DENTAL DISEASES AND OTHER INSULTS TO TEETH IN ANCIENT EGYPT

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(Received 24/02/2014; Revised 25/04/2014)

ABSTRACT

The objective of this article is to critically survey the literature of dental pathology in general and severe dental wear in particular. Dental wear was ubiquitous in the populations of Upper and Lower Egypt and we aim to show how other dental diseases are closely related to wearing down of teeth. Other diseases mentioned and discussed are caries, with special reference to the myth of the teeth-worm, periodontal disease, and hypoplasias. The causes, effect and treatment of dental pain following dental diseases clearly influenced the lifestyle of the individual. The Egyptians of the period did not seem to have much interest in an oral hygiene regime, with the significance of furthering their susceptibility to dental maladies. Dental pathology, in all its demeanours, is shown to have a direct and indirect effect on the demography of the population of ancient Egypt.

INTRODUCTION

The quotation by Philo (20 B.C.E.-50 C.E.) below emphasises the importance of a healthy set of teeth in ancient societies – second only to sight, but primarily essential for staying alive:

> 'Is then,' someone will say, 'a tooth of equal value with an eye?' (202) 'Each,' I would reply, 'is of equal value for the purposes for which they were given, the eye with reference to the objects of sight, the teeth with reference to those which are eatable.' But if any one were to desire to institute a comparison, he would find that the eye is entitled to the highest respect among all the parts of the body, inasmuch as being occupied in the contemplation of the most glorious thing in the whole world, namely the heaven; and that the tooth is useful as being the masticator of food, which is the most useful thing as contributing to life. And he who strikes

> out a man's eye does not hinder him from living, but a most miserable death awaits the man who has all his teeth knocked out (in Yonge 1995:1173-1174 XXXVI (202)).

Teeth are often the best and sometimes the only preserved part of the human skeleton. Teeth are the most resilient and chemically stable tissues in the body. Teeth provide dental anthropologists/odontologists with a wealth of information about health, diet, stress, occupation, cultural behaviour, kinship[1] and subsistence economy (Lukacs 1989:261). Analysis of dental pathology provides insight on health, disease, nutrition, subsistence and social organisation within selected communities (Işcan & Kennedy 1989:7). The analysis of teeth in bioarchaeological human remains therefore contributes to the reconstruction of past human behaviour.[2] Human dental and joint diseases are arguably the most commonly occurring abnormalities reported in bioarchaeological excavations of the past, and collectively with other forms of evidence from an archaeological site, they are valuable sources of information about the lifestyle of ancient populations (Roberts & Manchester 1995:44).

Judith Miller (2008:52) attests that in a survey of more than 5 000 skulls from sites in Upper and Lower Egypt, from the Predynastic to the Ptolemaic periods, a time-span of more than three millennia, research reveals severe dental pathology as the most ubiquitous of dental maladies. Miller points out that whenever there is a statistical variation between certain periods regarding the incidence of dental disease, it can usually be explained by the influence of the diet and methods of preparation of food, mainly from bread as a staple diet. It is directly linked to the traditions and culture of a population within a timeframe that directly constitute a certain lifestyle. To elucidate the lifestyle of the ancient Egyptians, a study of the dental status of the population of ancient Egypt is central to this study.

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1 Farrel (1973:558), through cephalometric X-rays, showed that Amenhotep II and Tuthmosis IV had class I occlusions, in contrast to Tuthmosis I, II and III who had bimaxillary protrusions. The Angle classification of the sagittal relationship between the maxilla and the mandible establishes a class I (neutrocclusion), class II (distocclusion), and class III (prognathism) relationship, as devised by Katz's modified method. This classification is not only race sensitive but also refers to a genetic kinship.

2 Alt and Buitrago-Tellez (2004:258) point out that dental anthropology also provides views into biological, ecological and cultural aspects of past populations for researchers to understand their individuality, human behaviour, lifestyle and environments. It also elucidates human phylogenic and ontogenic development and evolutionary processes.

CARIES IN ANCIENT EGYPT

Ortner and Putschar (1981:438) define dental caries as an infectious disease in which progressive destruction of tooth structure is caused by microbial activity on the tooth surface. The destruction of dental hard tissue is the direct result of the lytic activity by bacteria, which are almost exclusively lactobacilli and streptococci. Caries or *caries dentium* is a localised disease characterised by an irreversible and progressive destruction of the hard and soft dental tissues. Caries starts at the enamel surface of the tooth or in case of a regressed gingiva, at the exposed cervical or neck of the tooth, which is dentinal tissue in origin. Caries then works its way progressively through enamel and dentine into the pulp cavity in some severe conditions (Powell & Mielke 1985:317). Dental caries was not a common disease among the population of the Predynastic and early Dynastic periods. At the same time periodontal diseases ravaged the dentition of the population and dental wear was extensive and severe in all sectors of the ancient population.

