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**CONTENT**



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# Periodontal diseases in Antiquity*

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## Abstract

Periodontal disease has been one of the major oral health problems of the human race since the Stone Age. Many studies conducted on skeletal remains of populations from different time periods have established the presence of destructive periodontal diseases with alveolar bone loss and/or tooth loss. The aim of this review article is to present several studies, covering a wide range of time periods, localities and populations, that paint a picture of the severity and prevalence of historic periodontal conditions.

**Keywords:** ancient populations; periodontal diseases

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## Introduction

Periodontal conditions in ancient populations have been attracting a growing amount of interest in Periodontics and many investigators have studied skeletal remains from different centuries to identify these conditions, showing that destructive periodontal problems with alveolar bone loss affected early humans (1-12).

Periodontal disease is known from Australopithecus and therefore it is predicted that it has great antiquity in hominins (2). Many signs of periodontal diseases were seen in the Krapina Neanderthals and the archaic homo sapiens Kabwe man (who lived 300,000-130,000 years ago and is also known as the Broken Hill Man). Studies on ancient skulls have shed light on early humans' behavioral patterns in daily life, eating habits and diet and/or hygiene habits. However, since the alveolar bone is very fragile, it is very difficult to investigate and establish periodontal diseases from skulls that have been buried for a long time (6).

Despite the difficulties; some investigators have managed to study prehistoric skeletal remains in search of alveolar bone loss, which is the indicator of periodontal disease. Mitsis and Taramidis (3) examined 38 jaws from the skeletal remains of the 123 human inhabitants of Khirokitia (Cyprus 5800-3000 BC). The life spans of Khirokitian individuals were too short to study the remains of old people: the mean age was 35.2 for female and 33.6 for male skeletons. The researchers studied the alveolar bone around existing teeth and bone lesions which were likely to be a result of periodontal disease. The evaluations were made by direct measurements and X-rays, and photographs, leading to discovery of bone defects in different forms. The bone loss was less frequent within the age group between 21 and 30, and increased over the age of 31. This indicated that bone loss occurred with the progress of periodontal disease. Periodontal disease was highly prevalent in concordance with other publications (3).

Another study evaluated prehistoric Eskimo skulls for periodontal disease indicators (13). Two large groups of skeletal remains of prehistoric Ipiutak and Tigara people from Alaska were compared. Occlusal attrition increasing with age and proportionately decreasing crown height was found. Due to severe localized periodontitis, infrabony pockets were observed in Ipiutak people between the ages of 25 and 30, and Tigara people between 35 and 40. Most dental sites were affected by periodontal disease (13).

Lacy (2) published a doctoral dissertation on the oral health of Late Pleistocene Western Eurasian humans in 2014. Her periodontal research samples were categorized as: 44 Neandertals, 10 Middle Paleolithic modern human; 35 Early Upper Paleolithic; and 34 Late Upper Paleolithic humans. Among these samples, she was able to study 118 individuals whose age could be assessed, and reported the following results: 1) cemento-enamel junction, alveolar crest and alveolar septa scores are positively correlated; 2) for anterior teeth, bone loss was higher in the mandibula; 3) Neandertals had more severe periodontal diseases and generalized bone loss than modern humans; 4) excluding the Neandertals, periodontal diseases are found to be decreasing within modern humans over time; 5) geographical regions did not show statistically significant differences; 6) periodontal diseases increase in severity and prevalence across age categories for Late Pleistocene and Holocene groups; 7) the Point Hope group are the oldest and had the most severe periodontal conditions; 8) the Natufians had the least severity of periodontal disease, as well as having the youngest population; 9) the Indian Knoll group is the intermediate among the 3 groups; 10) periodontal diseases are quite prevalent in general, and most differences among groups result reflect the severity of the problem rather than the presence of the disease.

As stated earlier, it is very difficult to study skulls which have been buried for a long time, limiting the number of prehistoric studies, and most of the work in antique periodontal disease research has focused on the last two thousand years. The aim of this review is to present several such studies, which, when considered together, have established the following: periodontal diseases have been present since the beginning of human history (1).

## Periodontal diseases

One of the earliest investigations in antique periodontics was the result of a collaboration of anthropologists and periodontologists (14). The skeletal remains of 2 American Indian societies from 400 and 4000 years ago were studied. The first group had more decay and tooth loss, whereas the second group had more periodontal disease. The researchers stated that incisors were good indicators for studying periodontal disease and the six-tooth index of varying teeth studied was proposed for the root index and the wear index in future studies of oral health of ancient populations.

