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Evaluation of the Quantity and Direction of Dental Wear in A Chalcolithic Population

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Abstract

The objective of this study was to assess dental wear as a function of age within the population of a Chalcolithic burial cave: the Gaches ossuary (Aveyron). The teeth bear witness to the lifestyle and nutrition of this period. The frequency and distribution of teeth present, post-mortem and ante-mortem losses, and the amount and direction of tooth wear were studied as a function of age. The material studied includes 82 mandibles. Wear was assessed according to the classification proposed by Brabant and Sahly and age by the Brothwell classification. The results show a statistically significant difference in the amount and direction of wear depending on age. Early wear affects all types of teeth, and the high rate is probably due to a hard and abrasive diet. The molars and more particularly the first molars (M1) are the teeth most affected by wear due to their eruption chronology, which suggests a significant abrasive load from food.

Keywords: Dental wear; Age; Chalcolithic population

Introduction

Dental wear is a process of loss of dental substance [1] of non-bacterial origin linked to repetitive processes. It depends among other things on the masticatory function [2]. The wear profiles of the maxillary and mandibular teeth are formed by the circular movement of the mandible [3]. Dental wear is one of the most studied lesions and provides the most information on the diet and lifestyle of ancient populations. Dental wear is also of real interest in anthropobiology. Indeed, it can be a complex, evolutionary and adaptive physiological phenomenon of the masticatory system, which has existed since the origin of the human species [4]. Dental wear involves several parameters such as the nature of dento - dental contacts, the food bolus, masticatory function, lifestyle and cultural habits [5]. This is why the study of this phenomenon in prehistoric populations has dominated the literature, although it is an interesting and important aspect of the use of teeth to reconstruct the past, The Chalcolithic era is defined as a transitional period between the end of the Neolithic (final Neolithic) and the Early Bronze Age (2600 – 1700).

This era, following Neolithization, constitutes an epidemiological transition and corresponds to the passage from hunter-gatherers to farmers-herders [6]. Neolithization, also called the Neolithic revolution, had many consequences on populations. We could cite sedentarization and domestication [7]. It is important to study dental wear at this time because it corresponds to an upheaval in eating habits and lifestyle, with the appearance of cooking [8]. Etiopathogenic mechanisms. This is Attrition: loss of dental tissue due to dento -dental contact during chewing and has as etiology a hard and coarse diet,

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Erosion: loss of dental tissue due to a non-bacterial chemical process and has intrinsic or extrinsic acids (food, medication, environment) as its etiology. Abrasion is pathological loss of dental tissue due to an abnormal biomechanical friction mechanism and has as etiology an interposition of foreign bodies and eating habits. The interposition between the teeth of food, of hard or soft consistency, will play a considerable role in the development and intensity of wear. Abfraction is the pathological loss of substance caused by occlusal forces that cause coronal bending and degradation of enamel and dentin away from the point of load application. This pathology always occurs at the cervical level. The inclusion of abrasive particles is decisive and depends on the food collection (hunter-gatherers, herders, and farmers, industrialized countries), the nature of the diet (herbivore, carnivore, omnivore), whether the food is cooked or not, whether it is mechanized or not and whether it is preserved (drying, salting). The tooth is an important material in anthropology because its protective mineral structure is not subject to taphonomy. The study of wear provides objective information on the diet, lifestyle, and environment of populations. The objective of this study was to analyze the degree of preservation of each mandible and to evaluate the degree and direction of dental wear and the age of individuals at death in a Chalcolithic population from the Gaches cave.

Materials and Methods

The material consists of 82 mature mandibles from the Gaches collection, a magnifying glass, and a lamp. The Gaches cave is part of the Treilles group discovered by Louis Balsan in 1931. Thus, on each bone piece, the following were noted: the degree of preservation, the teeth lost ante-mortem and the teeth lost post-mortem, the teeth present, and their location using the FDI table. The degree and direction of wear, as well as the age of the individuals, were also studied on the teeth present. On each tooth present, wear was assessed according to two criteria: quantity and direction. The scale used for this quantitative and directional study of wear is that of Brabant and Sahly. It is a simple, reproducible, rapid, and easy-to-use visual scale. This method allows for rapid coding of dental wear with regard to quantity and direction [9-11].

The amount of wear is assessed in stages:

- Stage 0: No or negligible wear

- Stage 1: Worn enamel but without complete disappearance of the cusps and exposure of the dentin.