The reason caries were infrequently observed in ancient Egypt is due to the lack of fermentable carbohydrates in the diet of the general population (Forshaw 2009:423). Forshaw mentioned statistical values of dental caries among the adult population of between 2.3 per cent to 6.14 per cent in the Dynastic Period (Forshaw 2009:424). Derry (1933:112) quotes Professor Elliot Smith (1923) as having suggested that after the influx of large numbers of aliens in the 4th, 5th and 6th Dynasties of the Old Kingdom, dental caries became extremely common. More than 80 per cent of people were believed to have suffered from caries. Any serious scholar in palaeodontology and anthropology would frown upon statistics of this nature and repudiate them, as Derry (1933:112) did. Derry had empirically found the figure to be not more than 5.4 per cent. The author is of the opinion that Smith misidentified severe dental wear, which, when worn, exposed the pulp cavity, to mimic dental caries. Leek (1972:291) found the incidence of caries in the Predynastic Period to be less than one per cent. Hillson (1979:156) found the incidence of caries in the Dynastic Period to be in a range between zero and ten per cent. Leek (1972:291) accentuates how rare caries was in the Predynastic Period to the XXI Dynasty when he examined 4 816 teeth of the period and found that only 39 teeth exhibited simple surfaced carious cavities, calculated at less than one per cent .

Different theories of the aetiology of caries are known, but the most accepted theory is that the destruction of the hard dental tissue results from acids producing

microorganisms, especially those found in an adherent gelatinous film on teeth and gingiva, known as dental plaque.[3] The origin of dental plaque is on, or in, certain areas of the tooth that are not self-cleansing. Malnutrition affecting tooth development causing hypoplasia may also be a cause of dental caries. The diet of the ancient Egyptians excluded to a great extent red meats and sugars, both constituents for the development of calculus and caries respectively; however, caries was not a disease of significance that severely influenced the lifestyle of the Egyptians. The incidence of dental caries was found to be higher amongst the royalties and affluent people who had more access to refined carbohydrates such as sweet sticky foods. The little evidence of caries in the lands of the Pharaohs did have certain consequences for the individual. Caries can give rise to potentially lethal complications. Carious lesions that reach the pulp can lead to infections. An upper molar tooth infection may spread into the spaces within the maxillary alveolar bone and cause osteomyelitis. This infection may result in meningitis or cavernous sinus thrombosis, which may be fatal. Lacking modern antibiotic treatments, the death rate for acute dental infections was perhaps 50 to 90 per cent (Calcagno & Gibson 1988:510).

The tooth-worm as cause for caries

The tooth-worm has, according to popular belief through the ages and in various cultures, caused caries and periodontitis. The tooth-worm was also considered to be the cause of headaches, probably through referral of dental pain. The gnawing tooth-worm is thought to be responsible for toothache even to this day (Gerabek 1999:1).

Gerabek (1999:3) alludes to a number of remedies to eliminate the tooth-worm demon used in ancient Egypt. Mention is made of the following treatments: Myrrh[4] was used to counter the effects of the tooth-worm as did fumigation by means of the henbane seeds. Medicines obtained from the ingredients of henbane were popular.

[3] Plaque consists of food debris, salivary proteins, microorganisms and polysaccharides of bacterial origin built up on the teeth in the absence of efficient oral hygiene (Moore & Corbett 1983:140). Dental plaque is a calcium carbonate deposit on teeth and consists of food debris and various other components derived from the saliva, inclusive of bacteria that metabolise carbohydrates resulting in an acidic waste product that would then dissolve dental hard tissue, causing cavities (Mays 1997:149).

[4] Myrrh (*Commiphora myrrha*) was also used in ancient Egypt for a number of maladies – to stop diarrhea, relieve headaches, soothe gums, toothaches and backaches (Aboelsoud 2010:87).

Gerabek (1999:4) offers a recipe to treat the pain and rid the patient of the tooth-worm: henbane[5] oil mixed with wax to form a candle, which was then used to fumigate the patient, and finally the cauterisation of the tooth-worm by means of a thin wire would rid the individual of the tooth-worm. A piece of bronze wire firmly lodged in the root canal of an upper right incisor, presumably to close the "passage" and thereby prevent the tooth-worms from burrowing into the tooth and causing more pain, was found in Israel (Zias & Numeroff 1986:66). Wynbrandt (1998:16) cites the mentioning of the tooth-worm in the sacred texts of the Papyrus Anastasi. Asbell (1941:1099), in his study of dentistry amongst the early Israelites who had returned from Egypt after a sojourn of nearly five centuries, found them also believing that tooth decay and toothache was caused by a tooth-worm, probably a belief that was brought with them from Egypt. Asbell (1941:1102) states that the reason bitter herbs were used as a preventative measure was that it protected the person against demonic influences, of which the tooth-worm was a manifestation. Another remedy that proved to be efficacious was the ingestion of the eggs of grasshoppers. Asbell (1941:1102) is of the opinion that the tooth-worm had its origin in Babylonia, as the poem below demonstrates. The poem probably dates to the early second millennia B.C.E.

After Anu had created heaven,
Heaven had created the earth,
The earth had created the rivers,
The rivers had created the marsh,
And the maesh had created the worm –
The worm went, weeping, before Shamash,
His tears flowing before Ea:
"What will you give me for food?
What will you give me to suck on?"
"I will give you the ripe fig and the apricot."
"What good are the ripe fig and the apricot?

[5] Henbane (*Hyoscyamus niger*) is a narcotic related to the belladonna. Its effect concerns the blood circulation with a decrease in pulse rate. It is a sedative and shares some similarities with opium. Dried henbane leaves yield three other narcotic drugs namely atropine, hyoscyamine and scopolamine. Drugs of various kinds have been used for many centuries to reduce the distress of surgical operations. Homer wrote of *nepenthe*, which was probably cannabis or opium. Arabian physicians also used opium and henbane (Gerabek 1999:3).

