Case report: A medieval case of molar-incisor-hypomineralisation

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IN BRIEF

- Describes the dentition of a skull of a fifteenth century medieval woman of possible historic significance.
- Outlines MIH developmental defects and 'Turner teeth' on the dentition and their implications.
- Describes the dental caries, calculus and periodontal status of the dentition.
- Discusses the theories of MIH and possible aetiology in the light of medieval childhood conditions.

GENERAL

Introduction Molar-incisor-hypomineralisation (MIH) has been identified in recent years as a condition affecting the first permanent molars and, in some cases, the permanent incisors. Many factors have been suggested as to its aetiology. Examples of MIH have also been reported in skeletal remains in the past. These historical examples have, however, been for unknown individuals. **Case report** A skull that has become available for dental examination that is uncertainly attributed to be that of Lady Eleanor Talbot (c.1436-1468) who ended her life as a Carmelite nun in Norwich (England). The dental findings of the examination showed enamel defects of molar teeth 36 and 46, as well as small areas on other molars, and striations of the enamel of permanent anterior teeth consistent with MIH. There is exposure of the roots of some maxillary teeth with resultant root caries. The presence of areas of enamel decalcification commensurate with 'Turner teeth' on 43 and 44 indicates that there were likely to have been periapical abscesses secondary to dental caries of the primary teeth. In addition, there is occlusal wear of all of teeth with extensive calculus and periodontal exposure of the roots of the mandibular incisors. Failed development or very early ante-mortem loss of premolars 15 and 25 is evident, as well as evidence in the same region of a large abscess cavity with extensive maxillary bone destruction. Healing cribra orbitalia, porosity, which is considered to be an indicator of nutritional stress, is visible on the superior aspect of the left orbit. **Conclusion** A case of MIH is reported in a skull dating from the mid-15th century.

INTRODUCTION

Molar-incisor hypomineralisation (MIH) has attracted considerable interest in paediatric dentistry in recent years since a description by Weerheijm *et al.*,[1] who also described the condition as 'cheese molars'. Previously a number of different descriptions have been used concerning enamel defects affecting permanent molars and incisors. Developmental and morphological defects may arise because of problems in the secretory phase of tooth enamel, while diffuse or demarcated opacities have been attributed to the maturation phase.[2,3] During the late 1990s it was realised that these problems were more common than previously thought and as dental caries started to decline in the general population, attention was given to more specific developmental problems of the teeth, particularly in children. The term MIH has, therefore, been used since 2001 to describe a specific enamel developmental defect of permanent first molars and incisors that were evident in many children as an apparently separate entity.[1]

Following the establishment of the presently used diagnostic criteria,[4,5] the prevalence of MIH has been variously reported in a number of countries from 3.6% to 25%[6] and variation within countries can be significant.[7] Data on MIH from historical periods is limited and usually based on archaeological material from skeletal remains excavated from graveyards, plague pits etc.[8] In those cases while MIH in several individuals may be noted, their actual identity is unknown. The opportunity to examine a skull that is probably that of a known medieval individual also revealed evidence of MIH.

CASE REPORT

The skull reported upon here for dental examination is uncertainly attributed to be that of Lady Eleanor Talbot (Lady Eleanor Butler) (c1436-68). The skull was part of a skeleton found when limited excavations were undertaken of the Priory ruins in the 1960s, and is one of a group of skeletons found at that time. Osteological sex assessment was carried out using standard methodologies based on the sexually dimorphic morphology of the skull and pelvis, the pelvis being the most accurate. Analyses of both the skull (Figs 1a, 1b and 1c) and pelvis indicated that this individual was female. Age at death analyses suggested that this individual would most likely be categorised as a middle adult (25 to 44 years). The suggested sex and age at death of this particular individual does correspond with that of Lady Eleanor. The other individuals were considerably older.

