# CHAPTER 4: HUMAN PATHOLOGY

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## INTRODUCTION

This section details the results of the skeletal analysis of eighty inhumations and two cremation burials recovered from the Anglo-Saxon cemetery at Wolverton, Milton Keynes. The analysis was based upon recommendations made following initial post-excavation assessment of the assemblage (Jacklin 2008). The skeletal assemblage analysis results are summarised in Appendix 1.2: detailed results are retained in the project archive.

### Analysis & Recording Methods

Each skeleton was laid out and reconstructed where necessary, and record photographs were taken. The remains were recorded using a skeleton recording form (Jacklin 2005a), and skeletal inventories and pictorial sheets (after Buikstra & Ubelaker 1994) were also compiled. The skeletons were then assessed pathologically. Photographs were taken of any pathological conditions and congenital anomalies identified. On completion of the skeletal analysis all the data recorded were entered on to the ULAS Skeletal Database, and the pictorial sheets were scanned and archived accordingly.

### Statistical Analysis

A three-stage approach was taken during the statistical analysis of the congenital, pathological, traumatic and metabolic conditions affecting the Wolverton skeletal assemblage:

1 Statistical analysis of the entire skeletal assemblage in relation to the specified condition (CPR1)
2 Statistical analysis of the aged and sexed skeletons in relation to the specified condition (CPR2)
3 Statistical analysis of the specific skeletal location of the specified condition, in relation to the aged and sexed skeletons (TPR)

(NB: CPR refers to the crude prevalence rate %. TPR refers to the true prevalence rate %)

Where statistical calculations are made using a specified sample, the sample number is included in brackets. For example, if statistically analysing the number of males affected by periostitis in any skeletal location, then '(n45)' would appear after 'male' = male (n45). This means that a sample of 45 males were available for study. Or, if statistically analysing fractures affecting the left radius of the males within the assemblage, then '(n20)' would appear after 'male' = male (n20). This means that 20 males with their left radius present were available for study. Details of the samples used are included in each section.

## RESULTS: THE INHUMATIONS

### Completeness and Preservation

The completeness and preservation of the skeletal assemblage varied considerably. The completeness of the skeletons probably depended largely upon the date at which they were buried. Radiocarbon dates obtained for five skeletons indicated that the cemetery had been in use for at least 100 years. Their location within the cemetery, depth of the burial and soil acidity were probably also relevant factors. Finally, the preservation of undisturbed skeletal remains was better than those which had been damaged by root action, soil movement and more recent disturbance, such as land drains.

The completeness and the preservation of skeletal material has a direct impact on the amount and quality of data that can be recorded during skeletal analysis (such as whether age and sex can be determined). The state of preservation also impacts on the pathological analysis of bone: if the surface is severely eroded, then pathological conditions such as periostitis (which forms on the outer surface on bone) often cannot be diagnosed with any degree of certainty. During analysis and interpretation of the data, the completeness and preservation of the skeletons involved were taken into account.

The completeness of each skeleton (Fig. 4.1) was categorised after Buikstra & Ubelaker (1994, 8):

- '0-25%' (less than a quarter of the skeleton present)
- '25-50%' (between a quarter to half of the skeleton present)
- '50-75%' (between half and three quarters of the skeleton present)
- '75-100%' (between three quarters and all skeletal elements present)

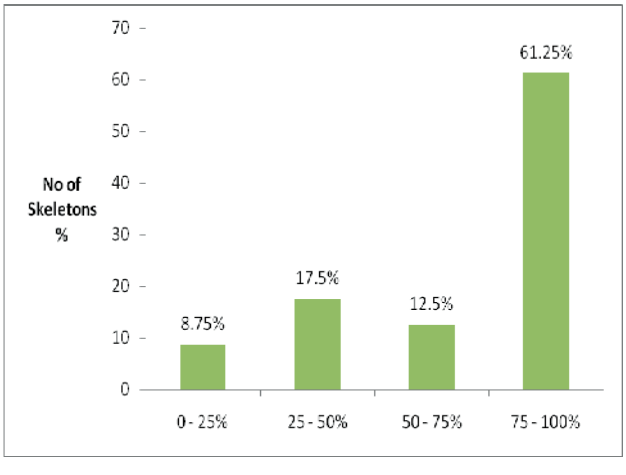


**Figure 4.1** Completeness of skeletal assemblage (CPR1)

The preservation of the skeletons (Fig. 4.2) was categorised as:

- 'Poor' (surface damaged, very fragmented, distal and/or proximal ends of long bones missing or damaged. Unable to record any bone changes related to pathology and trauma)
- 'Fair' (moderate condition, distal and/ or proximal ends of long bones damaged or missing)
- 'Good' (bone surface in good condition, most osteological information recordable)


**Figure 4.2** Preservation of skeletal assemblage (CPR1)

## Estimation of Sex

Specific references used during the analysis of the sex of each adult skeleton include Buikstra & Ubelaker (1994, 15–38; *Os coxae and cranial morphology)* and Bass (1995, 114, 159, & 231; *femoral/ humeral head maximum diameter, clavicle length and femoral circumference).*