Gonçalves et al. conducted a study aiming to evaluate the intensity of bone loss in a Medieval UK population and compare that with other antique UK populations from other time intervals (5). They studied 75 skulls (12-60 years of age) from a burial site in York (11th-15th century) and compared that with a Roman-British population from Dorset (3rd-5th century) and 18th century London inhabitants. They measured the distance from the cemento-enamel junction to the alveolar crest at six points around each tooth and the mean bone loss was computed. They found that the overall bone loss levels were the highest in the Roman-British group followed by the Yorkers and the Londoners respectively. They suggested that the severity of periodontal disease in United Kingdom decreased through the centuries with respect to the measured bone levels. This was said to be a result of changing environmental and life conditions.

Vodanovic et al., investigated how periodontal health in Croatia varied with geography and the passage of time (15). They examined 1118 skulls for calculus, bone loss, fenestrations, dehiscence and furcation problems, finding statistically significant differences among the samples. The presence of calculus in late antique (LA, 3rd-5th centuries) continental Croatia was 40.7%, whereas it was 50.3% in the LA sample of Adriatic Croatia. Bone loss prevalence ranged between 21.2% in the early medieval (EM, 6th-10th centuries AD) continental Croatia and 32.3% in the LA sample from Adriatic Croatia. Alveolar bone dehiscences changed from 8.6% to 15.0%, and fenestrations varied from 21.5% to 36.2%. The prevalence of individuals with exposed bi/trifurcations varied from 9.0% in the EM sample from Adriatic Croatia to 20.7% in the EM sample from continental Croatia. They inferred that the transition from late antique to the early medieval age in Croatia did not have a negative effect on periodontal health (15).

Another study on the quantification of alveolar bone loss was conducted by Topic et al (7). They studied 4-sample jaws and single teeth from 4 time periods, i.e., Krapina Neanderthals who lived 130,000 years ago and skeletal remains from the 1st, 10th, and 20th centuries. They established bone loss by measuring tooth-cervical-height index of 1097 teeth from 135 jaws. The levels of resorption on the vestibular aspects were higher than in the interdental areas with a statistically significant difference in the group of early civilizations. On the other hand, this difference was not statistically significant for the 10th and 20th century inhabitants. They stated that alveolar bone resorption on the vestibular side exhibited a tendency to decrease, whereas interdental resorption showed an increase through evolution. They indicated that this is in agreement with the increase in interdental plaque accumulation in the interdental areas of men from 10th and 20th century (7).

Kerr investigated the prevalence and natural history of periodontal disease in a series of studies (16-19). The first study evaluated the periodontal status of a Scottish medieval population (900-1600 AD). There was no healthy periodontium over the age of 11. Gingivitis was common in young individuals, which was found to progress into periodontitis slowly. It was stated that a small proportion of the group was either susceptible or resistant to periodontal disease (16). Secondly, he studied the periodontal health of an 18th century English population (1645-1852 AD). The degrees of textural and architectural changes in interdental septa were investigated. The prevalence of and distribution of periodontitis lesions were found to be similar to modern English populations. He suggested that susceptibility to periodontitis rose in the 16th century (17). His next study was about the periodontal status of a Scottish prehistoric population (pre-900 AD). An entirely healthy periodontium was not seen over 10 years of age. Gingivitis was common in adolescents and young people and progression towards periodontitis was at a constant rate. The prevalence of periodontal disease was not found to be higher than that of modern societies (18). Finally, he investigated the widespread presence of periodontitis in British people during the past 3000 years. Five hundred and four individuals were evaluated for being healthy, or having gingivitis or periodontitis. In spite of the alterations in the oral environment, the prevalence of periodontitis appeared to have remained constant during the past 3000 years in Britain (19).

Another study including skeletal remains from different centuries was conducted in the Swiss canton of Berne using excavations from the church of Bial-Mett. Forty-three skulls from the 6th/7th and 8th/9th centuries were examined. Bone and teeth loss were recorded along with other parameters. It was seen that the population had 23% teeth loss and most of the people suffered from periodontal disease (11).

A more recent article focused on commonness, intensity, and dimensions of periodontitis in a historical Austrian population from the early Middle Ages (700-800 AD). The skulls of 128

Avars, which were from one of the earliest Avarian settlements in Austria, were examined for tooth loss and root caries. Periodontitis was diagnosed by the measurement of alveolar bone levels and evaluation of dental septa. They found that 90% of the individuals had a periodontal disease (20).