Dentition

The permanent dentition is present (Fig. 1) with the exception of the maxillary left second premolar and right first and second premolars, possibly lost ante-mortem, and some incisors and the maxillary right canine, lost post-mortem. A radiograph (Fig. 1d) shows the presence of the posterior teeth and supporting structures. The teeth present are (FDI notation):

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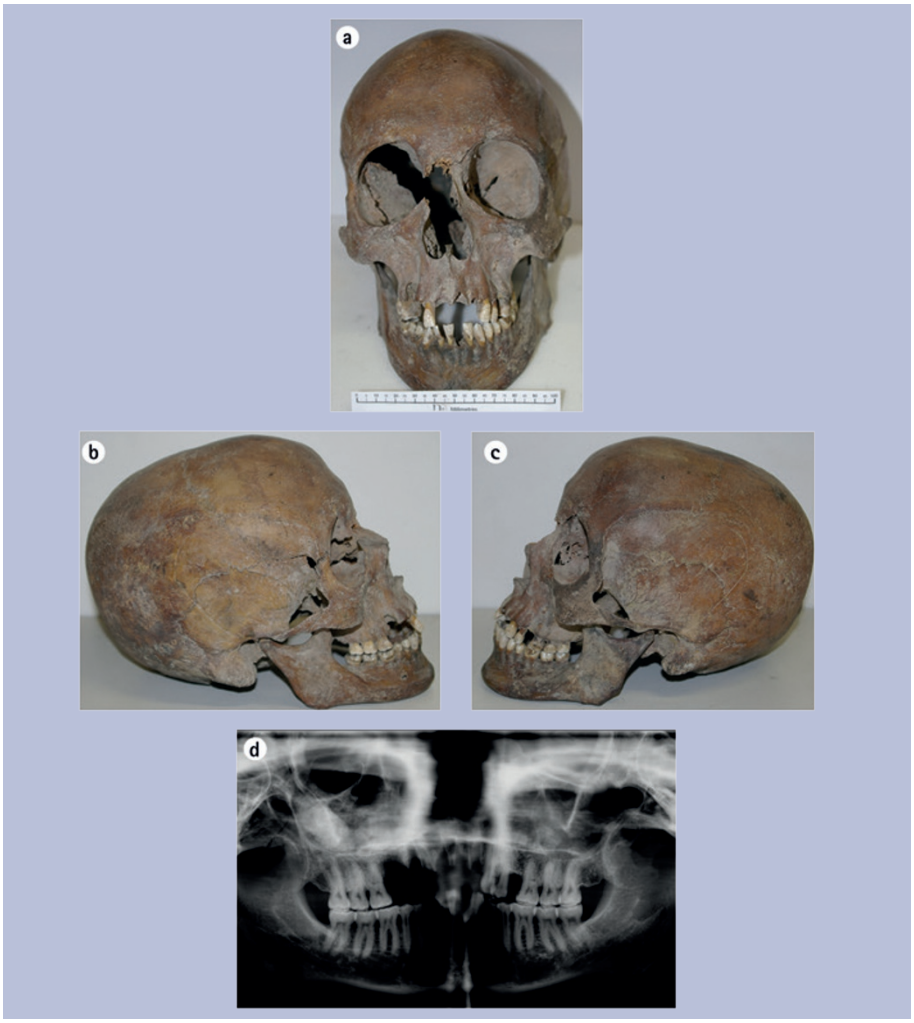

Fig. 1 Frontal view of the skull reputed to be that of Lady Eleanor Talbot

Fig. 2 Photographs showing: (a) palate and maxillary teeth with post-mortem loss of teeth 11, 13, 21, 22 and ante-mortem loss (or development failure) of teeth 14, 15 and 25; (b) occlusal view of the mandible showing marked wear of posterior teeth; (c) lateral view of the left side of the maxilla and mandible in occlusion showing enamel defects of teeth 26 and 36; (d) lingual aspect of the anterior mandible showing fractured tooth 42, extensive calculus deposits and enamel defects of the lingual surface of the canine (43) and the occlusal surface of premolar (44)

R 18 17 16 # + * 12 * / * * 23 24 # 16 27 28 L

48 47 46 45 44 43 42 41 / * 32 33 34 35 36 37 38

+ = ante-mortem loss; * = post-mortem loss; # =probably failed to develop.