The sex of each skeleton was assessed using defined criteria (Jacklin 2005b). The final sex estimation given for each skeleton took into account the several sexing methods used and the resultant estimation was based, not only on the results of the combined methods, but also with consideration of their reliability and accuracy. The sex of each skeleton was categorised as follows:

- 'Male' or 'M' (Where the most accurate of the sexing methods were available, and all point to a definite 'male' estimate)
- 'Female' or 'F' (Where the most accurate of the sexing methods were available, all point to a definite 'female' estimate)
- 'Possible Male' or 'M?' (Where almost all indicators point to a definite 'male' estimate but one or more indicators are absent or result in an 'indefinite' or 'possible male' estimate)
- 'Possible Female' or 'F?' (Where almost all indicators point to a definite 'female' estimate but one or more indicators are absent or result in an 'indefinite' or 'possible male' estimate)
- 'Non-Adult' (Below 21 years old). Sex estimation was not attempted on skeletons aged at less than 21 years owing to the lack of sexual dimorphism. For those on the cusp (c.18-21 years), assessment of sex was attempted, though in this instance none could be determined, and all were consequently recorded as 'non-adults'.
- 'Non-Sexable Adult' or 'NSA'. Of the assemblage, 13.75% was classed as 'non-sexable adults' (n11). Of the NSA, 81.82% had no indicators of sex available for study and 18.18% were unable to be sexed due to the sexual ambiguity of their remains.

For the purpose of this report the 'M' and 'M?' and the 'F' and 'F?' skeletons have been combined. The sex ratio of the Wolverton assemblage (n80) comprised 20% males, 30% females, 13.75% NSA and 36.25% non-adults (Fig. 4.3).

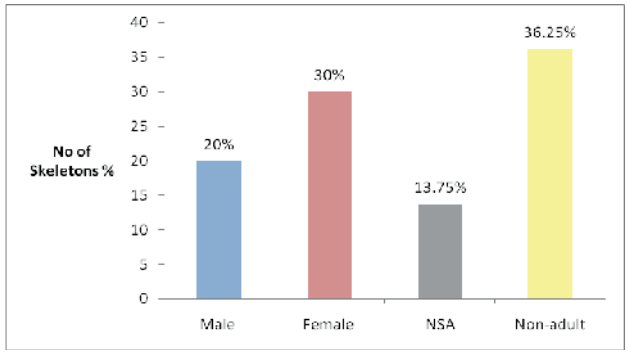


**Figure 4.3** Sex of entire assemblage (CPR1)

## Estimation of Age

Specific references used during the analysis of the age of each skeleton include Brothwell (1981, 72; *age estimation method*), Buikstra & Ubelaker (1994, 34–5; *dental attrition*.), Meindl & Lovejoy (1985, 32–8; *cranial suture closure),* Scheuer & Black (2000; *epiphyseal fusion, dental eruption and cranial/ post-cranial metrics) and* Schwartz (1995, 205; *rib end morphology:* used only when **Işcan** Rib Phase casts were not available). Also used were **Işcan**, Loth & Wright (1984 and 1985; **Işcan** *Rib Phase Casts*), (Loth & **Işcan** (1989; **Işcan** *Rib Phase Casts*) and Brooks & Suchey (1990; *Suchey-Brooks Female Age and Male Age Determination Sets*).

The age of each skeleton was assessed using defined criteria (Jacklin 2005b). The final age estimation given for each skeleton took into account the several aging methods used and the resultant estimation was based, not only on the results of the combined methods, but also with consideration of their reliability and accuracy. All the skeletons were placed in age categories based on the combined results of the various age indicators used.

The age categories used were adapted from Buikstra & Ubelaker (1994, 9) and are as follows:

- 'Infant' (birth to 3 years)
- 'Child' (4 to 12 years)
- 'Adolescent' (13 to 20 years)
- 'Young adult' (21 to 35 years)
- 'Middle adult' (36 to 50 years)
- 'Older adult' (51+ years)

Sometimes the age of a skeleton bridged two categories. The bridging of age categories was necessitated either by a lack of available age indicators, as in the case of 'adolescent to middle adult', or because the skeleton fell on the cusp between two age categories, such as 'infant to child' (often aged between three and four years),

'adolescent to young adult' (often aged between eighteen and 25 years) and 'young to middle adult' (often aged between 30 and 42.5 years). All the skeletons were given specific ages and these can be found in the skeletal database.

The age range represented in the assemblage (CPR1) (Fig. 4.4) comprised one infant (1.25%), one infant to child (1.25%), sixteen children (20%), ten adolescents (12.5%), one adolescent to young adult (1.25%), four adolescent to middle adults (5%), thirteen young adults (16.25%), three young to middle adults (3.75%), twenty-nine middle adults (36.25%) and two middle to older adults (2.5%).

In summary, the Wolverton assemblage (CPR1) comprised 36.25% non-adults and 58.75% adults: 5% bridged the non-adult and adult categories. Those skeletons that bridged the non-adult and adult categories were aged between 13-50 years and could not be sexed. They were therefore omitted from any further statistical analysis.