Lift me up, and assign me to the teeth and the gums!
I will suck the blood of the tooth,
May Ea strike you with the might of his hand!"

It is however still unclear as to whether the Babylonian population discovered their own dental treatment for the tooth-worm, or if this treatment originated from cultural exchanges between Babylonia and Egypt. The Egyptian physicians are thought to have made more rapid progress in medical knowledge and its application to patients than did the Babylonians, probably because of early specialisation (Brand et al. 2003:427). The authors mention that there were perhaps many cures for teeth infested by the tooth-worm, of which the following two cases testify:

> If a man (has) a worm in his tooth, you dry out the peel of […], apply it and he will get better. If a man (has) a worm in his tooth, you crush 'sailor's excrement' in pressed oil, if the tooth on the right which aches, you pour (the oil) on the tooth on the left and he will get better [sic].

PERIODONTAL DISEASE IN ANCIENT EGYPT

Periodontal disease is comparable to most of the other oral maladies with multifactorial causes. Harris and Ponitz (1980:45) attest that periodontitis is commonly caused by calculus and is the single major cause of tooth loss in ancient Egypt. The authors, however, mention a questionable advantage that severe or class III calculus may have: that of acting as a splint to support loose teeth. Clarke et al. (1986:182) point out that ancient populations did not have the level of sophisticated modern methods of oral hygiene. They are therefore known to have suffered from mild to severe calculus deposits. Despite the presence of substantial calculus in a number of mummies, there was no discernible horizontal loss of alveolar bone of periodontal origin, in more than 90 per cent of cases (Clarke et al. 1986:178).

Clarke et al. (1986:175) compared the incidence of loss of alveolar crestal bone in modern societies to that of ancient societies and found that in ancient Egyptian groups the incidence was ten per cent compared to 30 per cent among modern groups. The reason the authors propose is that in ancient groups the resistance of the progression of gingivitis to more serious periodontitis may be due to the host defence system that operates in the gingival crevice and the gingivae (Clarke & Carey 1985:690). In

modern societies, this natural defence system may be compromised by self-induced environmental factors such as stress, smoking and diet.

Reeves (2001:17) points out that periodontal disease was ubiquitous in ancient Egypt. One of the causes according to him was the stresses and strains exerted on the teeth during masticating that led to severe wear of the enamel of the teeth. Lerato (1970:49) attests that the reason for tooth loss is due to periodontal disease in ancient societies where severe dental wear and subsequent pulpal involvement is common. There is a strong correlation between severe dental wear and pulpal pathology especially where exposure of the pulp tissue occurs. Subsequently pathogenic microorganisms enter the pulp tissue, which then cause infections and ultimately the formation of periapical dental abscesses. Chazel et al. (2005:197, 201) demonstrated that the dietary habits and socioeconomic status of the population influenced their choice of the quality and quantity of food intake. These are paramount factors in dental wear in ancient populations, of which Egypt with its wide difference between classes is a good example.

HYPOPLASIA AND OTHER INSULTS TO AMELOGENESIS

Dental hypoplasia is a quantitative deficiency of enamel. Per definition dental enamel hypoplasia is a deficiency in enamel thickness (even total absence) resulting from a disruption in the matrix formation phase of amelogenesis (Goodman 1991:281). These defects commonly result from insults to the highly specialised ameloblast cells at vulnerable stages of amelogenesis or enamel formation during the development stages of primary and permanent teeth (Ford et al. 2009:382). The risk factors that were responsible in ancient times are similar to modern times and are mainly low socioeconomic status with resultant poor nutritional intake and various infecting agents: parasitic, viral and bacterial (Ford et al. 2009:386).

The bioarchaeological record of ancient Egypt can assess whether the transition from hunter-gathering, which proved to have been a relatively healthy lifestyle when nutritional impacts are taken into consideration, to the agricultural way of life, occurred gradually. The analysis of skeletal remains can also reveal whether the shift to agriculture improved the lifestyle of the early farmers and whether it was sustainable. In Starling & Stock's (2007:521) study of early Egyptian agriculturists, they found a poorer quality of life in the early Dynastic Period, which then gradually improved in later dynastic periods due to major agricultural intensification. The

bioarchaeological record relies on information that is commonly garnered from enamel hypoplasias, a non-specific stress indicator.

Lovell (2000:129) published the results of enamel hypoplasia from ancient Mendes in the delta of Egypt to assess the impact the socioeconomic environment has on the health status of a sector of the population over a period of 2 000 years. The prevalence for hypoplastic lesions in deciduous and permanent teeth was high. Hypoplasia in the deciduous dentition reflect maternal and neonatal hypocalcaemia, while defects in the permanent dentition reflect nutritional and infectious stresses that are commonly associated with the process of malnutrition, weaning and childhood diseases. The pattern of enamel hypoplasia (EH) frequencies during the various Dynastic periods of ancient Egypt suggests that episodic stress was more prevalent during the Old Kingdom period than subsequent periods. The late Old Kingdom period showed deterioration in general health of the population and regular periods of malnutrition (Lovell & Whyte 1999:78).

