

# Dental health and disease in ancient Egypt

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## IN BRIEF

- Examining skeletal and mummified remains from ancient Egypt can provide evidence for the dental health of the ancient Egyptian civilisation.
- The same dental diseases have been present over the millennia, but their incidence varies considerably with changing environmental factors.
- Investigating ancient dentitions can assist the archaeologist and historian in reconstructing lifestyle patterns.

In ancient Egypt the exceptionally dry climate together with the unique burial customs has resulted in the survival of large numbers of well-preserved skeletal and mummified remains. Examinations of these remains together with an analysis of the surviving documentary, archaeological and ethnographic evidence has enabled a detailed picture of the dental health of these ancient people to be revealed, perhaps more so than for any other civilisation in antiquity. In this, the first of two articles, the dental pathological conditions that afflicted the ancient Egyptians is considered. The commonest finding is that of tooth wear, which was often so excessive that it resulted in pulpal exposure. Multiple abscesses were frequently seen, but caries was not a significant problem. Overall the findings indicate that the various pathological conditions and non-pathological abnormalities of teeth evident in dentitions in the twenty-first century were also manifest in ancient Egypt, although the incidences of these conditions varies considerably between the civilisations.

The ancient Egyptian civilisation, one of the world's first great cultural awakenings, stirs the popular imagination and today holds an enduring fascination for many people. Developing from prehistoric origins, Egypt unified around 3100 BC into a single state, and then survived for over 3,000 years (the Dynastic period) before finally being incorporated into the Roman Empire in 30 BC. Their civilisation is an epic saga of bold innovation, monumental architecture, a glorious empire, and then final decline. A few of these ancient Egyptians involved in this struggle are known to us today, but the vast silent majority who created and sustained this spectacular culture are not. We know something about the society they lived in, but what is known about their health and in particular their dental health? Certainly, from the very earliest times, humans have been beset

by dental problems and for these ancient Egyptians living along the Nile valley in antiquity this was no different.

In ancient Egypt, the exceptionally dry climate together with their unique burial customs resulted in the survival of large numbers of well-preserved skeletal and mummified remains. Extensive examinations of these remains have demonstrated the many pathological and non-pathological conditions seen in the dentitions of these ancient people. This together with the surviving documentary, archaeological and ethnographic evidence has enabled a detailed picture of their dental health to be revealed, more so than perhaps for any other civilisation in antiquity.

The conclusions from these surveys suggest that far from having healthy dentitions the ancient Egyptians suffered from extremely worn teeth, periodontal problems and numerous dental abscesses. Significantly, these disorders were not only experienced by the peasants – the overwhelming majority of the population – but also by the pharaohs and the elite of society.

The most frequent pathological condition identified was that of excessive tooth wear, a condition so widespread that it was found in most of the ancient

Egyptian skulls throughout the dynastic period.<sup>1-4</sup> Leek<sup>5</sup> in a study of 4,800 ancient Egyptian teeth, found that nearly 90% of the teeth showed some evidence of tooth wear. This disorder has often been categorised as attrition, but analysis of the problem reveals that attrition was not the sole agent responsible for the loss of tooth tissue. Contamination of the food by significant numbers of inorganic particles resulted in an additional element of abrasion. Soames<sup>6</sup> suggests tooth wear with components of both attrition and abrasion is perhaps a better definition. This tooth wear increased with the age of the individual and varied from a slight polishing of the cusps to almost complete loss of crown structure. Often it was so extensive it occurred at a faster rate than the odontoblasts were able to lay down secondary dentine, resulting in pulpal exposure, necrosis of the pulp and subsequent apical infection (Fig. 1). Moreover, numbers of skulls show multiple abscess formation, indicative of how severe the problem of tooth wear was.

A possible later consequence of this apical infection was cystic formation, a phenomenon observed in a number of skulls. Additionally, osteomyelitis was considered not to have been uncommon,<sup>2</sup> and because of its frequently associated

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untreated bacteraemia could be a potentially lethal lesion. Certainly, Langsjoen<sup>7</sup> judged it to have been responsible for many deaths in antiquity.

The primary cause of this tooth wear was the chewing throughout life of a coarse fibrous diet made even more abrasive by the introduction of inorganic particles, particularly into the bread, the staple food of the ancient Egyptians. Analysis has determined that these particles were predominately quartz with the presence of some feldspar, mica, hornblende and other rock fragments.<sup>8,9</sup> The particles would have arrived from a number of sources, but primarily they were sand which was blown in from the desert. Contamination would also have been caused by the use of flint-tooth sickle harvesting tools as well as the ingress of particles from the soil where the grain was growing, and which were later not sieved out. Additionally, grinding the grain with soft sandstone implements and baking the bread on the outside of stone ovens would have also have further contributed to this process.<sup>10</sup> Evidence of all these practices is well illustrated in the various colourful scenes of daily life that are painted on the walls of many of the ancient Egyptian tombs, as well as being depicted in models retrieved from these tombs (Fig. 2). Sand could also have been intentionally added to aid the grinding process, as Pliny and certain other ancient writers noted that when the Carthaginians ground corn they would add crushed bricks, chalk or sand, and it is possible that the ancient Egyptians did likewise.<sup>8</sup>