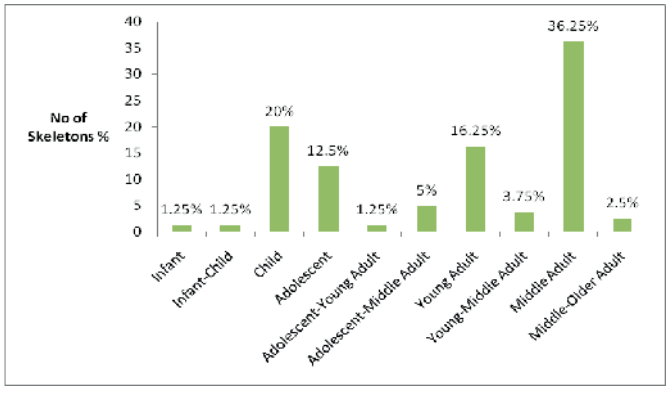


**Figure 4.4** Age range of entire assemblage (CPR1)

### *Age of Non-Adult Assemblage*

Statistical analysis (CPR2) revealed that the age at which death occurred most frequently within the non-adult population was between four and twelve years, followed by thirteen to twenty years (Fig. 4.5).

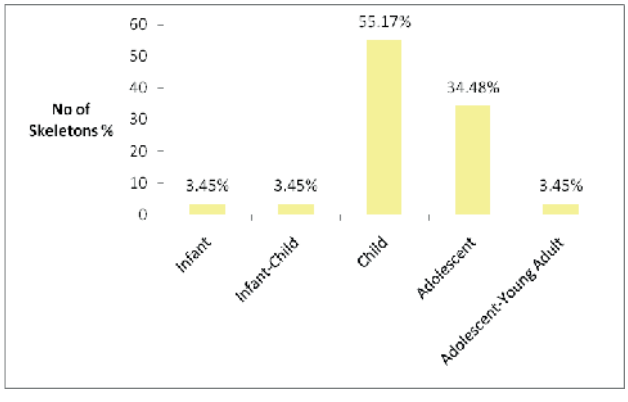


**Figure 4.5** Age range of non-adult assemblage (CPR2)

### *Age and Sex of Adult Assemblage*

Statistical analysis (CPR2) shows that the majority of males and females from the Wolverton assemblage passed away during middle age (Figs 4.6 & 4.7).

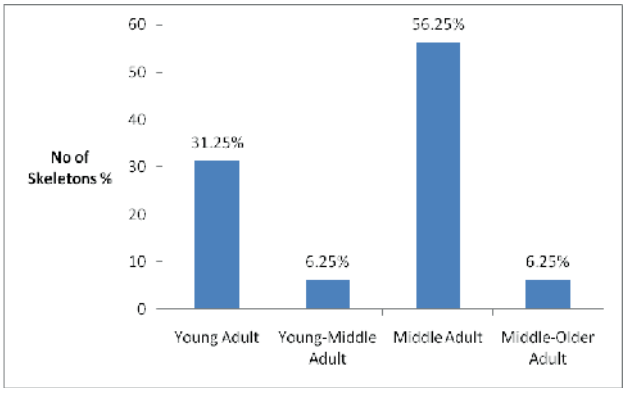


**Figure 4.6** Age range of male assemblage (CPR2)

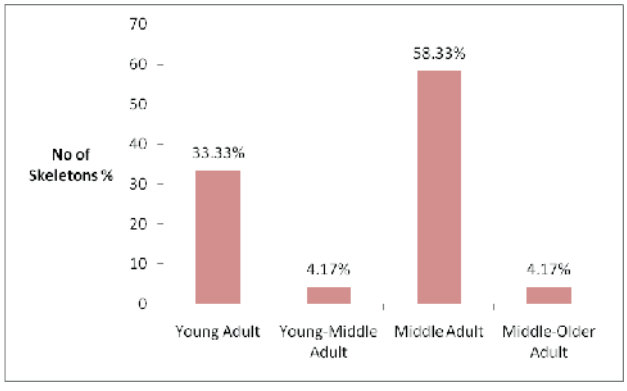


**Figure 4.7** Age range of female assemblage (CPR2)

### Stature of Adult Assemblage

References used during the assessment of the stature of each skeleton were Trotter & Gleser (1952 & 1958). The stature of fifteen males within the assemblage could be calculated, giving a mean height of 173cm (5'8"). The stature of sixteen females could also be calculated, giving a mean height of 163cm (5'4").

### Cranial Metrics and Non-Metric Traits

The cranial metrics and non-metric traits recorded during analysis were based on recommendations by Brothwell & Zakrzewski (2004, 29–31). References used during the analysis of cranial metrics and non-metric traits included Bass (1995, 66–88), Brothwell (1981, 79–83, 87–89 and 98–99) and Buikstra & Ubelaker (1994, 87–91).

A total of 44 adults had cranial material present, comprising 23 females, 14 males and seven NSAs. Due to the fragmentary nature of the surviving cranial material, only a small proportion of the above sample could have their cranial metric and non-metric traits recorded.

### *Cranial Index*

The cranial index calculates the overall size of the cranium (breadth to length ratio). It proved possible to record cranial index for only one male, Inhumation 2164, who was found to be *hyperbrachycrany* (very broad headed).