Enamel hypoplasia (EH) results from developmental disturbances. Malnutrition has historically been viewed as the primary cause of enamel defects. Lovell and Whyte (1999:70), however, mention that the interaction of two factors, namely diet and disease, is now thought to be the major cause. Enamel does not remodel and therefore disturbances of enamel formation can be everlastingly recorded on tooth surfaces (Ford et al. 2009:382). EH presents in a spectrum of severity, ranging from a change in translucency, known as enamel opacities, to reduction or loss of enamel known as enamel hypoplasia. Palaeopathological stress markers, of which linear enamel hypoplasia (LEH) of the dentition is arguably the most reliable non-specific stress indicator, occur (Starling & Stock 2007:521).

Langsjoen (1998:403) metaphorically alluded to hypoplastic enamel lesions as a biological window through which one can observe the long-term consequences of metabolic stresses and it provides a record from which an investigator may infer the time at which the hypoplasia formed and therefore the time of the stressful event that caused the insult. Hillson (2000:272) asserted the great potential in gaining anthropological information from the study of hypoplastic lesions in teeth, above all the knowledge of what it was like to grow up in ancient Egypt.

EH can mostly be observed on the buccal aspects of dental crowns. Among the incisal and canine teeth of the permanent dentition: 50 to 65 per cent of hypoplasias occur in the middle third; hypoplasias in the cervical third: 18 to 30 per cent, with the

remainder 12 to 22 per cent in the incisal third. In premolars: 50 per cent occur in the middle third, 25 to 50 per cent in the cervical third and 0 to 25 per cent in the occlusal third. Molars show 40 to 80 per cent lesions in the middle third, 20 to 60 per cent in the cervical third. Note that the second and third molars are wholly unaffected in most cases (Sarnat & Schour 1941:1991).

There are three distinguished aetiologies for hypoplasia, namely hereditary hypoplasia conditions, hypoplasia as a result of local trauma, and systemic metabolic disruption hypoplasias. The hereditary type of hypoplasia is very rare (Winter & Brook 1975:16). The second aetiology specifies hypoplasia due to trauma or localised infections (i.e., abscesses) according to Hillson and Bond (1997:89). This type results in a defect occurring in only one tooth with the possibility of an adjacent tooth being affected. The third aetiology is known as systemic metabolic disruption hypoplasias, or acquired hypoplasia, which is also known as environmental contributory hypoplasia. This category covers by far the majority of cases found as skeletal non-specific stress indicators (Ford et al. 2009:382). These hypoplasias are indicative of not only the health of ancient Egyptian populations, but also of the ecology at the time of the interment of the remains. It follows then that periods of famine or abundance, socioeconomic depression or prosperity and war or peace can be "read" into the condition of skeletal and dental remains. This information on Egyptian periods of famine can then be used to cross-reference biblical and extra-biblical sources to establish societal conditions of the past, particularly in the said periods (Roberts & Manchester 1995:167).

Boldsen (2007:65) alludes that linear enamel hypoplasia (LEH) analysis has a causal connection between health events in childhood and the risk of dying at an earlier period. LEH formation and the risk of dying are influenced by a common factor – poor health at an early age predisposes poor health throughout life. This phenomenon may reflect in a population like Egypt where a large percentage of the population died within the first decade of life. Armelagos et al. (2009:270) concur and add that individuals who display two or more hypoplastic lesions died, on average, ten years earlier than those devoid of enamel hypoplastic lesions. No difference has been found between the sexes vis-à-vis the prevalence of hypoplasia, however, adults have a higher prevalence of linear enamel hypoplasia than juveniles because LEH that is caused by systemic stresses appear more in the permanent dentition than in the deciduous dentition (Griffin & Donlon 2009:S99).

A new type of enamel malformation, closely related to enamel hypoplasia, has been identified within the past decade (Weerheijm 2003:114; 2004:9). The author of this article has speculated for a long time about the possibility of a condition that would cause "softening" of enamel, to the extent that within a family one sibling may have "soft" enamel with little outward signs of enamel disturbances while the other siblings have little or no problems with their teeth. Molar-incisor-hypomineralisation (MIH) may prove to be the reason. MIH is characterised by noticeable demarcation of the lesion often with indented defects on the enamel surface and some degree of change in its translucency, with the area presenting shades of white opacity, yellow or brown in colour (Ogden et al. 2008:166). MIH enamel is soft, porous and poorly delineated from normal tooth tissue. The hypomineralised enamel was found to have from three to fifteen-fold higher protein content than normal. MIH is thought to be acquired via multifactorial systemic disturbances of the process of amelogenesis at the cell level. There seems to be a link to illnesses during infancy and teeth dissociated from fluoride, although the primary cause of MIH remains a mystery (Mangum et al. (2010:1160).

DENTAL WEAR IN ANCIENT EGYPT

Klatsky (1939:73) viewed dental wear as a natural biological phenomenon and not as a pathological condition of enamel, unless it is a feature of the pathological softening of enamel such as amelogenesis imperfecta or molar-incisor hypomineralisation. Therefore, should dental wear be accepted as a natural phenomenon, then a study of worn teeth should reveal some record of the past (Molnar 1972:511). This type of study would also reveal the type of diet, the way in which food was prepared, as well as social or cultural uses and abuses of teeth.

