ACTA BIOL. SZEGED. 42, pp. 11-16 (1997)

PALEOODONTOLOGIC STUDY OF PRE-AGRICULTURAL AND AGRICULTURAL POPULATIONS

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(Received: January 10, 1997)

Introduction

The pathology of the periapical area is poorly documented in the paleopathological literature. However, such lesions nowadays comprise an important area of the dental pathology, in relationships with the diet, the dental wear, occlusal trauma and other direct trauma. Inflammation of the dental pulp, initially reversible, will lead, if untreated, to necrosis of the pulp. In most cases, this necrosis will subsequently give rise to a periapical lesion (more commonly known as an abscess), which can be detected macroscopically or radiologically, and which in consequence which can be observed on ancient human remains. In order to establish the frequency of periapical lesions and the etiological agents in the past, and also the variation during evolution, we studied these parameters in two ancient populations, dating from the Early and Middle Holocene, who exhibited an important difference in their diets, one living before and the other one after the beginning of agriculture. The first population is an African preagricultural series from Northern Mali: it belongs culturally in the Epipaleolithic or Mesolithic culture, but also characterized as "Early Neolithic"; their diet was that of hunter-gatherers, similar to the one in Paleolithic times. The other population is from a European agricultural Neolithic series belonging in the Seine-Oise-Marne civilization. This comparative study includes an exhaustive inventory of the series and a study of the pathologies to demonstrate the disparities which may exist in regard of periapical lesions between the European and African Neolithic populations.

The aim of this study was to compare the occurrences of periapical lesions in these two populations on the basis of direct observations on the maxilla and mandible, and by using periapical radiography. The bucco-dental state observed in currently living people provided the state of reference. From an etiological perspective, pulpal inflammation may have various origins, including tooth decay, dental wear, occlusal trauma and dental treatment.

Tooth decay is a chronic bacterial disease which destroys the hard tissues of the teeth. It involves demineralization of the dental tissues by organic acids arising from the fermentation of carbohydrates on the action of bacteria. According to KEYES (NITLICH,

1979), it is a result of 3 factors: diet, heredity and hygiene, which explains why decay is most commonly found in retention areas.

Several authors (BANG, 1989; BROTHWELL, 1989; DREIER, 1994) state dental wear depends on the diet (tough meat, badly cut, badly cooked, plant fibres, etc.), the bite of each person, the muscular strength exerted on the dentition, the masticatory habits, and the quality of the teeth. There are several methods for the study of dental wear: the earliest seems to be that of BROCA (1879), but we decided to use the method of MILES (1963), which is more accurate. We did not take into account the aspect of age in determinations with this method.

Occlusal trauma is generally caused by dental malposition. Such malposition may be caused by dental loss, which leads to the version of adjacent teeth, the shifting of antagonist teeth, and also dento-maxillar dysharmony (a poor relation between the size of the teeth and the size of the maxilla). Direct shocks may reach the pulp and lead to necrosis.

Periapical lesions are visible radiologically if the internal or external bone palate is attacked, or if there is a great destruction of medullary bone. Periapical lesions show up as round and regular radiololucencies. They can lead to pathological root destruction (rhizalysis) and/or or resorption of the alveolar bone. The regular shape of the lesion allows establishment of a differential diagnosis (PASLER, 1987). Many periapical lesions are nowadays found during systematic examination, before the patient experiences any pain. The periapical lesions described today may have either the same etiology as previously or an iatrogenic etiology, caused by poor endondontic treatment, cavity formation in vital teeth, or the effects of prosthetics on vital teeth.