### *Facial Index*

The facial index determines the overall size of the face (height to breadth ratio). Facial indices could not be

calculated for the Wolverton assemblage, owing to a lack of complete facial bones and poor preservation of the surviving skeletal material.

### *Cranial Non-Metric Traits*

For some skeletons a full list of cranial non-metric traits could be recorded, though for others only a few could be recorded, due to their fragmentary nature. No significant difference was found in cranial non-metric traits between males and females in the assemblage.

### Platymeric & Platycnemic Index

Occasionally within skeletal assemblages, the tibia and the femur can show noticeable differences in their general shape between different populations, and also between males and females. The *platymeric* index calculates the anterior-posterior flattening of the femur, while the *platycnemic* index calculates the transverse flattening of the tibia. The following calculations of *platymeric* and *platycnemic* indices were possible on the males and females within the assemblage:

Ten females and nine males were able to have the *platymeric* index recorded based on their left femur, nine females and five males were able to have the *platymeric* index recorded based on their right femur and six females and five males were able to have the *platymeric* index recorded for both femurs. Seven females and four males were able to have the *platycnemic* index recorded based on their left tibia, eight females and three males were able to have the *platycnemic* index recorded based on their right tibia and five females and three males were able to have the *platycnemic* index recorded for both tibias.

Differences in the *platymeric* index may be due to a number of factors, including mechanical adaptation, pathological change, vitamin deficiencies and undue strain on the femora during childhood and early adolescence. Brothwell (1981) suggests that the *platymeric* range is more commonly found in females than in males, and there is also a tendency for it to be more pronounced in the left femur than the right. Analysis (TPR) showed that two-thirds of males (88.89% based on left femur and 66.67% based on right femur) and females (60% based on left femur and 66.67% based on right femur) fell within the *platymeric* (broad or flat from front to back) range. About one-third of females were classed as *eurymeric* (more rounded from front to back), whilst about 17% of males were classed as *eurymeric,* and a similar sample were *stenomeric* (narrow from front to back).

Reasons for differences in the *platycnemic* index are also varied, ranging from pathological to mechanical factors. Analysis (TPR) revealed that the majority of males (100% based on left tibia and 66.67% based on right tibia) fell within the '*mesocnemic*' range (*platycnemic* index of 63-69.9), while the majority of females (100% based on left tibia and 90% based on right tibia) fell within the '*Eurycnemic*' range (*platycnemic* index of 70+). However, it should be noted that these results are based on a small sample.

### Robusticity Index

The robusticity index calculates the relative size of the femoral diaphysis (shaft of the femur). The results, obtained from only a small sample of the assemblage, were divided for ease of use. For four females and five males, robusticity was recorded based on their left femur, and for five females and two males robusticity was recorded based on their right femur. For the small sample analysed, the robusticity index for males averaged 66.6%, and for females, 50%.

### Post-Cranial Non-Metric Traits

The post-cranial non-metric traits recorded during analysis are based on recommendations by Brothwell & Zakrzewski (2004). No significant difference between males and females was found in relation to post-cranial non-metric traits.

### Developmental Conditions

References used in the diagnosis of specific developmental conditions include Anderson (2000), Aufderheide & Rodriguez-Martin (2003), Barnes (1994), Mann & Hunt (2005), Ortner (2003), Roberts & Manchester (1995) and Waldron (1993).

Within all societies, and during all time periods, developmental abnormalities occur affecting both the skeleton and the soft tissue. In the Wolverton assemblage, six females and one male had been affected by congenital conditions. All conditions recorded will have had little, if any effect on the individual's daily life. Inhumation 2364, a male aged between 36 to 42 years, had a condition known as *os acromiale* affecting his right scapula. Os acromiale is the non-fusion of the acromion process, and is a relatively common condition found within archaeological skeletal assemblages. This condition has not been included in the analysis below, as the available sample of intact male scapulae was too small to be even closely representative of the population. The females are discussed below.

Inhumation 2013, aged 36 to 46 years, was affected by Spina Bifida Occulta which showed itself by the non-fusion of the first sacral neural arch of the sacrum. She also had two extra facets below the left and right sacral articular surfaces, corresponding with extra facets located at the left and right os coxae. Inhumation 2096, aged between 30 and 32 years, had spondylolysis of her fifth lumbar vertebra (Fig. 4.8). Spondylolysis is identified by the non-fusion of the posterior part of the affected vertebra. The condition is sometimes referred to as 'shoveler's fracture', due to its appearance primarily in the lower back, and although a fracture, the condition is a result of a congenital weakness aggravated by repeated trauma. This weakness predisposes the individual to small fractures along the line of weakness resulting from continual stress and strain on the back, primarily through bending and lifting in an upright posture. Inhumation 2176, aged 36 to 50, had a very pronounced occipital bone (back of head), called an occipital bulge. Inhumation 2110, aged 36 to 50 years, was affected by three different developmental conditions: Spina Bifida Occulta (non-fusion of the sacrum's third to fifth neural arch and only partial fusion of the first to third neural arch), an extra vertebrae (L6) and Klippel-Feil Syndrome (ankyloses – immobility – of two


