SECTION 6.
Odontological Study

The study of the human dentition in archaeology can provide almost as much information about past populations as that of bones. Teeth can be studied under all the headings considered for skeletal material, but because of their equal importance they are generally accorded a separate section in skeletal reports. Information on age, sex, metrical and non-metrical variants, and pathology can all be gathered from dental study.

Since teeth have already been considered in the estimation of age (Section 3.1), and to a limited extent in the determination of sex (Section 3.2), only aspects of metrical and non-metrical characteristics and pathological processes will be considered here.

6.1. Dental Variation

6.1.1. Metrical Analysis

The two most common measurements to be taken on the teeth are the mesio-distal and bucco-lingual diameters (Hillson, 1986), although the odontometric points for these are not always easy to identify, especially on worn teeth. The two measurements, and their indices, can be used as a guide to overall tooth size within a population and, as mentioned previously, can be useful in sex determination.

Studies on mice, and twin studies, have suggested a strong genetic rather than environmental component in the determination of tooth size, although the extent of this is uncertain (Hillson, 1986). Obviously there is some correlation with disease and malnutrition, and it is possible that twin studies for example might be showing a pattern caused by shared prenatal environment rather than inheritance.

Population distancing has been attempted from odontometric studies. Lavelle (1973), for example, studied the difference between maxillary molars and premolars of different ethnic groups. He found that univariate statistics did not show a significant difference between groups, but that multivariate analysis proved useful in distinguishing between the main racial groups. He also noted a significant difference between the 19th century remains from St. Brides and the 16th-18th century group from Moorfields, and twenty Anglo-Saxons from Bidford-on-Avon. The last two, however, were very little removed from each other and from American Indian and West African groups.

Hillson (1986) reviews a number of studies on population distancing from tooth measurements based on various racial groups. He states that ‘by and large, dental measurements do not seem to be very efficient discriminators between populations’ (1986:243).

6.1.2. Non-metrical Analysis

Like cranial non-metric traits, dental variants are usually scored on a present or absent basis. They involve such variations as extra cusps, congenitally absent teeth, and general morphological differences.

A few traits have been considered in detail by various workers. For example, the presence of shovel-shaping of the maxillary incisors has often been studied in the past. Carbonell (1963) states that a high frequency of the trait is found in mongoloid races, and a low frequency occurs in caucasoid groups. She found that if the variant is present in the median incisor it is usually found in the lateral incisor to the same degree. Pronounced shovelling appears to be more frequent in females than males, although the actual prevalence of all degrees of the trait may be more common in males. At Westerhus, Sweden, for example, the trait occurred in 24.1% of females and 38.5% of males. Blanco and Chakraborty (1976) studied the trait in two Chilean groups, and concluded that 68% of the total variability of the trait can be ascribed to the additive effect of genes.

Congenital absence of teeth (hypodontia) was studied by Brothwell, Carbonell and Goose (1963). Complete hypodontia is rare, but absence of one or more teeth is not so uncommon. It may affect both the anterior and posterior teeth, or just one type of tooth in particular. The order of frequency of missing teeth is quoted as third molars, maxillary lateral incisors, second premolars, mandibular central incisors, and maxillary first premolars, with absence of other teeth occurring only very rarely. Heredity is stated to be the most important cause of hypodontia. The authors found the frequency of absence of the maxillary lateral incisors to be in general not greater than 2.5% in modern populations. Third molars vary in the frequency of absence from 0.2% to more than 25%, and this has increased through time.

Alexandersen (1963) studied Danish populations of the Neolithic and the Middle Ages for the presence of double rooted mandibular canines. In the Neolithic, the frequency of occurrence was 5.6%, and in the Medieval period it varied from 5.1% to 8.0%. Other European populations studied showed no significant difference from these figures.

Other traits are recorded by Hillson (1986). These include the number of lingual cusps on the premolars, the shape of the third molar (e.g. peg shape), the number of molar cusps, the presence of a Carabelli's cusp (a supernumerary cusp on the lingual surface of a molar), fissure shape in the lower molar crowns, and supernumerary teeth. These traits have various prevalences, but since many are not studied in a normal osteological analysis it is difficult to make comparisons between archaeological skeletal populations.

Hillson (1986) reviews some of the work done on population studies by dental traits. He concludes that dental morphology seems to be a useful method of examining biological distances in archaeological populations. He lists the advantages as being the generally good preservation of dental material, the direct comparability of morphology with modern populations, and the demonstrated ability of the technique to provide information on biological distances in modern groups. As with cranial non-metrics, however, there are also disadvantages. The genetic component of morphological variation is still little known, there is no universal standard list of traits or method of scoring, and missing, worn or decayed teeth are difficult to deal with.

Berry (1976) studied the prevalences of 31 tooth crown variants in six European populations. All but one of these studies were based on dental casts of modern children being treated for orthodontic problems. The remaining group was an archaeological group from Orkney and Shetland, from which only small and incomplete samples could be obtained. The examination of this last group showed that most minor dental traits are destroyed by attrition. Berry states that 'this means that great care must be taken when scoring teeth from older members of a population or from any population whose diet tends to early tooth wear, as variants present at eruption may have disappeared by the time the tooth is scored' (1976:266). This, together with the effect of decay, and the lack of knowledge on the interaction of genetic and environmental factors controlling these traits are major problems in the study of non-metrical variation in archaeological groups. Berry suggests that 'until these questions are answered dental variants cannot be considered to be of practical value in anthropological studies' (1976:266).

6.1.3. Dental Variation in the Study Populations

Metrical analysis of the teeth has not been carried out on any of the groups in this study. This is partly because dental measurements are not felt to provide a great deal of useful information, and partly because of the amount of time that such an intensive study would involve.

Only two of the non-metric traits mentioned above were considered in the populations studied here, these being congenital absence of teeth and presence of shovel-shaped incisors. General abnormalities of position or shape of the teeth were noted when they occurred, as was the retention of deciduous teeth in the adult dentition. Summaries of the few traits noted in each of the populations will be found in the relevant reports. Prevalences of abnormalities were not recorded owing to the difficulty of classification, and the fact that only a few occurred in each population.

In archaeological populations which are analysed without the aid of radiography it is usual to find that the prevalence of *unerupted* teeth is recorded, rather than that of congenitally *absent* elements. Often many of these teeth are completely absent, but without an X-radiograph of the mandible it is impossible to be certain unless the jaw happens to be broken at the relevant position. Jaws are only scored as having unerupted teeth if it is almost certain that the lack of a tooth is not due to antemortem loss.

The levels of unerupted teeth in the study groups vary considerably. They are presented in Table 6.1.

Site	Male unerupted		Female unerupted	
	N	%	N	%
HIR	26/1480	1.8	71/1994	3.6
MK	11/944	1.2	9/576	1.6
JA Sax	17/474	3.6	16/371	4.3
JA Med	14/594	2.4	22/767	2.9
BG	11/712	1.5	16/494	3.2
BF	19/497	3.8	14/133	10.5
GP	9/568	1.6	0/461	-

Table 6.1.

This table gives the percentages of unerupted teeth in males and females over the whole dentition. Since in every case the vast majority of unerupted teeth are third molars, it might be more realistic to provide percentages of absent third molars from third molar positions. These are therefore given in Table 6.2 below.

Site	Male 3rd Molar N	%	Female 3rd Molar N	%	Total %
HIR	24/180	13.3	58/238	24.4	19.6
MK	9/89	10.1	9/58	15.5	11.6
JA Sax	17/55	30.9	16/41	39.0	34.4
JA Med	14/58	24.1	20/86	23.3	23.6
BG	11/83	13.3	15/53	28.3	19.1
BF	15/75	20.0	14/20	70.0	30.5
GP	9/63	14.3	0/55	-	7.6

Table 6.2.

In every case, except Guisborough, more congenitally absent or unerupted teeth were found in females than males. A chi square test showed this difference to be significant at The Hirsel, Blackgate and, not surprisingly, Blackfriars, although at the other sites it was not. This sex difference is probably due to the fact that female jaws are smaller than those of males. The evolutionary trend is towards smaller jaws and reduction in number of teeth, and this tends to affect the third molar the most, since it is the last tooth to form. Studies on mice have suggested that absence of the third molar is determined by a gene for tooth size rather than actual absence. If the tooth germ fails to develop beyond a certain size, it will be reabsorbed before it is due to erupt. Since women in general have smaller teeth than men, it is not really surprising that they have a greater prevalence of third molar absence.

The percentages of unerupted teeth at these sites do show a slight increase with time, although Guisborough and Saxon Jarrow appear anomalous in this respect. This may be because the figures are based on small populations, or it may be due to their genetic make-up. This latter seems unlikely at Jarrow, however, since there would seem to be a decrease from early to late periods if the figures are representative.

Other teeth were found to be probably congenitally absent at most of the sites. At The Hirsel, for example, one female had only one premolar in each quadrant of her dentition, three individuals lacked one or more canines, two lacked an incisor, and in one female mandible the right second and third molars had apparently never developed. At Blackgate one female had retained her left deciduous maxillary second molar, and the second premolar had not erupted, either as a cause or an effect of this. The percentage frequencies of unerupted teeth by area of the jaw and by sex are shown for each site in Figures 6.1 to 6.7. These bar charts also show the percentages of teeth present, those lost ante- and post-mortem, and percentage of missing or unassessable jaw sections.

Shovelling of the incisors was only looked for systematically at two sites, Norton and Guisborough. At Norton the prevalence of occurrence based on individuals was 36.1% (Marlow, forthcoming), and at Guisborough it was 61.5%. This discrepancy may be due to variations between scoring techniques at the two sites, especially since the analyses were carried out by different observers, or it may be caused by the small sample size at Guisborough. On the other hand, it may be a real difference due to the possible inbreeding at Guisborough which was suggested by the cranial non-metric traits. Since the trait was only studied at two sites it is impossible to be certain of the reason for the divergence.

Other anomalies noted in the jaws included abnormal eruption position or impaction, extra roots of premolars, canines or molars, and traits such as Carabelli's cusp. At Guisborough, for example, three individuals had premolars with one or two extra roots, and one man had an upper left canine which had remained in the alveolar bone and appeared to be erupting towards the incisive foramen.

6.2. Dental Pathology

6.2.1. Introduction

A number of common pathological processes can be seen in the teeth and alveolar bone of ancient populations. The most obvious, and most frequently occurring today, is tooth decay or caries. However, individuals in the past were affected by processes which occur less often in modern societies. These include periodontal abscesses, enamel hypoplasia and dental calculus (tartar). Although gingivitis (gum disease) is a relatively common infection in modern mouths, and was likely to have affected past individuals to an even greater extent, it is unfortunately unlikely to be recognised in the alveolar bone.