Material and methods

Two series were studied: the Hassi-el-Abiod (Malian Sahara) sample consisted of 92 individuals belonging to an early Holocene population of hunter-gatherers whose diet comprised mainly fish, meat and graminae. In our inventory, we included only the individuals with maxilla, mandible or teeth. Because of their very advanced mineralization, it was impossible to date the human remains directly, but the fauna allowed dating of the bones to 6970 ± 130 BP and 8450 ± 60 BP (DUTOUR and PETIT-MAIRE, 1983). The age distribution was as follows: 76 adults (6 women and 10 men) and 16 children.The 76 adults yielded 37 isolated mandibles, 8 isolated maxillae, and 31 associated mandibles and maxillae. The 16 children provided 6 isolated mandibles, 1 isolated maxilla and 9 associated mandibles and maxillae. During this inventory, we encountered two problems: (i) due to several movings, 5 individuals described previously by DUTOUR (1986) were missing; (ii) as several small pieces were found in the digs AR7 and MK37, we decided to consider each piece as a separate individual, which explains why we total more than the 89 individuals listed in the previous studies.

As concerns the Loisy-en-Brie sample, the previous studies showed the number of people involved to be around 140 (DUTOUR, 1994). We have again made an exhaustive inventory of the maxillae and mandibles kept in the laboratory. Unfortunately, we could not examine the isolated teeth of the series, and some trephined skulls are missing. It has also been necessary to match again mandibles and maxillae because the previous inventory had been lost; further, the numbers on the bones were not matched and there was no posibility to relate cranial/postcranial due to the burial customs.This sample was dated by the 14C method, which gave 3690 ± 100 BP. The population was an agricultural one, whose diet mainly consisted of cereals and other plants. According to our inventory, this population numberd 149 individuals: 116 adults and 33 children. The 116 adults gave 77 isolated mandibles, 13 isolated maxillae and 26 associated mandibles and

maxillae. The 33 children afforded 21 isolated mandibles, 13 isolated maxillae and 7 associated mandibles and maxillae.

General data

Age and sex determination: in order to homogenize the population and to obtain more consistent results, children were not included in the study. Only one subject exhibited enamel decay and none of them had periapical lesions. The dividing line between children and adults was taken as the evolution of the second molars (BRABANT and TWIESSELMANN, 1964): if the second molar roots could not be detected radiologically, the subject was regarded as a child (NOSSINTCHOUK, 1991). As regards the adults, in previous studies (DUTOUR, 1986, 1994), the individuals in these series were classified in three categories (young, mature and senile), using classical methods. As we did for the age, we used the previous data for sex determination; some problems arose as concerns the poor preservation for the African series and the dissociation cranial / postcranial remains for the European series.

Dental study

For each series, we made an exhaustive inventory on the basis of analysis of dental morphology (ROMEROWSKI and BRESSON, 1994; TAVERNIER, 1994).Two different methods were used to study the dental pathologies. The first was gross examination, focussed in particular on the periapical lesions mostly revealed by perforation of the internal or external bone plate, on dental decay and on dental wear, quantified via the Miles classification. The second part of this study comprised a systematic radiological examination of all maxillae and mandibles analysed macroscopically.

Results

In connection with the state of preservation of the two series, we established that it was different, to the disadvantage of the Saharan sample (32.7% Hassi-el-Abiod vs. 47% Loisy-en-Brie). This difference seems mainly due to the burial mode (cave protection for Loisy-en-Brie, whereas Hassi-el-Abiod was exposed to various taphonomic agents, such as wind erosion and thermal shock in a desert environment).

As concerns the determination of the age at death of the adults, categorized as young, mature or senile, the success of the determination differed in the two series. More young adults were found in the European series, whereas a rather more "normal" curve for the age distribution was observed for the Saharan material. This repartition in the European series may be caused by a special funeral rite if it could not interpreted as a life span in these European Neolithic series (MASSET, 1986). As regards the sex distribution, in the Hassi-el-Abiod series we could only determine the sex of 16 out of the 76 individuals in the sample, i.e. a determination rate of 21%. The distribution was 6 women and 10 men, which shows an unequal sex ratio, with a male prevalence of about 25%. However, this result may be explained by the small number of individuals studied, the diagnostic methods used (based only on coxal bones) and the very high percentage of undeterminate individuals, linked to preservation problems; this prevents the drawing of general conclusions. In Loisy-en-Brie, we determined the sex of 92 of the 116 individuals, i.e. a determination rate of 80%. The distribution was 40 women and 52 men, which shows a quite balanced sex ratio.