**Figure 4.8** Inhumation 2096, Spondylolysis of L5 vertebra, posterior


**Figure 4.9** Inhumation 2444, Osteochondroma affecting left tibia, anterior

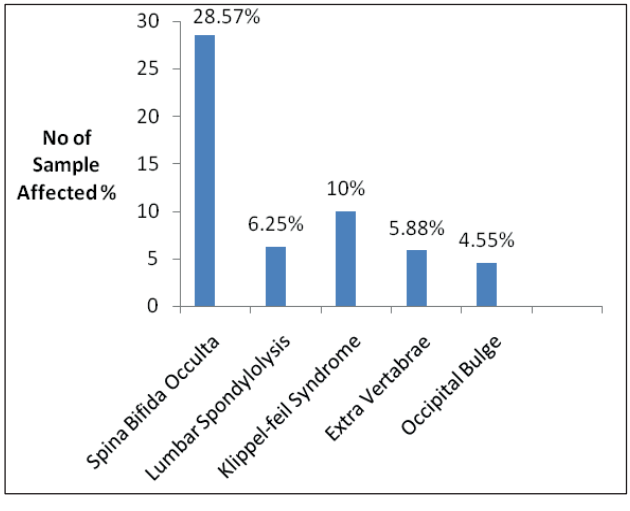


**Figure 4.10** Developmental conditions (TPR)

or more cervical vertebrae, in this case C6 and C7). Also of interest is Inhumation 2444, a female aged between 36 and 50 years, although she is not included in the prevalence rates below. This individual was affected by extra bone growth on her right mid-lateral tibia, which was originally fused to her right fibula (Fig. 4.9). Analysis revealed that the growth was not caused by trauma to the bone, but due to a benign neoplasm (*osteochondroma*). The skeleton is recorded here in the developmental section of this report as Roberts & Manchester (1994, 187) state that the condition is 'strictly a developmental aberration'.

For the prevalence rate for the developmental conditions mentioned here (Fig. 4.10), it should be noted that the results are based upon a small sample, and as such may not accurately represent the developmental conditions affecting the Wolverton population.

## Dental Health

References used during the analysis and diagnosis of dental disorders include Brothwell (1981), Buikstra & Ubelaker (1994), Hillson (1986), Ogden (2005), Ortner (2003), Roberts & Manchester (1995), Rose, Condon & Goodman (1985) and White (2000). Details of the analysis results relating to dental health are retained in the project archive.

### *Dental Caries*

Dental caries is defined by Pindborg (1970) as an infectious and transmissible disease initiated by microbial activity on the tooth surface, leading to progressive destruction of the tooth structure, crown or root. Dental caries are often the most common dental pathologies found within archaeological human bone assemblages. Buikstra & Ubelaker (1994) explain that an association between increased frequencies of caries and the consumption of sugar/carbohydrate-rich foodstuff makes the recording and subsequent analysis of caries useful in dietary reconstruction. Within the Wolverton assemblage dental caries have been found to affect both the enamel (often as a result of poor dental hygiene) and the root (due to exposure to cariogenic bacteria by periodontal disease). All dental caries were scored between '0' (no lesion present) to '6' (large caries which cannot be assigned to a surface of origin) after Buikstra & Ubelaker (1994, 55). For the purpose of this report the specific scores assigned to each dental carie have not been statistically analysed, but the results are recorded in the skeletal database for future researchers.

The results represented here with regard to dental caries are based on both the maxilla and the mandible being present. It should be recognised that some individuals lost a number of teeth either *ante-mortem* or *post-mortem* and these results are not recorded here, although they can be found in the skeletal database. Analysis showed that 61.25% of the entire assemblage (CPR1) had both a maxilla and mandible available for study. Within this sample (CPR2), 33.33% had one or more teeth affected by dental caries. The results (CPR2) show that although based upon a small sample, females appear to have had a slightly higher prevalence rate of caries than males (Fig. 4.11). Analysis also revealed that no deciduous teeth were affected by dental caries, and only the adolescents from the non-adult age range were affected. No NSAs were affected. No significant link was found between an increase in caries and an increase in age. A number of skeletons also showed multiple cases of dental caries

affecting a single tooth. Caries affecting two adjacent teeth was also a common finding.

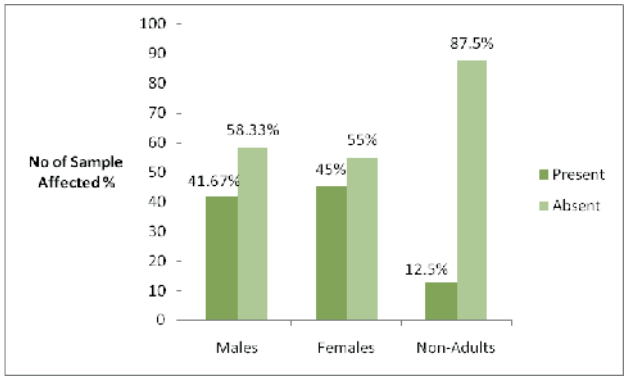


**Figure 4.11** Incidence of dental caries (CPR2)

### *Dental Abscesses*

A dental abscess can occur when dental caries and/or periodontal disease are present, due to the exposure of the pulp cavity and subsequent infection via bacteria. Out of the sample (CPR2), 6.25% had one or more dental abscesses (Fig. 4.12). No abscesses were found to affect the non-adults within the assemblage, or the NSAs. The results (CPR2) also show that 5% of females were affected by abscesses, compared with 16.67% of males. Only middle adults were affected. It should be noted that these results are based upon a small sample.