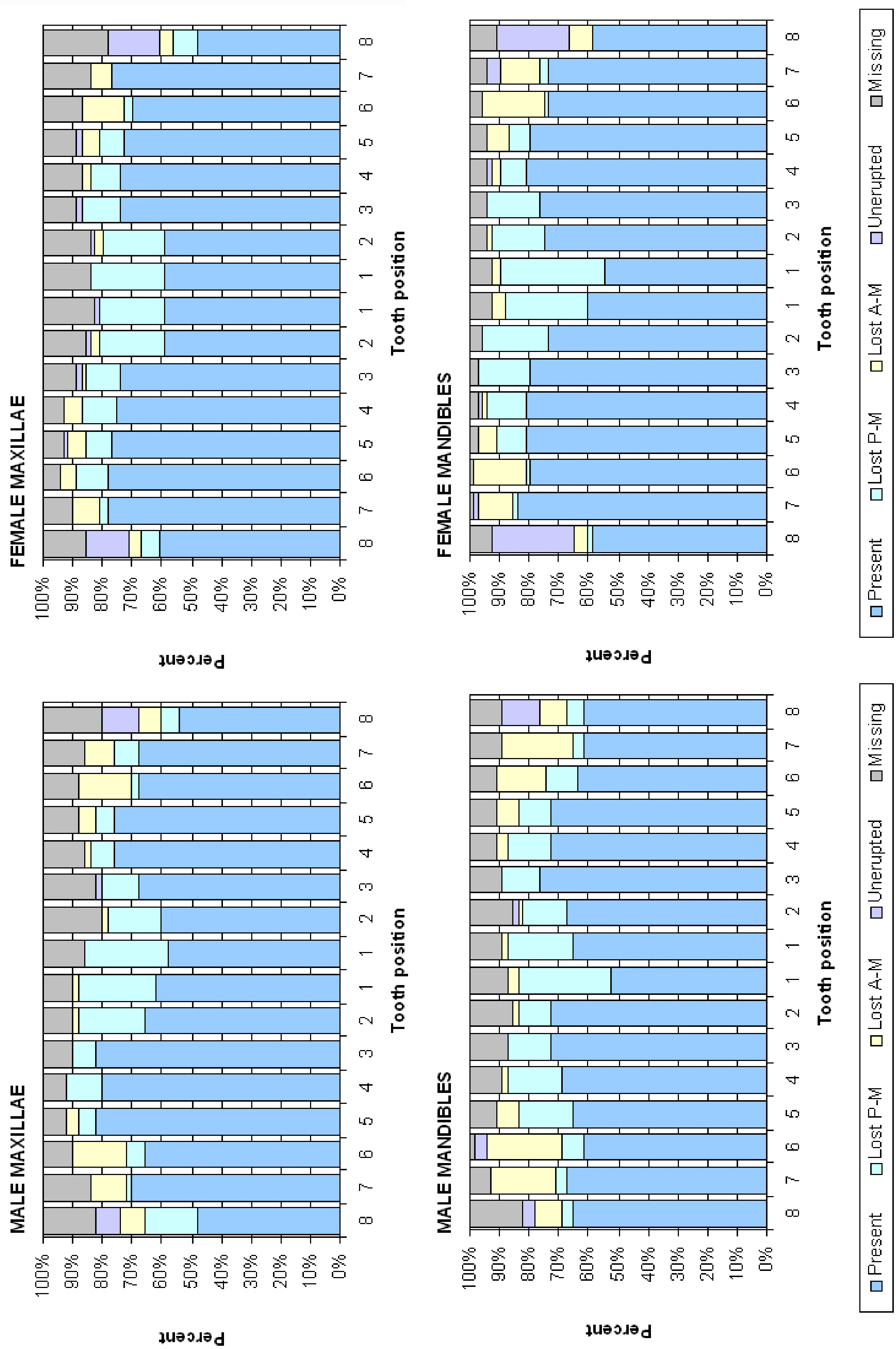


Figure 6.1. Percentage remains by tooth position 1: The Hirsel

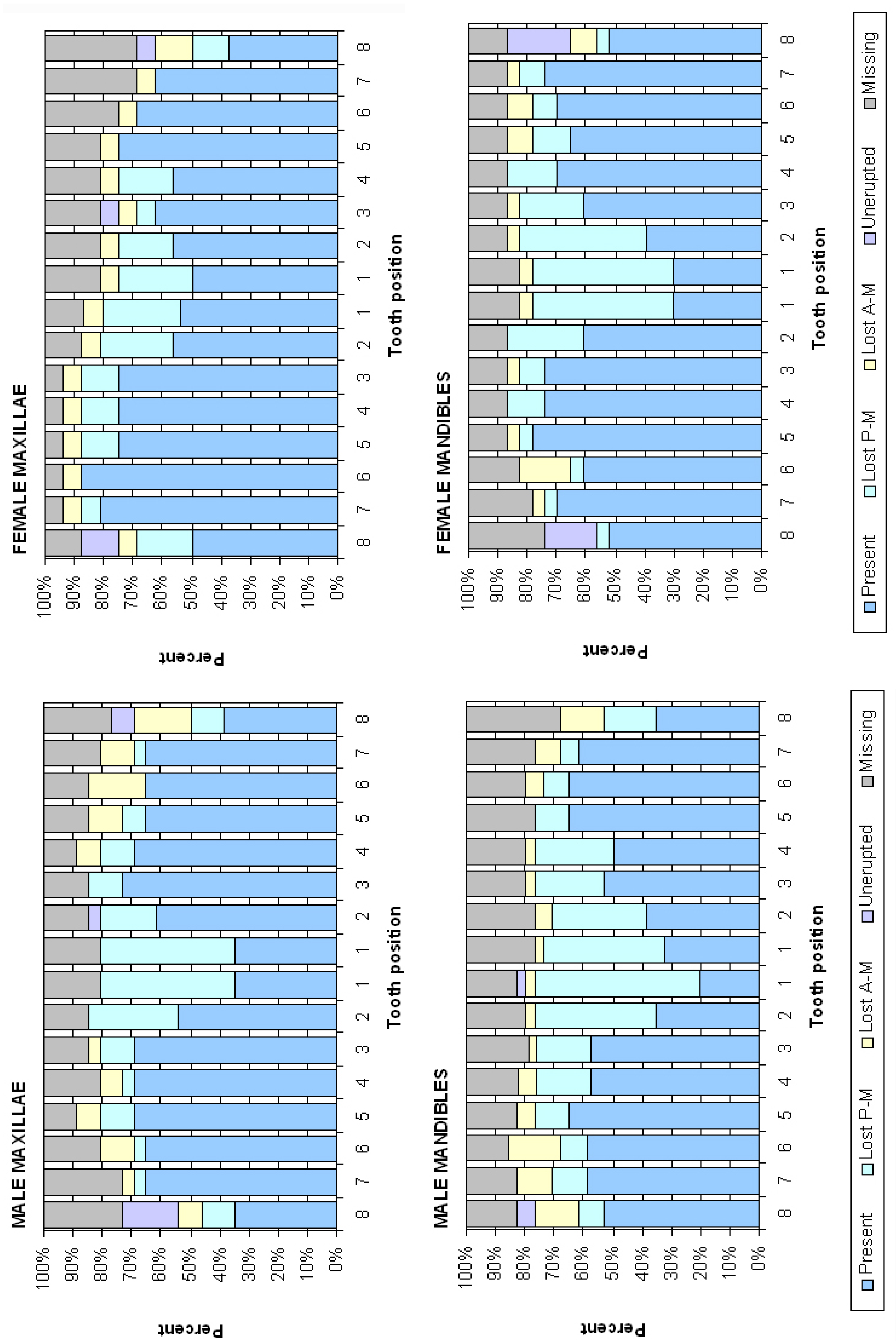


Figure 6.2. Percentage remains by tooth position 2: Monkwearmouth

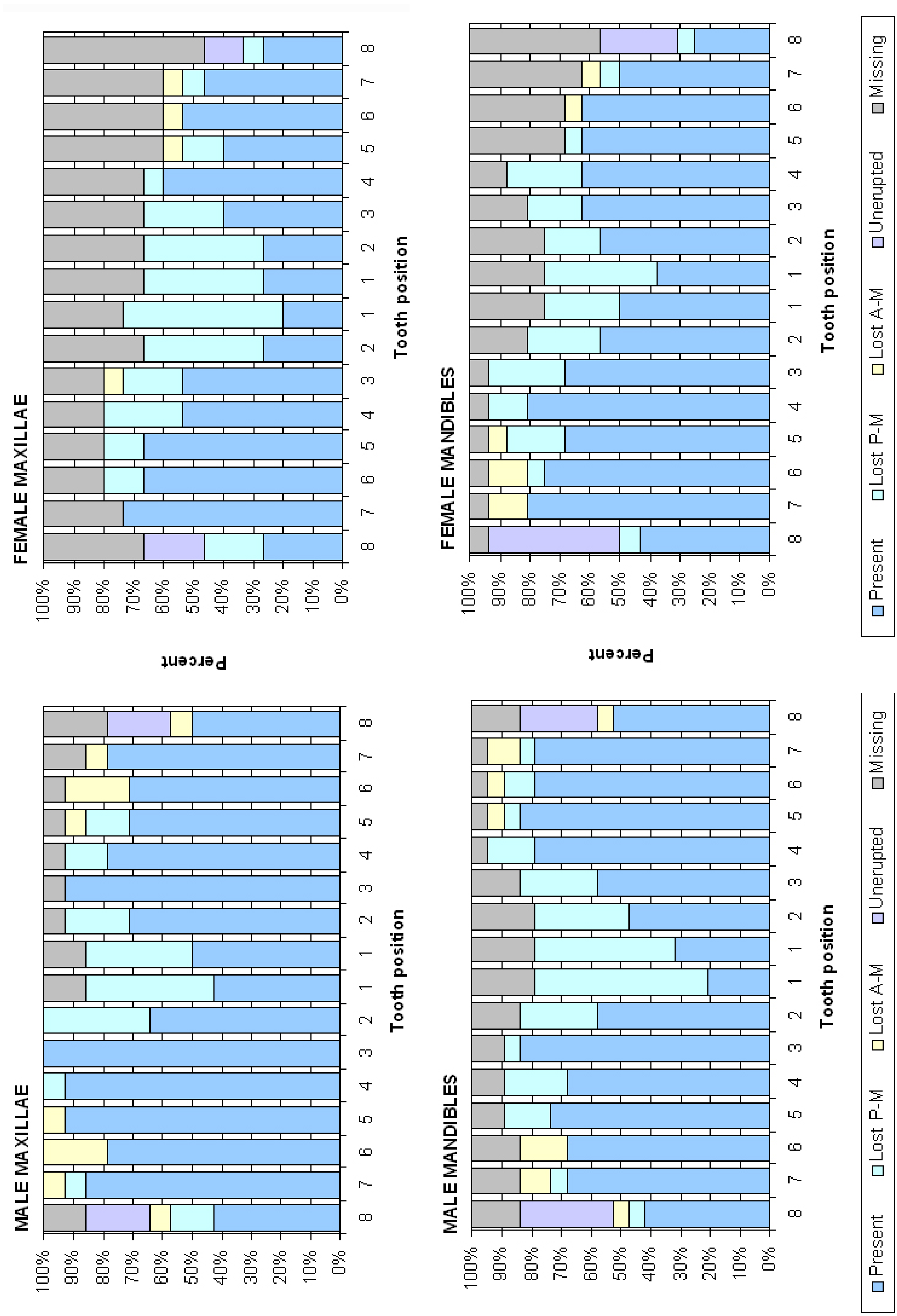


Figure 6.3. Percentage remains by tooth position 3: Saxon Jarrow

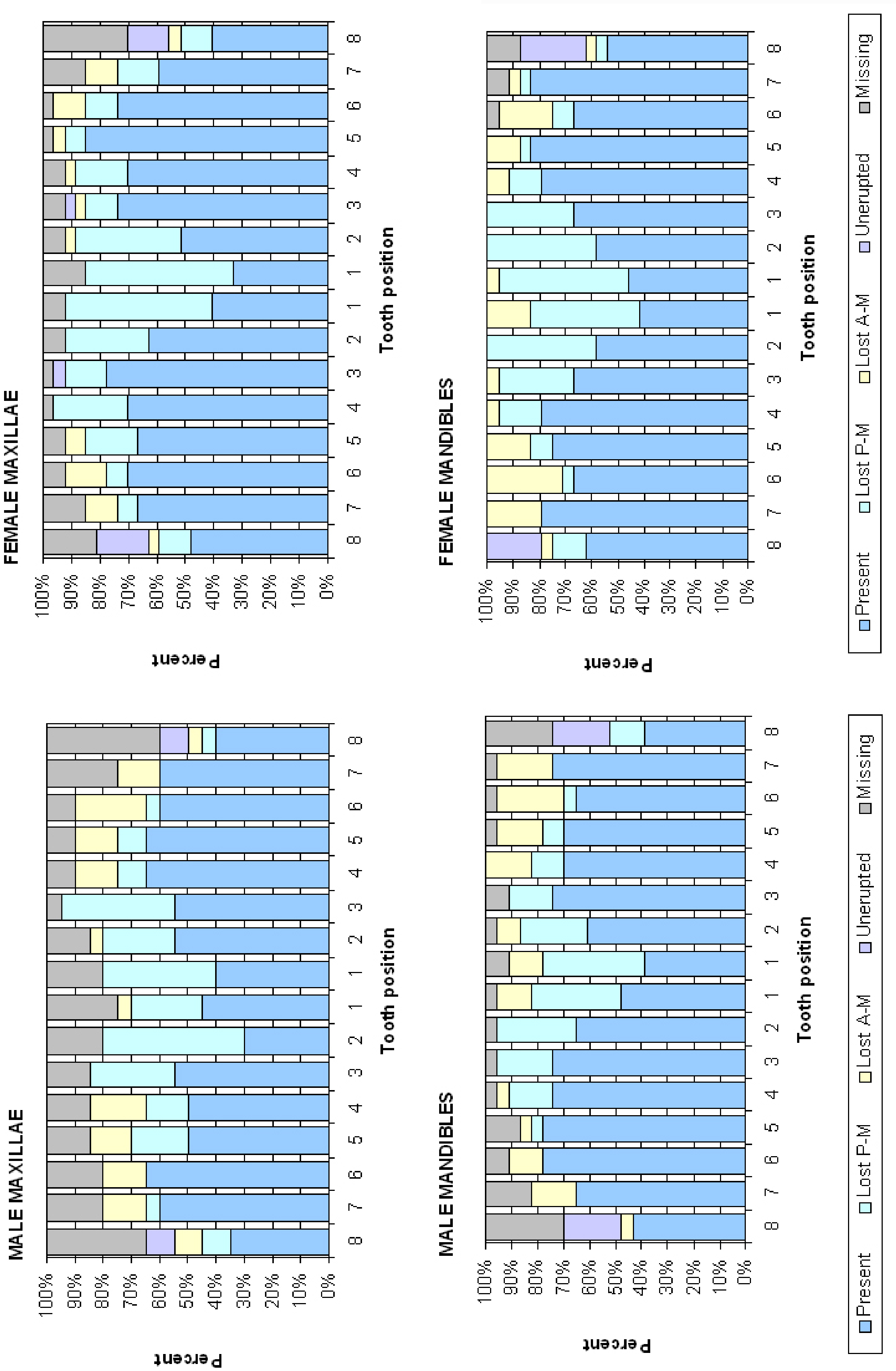


Figure 6.4. Percentage remains by tooth position 4: Medieval Jarrow

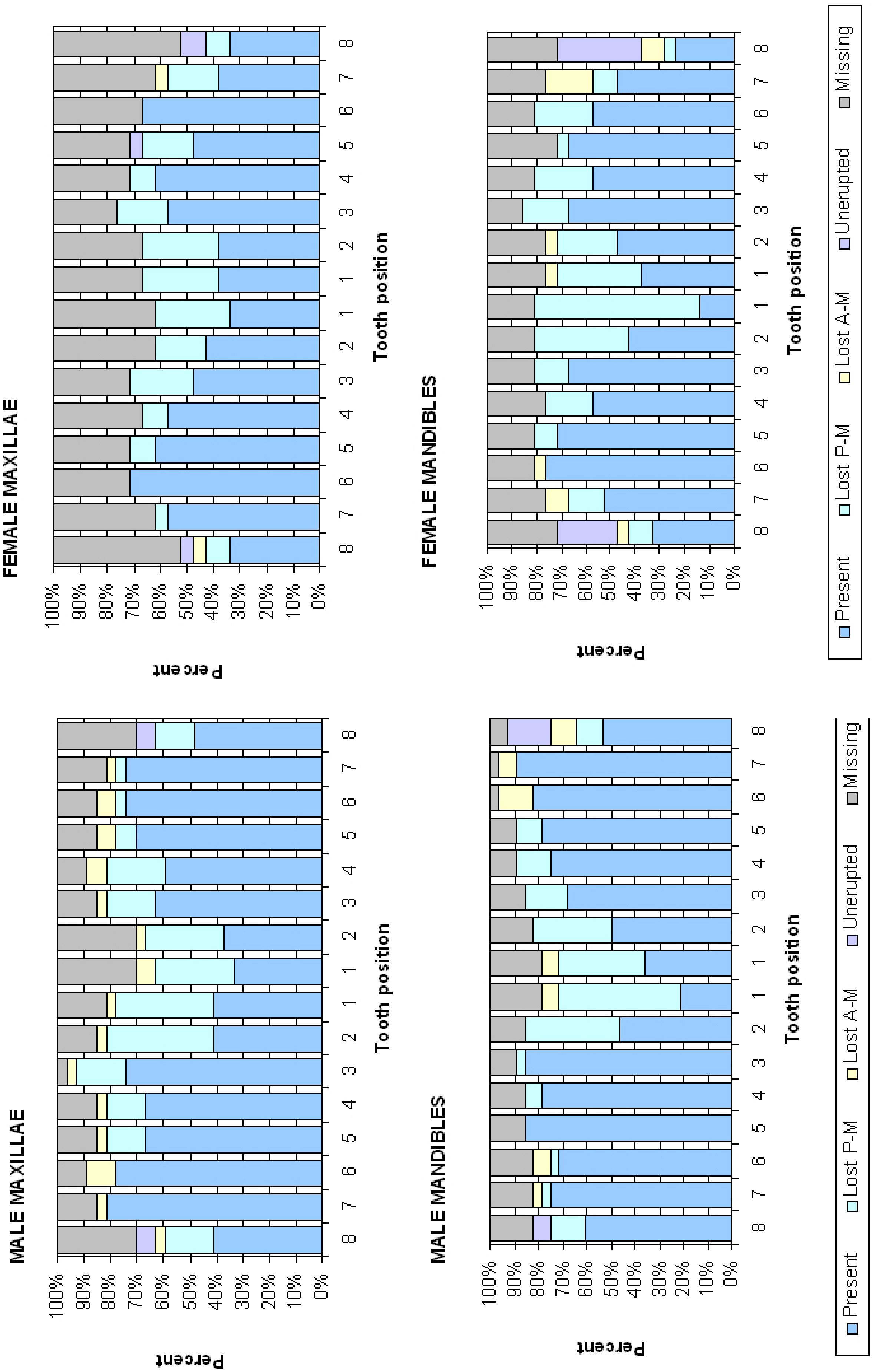


Figure 6.5. Percentage remains by tooth position 5: Blackgate

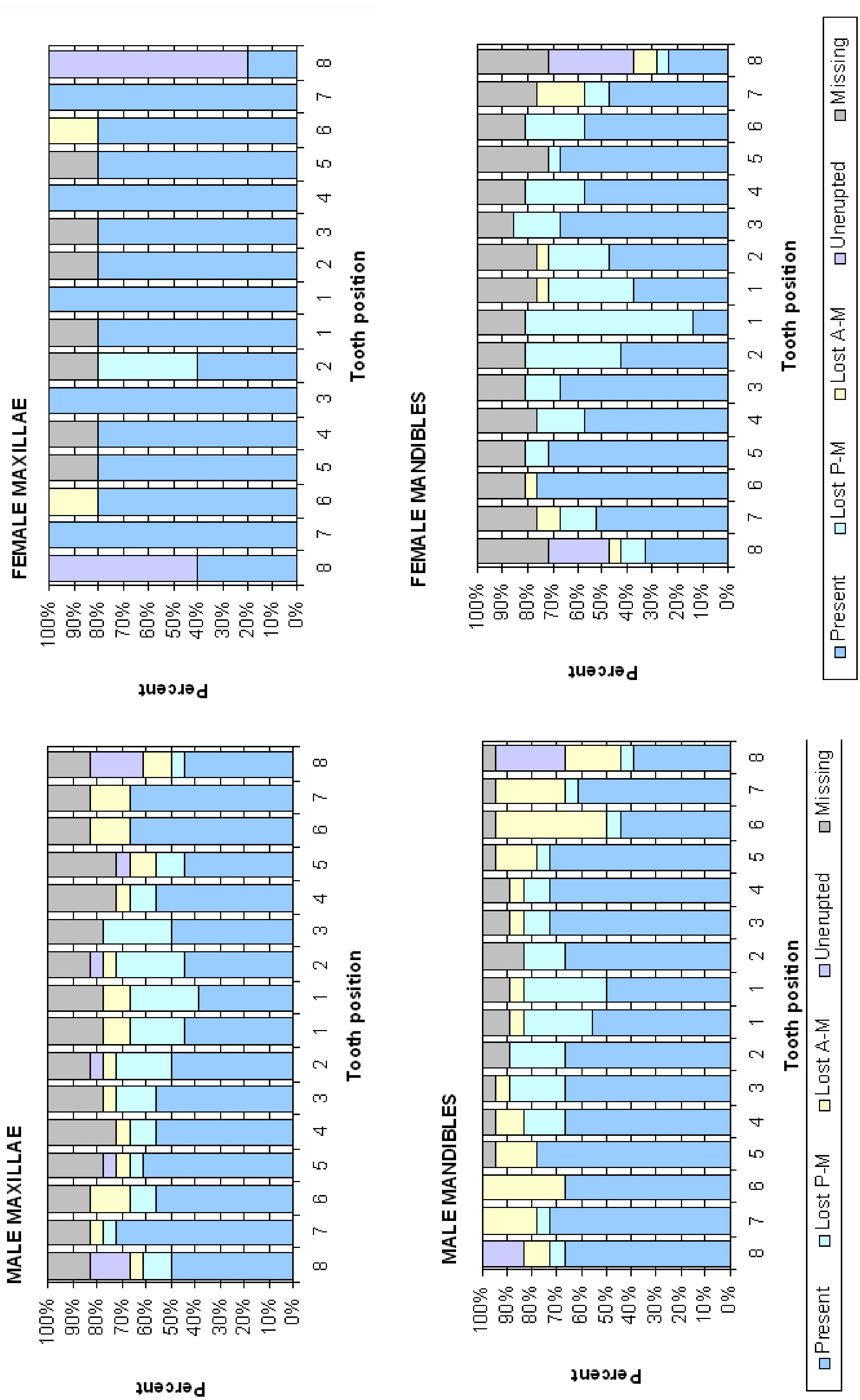


Figure 6.6. Percentage remains by tooth position 6: Blackfriars

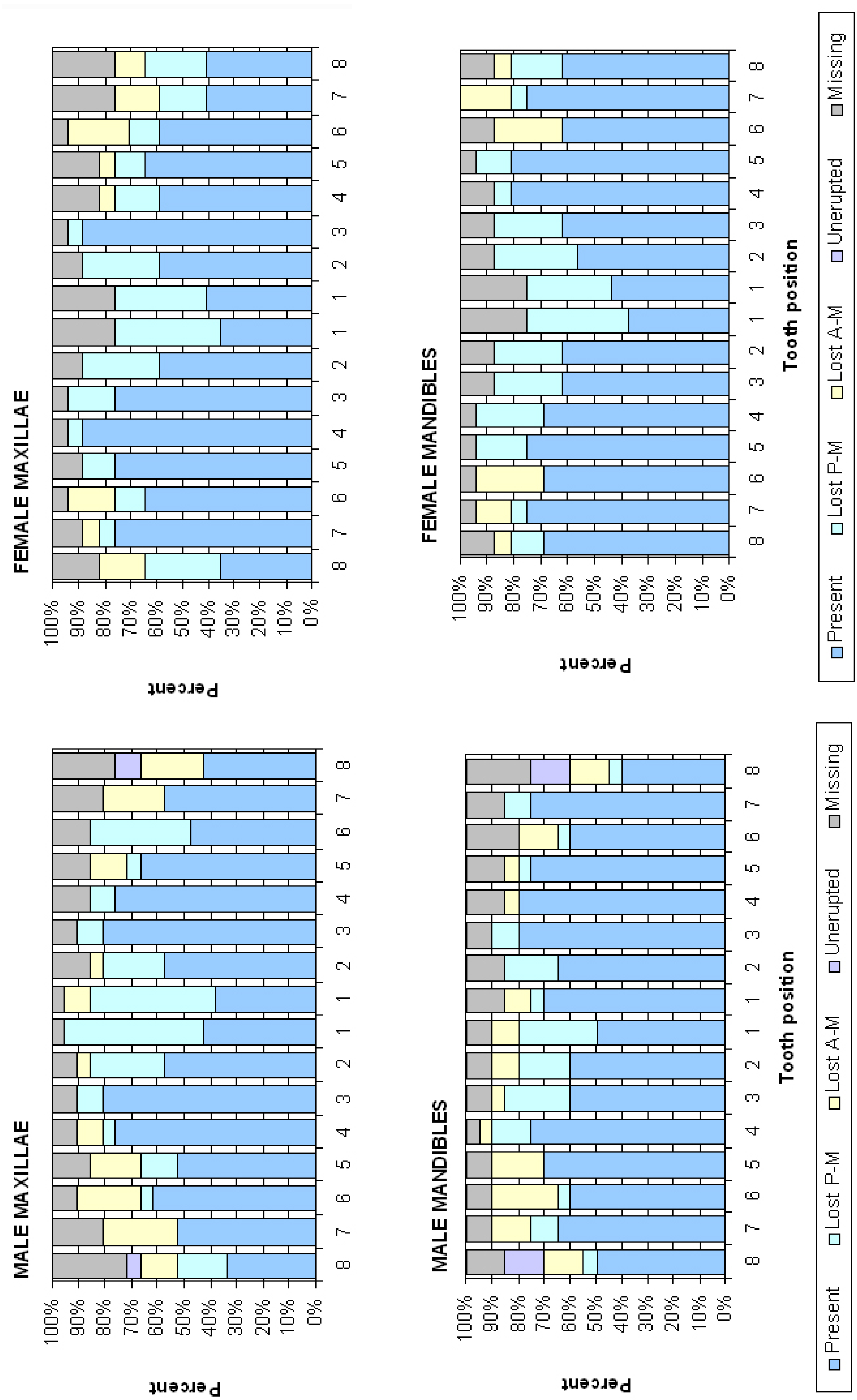


Figure 6.7. Percentage remains by tooth position 7: Guisborough

A brief aetiology of each of the major dental diseases found in archaeological populations, together with some of the archaeological problems involved in their study, is provided below. Microbiological details involved in the disease processes are not given since these are covered in detail in general works such as that by Hillson (1986).

6.2.1.1. Caries

Caries, or tooth decay, is caused by acid attacks on the enamel, cement and dentine of a tooth. Acid is produced by the interaction of various bacteria with food remnants in the mouth, and particularly in the tooth fissures. Decay occurs at pH 4 to 5.5, a level which is particularly easily reached when sucrose or other fermentable carbohydrates form part of the diet. It is possible for small lesions to remineralise or remain stable, but if decay spreads large lesions may reach the pulp cavity, often resulting in tooth loss (see below, Periapical Lesions). Susceptibility to caries may be genetically controlled, but obviously some environmental factors must also be involved, since these may determine the strength of the enamel.

Lesions can occur at a number of sites on a tooth. In modern societies they are most frequently located in the occlusal or chewing surface of the molars, where remnants of food remain stuck in the fissures and are difficult to remove even by brushing. Soft, easily consumed foods are partially to blame for this, since vigorous chewing can often remove such vestiges. The second most common site of tooth decay in modern man, and by far the most common in past populations, is at the contact (interproximal, interstitial or approximal) areas of neighbouring teeth. Surface wear can occur at this point, and this facilitates the acid attack, since it is another position where plaque is easily built up. Another common position for carious lesions is at the gingival margin, in the cervical region of the tooth, particularly if periodontal disease is also present. Early lesions at this position can be very difficult to distinguish from post-mortem decay, which frequently occurs at the junction between the alveolar bone and the neck of the tooth, particularly on the buccal surface. Other sites may be affected by caries, but these are rarely seen in archaeological specimens.

Caries can occur in both the deciduous and the permanent dentitions, but in archaeological populations it is most often seen (or at least more frequently scored) in adult teeth.

6.2.1.2. Calculus

Dental calculus, or tartar, is caused by the mineralisation of plaque which occurs when a low pH does not predominate, and when the teeth are not cleaned on a regular and frequent basis. It is composed mainly of minerals (70-90%), but the remainder consists of plaque bacteria and matrix. In life it is usually covered by a layer of active plaque.