The molar teeth show marked enamel wear exposing islets of dentine on the cusps of the first permanent molars (teeth 16, 26). Figure 2a shows the maxilla with the sockets of the teeth that were lost post-mortem. On the left side the presence of healed bone, in the position of the second premolar (tooth 25), indicates that this tooth was lost years before death or, more likely, had never developed. Second premolars are the third most common permanent teeth to fail to develop in the human dentition.[8] On the right side of the maxilla there is considerable bone loss in the premolar region with little sign of repair (discussed below). The mandible (Fig. 2b) shows that the left central incisor (tooth 31) was lost ante-mortem. The second incisor (tooth 42) is fractured exposing the dental pulp, however, it is most likely that this fracture occurred post-mortem as the fractured surfaces have not been rounded by wear. As in the maxilla, there is marked wear of the occlusal surfaces of the molars with cuspal exposure of islands of dentine. The occlusal surfaces of the first permanent molars (teeth 36, 46) show significant enamel defects, which are discussed later.

Dental caries

Detailed examination of the teeth present showed no active or arrested enamel dental caries. However, there is a large area of root caries on the exposed buccal surface of the left maxillary first premolar as shown in Figure 2c.

Enamel defects

Of considerable interest is the presence of enamel defects affecting several teeth. These defects are of two types. The mandibular first permanent molars (teeth 36, 46) show hypomaturation and disturbance of the tooth structure. The occlusal surfaces show moderate wear and also defects commensurate with MIH. The defects seen in the molars are stained brown enamel without breakdown of the surface. The lower left molar shows this defect clearly on the buccal surface (Fig. 2c). The occlusal view (Fig. 3b) of this same tooth shows defective enamel, although much of it has been worn away by chewing. The first permanent mandibular molar on the right hand side (tooth 46) shows probable MIH, but only affecting the occlusal surface, but again there has been significant wear.

In the full presentation of MIH, as the name implies, there are defects of the incisors. As

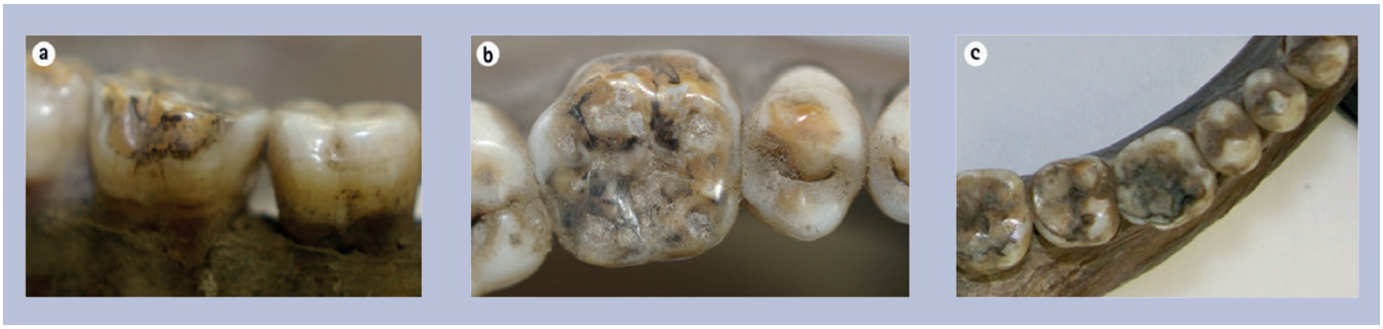

Fig. 3 Close-up photographs of: (a) tooth 36 showing extensive MIH defect of the buccal enamel; (b) occlusal surface of molar tooth 36 exhibiting MIH and wear; (c) occlusal view of right side of mandible showing MIH originally affecting the molar 46 but with significant superimposed occlusal wear

so many of the incisors in this case have been lost post-mortem it is difficult to make such an encompassing diagnosis. However, the one maxillary tooth present (Fig. 2c) in the top left hand corner of the photograph shows striations and perikymata (rippling) of the surface enamel consistent with incisor MIH.

Other enamel defects.