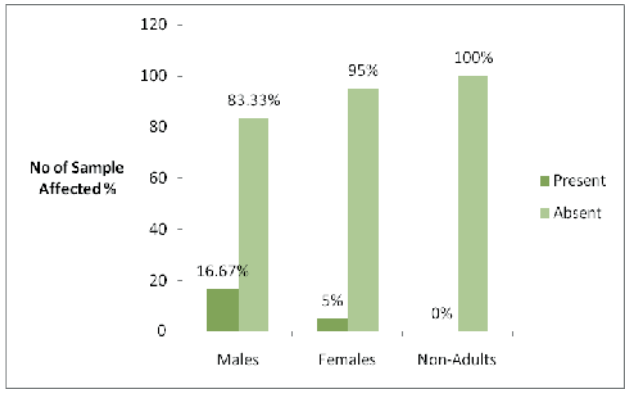


**Figure 4.12** Incidence of dental abscesses (CPR2)

### *Periodontal Disease*

Periodontal disease (a loss of aveolar bone and periodontal ligament) is a consequence of severe gingivitis, inflammation of the gums immediately surrounding a tooth/or teeth. Gingivitis is often caused by an excess of calculus (mineralised plaque) adjacent to the infected gum. Periodontal disease can also result in *ante-mortem* tooth loss owing to the loss of periodontal ligament which supports the structure of the teeth. Metabolic disorders such as scurvy can also result in inflammatory conditions which may adversely affect periodontal tissue. Within archaeological samples periodontal disease can often be difficult to score, owing to taphonomic damage. The skeletons within the sample were scored between '0' (no periodontal disease) and '4' (severe periodontal disease) after Brothwell (1981, 155, fig. 6.14) and Ogden (2005). Analysis showed that 6.25% of the assemblage (CPR2) had signs of periodontal disease and only females were affected. All were aged between 36 to 50 years (Fig. 4.13). For example, Inhumation 2013, a female aged between 36-46 years, had recession of alveolar bone and severe dental attrition, although this did not affect the wisdom teeth.

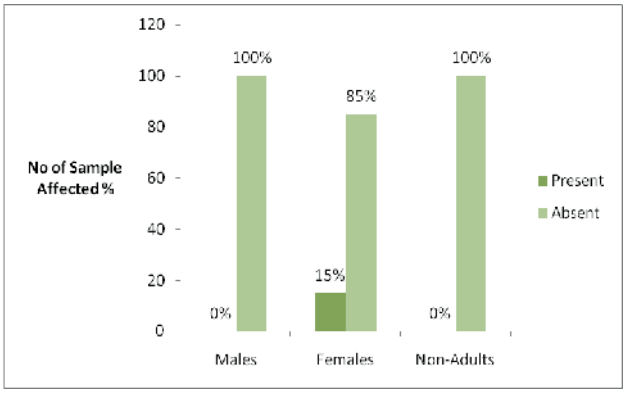


**Figure 4.13** Incidence of periodontal disease (CPR2)

### *Dental Calculus*

Dental calculus is caused by the mineralization of dental plaque, which is comprised of micro-organisms embedded in a matrix composed of proteins and saliva (Hillson 1986). During analysis, calculus was scored between '0' (no calculus present) and '3' (large amount of calculus present), after Brothwell (1981, 155, fig 6.14). Analysis revealed that 58.33% of the skeletons (CPR2) had calculus present. Females in the assemblage showed a higher frequency of dental calculus (80%) compared to males (66.67%). Non-adults were not as frequently affected (25%) and no NSAs were affected (Fig. 4.14).

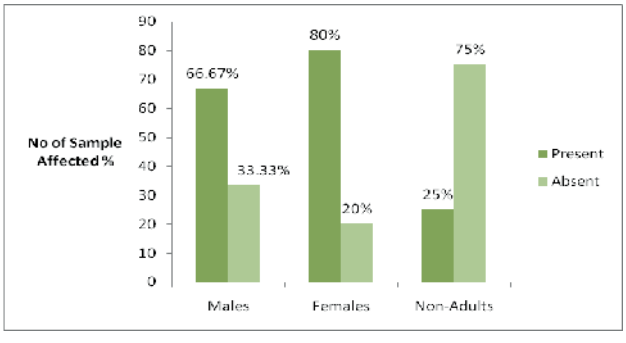


**Figure 4.14** Incidence of dental calculus (CPR2)

## Acquired Pathological Conditions

### *Infectious Disease*

References used here in the diagnosis of specific infectious diseases include:

*General:* Ortner 2003, Roberts & Manchester 1995.
*Encyclopedia:* Resnick 1995, Aufderheide & Rodriguez-Martin 2003, Mann & Hunt 2005.
*Tuberculosis:* Dormandy 1999, Roberts 1999, Roberts & Buikstra 2003, Santos & Roberts 2006.
*Infectious disease:* Kelley 1989.
*Infectious disease during childhood:* Lewis 2007.