The nature of the material is such that it is usually preserved in archaeological material - if the tooth survives then so will the calculus. However, despite the difficulty of removing this deposit in life, it is very easily removed after a long period of burial and can be lost in the cleaning process. Small pieces tend to stick to the tooth more firmly than larger deposits, so lack of care during bone washing is more likely to remove the latter. This could lead to a bias in the scoring of extent of calculus, suggesting that a slight amount of calculus was more common than was actually the case.

Two kinds of calculus may be formed, supragingival and subgingival. The former is the most common type to find in archaeological populations. It is hard and clay-like, varying in colour from light brown through grey to green. Subgingival calculus is harder and more heavily mineralised, and dark brown to green-black in colour. It could be mistaken for a ground water mineral deposit and either scrubbed off or not scored.

Deposits are usually scored on a three-point scale of light, medium, heavy after Brothwell (1981:155). Calculus can occur at any age, but is usually more frequent and more extensive in adults.

6.2.1.3. Periodontal Disease, Periapical Abscesses and Ante-mortem Tooth Loss.

As stated above, ordinary gum disease cannot be distinguished on bony remains, since it only affects the soft tissues. However, if teeth are not cleaned the accumulation of plaque associated with gingivitis can, over a number of years, intensify into the more serious condition of periodontitis. Until the advanced stage is reached, this disease is difficult to diagnose or detect in the alveolar bone of skeletonised material.

The advanced stage consists of the formation of a sulcus which enlarges into a ‘periodontal pocket’, due to the activities of plaque bacteria. Supragingival plaque along the gum margin contributes to the inflammatory process, and the plaque is able to penetrate behind the gum, bringing its bacteria with it. Alveolar bone may be lost following this process, although this can also occur simply as a phenomenon of ageing, and cannot of itself be used as evidence for periodontal disease. Periodontitis can affect individuals of all ages, but is most common past the age of 30-35 years.

As stated above, carious lesions can spread to the pulp cavity. This, as well as opening of the cavity by severe attrition or occasionally trauma, allows bacteria from the mouth to invade the soft tissues causing infection and inflammation, and an abscess is formed within the pulp chamber. The pulp will eventually be killed, and the infection then proceeds down the root canal to the root tip (apex), where a periapical abscess is formed. Bone is resorbed around the root, and eventually the pus within the abscess may break through one of the alveolar walls, most often the buccal. The sinus or fistula formed in this way may be the only evidence for such a process in an archaeological specimen, unless radiography can be used to look for smaller lesions.

Enlargement of the lesion to the stage where it is able to break through the compact bone may have a number of consequences. If it has happened early on in the process, if the lesion was close to the wall for example, the pus may be lost and the tooth will probably remain in the jaw. If the lesion was large, however, the release of purulent material may leave a hole large enough for the tooth to move about in, and it may consequently be lost (although there may be other reasons for such an eventuality). There may also be an infection of the jaw if the soft tissues become infected, or of the maxillary sinus if the abscess breaks through in that direction.

6.2.1.4. Trauma

Traumatic events, if they occur at all, most commonly affect the front teeth, since these are the most exposed to accidents or violence. The most frequent such event affecting archaeological dental remains is the fracturing and rehealing of the incisors. If teeth are broken without rehealing it is unlikely that this will be noted since other processes, such as caries or attrition, will affect the tooth after the crown, or part of it, is lost.