Surveys suggest that the amount of tooth wear decreased later in Egyptian history, due to improvements in diet and food processing techniques. Additionally, regional variability in tooth wear has been noted, probably due to cultural, socio-economic and dietary differences between the various localities, which can as a consequence provide an insight into both dietary and socio-economic change.<sup>11,12</sup> Because of its association with biological ageing the degree of wear has been recognised as a useful method of estimating the age at death of an individual.<sup>13,14</sup>

Periodontal disease, a major dental disorder of the twenty-first century,

was also known in antiquity. Evidence of chronic periodontal disease has been described in a 3 million year old hominid, acute gingivitis/periodontitis was recorded in the army of the Greek general Xenophon in 400 BC, and this disease has also been demonstrated in ancient Egypt.<sup>7</sup> Periodontal disease in archaeological specimens has to be identified with care, as the increase in the distance between the cemento-enamel junction and the alveolar crest, which has erroneously been used as an indicator of periodontal disease in the past, has been shown to be due to continuing eruption as a result of tooth wear.<sup>15</sup> A more positive indicator is the appearance of pitting on the alveolar bone caused by the resorption of the outer cortical plate, which then reveals the underlying porous cancellous structure.<sup>16</sup>

The primary cause of periodontal disease today is bacterial irritation brought about by the accumulation of plaque at the dentogingival junction, and this may well have been the case in ancient Egypt. Additionally, local and systemic factors are known to influence the progress of the disease<sup>17</sup> and again this is likely to have been similar in antiquity. There is paleopathological evidence of diseases such as anaemia, diabetes mellitus and tuberculosis, all of which can cause gingival destruction and bone loss.<sup>10</sup> The archaeological record also provides evidence for drought and famine, which would have resulted in nutritional deficiencies, again factors that potentially affect the status of the periodontal tissues. The ancient Egyptians were heavily dependent on agriculture and whilst rainfall was often negligible, the annual flooding of the Nile (the inundation) together with the efficient irrigation they engaged in, produced extremely fertile land along the river banks. However, during periods of inundation failure, drought and famine conditions prevailed.

To what extent periodontal disease alone was a factor in causing bone destruction and indeed tooth loss is not certain, but there is evidence that it may not have been as significant as seen today. Clarke *et al.*<sup>15</sup> examined over 1,000 skulls from antiquity, a study which included a number of ancient Egyptian specimens, and found numerous exam-



**Fig. 1** Tooth wear, pulp exposure, caries. Egyptian skull c. 1,500 BC. Courtesy of the Duckworth Collection, Cambridge University

ples of severe localised periodontitis, but by and large a low incidence of generalised horizontal bone loss. This latter case they suggested may have been due to a greater level of efficiency of the host defence systems operating in the gingival crevice as compared to modern populations. They considered that in the present populace these systems may have been compromised by environmental factors such as stress, smoking and diet. Koritzer<sup>18</sup> concluded from his examination of 81 ancient Egyptian skulls that it was not periodontal disease alone that resulted in tooth loss, but more likely to be a combination of calculus formation causing some weakened bony support associated with excessive tooth wear and periapical infection. Significant to all such studies is perhaps the fact that the average life expectancy in ancient Egypt was only about 35 years,<sup>19</sup> and as the risk of periodontal disease increases with age, this factor needs to be considered when evaluating the periodontal status of these ancient people.

There appears to be little indication of an oral hygiene regime in ancient Egypt and indeed many skulls show considerable deposits of calculus. Hygiene, however, was important and evidence suggests that many of the population washed every day with cosmetics and perfumes being an important part of life for both sexes. Although many cosmetic and toilet articles have been unearthed, nothing resembling a toothbrush has ever been discovered. The only possible aid to oral hygiene known to have been in use was masticatories and these were probably employed to refresh the mouth. Priests are known to have chewed natron pellets as a purification ritual and the



Fig. 2 Tomb model showing a women grinding corn. Courtesy of Manchester Museum



Fig. 3 Enamel hypoplasia (indicated by the horizontal grooves on the teeth). Ancient Egyptian mandible c. 1,500 BC. Courtesy of Duckworth Collection, Cambridge University

general population are, on occasions, thought to have done so before a meal.<sup>20,21</sup> Possibly some form of wooden tooth pick may have been used since it is known from other civilisations in antiquity that various implements such as chew sticks, tree twigs, birds feathers, animal bones and porcupine quills have all been used for oral hygiene purposes. Perhaps something resembling a miswak, which is a twig of the *salvadora persica* tree whose ends have been frayed, may have been utilised. The miswak is known to have been used for oral care by Muslims since the birth of Islam, and, indeed, is still in use today.<sup>22</sup>