*Overview of infectious disease in Britain:* Roberts 2000. *Archaeological data on infectious disease in Britain:* Roberts & Cox 2003.

Infectious disease can be attributed to four different agents; bacterial, viral, fungal and parasitic (Aufderheide & Rodriguez-Martin 1998). Bacterial infections found within the Wolverton assemblage are osteomyelitis and possible spinal tuberculosis. Statistical information on pathological conditions present in the assemblage can be found in the project archive.

### *Osteomyelitis*

Osteomyelitis is an inflammation of the medullary cavity of a bone, caused by pus-producing bacteria. It can be classed as either 'acute', 'sub-acute' or 'chronic'. Osteomyelitis can be caused by direct infection through trauma, by direct extension from an adjacent soft tissue infection, or by the haematogenous route from a remote septic focus (Ortner 2003).

Of the entire skeletal assemblage (CPR1), only 2.5% were affected by osteomyelitis (Fig. 4.15). No NSAs were affected. Out of the sample of males, females and non-adults (CPR2), 6.25% of males and of 3.45% non-adults were affected. No osteomyelitis was observed in females.

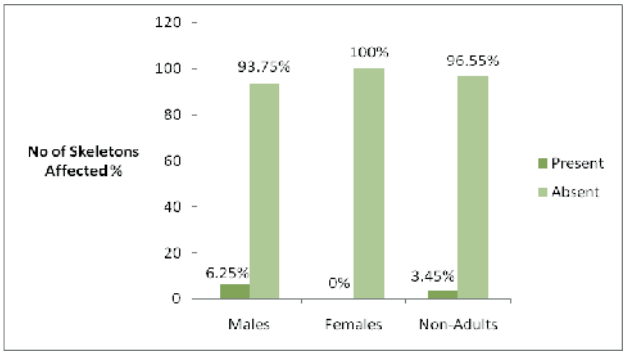


**Figure 4.15** Incidence of osteomyelitis (CPR2)

Inhumation 2010, an adolescent aged between 16 and 18 years, was affected by localised osteomyelitis which was active at the time of his/her death. The adolescent's left femur was affected by three cloacae (entry sites for pus-producing bacteria), all situated at the distal anterior surface of the bone (above the knee). The distal epiphysis was unaffected. Taphonomic damage was visible which may have obscured the true extent of the infection. The cloacae measured 8.34 x 2.98mm, 6.98 x 2.99mm and 3.2 x 2.4mm. The cause of the localised infection is unknown, but may be related to trauma to the overlying tissue of the left knee, which subsequently became infected.

**Figure 4.16** Inhumation 2014, Left tibia, medial view

Inhumation 2140, a male aged 36 to 50 years, seems to have recovered from a localised case of osteomyelitis. A healed, localised osteomyelitic reaction affecting the distal diaphysis of his left tibia (just above his left ankle) was observed. The condition was healed, although the entry site of the infection was still faintly visible at the time of death (Fig. 4.16). A significant difference in length between the left and right tibiae (20mm) was noted (Fig. 4.17). This

**Figure 4.17** Inhumation 2014, Left and right tibiae, anterior view

may have caused an unsteady gait, and as a possible consequence subsequent trauma may have ensued, causing the localised osteomyelitic reaction. The reason behind the difference in the leg length remains unclear. One possibility is the contraction of the Poliomyelitis virus (*poliovirus*) during childhood. The virus enters the body through the mouth, infecting the intestinal lining. If untreated, it makes its way through the blood stream and into the central nervous system, attacking the nerve tissues in the brain and spinal cord. This can cause paralysis and muscle weakness. In some cases, the virus may affect muscles on both sides of the body, but more often the paralysis is asymmetrical. As well as paralysis, the growth of the affected limb can be disrupted, as in the case of Inhumation 2140. An increased likelihood of fractures is another consequence of infection by the virus. Inhumation 2140 fractured his clavicle in the months prior to death. Whether this is, or is not related, cannot be established. Inhumation 2140's foot bones were examined for 'equinus foot', another sign of polio, but no evidence was found.

### *Possible Spinal Tuberculosis*

Tuberculosis is a chronic infectious disease caused by a species of *mycobacterium*. *Mycobacterium tuberculosis* can be passed directly from human to human, whilst *Mycobacterium bovis* is transferred to humans via cattle products, primarily infected milk. The route of infection by *mycobacterium tuberculosis* is most commonly through the respiratory tract to the lungs through infected droplets (e.g. by sneezing and coughing). If the condition remains untreated, the bacilli spreads via the blood and lymphatic system to the rest of the body, including the skeleton. Rosencrantz, Piscitelli & Bost (1941) studied the regional distribution of bone and joint tuberculosis in 160 patients and found that the spine was most frequently affected. Resnick & Niwayama (1995) suggest that in 25-50% of cases of skeletal tuberculosis, the spine is involved, while Aufderheide & Rodriguez Martin (2003) suggest that 40% of people with skeletal tuberculosis have spinal involvement.