Occasionally a fractured jaw may occur, and if the event took place in childhood it is possible that some of the developing teeth may be affected. This type of lesion is rarely seen in archaeological remains.

6.2.1.5. Odontomes

Odontomes are usually developmental malformations of teeth. Hillson (1986) considers the enamel pearl to be one of these, but the more normal type involves the retention of a mass of dental material within the alveolar bone. Small examples may not be found unless an X-radiograph is available, but larger specimens may break through the compact bone and be easily seen. Brothwell (1959a) describes a particulary large one from Socotra in the Indian Ocean.

6.2.1.6. Enamel Hypoplasia

Although strictly speaking this condition is not itself pathological, it may be caused by disease processes or poor nutrition in childhood, and it will therefore be considered under the heading of dental pathology.

Goodman and Armelagos (1985) state that ‘dental enamel hypoplasia is a deficiency in enamel thickness resulting from a disruption in the secretory/matrix formation phase of amelogenesis’ (1985:479). The defects can be caused by local trauma, hereditary conditions, or stress. The latter type is the one most commonly seen in archaeological material. The main difference is that stress induced hypoplasia will occur on more than one tooth, and the area of the defect will reflect the stage of calcification of the crown of each tooth. Single events will therefore occur at different heights on different teeth, since each type of tooth is formed at a different age. Hereditary conditions will cause enamel defects from birth, and these therefore affect the whole of the tooth crown, whereas localized trauma will probably only affect one or two adjacent teeth.

Goodman and Armelagos found that time of development of the tooth is not the only determinant of hypoplasia, since sections of teeth developing at the same time do not record hypoplasias to a similar degree. This suggests differences in susceptibility both within and between tooth crowns. Differences in defect frequency between teeth are likely to be caused by the genetic stability of the particular tooth. Stable teeth (i.e. those which have a fixed size to which they will develop) will be more affected by hypoplasia than unstable teeth, since the latter will merely be stunted in growth.

Although stress induced hypoplasia is related to the environment of the individual, and in particular to nonspecific disease, some workers on modern populations have shown that the occurrence of hypoplastic defects is not entirely correlated with malnutrition and disease. Dobney (1988) studied groups of children in Mexico and Bradford. In Mexico one of two groups was provided with vitamin supplements, whilst the other was not. More hypoplasia was found in the non-supplemented children, as would be expected from previous theories. However, the Bradford school children showed a greater amount of hypoplasia than the non-supplemented Mexican children, so the link with malnutrition is far from clear cut. El-Najjar *et al* (1978) could not find any specific aetiology for the condition.

Hypoplastic defects generally consist of grooves or pits in horizontal lines across the surface of the enamel. If there is more than one band the tooth has a wrinkled appearance. Grooving seems to be more common in archaeological populations than pitting. The most affected teeth vary between populations, but the most frequently defective teeth seem to be the lower canines and the upper mesial incisors.