- Stage 2: Cuspid teeth are worn more or less completely and dentin is occasionally exposed naked.

- Stage 3: A significant part of the crown, the enamel, has disappeared and the dentin is completely exposed.

- Stage 4: Almost the entire crown has disappeared and wear may extend to the neck dental.

The direction is coded in 5 stages as well:

- Stage 0: No wear

- Stage 1: Horizontal and flat wear

- Stage 2: Oblique and flat wear

- Stage 3: Horizontal and concave wear

- Stage 4: Oblique and concave wear.

Concerning the age of the individual at death, the method used is that of Brothwell

(1981) described in the following table1:

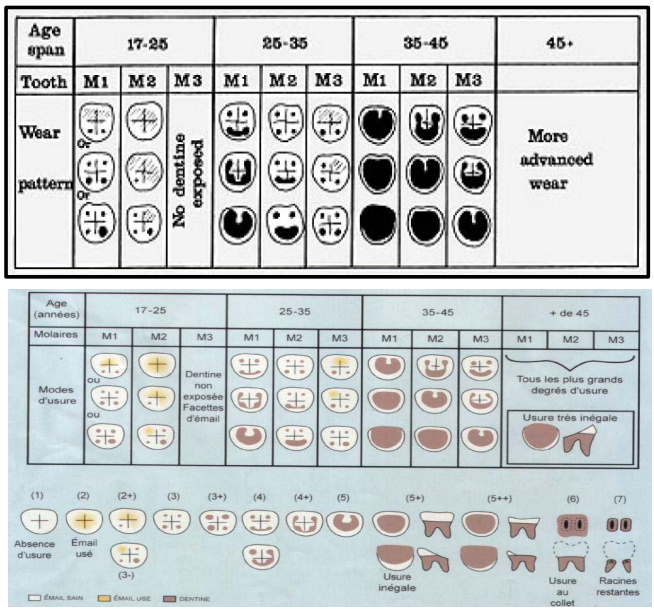

Table 1: The different age groups according to Brothwell et al. [12].

The various measurements were performed by two calibrated examiners. A first assessment of the amount and direction of wear of each tooth and the age was performed by the first observer on each mandible. Then, separately, a second assessment of the same parameters was made by the same examiner under the same conditions. To assess the reproducibility of the measurements, another examiner studied the same parameters to confirm the results. In case of disagreement, a consensus meeting was organized to validate the measurements. Les données ont étés saisies et analysées avec le logiciel Statistical Package for Social Sciences® (SPSS version 11.5 Chicago Illinois). Les variables quantitatives ont été exprimées par leurs moyennes et leurs écarts types. Les variables qualitatives ont été décrites par leurs nombres et leurs pourcentages. Le test de X2 a été utilisé pour étudier l'association entre deux variables qualitatives. Le seuil de significativité était fixé à $p \leq 0,05$.

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Results

Of the 82 mandibles observed, 44 or 53.65% were preserved at more than 50% or even entirely. Post-mortem dental losses were more significant in the anterior teeth. In the posterior teeth, ante-mortem losses predominated (figure1). These losses were more noted in the 2nd and 3rd molars with 32 % and 23% respectively. Statistical analysis of the results shows that post-mortem losses were more significant in the anterior teeth (P=0.09) (figure 2).