The odontological sites (O.S.) studied were:

- the dental odontological sites (D.O.S.) = whole teeth in their proper place;

- the radicular odontological sites (R.O.S) =crown missing, roots in their proper place;

- the alveolar odontological sites (A.O.S) = teeth missing, sockets kept.

As concerns the preservation of the O.S. for the maxilla, the D.O.S. were comparable in both series, but there was a reversal between the R.O.S and A.O.S percentages. For the mandible, the same was true for the A.O.S and R.O.S, but the preservation of the D.O.S. was very different, with a preference for Loisy-en-Brie (36.4% vr. 16.2% for Hassi-el-Abiod); this could not be considered a bias, because it was presumed that the ante-mortem losses were caused by taphonomics problems and not by pre-existing pathologies, periapical or not.

As to the frequency of periapical lesions, we obtained the same result in the two series (0.96 in Loisy-en-Brie, and 0.96 in Hassi-el-Abiod).

When this result was compared with the totality of the dental pathologies observed in these series, the frequency of dental decay was found to be 6 times higher in Loisy-en-Brie than that in Hassi-el-Abiod. This can be linked with the difference in diet: a pre-agricultural series with a diet consisting mainly of meat, followed by an agricultural series with a diet of cereals and plants (KNYCHALSKA-KARWAN et al., 1972). On the other hand, the dental wear of those population does not reveal a significant difference, though wear occurred earlier in Loisy-en-Brie than in Hassi-el-Abiod. Two hypotheses might explain this difference: the first one is based on the effect of oclusion, leading to a different masticatory strength. This interpretation can be correlated with the fact that the Saharan series displays an archaic occlusion (MAYTIE, 1976), classified as "end-to-end occlusion" or class III in Angle's classification, whilst the European Neolithic series presents an occlusion similar to ours (class I of ANGLE, BENAUWT and LORETTE, 1882). The second interpretation is a reduced enamel toughness at Loisy-en-Brie, due to genetic differences in enamel robusticity between the two series.

The ante-mortem loss occurred 3 times more often in Loisy-en-Brie than in Hassi-el-Abiod (7.1% vs. 2.4%.) This ante-mortem loss can be linked with the higher frequency of caries found in Loisy-en-Brie.

However, it is difficult to link it with periapical lesions: even with 6 times more caries in Loisy-en-Brie, the frequency of periapical lesion is roughly the same in the two series. By comparison, about 70% of the current population have missing teeth (SAILLY et al., 1995).

A comparison of these series with present populations reveals the following differences :

- an improvement in bucco-dental hygiene in comparison with the Neolithic period;

- a significant increase in the frequency of decay (the third cause of morbidity according to the OMS); this is caused by a change in diet and mainly by the introduction of refined sugar;

- a decrease in dental wear, which can also be linked with the change in diet; nowadays dental wear similar to that found in Neolithic times is very seldom (GAMBAROTTA, 1995);

- a decrease in ante-mortem loss due to dental decay, but an increase of those related to parodontal problems.

Conclusions

Overall, this study revealed that:

- the frequency of dental decay is much more greater today than in prehistoric times, even in agricultural populations;
- the frequency of missing teeth is higher nowadays;
- periapical lesions also seems more frequent today in relationship with dental decay, dental trauma, etc.;
- only dental wear has decreased, but this wear has little influence on periapical problems and ante-mortem loss.

The results demonstrate the pernicious effects of modern life on the dental system of *Homo sapiens* in comparison with the more natural way of life in prehistoric times, whatever the type of the diet (hunter-gatherers or pastoralists) and in spite of the then lack of dental hygiene and care.

References

BANG, G., (1989): Age Changes in Teeth: Developmental and Regressive. In: ISCAN, M. Y. (ed.): Age Markers in the Human Skeleton. - C. C. Thomas, Spingfield, Illinois, 211-235 pp.

BENAUWT, A. and LORETTE, A. (1982): Manuel d'Orthodontie pour Omnipraticiens. - SNPMD, Paris, 136 p.