Since enamel hypoplasia is a developmental defect, it only forms during the calcification and eruption stages of tooth growth, and can therefore only reflect periods of stress occurring in childhood or adolescence. The actual hypoplastic defects, however, are retained into adult life and are not resorbed, thus leaving a record of physiological disturbance, even if the exact cause is unknown.

6.2.2. Archaeological Studies in Dental Pathology

A number of studies have been carried out on dental disease in various of the world's populations. Only the ones most related to the present study will be considered here.

In 1959, Brothwell produced a broad review of dental pathology in man from the palaeolithic to the present day. The British remains showed a decrease in caries rates from the Neolithic to the Bronze Age, followed by a rise to Roman times, another decline in the Anglo-Saxon period, and a steep increase to the present day. Tooth loss due to disease was found to be highest in Roman times and lowest in the Bronze Age. Periodontal disease and calculus were common from the Neolithic to Saxon times. He concludes that 'the last straw, as far as British populations are concerned, was the introduction of sugar in the 12th century, and refined white flour in the 19th. Indeed, we are led to the painful conclusion that if we had been content to chip flints and keep away from foreign trade our teeth would have been the healthier for it' (1959b:64).

Hardwick (1960) considered caries through the ages in relation to diet. This was based on Brothwell's studies of past populations, together with a study of the effects of the use of refined sugar. He found a greatly increased caries rate from the second half of the 19th century onwards, and noted a high correlation between this and the consumption of refined sugars and flours of finer texture. He suggested that natural or raw foods actually contain 'protective factors of an inorganic nature, possibly as trace elements' (1960:17) which would help to prevent caries. He concluded that the major influence on caries susceptibility was dietetic in nature.

Emery (1963) also studied dental disease in various archaeological populations (Neolithic to Saxon). He states that caries has always existed but that its widespread distribution seems to be related to the cultivation of cereals and the spread of civilisation. Ante-mortem loss was found to be greatest in highly civilised populations, where teeth could have been extracted and replaced by artificial ones. Pathological lesions occurred most frequently from the Iron Age to Saxon times.

Tattersall (1968b) looked at dental disease in Medieval Britain, which had hitherto remained unstudied. The data, based on a group from Clopton, Cambridgeshire, showed that the prevalence of caries was higher than that of the Anglo-Saxon period, similar to the Roman, and lower than 17th century London, as would be expected. No clear pattern of ante-mortem tooth loss was found, as was the case in Brothwell's study (1959b). The percentage of abscesses (9.19%) recorded was remarkably high compared to all other time periods. Hypoplasia was found in most individuals in varying degrees. Congenital absence of the third molar was found to be significantly more common in females.

Moore and Corbett (1971, 1973) carried out an extensive survey of dental caries in archaeological populations from the Iron Age through to the Medieval period. (They also considered 17th and 19th century populations in later papers, but these are outside the scope of the present study.) Studies on the four earlier groups (Iron Age, Romano-British, Anglo-Saxon and Medieval) showed that there was no great change in the distribution of dental caries by site, age and tooth throughout the periods. The interstitial cervical area of the tooth was most commonly affected, although in younger age groups occlusal fissure cavities were more frequent, probably due to the fact that in older individuals this area would be almost worn away. They suggest that the majority of lesions were secondary to alveolar recession following severe attrition, which allowed stagnation of food deposits around the necks of teeth.

In their 1983 study, Moore and Corbett found a low caries rate in the Saxon period, with more caries in the back teeth, and an increasing number of lesions with increased attrition. Cemento-enamel junction caries seemed to be more correlated with attrition than were contact area lesions. Lavelle and Moore (1969) found a marked increase in alveolar bone resorption from the Saxon period to the 17th century. However, although they claim to have excluded age differences by using only individuals with very little wear, it is clear that the later population suffered less overall attrition, and was therefore likely to contain older individuals than those in the Saxon period with a corresponding amount of attrition. This is not to exclude the possibility that alveolar bone loss does increase through time, but the problem of ageing later populations needs to be dealt with in more detail before making such a conclusion.

6.2.3. Dental Pathology in the Study Populations

In the populations considered here, the dental study is based on macroscopic analysis, since the time and resources for histological and radiographic study were not available.

The numbers of dental remains available for study in the populations considered here are presented in Table 6.3 below.

No. of:	HIR	MK	JAS	JAM	NEM	BG	BF	GP
Males	56	37	20	26	37	28	18	21
Maxilla	50	28	14	20	16	25	18	21
Mandible	55	32	19	23	31	26	18	20
Females	71	21	18	28	25	24	5	17
Maxilla	69	15	15	27	12	22	5	17
Mandible	68	21	16	24	21	22	5	16
<u>Position</u>								
Expected	3872	1536	1024	1504	1280	1520	736	1184
Missing	398	258	179	143	152	317	92	155
Observed	3474	1278	845	1361	1128	1203	644	1029
PM Loss	458	265	169	275	159	248	77	187
AM Loss	239	97	34	126	46	42	73	101
Unerupt.	96	20	33	36	17	27	33	9
Teeth	2681	896	609	924	906	886	461	734

<u>Table 6.3.</u>

The percentage distributions of the lower rows of the table are shown in Figures 6.1 to 6.7 by section of jaw and by sex. The basic trends which can be seen from these bar charts are as follows: (1) missing sections of jaws are fairly evenly spread throughout, although in most cases the percentages are greater in the less well-preserved material and at the ends of the quadrants; (2) unerupted teeth are most commonly third molars; (3) ante-mortem loss is usually greatest in the molar area (6-8); (4) post-mortem loss occurs most frequently in the anterior teeth (1-5), since these are single rooted and most liable to fall out, particularly in the maxilla; (5) the percentage of teeth present reflects both preservation of the material and care in excavation.

6.2.3.1. Caries, Tooth Loss and Periodontal Disease

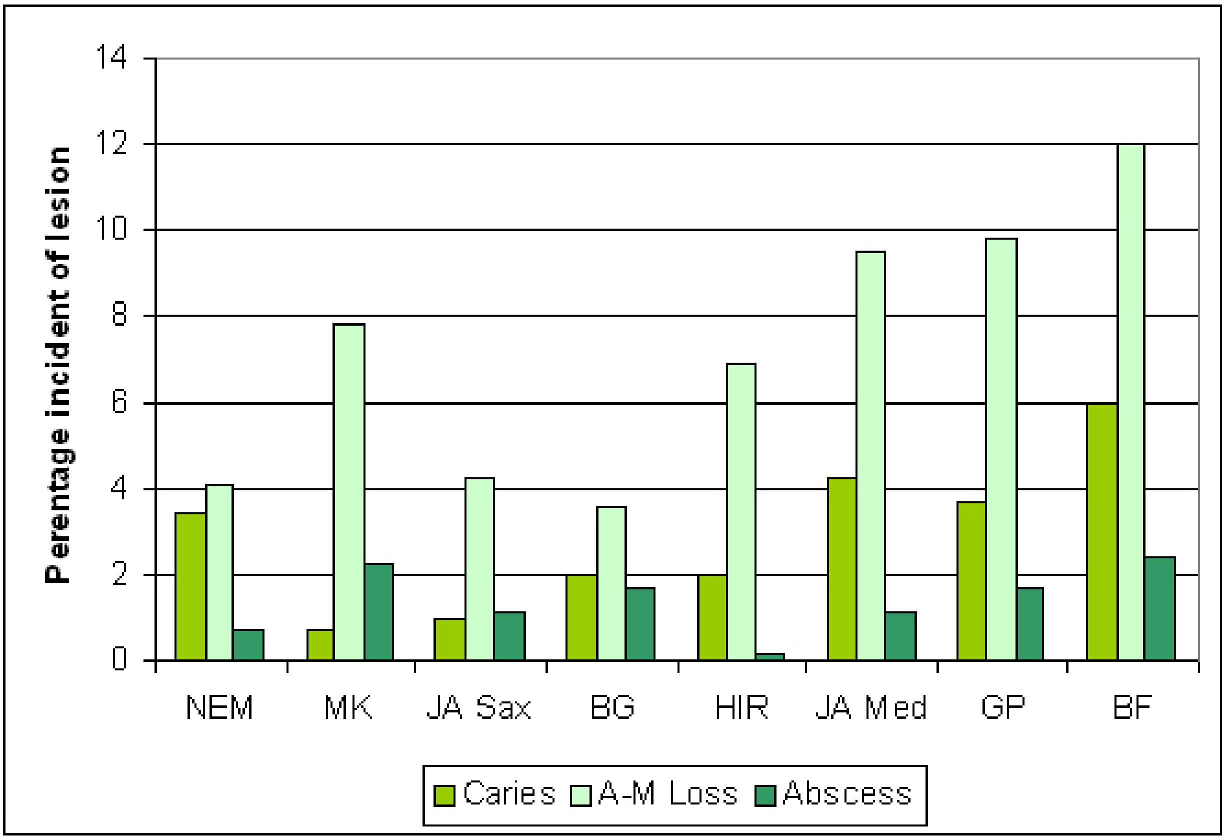
Table 6.4 below gives the percentages of caries, antemortem tooth loss and periodontal abscesses for combined sexes in each of the eight groups.

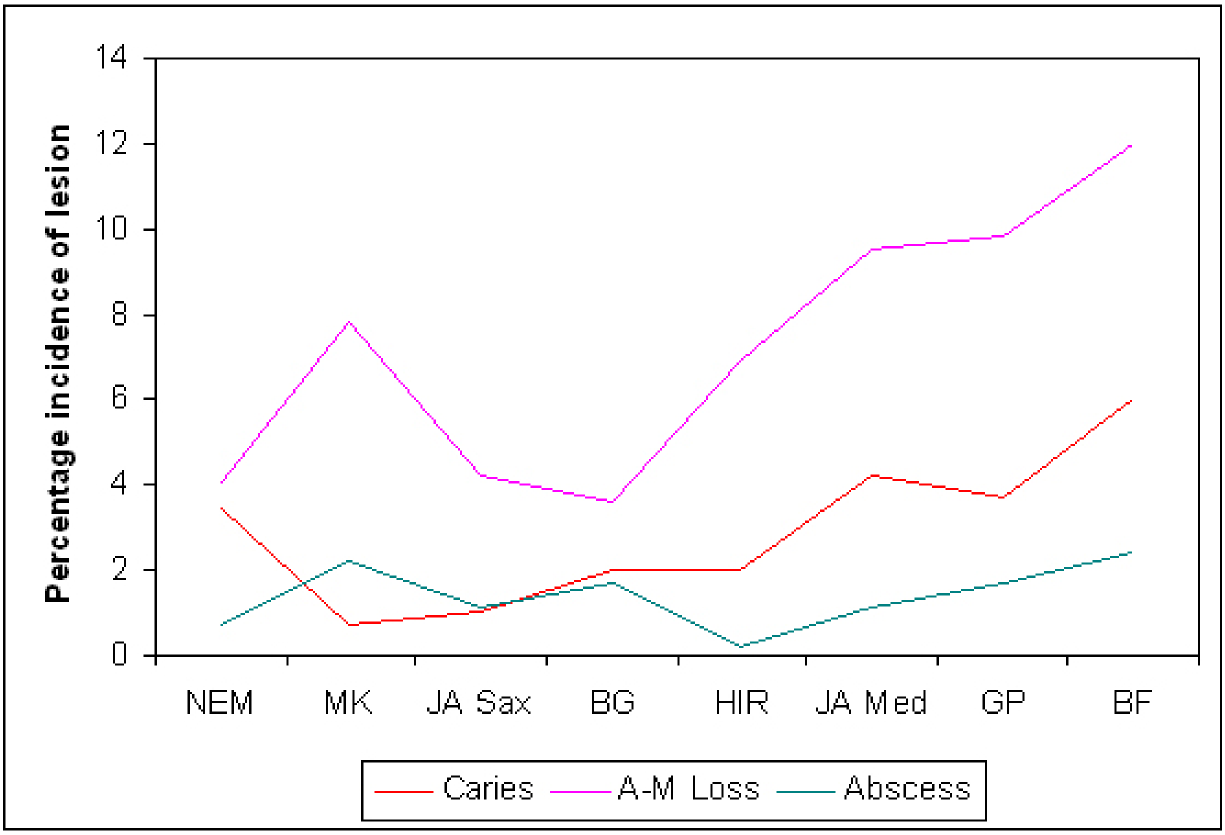
Site	% Caries	% A-M Loss	% Abscesses
HIR	2.0	6.9	0.2
MK	0.7	7.8	2.2
JA Sax	1.0	4.2	1.1
JA Med	4.2	9.5	1.1
NEM	3.4	4.1	0.7
BG	2.0	3.6	1.7
BF	6.0	12.0	2.3
GP	3.7	9.8	1.7