Scott and Turner (1988:109) note that dental wear has only two components: attrition and abrasion. Attrition (which results from direct tooth-on-tooth contact) would include bruxism, which is the pathological process of grinding the teeth during sleep. Davies et al. (2002:12) defined bruxism as the grinding of teeth during non-functional movement of the masticatory system, in other words, it is a mandibular parafunction. The wear in bruxism is usually uniform when opposing teeth are affected. In cases where periodontal support is compromised, hypermobility of teeth may result. Other effects of bruxism are sensitivity to thermal stimuli, and loss of

vertical height and fracturing of unsupportive enamel. The aetiological models proposed by Davies et al. (2002:13) are structurally a malocclusion in the maxilla-mandibular relationship and secondly a psychological model, unproven in ancient populations, but highly probable in modern societies. The other component is abrasion (produced by teeth making contact with a foreign material like food objects) and abrasives that are added to food (i.e., during food preparation). Abrasion is due less to the food people eat than to the abrasives incorporated in it during preparation. Moorrees (1957:133) epitomised dental attrition simply as the frictional wear of the teeth, and abrasion as the result of abrasive food material.

Dental wear has a multifactorial aetiology. Tooth wear is a slow process in most cases and the gradual loss of dental enamel happens through three distinct processes: abrasion, attrition and erosion. Addy and Shellis (2006:17) have shown that the three components of tooth wear, i.e., abrasion, attrition and erosion have been proven rarely to act alone but would rather interact with each other. The most important interaction is the potentiation of abrasion by erosive damage to the hard tissues. The science of dental wear, friction and lubrication is known as tribology, which recognises the variety of mechanisms by which wear can occur. Abrasion or corrosion is defined as the chafing or rubbing away of tooth surfaces caused by a foreign substance, for instance mineral particles in food. Erosion is the loss of tooth substance due to a chemical process (Smith & Knight 1984:435, 436). Davies et al. (2002:16) segregate the different types of tooth surface loss: the flattening of cusps or incisal edges and localised facets on occlusal or palatal surfaces would physically indicate a primary attrition aetiology. The loss of tooth surface caused purely by abrasion has sharply defined margins and a smooth, hard surface. The lesions with sharp edges would become rounded and shallow if there is an element of erosion present. The distinction between erosion and attrition is defined by the latter, which presents with well-demarcated wear facets on the occlusal surface. Dental wear is excluded when the affected areas cannot be brought into contact in natural occlusion (Klimet & Borkowski 2002:54).

Dental wear is one of the most devastating conditions affecting the tooth crown. Severe dental wear was the cause of various oral diseases and was detrimental to the general health of the population of Ancient Egypt. Antithetical to this hypothesis is the advantageousness of dental wear on dental and temporomandibular joint function. Dental wear is an excellent tool in the conjecture of the palaeodiet of Ancient Egypt,

and in the all-important palaeodemographical aspects of age determination and life expectancy to infer population censuses of past civilizations.

Figure 1: Various degrees of dental wear of a section of the mandible, typical of ancient and modern Egyptians (Harris & Ponitz 1980:45).

Figure 2: Typical dental wear dentine islands of upper arch of the maxilla showing classical wear patterns on most teeth bar the wisdom teeth (Miles 1963:2000).

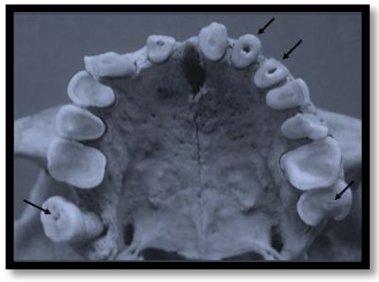

Figure 3: Severe dental wear in an individual with an abrasive diet. Pulp chamber exposure visible on teeth numbers 22 and 23. Pulp defence by secondary dentine evident on most other teeth (Miles 1978:459).

Ancient Egypt was a country with a clearly demarcated dualistic social system with a thin layer or veneer of bureaucracy on top and a vast layer of craftsmen and peasants

below. Its entire population was nonetheless uniformly affected by the dental wear and attrition conditions; even the kings and pharaohs could not escape this devastation of tooth structure (Allen 2000:31). Certain clinical features (see figures 1 to 3 above) when examining human teeth may be regarded as diagnostic of pathological tooth wear are listed by Smith and Knight (1984:436-437), and are as follows: pulp exposure; exposure of secondary dentine; exposure of dentine on the buccal or lingual surfaces; cupped incisal or occlusal surfaces; wear in one arch more than in the other; and reduction in the length of incisor teeth so that the length is out of proportion to the width.

Dental wear was ubiquitous in ancient Egypt. When the occlusal enamel and underlying dentine are worn away by the tough gritty foods, the pulp of the tooth is in danger of being exposed to the oral environment. Once this happens the pulp becomes infected and abscessed which eventually leads to tooth loss. Not only will the individual experience excruciating pain and the health dangers of an active infection, but, once the tooth is lost, the ability to chew and eat will be lost. All of this potentially contributes to premature death.

Diet and dental wear

Walker et al. (1991:169) discussed the importance of tooth wear in making inferences about diet, food preparation techniques and habitual activators involving the teeth, as well as an important source of data on the age structure of prehistoric populations. They also indicated that the demographic information provided by tooth wear varies according to the abrasiveness of the diet. Most ancient peoples consumed tough grit-contaminated food. Dental wear is also not a disease per se, but more than hypoplasia is instrumental in causing other dental diseases.