Bagis et al. also published a series of articles regarding periodontal disease, bone destruction due to abscess, and tooth loss in the skeletal remains of 10th century inhabitants of historical Hadrianapolis (aka Adrianapolis, the modern city of Edirne in Turkey) (21-23). The skeletal remains found during archeological excavations in the Hadrianapolis region by the Edirne Museum during 2002-2003 were linked to the Eastern Roman-Byzantium period. Thirty-seven sufficient skulls out of 139 were evaluated for determining the periodontal status, tooth loss and abscess defects of the individuals. Only two cases presented with inflammatory bone destruction due to abscess of the periodontium which can be a common clinical finding among patients with moderate to advanced periodontitis (21). Periodontal disease was classified as falling into three levels of severity: 1. No periodontitis, 2. Mild periodontitis, and 3. Severe periodontitis. In the group of young adults aged between 18 and 25, 74% of individuals had no periodontitis, 23% had mild, and 3% had severe periodontitis. The group of adults (25-45 years of age) mostly had mild periodontitis (51%), followed by no periodontitis (46%), and severe periodontitis (3%). The individuals over 45 had mild periodontitis at a rate of 70% and severe periodontitis was seen in 8% of the group. The highest prevalence of destructive periodontitis and tooth loss was found in the oldest age group (22). A few years later Bagis published another paper on prevalence of ante-mortem tooth loss of the same study group. In order to determine ante-mortem tooth loss and its relation to environmental factors, the upper and lower jaws of 106 intact skeletons from young adult, adult, and elderly groups were evaluated. The measure of ante-mortem tooth loss was the proportion of extracted teeth to the total of the existing alveoli plus the ante-mortem teeth. Eleven individuals had lost all their teeth. Prevalence of ante-mortem tooth loss was very high in elder adults and this difference was statistically significant ($p<0.05$). Tooth loss was more common in men than in women (23).

In skeletal series from archaeological periods, the primary cause of ante-mortem tooth loss is regarded as dental problems. Although biological, cultural and genetic factors have an effect on tooth loss, especially periodontal diseases and dental caries are considered the main cause of ante-mortem tooth loss. Yılmaz stated that, the primary cause of tooth loss in his study in the skeletal remains of an Ablanganis population (Early Iron Age) was found to be abscess and/or periodontal infections (24). These outcomes were in compliance with Bagis' results (21-23).

Clarke et al., documented 30,057 teeth from 1149 skulls of various civilizations which they collected from 20 museums around the world (4). They considered bone loss as periodontal disease only when the margins of alveolar crest either lost cortical surface, revealed porous cancellous spaces, or the morphology of the crest was altered. These differentiations appeared with a porous bone surface or a shelf-like margin instead of the normal knife-edge appearance. They compared the skulls of ancient civilizations with those from modern groups. They found that despite the existing massive calculus deposits in many instances, there was no bone loss in 90% of teeth evaluated. They stated that almost 10% of subjects had lost crestal bone due to a gingival lesion in premodern groups, whereas this ratio was 30% for modern groups. They also suggested that the periodontal disease was not aggressive, but mild, which led to minimal tissue lost (4).

**Calculus**

Calculus has long been shown to be related with periodontal diseases (25). Some researchers studied calculus and bone loss which may indicate periodontal disease in skulls. Wittaker et al. studied the amount of calculus and its relation to bone loss in 18th century and Romano-British Londoners (26). They spotted significantly different amounts of calculus deposition in 2 groups but this was found to have little effect on the levels of alveolar bone contour. They suggested that the quantity of calculus may be diet-related; however, bone height level changes may be independent (26).

Ancient calculus was studied by some other investigators as well. Velsko et al. stated that dental plaque formation cycles and calcification make calculus a well-preserved, long-term record of host-microbial action for archeological records (27). They made the first wide scale characterization of the human calculus metabolome with the help of a multi-platform approach. Two hundred and 85 metabolites from modern and historic (200 years old) dental calculus were quantified with ultra-performance

liquid chromatography-tandem mass spectrometry. Metabolites of 2 groups were compared to establish patterns of persistence and loss. They found that particular metabolite groups remain over a long time and may guide some future studies regarding evolution (27). In a later study Velsko et al. compared the microbial characterizations of modern dental plaque, modern dental calculus, and historical calculus to identify predicted differences between groups (28). They generated metagenomic data from calculus, and the plaque data was downloaded from the Human Microbiome Project. The taxonomic and metabolic functional profiles between plaque, modern calculus, and historic calculus were different. However, no distinction was observed between calculus obtained from healthy and periodontally affected teeth. They found systematic microbial differences between plaque and calculus related biofilm physiology. They stated that knowing these distinctions is important for data interpretation in comparing dental calculus and plaque (28).

## Conclusion

This review collected and presented studies on skeletal remains with periodontal diseases. The studies were randomly selected from among many articles, covering a range of different time periods. The causes of the periodontal disease, the localization of the defects, and the contents of calculus may vary from century to century as a result of environmental and dietary changes. Yet, periodontal diseases in varying severities exist. In order to have a better understanding of the underlying conditions, more studies regarding periodontal health of ancient populations should be conducted.

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## Declarations of interest

None.

## Author contributions

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