<u>Table 6.4.</u>

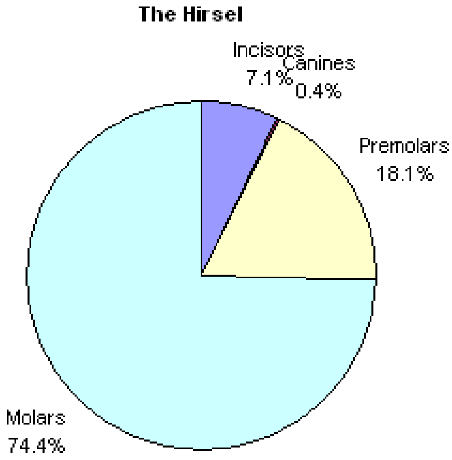
The percentages in Table 6.4 show a great difference in prevalence of the three lesions at all the sites. A possible reason for this is the change of disease patterns through time. Figures 6.8 and 6.9 show the percentages of pathological lesions (per tooth in the case of caries, and per alveolar position in the case of ante-mortem loss and abscesses) by broad time period from earliest to latest sites. The bar graph, although being the more correct form of representation in this case, is supplemented by a line graph of the same data, since the trends are easier to pick out in this format. The high percentage of antemortem loss at Monkwearmouth is probably due in the main to the presence of three edentulous individuals. Exclusion of these would reduce the figure to fit better with other Saxon groups. Nevertheless, the pattern of increasing tooth loss and caries through time can be easily seen, although the trend of abscess prevalence is more obscure. The low percentage at The Hirsel is particularly difficult to explain. It is possible that it could be related to the smaller number of old individuals at this site. This shows the problems involved when comparisons are made of prevalences over whole sites regardless of age groups (Perizonius and Pot, 1981; Pot, 1988), since all of these lesions appear to be more associated with old age.

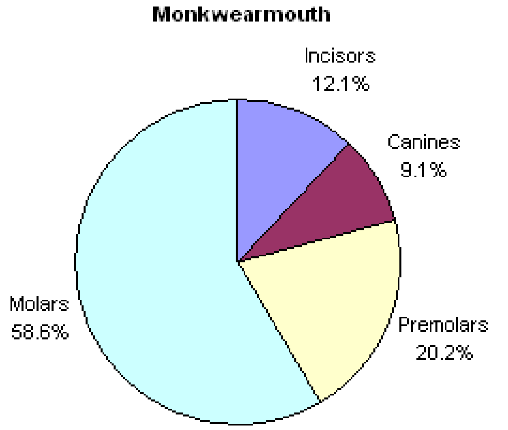
The numbers given in Tables 6.3 and 6.4 are important in the study of dental disease prevalence. However, the percentages of disease at each tooth position may give a better picture of spread of disease, since some regions of the jaw may be less affected than others. Figures 6.10 to 6.17 show the distribution by tooth type of ante-mortem tooth loss at each of the sites for each sex. In every case the molars are affected to a significantly greater extent than the other teeth, which vary in the different groups. The reason for such variation is uncertain, but may be due to differing genetic susceptibility or eating habits in the different groups.

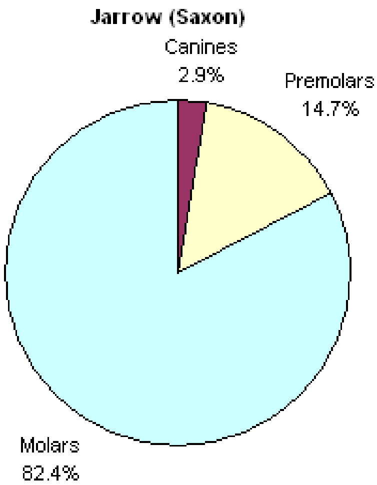




Figures 6.8 and 6.9. Dental Pathology by broad time period







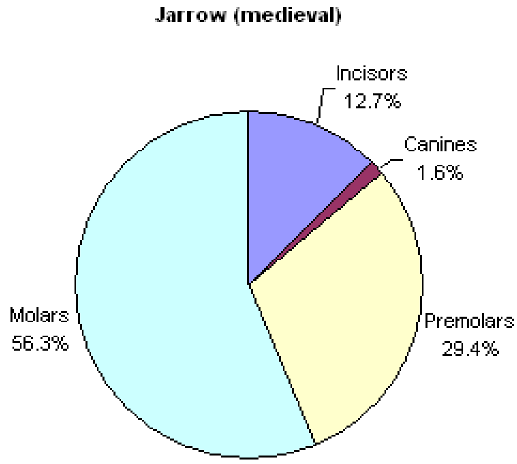
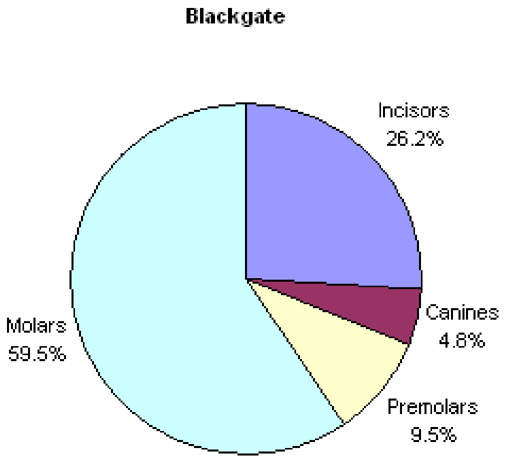
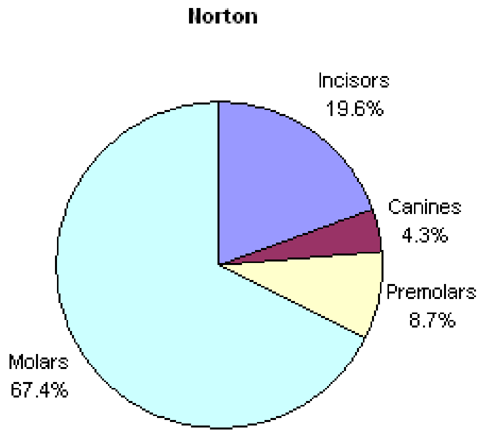
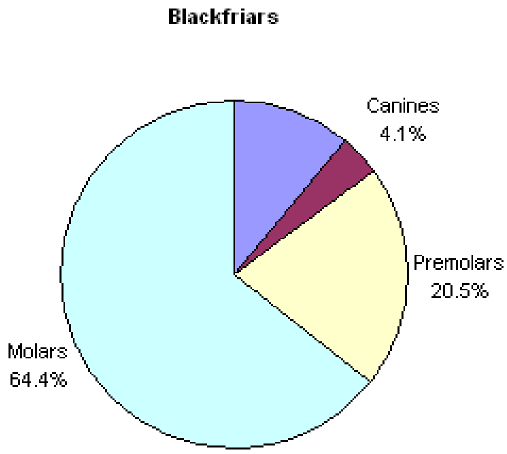


Figure 6.10. Ante-mortem tooth loss by jaw area: The Hirsel
Figure 6.11. Ante-mortem tooth loss by jaw area: Monkwearmouth
Figure 6.12. Ante-mortem tooth loss by jaw area: Saxon Jarrow
Figure 6.13. Ante-mortem tooth loss by jaw area: Medieval Jarrow







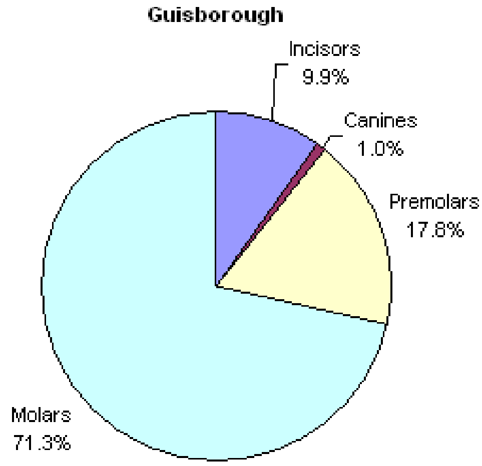


Figure 6.14. Ante-mortem tooth loss by jaw area: Blackgate
Figure 6.15. Ante-mortem tooth loss by jaw area: Norton
Figure 6.16. Ante-mortem tooth loss by jaw area: Blackfriars
Figure 6.17. Ante-mortem tooth loss by jaw area: Guisborough

The percentages of caries were tested for significant difference between sides and type of jaw at The Hirsel using the chi square test. The results are shown in Table 6.5 below.

Jaw Segment	R. Max.	L. Mand.	Mand.	R. Side
R. Mandible	0.50	0.35	-	-
L. Maxilla	0.01	0.05	-	-
Maxilla	-	-	0.39	-
L. Side	-	-	-	0.21

Table 6.5.

None of these differences are significant at the 5% level. All sites were tested for significant differences between the caries rates in the sexes, with the following results.

Site	X^2	Site	X^2
HIR	0.04	BG	0.93
MK	0.16	BF	0.05
JA Sax	0.19	GP	2.24
JA Med	1.82		

Table 6.6.

Again, there was no significant difference at the 5% level. Similar tests were applied to ante-mortem tooth loss and periodontal abscesses. Significant differences were found between the sexes at The Hirsel and Medieval Jarrow for both lesions, and at Blackfriars and Guisborough for ante-mortem tooth loss only. Numbers of abscesses were found to be significantly different between the maxilla and the mandible for Hirsel males. The frequencies of male and female maxillary and mandibular lesions are presented in Figures 6.18 to 6.21, which show distributions of the three diseases by tooth position at The Hirsel. Similar patterns would be seen at all the sites, with most lesions affecting the molar region, particularly the first molar.

The numbers of individuals with dental lesions are recorded in Tables 6.7 and 6.8 below. They show that the majority of individuals had caries of only one or two teeth, but abscesses often affected two or more alveoli. The total column shows the percentages of individuals with the two types of lesions out of the total number of jaws seen for the particular site and sex.

Site		Carious Teeth Per Individual					Total	
		1	2	3	4	5+	N	%
HIR	M	10	2	0	0	0	12	21.4
	F	14	7	0	0	0	21	29.6
MK	M	4	0	0	0	0	4	10.8
	F	2	0	0	0	0	2	9.5
JASax	M	2	1	0	0	0	3	15.0
	F	1	0	0	0	0	1	5.5
JAMed	M	4	1	1	0	0	6	23.1
	F	6	2	3	0	1	12	42.9
NEM	M	6	0	1	3	0	10	27.0
	F	3	0	1	2	1	7	28.0
BG	M	2	4	0	0	0	6	21.43
	F	2	2	1	0	0	5	20.8
BF	M	4	2	3	0	1	10	55.6
	F	1	0	0	0	1	2	40.0
GP	M	5	1	0	1	0	7	33.3
	F	1	1	3	1	0	5	29.4

Table 6.7.