The Egyptian diet was high in abrasives (such as sand left over from grinding, grain and sand intentionally added to the grinding process). This resulted in flat occlusal tooth surfaces at a relatively young age (Sicher 1953:408). Due to their diet ancient people soon reached a score of five on Molnar's scale.[6]

Arensburg (1985:27) mentioned temporomandibular joint pathology frequently found in the osteological remains in ancient Egypt, which he believed to be related to

[6] The Molnar "three dimensional scoring system" for dental wear in Molnar (1971:179): a 1-8 ordinal scale based upon the number of dentine patches (islands) and the amount of secondary dentine present on the occlusal surface of a tooth.

extreme dental attrition. Leek (1972:289) found 92 per cent of the adult population in ancient Egypt suffered from a reduction in crown height (between 1 and 4 mm.). This phenomenon occurs only in cases of severe dental wear.

The effects and significance of dental wear

Associated with the gradual loss of tooth material are certain anatomical relationships between the teeth and jaws: teeth undergo certain changes apart from loss of their enamel covering; structures within the tooth are under threat (pulp tissue) with the resultant effect a change in the general oral health of the individual.

There are noticeable changes that occur in the dental arch dimensions, vertical facial dimensions, relationship changes between the mandible and the maxilla and atypical migration of teeth amongst adults in high dental wear environments like ancient Egypt. Newman (1999:731) reports compensatory changes in the vertical dimension of the jaws in response to the loss of occlusal enamel covering. The upper border of the inferior alveolar canal is a fixed reference point from which vertical changes in the mandible is measured. The relationship between this upper border of the inferior alveolar canal as a reference line and the occlusal surface (occlusal plane), the cemento-enamel junction, the alveolar crest and the root apices of the second lower premolar and the three lower molar teeth remain constant throughout the life of the individual. Johansson et al. (1993:398) report other factors associated with occlusal wear in high-wear environments:

- the significantly higher wear profile among the male population compared to that of females;
- an increased biting force found in men;
- decreased occlusal tactile sensitivity, also resulting in increased biting force;
- less crowding found within the dental arches; and
- cephalometric changes of the jaw relationship; signs are seen in the retroclination of the maxillary incisors, as well as a greater interincisal angle.

Dental wear has the result of compensatory tooth eruption to counteract the loss of occlusal tooth material. Passive eruption of the teeth keeps pace with the continual loss of tooth material; therefore, no change in facial height is likely to occur in the living entity (Hylander 1977:303).

TOOTHACHE AND OTHER PAINFUL ORAL CONDITIONS

Pain due to pulpitis is discussed by Alt et al. (1998:250); pulpitis is an acute or chronic, local or generalised inflammation of the pulp. It is typically accompanied by a sharp or dull, sometimes throbbing pain with moderate to severe intensity. Pulpitis is usually associated with caries; conversely, in the ancient Egyptian context the prevalent causes of pulpitis and subsequent periapical lesions appear to have been a dental pulp exposed by excessive dental wear (Taylor 1963:101).

Dental wear is often referred to as a normal physiological process; however, even with the self-adapted protective measure of the formation of secondary dentine, the psychological process may become a pathological problem and be the cause of mild to severe pain (Senawongse et al. 2008:14). With a population which commonly suffered from extreme dental wear like the ancient Egyptians, it would make sense that they were perhaps a rather melancholic society – unless they had some form of treatment with efficacy not yet known to science

The author of this article is a dentist with reputable experience in the diagnosing and treatment of toothache and tooth hypersensitivity, and wishes to make the following observations on tooth sensitivity. The lack of insight of scholars into the extent of dental hypersensitivity, unless they have experienced it first hand, proves to influence their judgment on dental pain amongst the ancient Egyptians. In the "Molnar dental attrition scoring system" hypersensitivity may be initiated at the score of 3 where the dental attrition or wear has merely exposed one minute "dentine island". Hypersensitivity to contact and temperature on such exposed dentine areas can, at times, be the source of excruciating pain. This newly exposed area compels a great number of patients with this malady to seek urgent dental treatment in modern times. Hypersensitivity of various degrees may be experienced in an on-going manner as the wearing down of tooth substance continues throughout the Molnar scoring stages 4 to 9. Sensitivity continues as long as the pulp has not died down and the wearing of enamel stays ahead of the formation of secondary dentine. The symptoms of an acute osteomyelitis[7] usually following what Hillson (2000:259) called "gross gross" caries

[7] Osteomyelitis is a term applied to any inflammation of bone or bone marrow, usually caused by infection from such microorganisms as Staphylococcus aureus, various streptococci, Mycobacterium tuberculosis, as well as, several fungi. The microorganisms generally reach the bone through the bloodstream from localised infection or even from infection elsewhere. Occasionally osteomyelitis occurs by direct infection after surgery, after a compound fracture, or as a result of trauma. Osteomyelitis, especially bacterial,

involving the pulp, are similar to those of an acute infection, with excruciating pain and a raised temperature being the most prominent features. Teeth in the affected area are tender to percussion and become loose (Alt et al. 1998:262). Dental abscesses usually erupt on the labial side of the mandibula or may cause severe complications in the maxillary sinuses. Forrai (2009:189) is confident that the ancient Egyptians suffered from various extensive, severe and painful dental diseases. She also states that it could hardly have been alleviated, or relieved, by the treatments or prescriptions made available in the medical papyri. She did, however, mention that the bark of the willow tree suggested in one of the recipes, mixed with ground beans, may have been the forerunner of aspirin (Forrai 2009:190).