Caries, similar to periodontal disease, was also known in antiquity as evidence of it is traceable back to at least the upper Palaeolithic period, some 20–30,000 years ago.<sup>23</sup> Although prevalent in modern society it was infrequently seen in ancient Egypt due to the lack of

fermentable carbohydrates in the diet coupled with the fibrous abrasive nature of the food, which tended to inhibit the retention of plaque on the tooth surface.<sup>24</sup> Also tooth wear was a factor since occlusal wear would have eliminated pits and fissures, and in addition interproximal wear would have caused flattened tooth contacts, both producing a more difficult environment for plaque and caries to proliferate in.<sup>4</sup>

A review of the literature seems to find little consensus as regards the incidence of caries in ancient Egypt, and this would appear to be due to factors such as sample selection, choice of settlement site, social class, and the time factor chosen. Additionally, in any dental survey on dry skulls, many teeth are likely to have been lost both ante-mortem and post-mortem, which then calls into question the accuracy of any such figures. Brothwell<sup>25</sup> surveyed 1,742 Predynastic (pre-unification) adult teeth and found an incidence of caries of 2.3%. Grilletto<sup>26</sup> found 6.14% of Predynastic teeth affected by caries, but only 4.65% of Dynastic teeth. This reduction, he suggested, was caused by improving environmental conditions in the Dynastic period, but equally so could have been due to settlement selection or methodology in sampling. Hillson<sup>3</sup> in his study determined a figure of 10% of individuals affected by caries for the Dynastic Period, whilst Pain<sup>27</sup>

suggested it had risen to as much as 34% affected individuals by the Ptolemaic period (the period when Egypt was ruled by Hellenistic rulers ie 332 BC to 30 BC). Indeed, the consensus in the literature indicates that caries increased during the Ptolemaic and later periods of Egyptian history, and this would appear to be directly related to the changing dietary habits.

In the Neolithic period (c. 10,000 BC – c. 4,000 BC) Egyptian society developed from one of hunter-gatherers to a more sedentary agricultural lifestyle dwelling in settled communities along the Nile valley. One consequence of this was that the diet would have changed from one rich in protein, to one where carbohydrates played a predominant role. However, these carbohydrates were primarily of the non-fermentable variety and so caries was not at that time a significant dental disease. This changed, however, with the arrival of the Greeks into Egypt in the fourth century BC, when food items such as fine white bread, honey and dates, previously not consumed by the majority of the population, became more readily available. As a result of the increased levels of fermentable carbohydrates in these particular foodstuffs, caries incidence rose. Interestingly, due to the nature of their diet caries was more prevalent in the upper echelons of society, during most periods of pharaonic history.

As well as the pathological tooth wear, periodontal disease and caries described above there is evidence of other oral conditions in ancient Egypt such as osteoarthritis of the temporomandibular joint, which is a recurrent finding in many skulls.<sup>10,28</sup> Leek<sup>10</sup> in his study attributed this to altered mechanical function of the joint brought about by excessive tooth wear, which in some cases had resulted in a loss of vertical dimension. This is supported by findings in other historical populations such as an investigation by Seward<sup>29</sup> who examined pre-colonial Aboriginal skulls, Hodges<sup>30</sup> in her study of ancient British skulls and Langsjoen<sup>7</sup> in his review of ancient diseases of the dentition. However, Whittaker *et al.*<sup>31</sup> in a study of an ancient British population and Eversole *et al.*<sup>32</sup> in investigation of a more modern collection were unable to

find a significant relationship between tooth wear and osteoarthritis.

Enamel hypoplasia is a fairly common occurrence in many ancient Egyptian teeth with Hillson<sup>3,33</sup> finding figures as high as 40% in skeletal samples from both Predynastic and Dynastic Egypt (Fig. 3). Malnutrition is usually recognised as the most frequent cause of this condition, although other factors such as major infections, haemolytic disease of the newborn and vitamin deficiencies have all been implicated.<sup>7</sup> As enamel hypoplasia is often displayed as a limited band arranged around the circumference of the tooth, it is able to provide a record of the period that the particular childhood stress occurred. Clearly the lesion is not a marker for a specific disease but it can be useful in inferring the general health status of a population.

Studies of several thousand ancient Egyptian skulls from museums in Cairo, Cambridge, London, Manchester and Turin have also recorded various non-pathological dental abnormalities such as impacted third molars, retained deciduous teeth, incisor crowding as well as examples of displaced, transposed, rotated and tilted teeth.<sup>5,10,27,34,35</sup>

So this review has been able to highlight that the various pathological and non-pathological conditions of teeth, which are evident in dentitions in the twenty-first century, were also manifest in ancient Egypt, although the incidences of these conditions varies considerably between the civilisations. The results of the numerous surveys into the dentitions of the ancient Egyptians also indicate<sup>1,5,18,34,36,37</sup> that oral health was poor, and with little evidence of dental care, infection and dental pain must have been widespread.

Finally, the diagnosis and interpretation of dental disease from ancient

remains is able to provide indicators of general health of a population as well as furnishing information about diet, oral hygiene, the environment and prevailing economic conditions. Significantly, such analyses when integrated with supporting archaeological evidence play an important part in any attempt to reconstruct the lifestyle of ancient peoples.

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