BRABANT, H. and TWIESSELMANN, F. (1964): Observations sur l'Evolution de la Denture Humaine en Europe Occidentale. - Bulletin du Groupement International pour la Recherche Scientifique en Stomatologie *1*, 63-72.

BROCA, P. (1879): Instructions Relatives à l'Etude de l'Anthropologie du Système Dentaire. - Bulletins de la Société d'Anthropologie de Paris, 126-165.

BROTHWELL, D. R. (1989): The Relationship of Tooth Wear to Aging. In: ISCAN, M. Y. (ed.): Age Markers in the Human Skeleton. - C. C. Thomas, Spingfield, Illinois, 303-316 pp.

DREIER, F. G. (1994): Age at Death Estimates for the Protohistoric Arikara Using Molar Attrition Rates: A New Quantification Method. - International Journal of Osteoarchaeology *4*, 137-147.

DUTOUR, O. (1986): Anthropologie Ecologique des Populations Néolithiques du Bassin de Taoudenni (Mali). - Doctorat ès Sciences de l'Université d'Aix-Marseille II.

DUTOUR, O. (1994):L'Hypogée Néolithique de Loisy-en-Brie (Marne), Lieu-dit les Gouttes d'Or. Données Paléoanthropologiques générales. - Revue d'Etudes Préhistoriques et Protohistoriques de Champagne-Ardenne *18*, Montmirail, 63-64.

DUTOUR, O. and PETIT-MAIRE, N. (1983): Sépultures et Restes Osseux. In: PETIT-MAIRE, N. and RISER, J. (eds): Sahara ou Sahel? Le Quaternaire Récent du Bassin de Taoudenni (Mali). - Marseille-Lamy, Marseille, 277-316 pp.

GAMBAROTTA, J. P. (1995): Usure Dentaire Macroscopique de Quelques Echantillons de Populations du Nord du Maroc (Préhistoriques et Actuelles). - Bulletins et Mémoires de la Société d'Anthropologie de Paris *7*(1-2), 21-36.

KNYCHALSKA-KARWAN, Z., LASKOWSKA, L., PELCOWA, M., SZAFRANIEC, I. and WELDER, A. (1972): Carie et Abrasion Dentaire. - Rev. Odontostomatol. Paris *19* (6), 471-474.

MASSET, C. (1986): Estimateurs Paléodémographiques. In: FEREMBACH, D., SUSANNE, C. and CHAMLA, M. C. (eds.): L'Homme, son Evolution, sa Diversité. Manuel d'Anthropologie Physique. - Editions du CNRS, Paris, 65-69 pp.

MAYTIE, A. (1976): Usure et Articulé Dentaire en Anthropologie. - Actual. Odontostomatol. Paris *113*, 147-165.

MILES, A. E. W. (1963): Dentition in the Estimation of Age. - J. Dental Res. *42*, 255-263.

NITLICH, J. and ZEILIG, G. (1979): Abrégé de Dentisterie Conservatrice, 1 : Les Tissus Durs. - Masson, Paris, 141 p.

NOSSINTCHOUK, R. M. (1991): Manuel d'Odontologie Médico-Légale. - Masson, Paris, 214 p.

PASLER, F. A. (1987): Manuel de Radiologie Dentaire et Maxillo-Faciale. - Doin Editeurs, Paris, 374 p.

ROMEROWSKI, J. and BRESSON, G. (1994): Morphologie Dentaire de l'Adulte. - Encycl. Med. Chir. (Paris - France), Stomatologie et Odontologie I, 22-033-A-10, 34 p.

SAILLY, J. C., LEBRUN, T. and MENNARAT, F. (1995): Situation de la Santé Dentaire en France. - Etat des Lieux, Orientations Stratégiques, Centre Odontologique de Médicométrie et d'Evaluation (COME), Toulouse.

TAVERNIER, B. (1994): Morphologie Dentaire Temporaire. - Encycl. Med. Chir. (Paris - France), Stomatologie et Odontologie I, 22-003-M-10, 12 p.