Several other teeth show enamel defects that cannot be classified as MIH. Thus, in Figures 2d and 3b the second premolar (tooth 35) shows an area of brown discolouration related to the occluso-buccal cusp surface. Other similar areas of brown discolouration are seen on the lingual surface of the lower right canine (43) and the occlusal surface of the lower right first premolar (44), suggesting that the enamel has been damaged in regions where the apex of their primary predecessor would have been. This is typical of a situation known as a 'Turner tooth' where there was dental caries in the primary teeth with associated periapical abscess formation with damage to the underlying permanent tooth.[9] In this condition the acidity and toxicity of the infective material attacks the underlying developing permanent tooth producing the enamel disturbance seen here. Because several teeth are so involved it is possible to speculate that this individual had extensive caries of the primary dentition related to a highly cariogenic diet as reported in a similar case.[10] If this skull is that of Lady Eleanor Talbot, being the daughter of one of leading aristocrats (Earl of Shrewsbury), she would have ready access to a cariogenic diet even though sugar at that time was very expensive. However, plentiful supplies of honey were available to the wealthy as well as the bulk of the population.[11]

Dental calculus and periodontal disease

There are heavy deposits of calculus in many places. This is particularly noted around the mandibular incisor area (Fig. 2d) and is a common finding in individuals from this historical period where effective oral hygiene would not be practised even by the wealthy and privileged.[12]

Rings of calculus are seen where the gingival crevices would have been. Such calculus deposits are particularly heavy near the openings of the submandibular salivary glands, and in the maxillary molar region adjacent to the parotid salivary ducts. Calcium and phosphate salts from saliva become readily deposited in undisturbed dental plaque on tooth surfaces due to a lack of oral hygiene. In Figure 2d it is to be noted that there is significant bone loss leading to exposure of the roots of the incisors. There is marked bone loss due to periodontal disease. Similarly in the maxillary left quadrant (Figs 2c, 2d and 3a) there is considerable bone loss affecting most markedly the first premolar and first permanent molar exposing the roots of these teeth. Here again, there are thick calculus deposits on the roots of the molar. The early ante-mortem loss of the second premolar (tooth 25), or its failure to develop, has led to a resorption of the bone that would have left a deep depression or 'pocket' in the alveolus. Such a stagnation area, in a mouth with poor oral hygiene, would have provided an environment for root caries to develop in the exposed dentine and cementum of the adjacent teeth.

Fig. 4 Enlarged view of: (a) the right maxilla showing the extensive bony defect; (b) left orbit showing cribra orbitalia porosity on the superior part of the orbit

Other comments.

Abscess.

Of considerable interest is the loss of teeth in the maxilla on the right hand side with significant bone loss without repair. The second maxillary premolars may have failed to develop (Fig. 2a). The bone loss shown extends onto the mesial surface of the first permanent molar ascending deep into the maxilla, exposing the molar root. In addition the first premolar was also lost ante-mortem. A possible conclusion of this finding is that at some time, possibly shortly before death, an abscess formed in the premolar area, producing what would have been a very painful condition. In such a situation, before the advent of dentistry and of antibiotics, there would have been a high risk of the infection in the face,[12] and such infections could track up to the base of the brain via a cavernous sinus infection leading to meningitis and death. There being no sign of bone repair in the skull as described herein would indicate that the infection occurred shortly before death and might indeed have been a cause of it.

Interestingly, this individual had cribra orbitalia (porosity on the superior part of the left orbit), which appears to be healing (Fig. 4). Cribra orbitalia is considered to be an indicator of stress, both in childhood

or adulthood. It is usually attributed to metabolic diseases such as rickets, or other deficiencies in nutrition. Cribra orbitalia has also been associated with anaemia and even infection or trauma.[13] However, the examination of this skeleton showed no further evidence of scurvy, rickets, trauma, infection or anaemia.