The effect of dental disease in ancient Egypt is clearly seen in the text of the medical papyri: citations such as "pain in the teeth", and a "tooth that gnaws into an opening in the flesh" were most certainly uttered by sufferers of dental disease because these words were mentioned in the surviving medical papyri (Leek 1972:289). There are numerous causes of painful experiences within the oral cavity. Pain due to caries in ancient Egypt did not play a big role because caries was not commonplace among the general population. Pain should certainly have been a problem because of the rapid and intense wear of teeth that caused exposure of the pulp. Leek (1967:53) mentions periodontal lesions, which invariably leads to the loosening of the affected teeth with the sequelae of inflammation and severe pain in the surrounding gingival tissues.

Treatment of dental pain in ancient Egypt

Weinberger (1981:110) mentions the use of ground kidney beans in another prescription. It was to be placed on a woman's tooth (*nhdt*) "on the day on which she gives birth": as a "preventative of toothache; true and a million times excellent!" There is little evidence the ancient Egyptian had any idea of the aetiology of

presents as an acute disease. Common symptoms include chills followed by fever, with acute pain and swelling above the site of inflammation. The inflammation begins in the marrow cavity and causes softening and erosion of the bone structure, often with the formation of pus-containing abscesses, which soon spreads over the entire bone, with consequent death of the hard portions of the bone (sequestrations) and in ancient time may have caused the death of the individual (Vorhaus 2009: s.v. Osteomyelitis).

toothache. The papyrus Anastasi IV mentions the following incident of an Egyptian official on an outpost, describing the suffering of a colleague:

> I am staying at Kenkenente, unequipped, and there are neither men to make bricks nor straw in the neighbourhood … I spent the whole day watching birds … There is a gnat at sunset and the n=midge at noon; the sand-fly stings and sucks and sucks at every vein … A mns-scribe is here with me, every muscle of whose face twitches, the wštt-disease has developed in his eye and the fnt-worm into his tooth. I cannot leave him to his fate (Anastasi 12, 6-13, 7) (Weinberger 1981:110).

An unconventional reference to a condition that relates to toothache, found in a classical article of Griffith quoting the Papyrus Kahun, is mentioned by Bouwer (2012:225) in her research of obstetrics and gynaecology of ancient Egyptian women and contains the following prescription:

> Knowledge of a woman pained in her teeth and jaws; she knows not [how to open?] her mouth. Say thou to her it is the itching (?) (determinative a tooth) of the vulva. Do thou for her (thus): kap her with oil and incense in a bowl (?), pour on her the urine of an ass that has engendered two colts on the day that it has passed it (the urine). If her ... is pained from her … shoulder (?) to her ... hips (Griffith 1898:11).

Bouwer (2012:225) states that the prescription is for an unknown complication, disease, or ailment and concludes that the urine of a donkey mare that had just given birth to twin foals may perhaps be because the mare would have high levels of oestrogen in her urine, which may have some bearing on the prescription.

Although the Kahun papyrus deals with mainly gynaecological matters, it does refer to yet another toothache incident in Kahun (Kah 33 (3, 25-26)):

> Not allowing that a woman having toothache […]: beans, should be milled […] at her tooth (nḥḏ.t) on the day that she will bear a child, [that is] the elimination of the toothache. Really divine, a million times (von Deines et al. 1958:287).

A repulsive treatment features in a prescription for painful periodontal disease recorded by Blackburn (1977:29): Egyptian peasants would split the body of a living

mouse[8] and then lay the halves while still warm along the gums of a patient. The bleeding would stop. The superstition of ancient Egyptians regarding toothache led them to turn to the local mice, which they regarded as protected by the deity Re and capable of fending off death. The mouse had been one of the sources of therapy in ancient Egypt. Mice were regarded as "Givers of Life". There is a connection between the inundation of the Nile River, source of life, and the belief that mice were spontaneous products (abiogenesis) of the Nile mud after each inundation (Dawson 1924:83). Occasionally the presence of mice bones in the alimentary canal of children proves that small rodents had been eaten after being skinned, as treatment in difficult situations (*in extremis*) (Smith 1923:50). Other uses of mice as treatment for various maladies that are mentioned in the medical papyri are found in the Ebers, Hearst, and in magical papyri. Within these papyri there are amongst others: treatments for rheumatoid arthritis, for various hair disorders, to drive out *sesmi* (some unknown infantile ailment), applied to scorpion stings and helps to stop dribbling of the mouth. The ash of a mouse mixed with honey would cure earache, or when rubbed on the teeth, wass a mouth refresher (Dawson 1924:84).