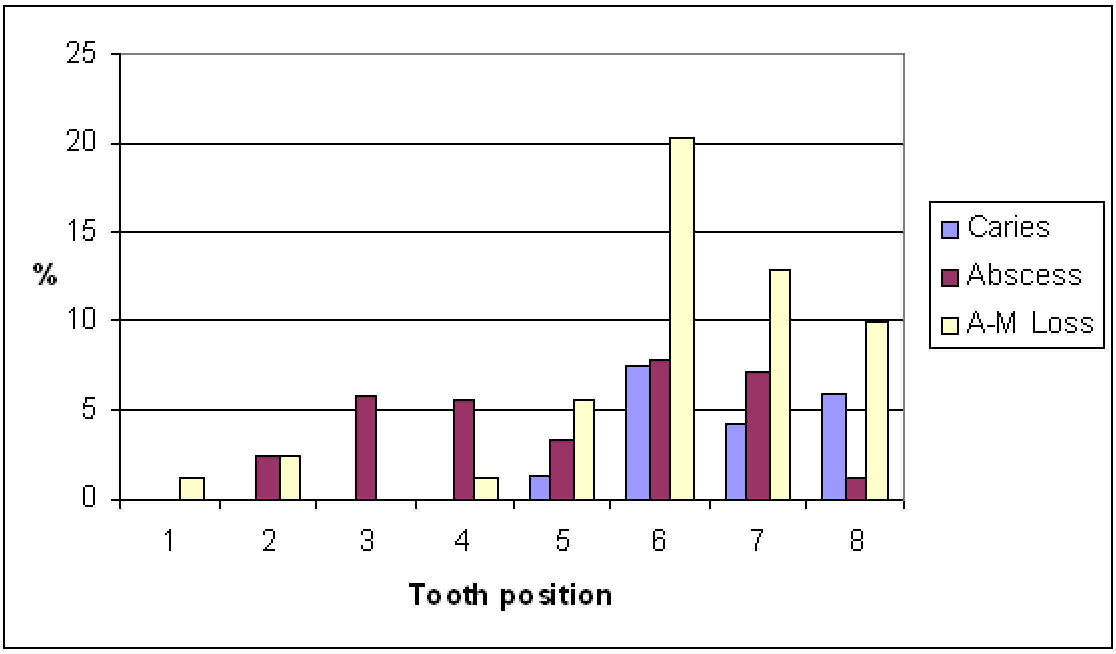


Figure 6.18. Distribution of lesions by tooth at The Hirsel: male maxillae

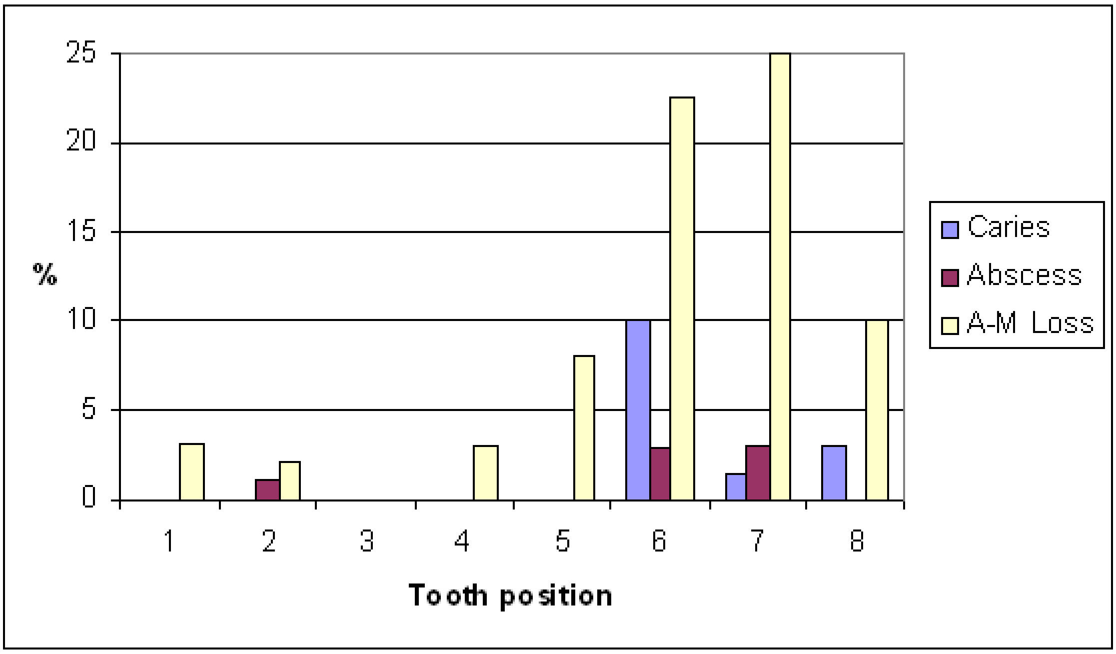


Figure 6.19. Distribution of lesions by tooth at The Hirsel: male mandibles

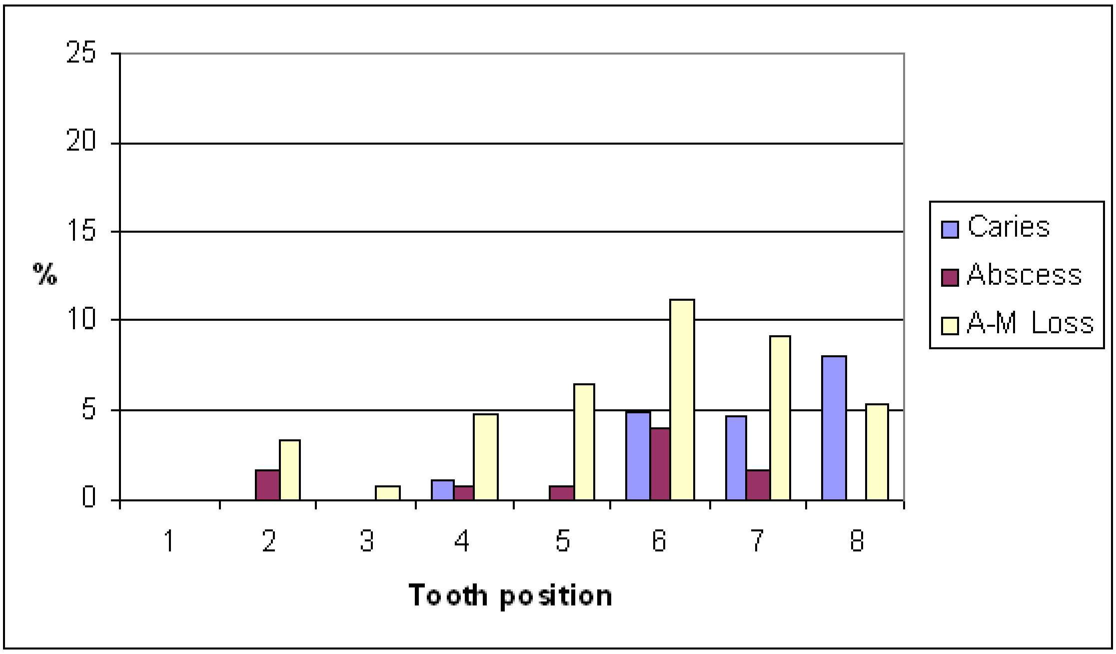


Figure 6.20. Distribution of lesions by tooth at The Hirsel: female maxillae

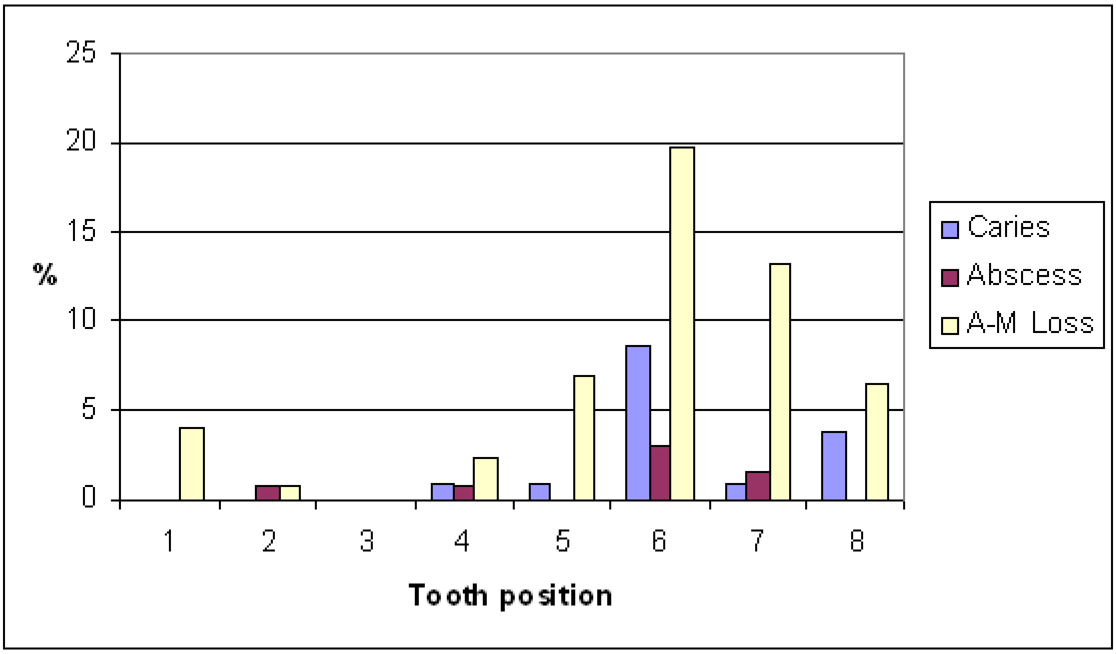


Figure 6.21. Distribution of lesions by tooth at The Hirsel: female mandibles

The medieval sites show a higher proportion of individuals with caries, as would be expected.

Site		Abscesses Per Individual					Total	
		1	2	3	4	5+	N	%
HIR	M	4	3	3	1	1	12	21.4
	F	12	2	0	1	0	15	21.1
MK	M	4	3	1	1	0	9	24.3
	F	2	2	0	1	0	5	23.8
JASax	M	2	0	0	0	0	2	10.0
	F	2	0	0	0	0	2	11.1
JAMed	M	4	0	1	0	1	6	23.1
	F	1	1	0	0	0	2	7.1
NEM	M	2	1	0	0	0	3	8.1
	F	0	2	0	0	0	2	8.0
BG	M	5	3	2	0	0	10	35.7
	F	2	1	0	0	0	3	12.5
BF	M	1	1	1	0	1	4	22.2
	F	0	0	0	1	0	1	20.0
GP	M	2	0	0	1	1	4	19.0
	F	2	2	0	0	0	4	23.5

Table 6.8.

A fairly similar proportion of individuals seem to be affected at each site, except Saxon Jarrow, Norton, the females from Medieval Jarrow, and Blackgate.

Perizonius and Pot (1981) found that the three major dental diseases (caries, periapical lesions and ante-mortem tooth loss) increased markedly with age. Because of this, they concluded that disease prevalences should not be compared between populations of greatly different mean adult age at death. Similar patterns have been found by other workers, for example by Lunt (1974) in Scottish Neolithic to Medieval groups, and by Whittaker *et al* (1981) at Poundbury. Figures 6.22 and 6.23 show the trends by age of the three pathological processes at The Hirsel, which was the only site with a large enough sample to split into age groups. This does show a marked increase in both sexes of all the lesions with increasing age. Antemortem loss is particularly high in the 45+ age group, which is perhaps not surprising since individuals with a large amount of tooth loss are most likely to be classified as old (their most likely, but not necessarily correct, age group).