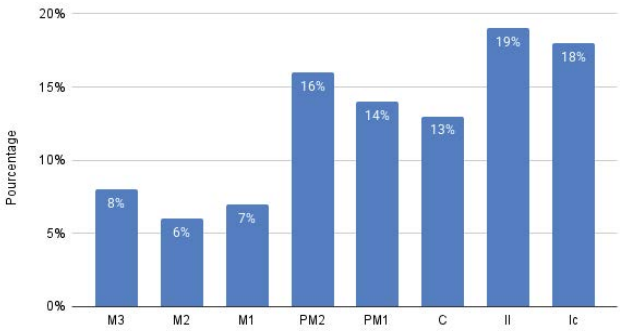

Figure 1: Post-mortem losses

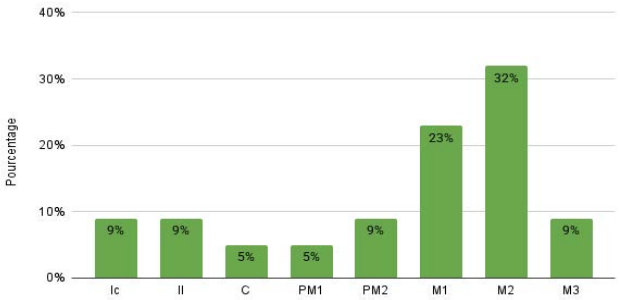

Figure 2: Ante-mortem losses

The average age is 25 years +/- 5 years, molars are the most present teeth regardless of age with 69% in those under 25 years and 62% in those over 25 years. In those under 25 years, there is more ante -mortem loss at the level of premolars with 60% than at the level of molars with 40%. No ante -mortem loss, at the incisor-canine level in those under 25 years, was observed (P<0.05). The assessment of the amount of wear shows that posterior teeth (molars) are more affected than anterior teeth, with an amount of wear up to 6 on the Brabant and Sahly scale. In addition, the number of worn teeth is higher in molars 205 compared to 38 for incisors and canines and 39 for premolars. There is a statistically significant difference in the amount of wear between anterior teeth and posterior teeth (P<0.04), with no significant difference between the right and left sides.

Grade 3 of the scale is the one that records the most results regardless of the tooth group: 65% for the IC group, 34% for the premolars, and 60% for the molars. Regardless of age, molars are the most worn teeth. In those under 25, the maximum degree of wear is 3. In those over 25, there are more worn teeth with a degree of 3 and some teeth with a degree of wear of 4 or even 6. There is a significant difference in the amount of wear of posterior teeth depending on age (P=0.028). The flat and predominantly horizontal direction was noted with 53% at the incisivo-canine level, 56% at the premolar level and 46% at the molar level. It should also be noted that the cupped state has an anteroposterior gradient. In those under 25 years of age, at the incisor-canine and premolar level, wear is essentially flat and more horizontal than oblique with 80% and 85% respectively.

At the molar level, wear is almost exclusively horizontal and flat at 88% and in the cup at 1%.

Oblique cup condition was not found in those under 25 years of age. No statistical difference in the direction of wear in those under 25 years of age.

In those over 25 years old, at the incisor -canine level, the wear is horizontal and cup-shaped at 50 %, horizontal plane at 40% and oblique plane at 10%.

At the premolar level, horizontal plane wear dominates with 46% but we note an increase in the state in cup with 32% for horizontal in cup and 14% for oblique in cup.

At the molar level, the oblique state dominates with the oblique plane at 30% and the oblique cup at 42%. There is a statistically significant difference in the cup state according to age (P=0.018) and the obliquity between the anterior and posterior teeth is more marked at the posterior teeth. Between posterior teeth, there is also a statistically significant difference between the first, second, and third molars, more pronounced on the first molar regardless of the side (P=0.03). The oblique cup state has an anteroposterior gradient and is age-related.

Discussions

Anterior teeth show a high number of post-mortem losses in osteological samples due to their non-resonant single-rooted and conical shape and topography [3]. Molars are the most affected teeth in terms of ante -mortem loss which may be a sign of oral health. In this present study, wear was noted in all groups of teeth. Grade 3, on the Brabant and Sahly scale, is the most frequently found with approximately 60%. However, grades 4, 5, and 6 were only noted on molars. The tooth most affected by wear is the first molar. This confirms the results of other previous studies on ancient French and European populations [3;9;13]. As in all studies, the first molar presents the highest degree of wear, even in the youngest. This can be explained on the one hand by its chronology of eruption and its topography on the arch and on the other hand by its degree of involvement during masticatory functions.

Dento -dental contacts. In this study, early wear of grade 3 was noted in both age groups. With age, wear progresses until pulp exposure, especially on molars with grades 4, 5, and 6. The profile of this wear and its precocity if we only take into account extrinsic factors are related to the lifestyle of that time, Hunter-gatherers, with a wild, hard and raw diet which required more chewing cycles and more ample lateral movements of the mandible which amplifies this wear [14].

Conclusion

Dental wear is a physiological phenomenon that has existed since the origin of the human species. It is linked to diet (type of food, cooking method) and lifestyle. This study consisted of evaluating the amount of wear and its direction according to age, for a Chalcolithic population. Dental wear is preponderant within this population. It was early, rapid, and widespread and led to the loss of substances. The wear takes on a very regular and functional aspect on all the mandibular teeth. This is where linked to lifestyle and diet.

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