There is no indication that the sufferers of pain in ancient times used any specific drugs to dull toothache apart from what the recipes prescribed in the medical papyri. However, the use of opium could well have filled the gap between professional treatment and private use. Opium trade between Cyprus and Egypt in the 18th Dynasty was well documented in the many Cypriote base-ring pots discovered in Egypt (Merrillees 1962:289). Reeves (1984:317) infers that the Edwin Smith papyrus' mention of a drug referred to as *spn* or *spnn* translates as poppy, which probably refers to *Papaver somniferum.* Opium from the Eurasian poppy *Papaver somniferum* is a narcotic drug known for its pain relief, physiognomies and sleep inducing properties. The alkaloids of the drug namely morphine, codeine and others, are not known to have existed in ancient Egypt. Merrillees (1962:292) is of the opinion that the population did not only wear an amulet in the form of a vessel modelled on the unripe seed capsule of the *Papaver somniferum* to ward off evil-causing maladies, but also a symbol for its pharmacotherapy properties. In summary Merrillees named opium's probable uses as: a sedative for wounds and necrotic wounds in the breast, a sedative for an abscess with a prominent head, a sedative for exanthema of the scalp, a dusting

[8] The Egyptian mouse would probably have been of the genus *Acomys*.

powder to be mixed with other drugs for scalp problems, and a sedative for a child in distress.

Opium may well have been the panacea for all common illnesses, an indispensable medicament in ancient Egyptian households. Merrillees (1962:292) named other maladies that opium would have been taken orally for: diarrhoea, dysentery, cold shivers, fits of fever, asthma, chronic coughs, rheumatism, diabetes and pains of all kinds. Opium must certainly have been the drug of choice in toothache because dental pathology was ubiquitous among the ancient Egyptians.

Apart from their pharmaceutical knowledge, the ancient Egyptians made inroads in the study of anaesthesiology. There is ample evidence to suggest that "primitive man employed digital compression of the carotid arteries to produce anaesthesia" (Zorab 2003:826). Instead, the ancient Egyptians advanced the science, using both hemp[9] (*Cannabis sativa*) and "poppy juice" to induce drowsiness in patients, which would eventually result in loss of consciousness. An interesting use of herbs in Egyptian medicine is their role as analgesics, i.e., to relieve pain. Cannabis was one such medication which was administered by mouth, rectum, vagina, topically and via fumigation. Through research and collaboration in the field, researchers agreed that the Egyptian hieroglyphs pronounced *sm-sm-t* or *shm-shm-t* literally translates into "the medical marihuana plant" (Bouwer 2012:70).

CONCLUSION

Various dental diseases were discussed in this study, all relative to the understanding of the health of the individual and of the population as a whole. Dental caries tended to be an uncommon condition in ancient Egypt as a whole, albeit a condition which slowly evolved in prevalence from the Prehistoric Period to the Roman Period to a more universal dental disease. The generally accepted aetiology of the disease is sugar, a product uncommon in the early dynasties, but which in later dynastic periods increased when sugar was introduced to the New Kingdom. The aetiology of caries was not understood at the time until the tooth-worm was erroneously blamed as the causative factor, a concept proved to be preposterous to the modern scientific understanding of the causative factor for caries. Periodontal disease is arguably the

[9] This association of *sm-sm-t* or *shm-shm-t* with cannabis or hemp is derived from its association with rope-making and basketry, as well as medicine, leaving researchers like Dawson (1934:44) to identify hemp with cannabis.

most common disease in the world today, surpassing caries as the most common disease. In ancient times caries played a minor role, whilst periodontal disease was rampant in most societies and the aetiology and pathogenesis of this disease proves to be multifactorial. The theory claiming that periodontal disease was the predominant causative factor for losing teeth in ancient Egypt was later shown not to be the case. Periodontal infection in the form of periodontitis is a very painful condition with many aetiologies. Enamel hypoplasia (EH) is a quantitative deficiency of enamel and is often termed a "non-specific indicator of stress". Molar-incisal-hypomineralisation (MIH) is similar to EH and is discussed as a possible cause of widespread dental wear because of the softening of the enamel surface on teeth.

The lack of effective oral hygiene was perhaps instrumental in the aetiology of many maladies of the oral cavity including caries, periodontal diseases and other infectious conditions of the soft tissues of the mouth. The paucity of information on dental pain in ancient Egyptian literature or any other references to dental pain is still an enigma. The severe pain from dental maladies that I assume the general population would have experienced was barely mentioned in the "media" of the time. This may imply that the ancient Egyptian had dentists who could alleviate their continuous suffering and morbidity due to dental pain in ways unknown to modern science.

The question whether the treatments advocated in the medical papyri could allay the pain and resolve painful dental conditions, is still unanswered. Can modern dental science afford to ridicule their means and methods? Further research can include empirical studies to establish whether the ancient Egyptians conducted good dentistry. Research on the constituents of the recipes in the medical papyri may yield answers, if the constituents can be identified and put to the test.

Severe dental wear in ancient Egypt was ubiquitous to the point of perhaps being an important factor determining the health and wellbeing of an entire population, with no regard to individuals. It is hypothesized that the royalty of the land suffered from dental pathology to a greater degree than the average population due to a diet of more carbohydrates and sugars. Dental pain may have resulted in constant morbidity,[10] and may even have been instrumental in the mortality of the sufferer.

[10] The expression "like a bear with a sore tooth" implies anger or irritation – a monarch with a sore tooth may very well negatively influence his decisions and even the course of history.

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