6.2.3.2. Juvenile Caries

Although alveolar resorption and ante-mortem loss are not likely to be seen in juvenile individuals, carious lesions are, and these were scored in the groups studied here. Table 6.9 records the percentages of children with carious lesions at each site (except Jarrow and Norton, for which figures were not available). The number of children scored includes only those juveniles with more than one erupted tooth. The percentage given in this column is out of the total number of children scored from the site. The problem with any method of scoring caries in juvenile jaws is that the sample is generally too small to divide the group up into age sets, but the scoring is not really correct unless this is done. Very few children had caries at any of the sites. The majority of lesions were in the deciduous teeth, but occasionally the first permanent molar was affected.

Site	Children scored		Children with caries	
	N	%	N	%
HIR	82	53.6	9	11.0
MK	22	19.0	1	4.5
BG	15	41.7	0	-
BF	2	66.7	0	-
GP	4	57.1	2	50.0

Table 6.9.

Williams and Curzon (1985, 1986) studied the dentitions of 34 children from The Hirsel. At least eleven of these children (some of which have not been seen by the present author) had caries, but since the group was specifically selected for the purpose of studying dental pathology in a medieval population it can hardly be seen as a random sample.

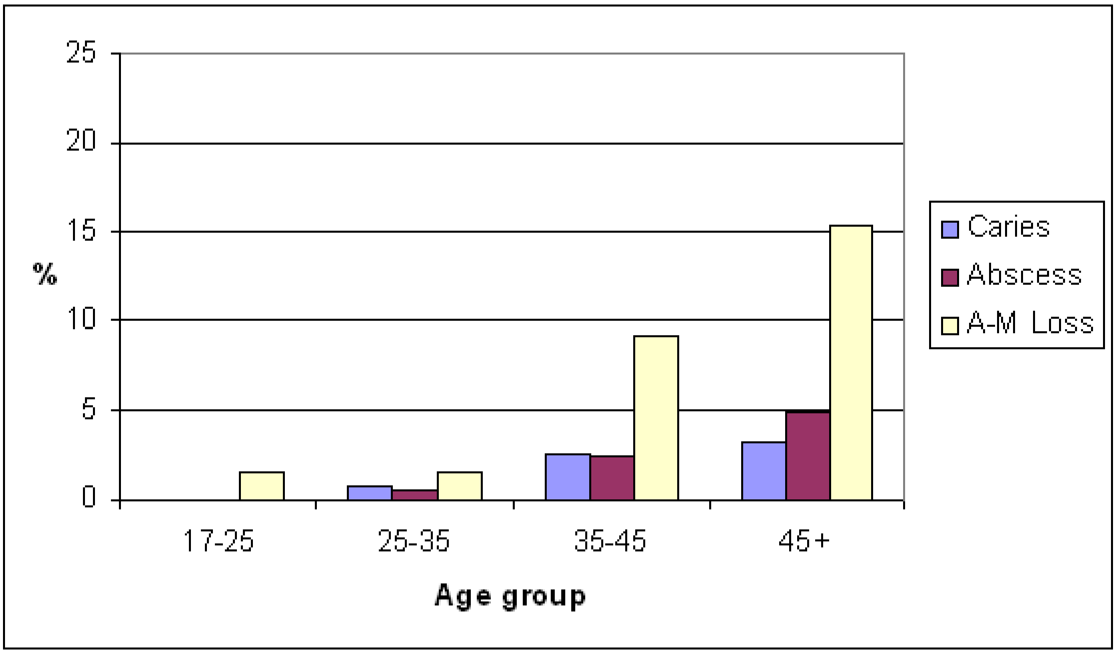


Figure 6.22. Dental pathology by age at The Hirsel: males

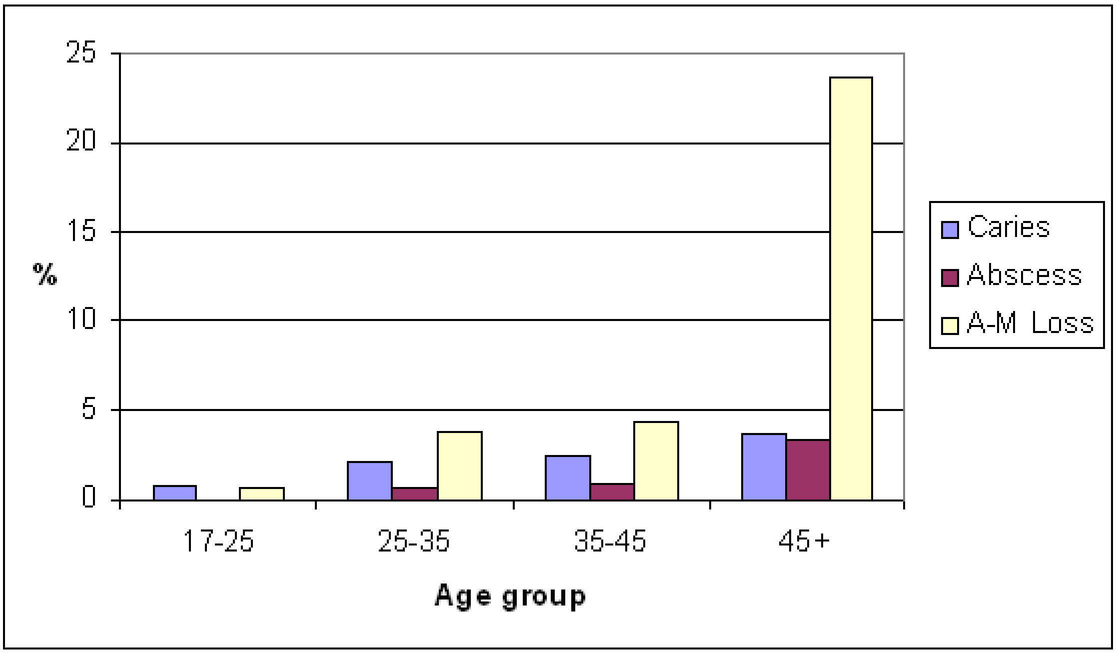


Figure 6.23. Dental pathology by age at The Hirsel: females

6.2.3.3. Alveolar Resorption

Alveolar resorption was scored as slight, medium or heavy at most of the sites. A heavy amount usually correlated with old age or the presence of periodontal abscesses, as would be expected. A typical example, from The Hirsel, is shown in Table 6.10 below.

Sex	Jaws	Slight	Medium	Heavy	Total
	N	N %	N %	N %	N %
M	42	15 35.7	18 42.9	6 14.3	39 92.8
F	55	16 29.1	17 30.9	9 16.4	42 76.4
?	4	0 -	2 50.0	1 25.0	3 75.0
All	101	31 30.7	37 36.6	16 15.8	84 83.2

Table 6.10.

This shows a slight difference between males and females, with males showing a greater frequency of resorption but with females more affected by heavy resorption. This may be due to the fact that the males were living to a greater age and that this was the main cause of the resorption seen in their jaws, whereas the women with heavier resorption were more affected by periodontal disease, perhaps due to different eating habits.

6.2.3.4. Calculus

Deposits of calculus were also scored on a threepoint scale, with the following results at The Hirsel.

Sex	Jaws N	Slight N %	Medium N %	Heavy N %	Total N %
M	45	19 42.2	8 17.8	1 2.2	28 62.2
F	55	18 32.7	11 20.0	4 7.3	33 60.0
?	4	0 -	1 25.0	0 -	1 25.0
All	104	37 35.6	20 19.2	5 4.8	62 59.6
Juv	73	14 19.2	2 2.7	0 -	16 21.9

Table 6.11.

Again, the males have a slightly greater frequency than the females, but the greater degrees of occurrence are present in the females. This seems to concur with the evidence from alveolar resorption, to suggest that females had a slightly different diet to the males. Wells (Jarrow MS) suggested that they were eating a greater proportion of softer foods than the males, and this would seem to fit in with their general levels of dental health. Table 6.12 presents the overall distributions of calculus for males and females at some of the other sites.

Site	% Calculus	
	Males	Females
HIR	62.2	60.0
JA Sax	25.0	47.1
JA Med	42.3	60.7
NEM	82.9	91.3
BG	86.7	82.6
BF	94.4	100.0
GP	95.0	70.6

Table 6.12.

At Jarrow the females were found to have a greater frequency of calculus and the degree was also much greater in the women. These figures are possibly even more suggestive of the greater consumption of soft foods by women. Wells explains this in the Jarrow MS as follows: 'Since tartar tends to be reduced when the teeth are vigorously used for powerful chewing and increased by diets of paps, light snacks and functionally less demanding foods, it is possible that the Jarrow women were affected more than the men because they used to nibble cakes and buns about the house, cull dainty morsels from the cook pot and, by assuaging their appetites on tit-bits, feel less inclined to champ the tougher cuts of meat which their ravenous menfolk gnawed with relish, at the end of a hungry day, to the benefit of their jaws if not their digestive systems.' However, at the other sites the difference between the sexes is small, and at two the males are greater than the females, so the theory is by no means well established.

6.2.3.5. Hypoplasia

Hypoplastic lesions were distributed as follows at The Hirsel.

Sex	Jaws N	Slight N %	Medium N %	Gross N %	Total N %
M	45	26 57.8	5 11.1	0 -	31 68.9
F	54	32 59.3	2 3.7	0 -	34 63.0
?	4	2 50.0	0 -	0 -	2 50.0
All	103	60 58.3	7 6.8	0 -	67 65.0
Juv	76	19 25.0	7 9.2	2 2.6	28 36.8

Table 6.13.

This shows a slightly greater and grosser occurrence in males than in females, although the children exhibit the most gross lesions. It is possible that the worst lesions are consistent with long periods of illness in childhood, which makes it less likely that such individuals will reach maturity. Table 6.14 shows the male, female and juvenile figures for some other sites.

Site	% Hypoplasia Male	 Female	 Juvenile
HIR	68.9	63.0	36.8
NEM	80.0	69.6	-
BG	43.3	47.8	27.3
BF	94.4	100.0	-
GP	70.0	76.5	66.7

Table 6.14.

The high figures recorded at Blackfriars and Guisborough are probably partly a result of the small numbers of individuals (5 females at the former and 3 juveniles at the latter). The reason why the earlier site of Blackgate should have less hypoplasia than the medieval sites is uncertain.

6.2.3.6. Conclusions

The pattern of dental disease seen at all the sites was broadly similar, although there was an increase in prevalence through time. Where caries occurred, it was most common on the interstitial surfaces of the teeth, and in the cervical area. Occlusal caries was very rarely seen, probably due to the amount of attrition in older individuals, particularly on the molars. Antemortem loss was most frequent in the molar area and in old age, and abscesses affected the premolars and molars more than the anterior teeth. Calculus and hypoplasia were common on all teeth at all sites. Hypoplasia particulary affected the canines and the second molars, whereas calculus was common on the incisors and molars. Other dental pathologies were rare. Odontomes were seen in the maxillary incisive fossa of a child from The Hirsel, and in the same position in a child from Blackgate. Enamel pearls were present on the maxillary second molars of a Medieval female from Jarrow. One child from Blackgate had a fractured lower incisor which had healed at a slight angle. Otherwise, the people of these eight populations were quite normal in their dental health for the periods in which they were living. They probably took little care over dental hygiene, and halitosis was likely to have been the norm, with lost teeth and painful mouths being accepted occurrences.