, the development of enamel from shortly after birth up to 6 - 7 years of age was examined. Only linear and pitting types opposed to brown pigmentation were considered. A scheme of the mineralization of teeth during development is recommended by the Workshop of European Anthropologists (1980), and the positions of hypoplastic lines at 1.5 yearly intervals have been reported by Kerr (1989).

The occurrence of porotic hyperostosis according to localization and type of involvement was defined, consideration being given to the study by Nathan and Haas (1966).

The association between Harris lines and enamel hypoplasia was determined by examining each individual in each age category for the occurrence of either or both traits. Co-occurrence was defined as the presence of both traits at the same age in the same individual.

**Belmegyer 8th century (in elaboration)**
**N = 82**

| | Males | Females | Juvenile | Inf.I-II | Together |
|---|---|---|---|---|---|
| Harris lines (HL) | 11 | 10 | 1 | - | 22/27% |
| Enamel hypoplasia (EH) | 5 | 4 | 1 | - | 10/12% |
| Porotic hyperostosis (PH) | 5 | 4 | 4 | 2 | 15/18% |
| EH+HL | 4 | 3 | 1 | - | 8 |
| EH+PH | - | 2 | 1 | - | 3 |
| PH+HL | 2 | 1 | 1 | - | 4 |
| EH+HL+PH | - | 1 | 1 | - | 2 |

**Algyö 10th century (in elaboration)**
**N = 33**

| | | | | | |
|---|---|---|---|---|---|
| Harris lines | 11 | 3 | - | 3 | 17/51% |
| Enamel hypoplasia | 7 | 3 | - | 1 | 11/33% |
| Porotic hyperostosis | 3 | 2 | 3 | 3 | 11/33% |
| EH+HL | 3 | - | - | - | 3 |
| EH+PH | 1 | - | - | - | 1 |
| PH+HL | 2 | 1 | - | 2 | 5 |
| EH+HL+PH | 1 | - | - | - | 1 |

## RESULTS AND DISCUSSION

In our material, the Harris lines must generally have been formed prepubertally and pubertally, and in fewer cases in adolescence and infancy. In some cases, the tibia, though in a well-preserved condition, was not fully intact, and it was not possible to determine the age at which transverse lines formed. The hypoplasias exhibited only a linear appearance, either singular or multiple, and they were mainly localized on the frontal teeth and on the premolars (only one molar had linear hypoplastic defects).

The primary site of occurrence of porotic hyperostosis as a porotic type was the orbits. The cribotic form was found only in four cases (in one case associated with hyperostosis spongiosa cranii).

Another skull displayed hyperostosis spongiosa cranii without cribra orbitalia.

The frequencies of the three alterations are as follows. Results are given per individuals.

The results demonstrate that Harris lines, enamel hypoplasia and porotic hyperostosis (per individual) exhibit higher incidence in the samples from Algyö (10th century). From 21 specimens in 11 cases (Algyö = 3 - Belmegyer = 8), enamel hypoplasia occurred together with Harris lines in the same individual. This co-occurrence was defined as the presence of both traits at the same age. Harris lines were associated with equivalent hypoplasia only in 5 cases (Belmegyer = n° of graves : 71, 75, 90, 92 - Algyö : n° of graves : 27) (Fig. 1, 2).

Enamel hypoplasia with porotic hyperostosis occurred in 4 cases (Fig. 3, 4). The age at which porotic hyperostosis developed cannot be estimated. In fact, porotic hyperostosis in adults is probably indicative of anemia in childhood. In 5 cases Harris lines were associated with porotic hyperostosis.

Three alterations in the same individual could be estimated only in 3 cases (but hypoplasia was not associated with equivalent lines).

Our material displays the following variations concerns the association of enamel hypoplasia and Harris lines :

enamel hypoplasia without Harris lines ;
enamel hypoplasia with Harris lines (developing at the same age) ;
enamel hypoplasia with Harris lines (developing at different ages) ;
Harris lines without enamel hypoplasia.

Summing up the results. In the samples (Belmegyer and Algyo) 21 specimens have linear enamel hypoplasia. From these 11 individuals have also Harris lines, but only in 5 specimens developed Harris lines at equivalent ages of enamel hypoplasia.

Using $\chi^2$ test with one degree of freedom no significant difference ($P > 0,1$) could be detected between skull with or without porotic hyperostosis in relation to enamel hypoplasia ; between skull with or without porotic hyperostosis in relation to Harris lines in tibias.

In the both samples the association of Harris lines and enamel hypolasia was significant ($P < 0,1$) within the same individuals, but this association concerning at the same ages was not significant ($P > 0,1$).

There have been several recent studies of the co-occurrence of Harris lines and enamel hypoplasia, with mixed results. In Maat's studies (1984) specimens of 50 whalers had been examined for Harris lines and enamel hypoplasia. The transverse lines appeared to correspond with enamel hypoplasia within the same individual. According to Wells (1964), there is only a very slight connection between the two phenomena. In the study by McHenry and Schultz (1976), the results of tests of the co-occurrence of enamel hypoplasia and Harris lines in specific age categories were totally non significant. The occurrence of cribra orbitalia in connection with Harris lines and enamel hypoplasia considered Kühl's (1980) study concerning prehistoric cremations.

## CONCLUSIONS

Likewise, in our material, the occurrence of Harris lines is not significantly associated with that of enamel hypoplasia. The recovery phase necessary for Harris formation (but not for enamel hypoplasia) highlights the fact that the etiologies of these pathologies only partially overlap and it may be assumed that other etiological factors may also play a role in the development of enamel hypoplasia and Harris lines. In some cases Harris lines is undergoing resorption and can disappear, in other cases they remain up to adult age. Thus, the absence of Harris lines never means that the individual did not suffer from any disease or starvation.

The literature and our own results demonstrate that enamel hypoplasia, Harris lines and porotic hyperostosis can occur in the same individual ; enamel hypoplasia and Harris lines can be associated at the same age, but their co-occurrence is not regular or frequent in any historic population. In spite of this, in all specimens the presence or absence of enamel hypoplasia, Harris lines and porotic hyperostosis must be recorded in order to indicate the health status of the individual.

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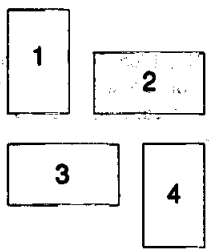
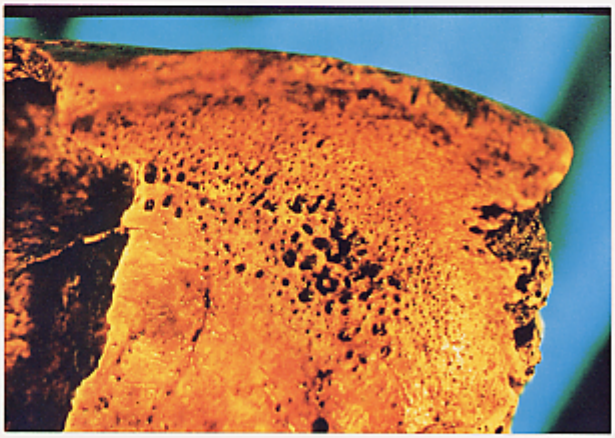



**Fig. 1 :** Harris lines / Bélmegyer, grave 92
**Fig. 2 :** Enamel hypoplasia / Bélmegyer, grave 92
**Fig. 3 :** Porotic hyperostosis / Algyő, grave 97
**Fig. 4 :** Enamel hypoplasia / Algyő, grave 97



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