DISCUSSION

Historically, enamel defects of permanent molars and incisors have been noted in sporadic reports, but without any clearly ordered criteria of diagnosis. Dental enamel hypoplasia has been attributed to physiological stress during early life.[14] Many childhood diseases and conditions could account for the enamel defects including malnutrition, dysentery, diphtheria, whooping cough, smallpox, as well as various nonspecific fevers and prenatal, perinatal and childhood medical conditions that affect the developing enamel, while an underlying genetic predisposition cannot be excluded.[2]

More recently other suggested aetiologies have included industrial pollution, pesticides and other organic radicals such as dioxins; the latter have even been suggested as contaminants in breast milk.[15] None of these recent environmental conditions, however, are likely to have existed in the fifteenth century. Accordingly, the aetiology in the case presented must most likely be peri-natal conditions, very early childhood diseases or nutritional deficiencies. Until the introduction of water purification and adequate sewage disposal, dysenteric and parasitic disease was rife and the cause of much infant morbidity and death. It is suggested that this was the likely cause of the MIH noted here.

While the true historical prevalence can never be known there have been other instances where skull-teeth specimens of specific individuals have shown dental enamel defects including those resembling MIH. The skull of a child aged about 11 years old, from the Chelsea Old Church graveyard in London (England), clearly showed enamel defects that could be diagnosed as MIH.[8] In that case the aetiology was probably rickets. A large cemetery was uncovered in 1985 in east-central London (England), known as the 'New Graveyard', which was founded in 1569 by the City of London as an overflow burial ground to relieve congestion in London's parish burial grounds; its use was continued until the middle of the 18th century.[16] The cemetery contained many primary uncoffined burials at a high density[17] and while only a small part of the cemetery was excavated some 388 individuals, of whom 45 were children and adolescents, were retrieved and stored at the Museum of London. This material offered the opportunity to assess the number of individuals exhibiting enamel defects including MIH. As these studies concerned mass graves, however, the identity of the individuals is not known. Nevertheless, it is suggested that MIH has affected individuals for centuries.[18]

The presence of 'Turner's Teeth' defects in this individual on three permanent successors of the primary teeth indicates that this woman had marked childhood dental caries leading to periapical abscesses probably to primary teeth 74 and 83 or 84, as well as 84 or 85. Dental caries of primary teeth was not widely prevalent in fifteenth century general populations. However, caries of the primary teeth is recorded among children of the aristocracy. For example, the primary teeth of the skeletal remains of Anne Mowbray (1472-1481), were described by Professor Martin Rushton[10] as showing extensive primary teeth dental caries. Honey was used by most of the population in considerable quantities,[11] but sugar was also imported from India along the silk route and through the Mediterranean so that by the time it reached England it was extremely expensive. Accordingly it was only the wealthy upper classes that could afford the frequent use of sugar. This would be associated with dental caries. The presence of 'Turner's teeth' described herein indicates the skull is that of someone who, as a child, must have been brought up in wealthy surroundings. This finding possibly adds some evidence as to the skull's possible identity.

It remains to be determined if the skull discussed herein is or is not that of Lady Eleanor Talbot. The skull was of one of a number of skeletons excavated from the ruins of the under croft of the Norwich Carmelite Priory, destroyed during the dissolution of the monasteries in England in 1538. The skull is clearly that of a young woman and presumably one of the nuns of the priory, and was first described by Ashdown-Hill[19] in a discussion of the historical facts relating to Lady Eleanor. While that article showed a small black and white picture of the skull where enamel defects could possibly be seen, no comments were made concerning the dentition. The location of the grave(s) indicates that the persons were of some significance, as most ordinary nuns would have been buried outside of the priory walls in a separate graveyard. The evidence of dental caries in the primary and secondary teeth indicates a woman of upper class upbringing during childhood. A confirmation or not concerning the identity of these skeletal remains may now be possible with DNA techniques.

SUMMARY

The dental aspects of this skull of a young woman show that the individual had a number of dental defects. In the case of the first permanent molars, such appearances are characteristic of molar-incisor-hypomineralisation. Several premolars and a canine have defects consistent with 'Turner's teeth' indicating root infections of the primary teeth. There is extensive calculus present, indicative of poor oral hygiene and periodontal disease. Ante-mortem loss of maxillary premolars on the right side of the maxilla indicates an extensive maxillary abscess most likely shortly before death and possibly related to death.

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