The classification of 'early stage tuberculosis' and 'advanced stage tuberculosis' has been used (after Jacklin 2009) to aid analysis. All possible cases within the Wolverton assemblage were classified as 'early stage tuberculosis'. All cases had spinal involvement, and in all a number of adjacent lumbar vertebra were involved. In order to examine prevalence rates of the disease, males, females and non-adults with L1 to 5 present for study were used (TPR). Of this sample, 9.68 % showed evidence of possible spinal tuberculosis (Fig. 4.18). No non-adults or NSAs were affected. Females and males were jointly affected (12.5%). These individuals are discussed below.

Only one male (Inhumation 2214), aged 36 to 50 years, was affected by possible spinal tuberculosis. Severe, destructive lytic lesions were found affecting the adjacent surfaces of L3 and L4 (Fig. 4.19). The lesions were very advanced and no remodelling was apparent, indicating that the disease was active at the time of death. The trabecular bone was also more loosely woven than normal. Alternate diagnoses considered yet discounted were; brucellosis, Scheuermann's disease or an aortic aneurism.

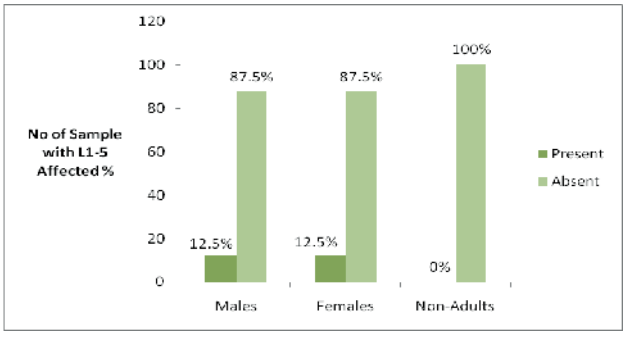


**Figure 4.18** Incidence of possible, 'early stage' spinal tuberculosis (TPR)


**Figure 4.19** Inhumation 2214, L4 vertebra, inferior surface

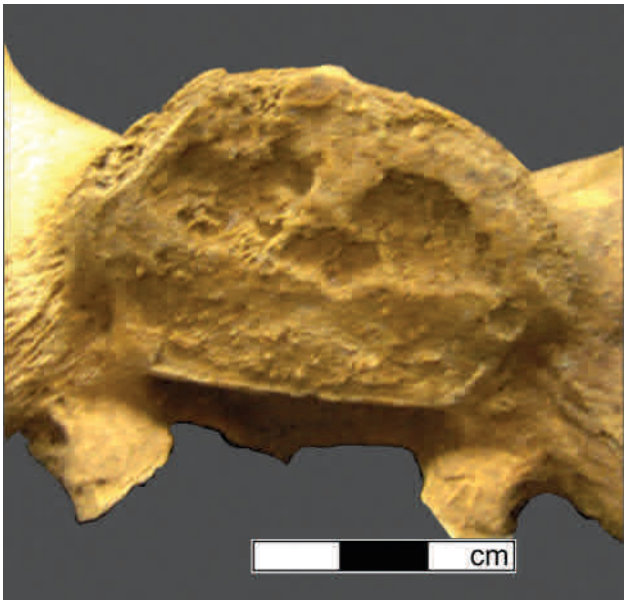


**Figure 4.20** Inhumation 2087, S1 vertebra, superior surface

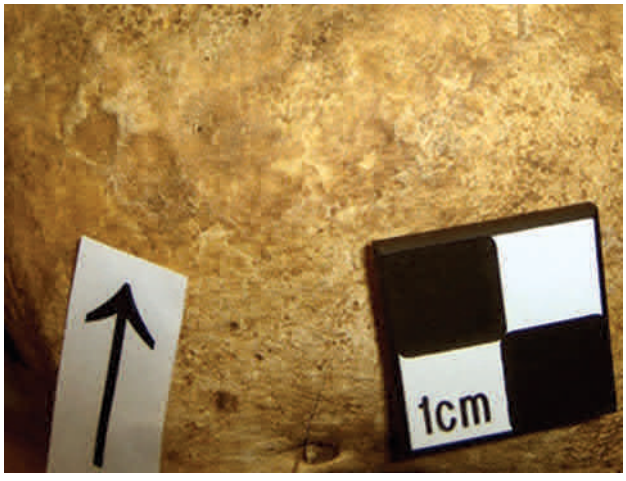


**Figure 4.21** Inhumation 2087, frontal bone

Inhumation 2122, a female aged 42 to 50 years, also showed destructive 'tuberculosis-like' lesions affecting L1 and L3-5 (L1 inferior-posterior surface, L3 inferior surface, L4 inferior surface and L5 superior surface). The youngest female to be affected by possible 'early stage' spinal tuberculosis was Inhumation 2087, aged 30 to 32 years. Destructive 'tuberculosis-like' lesions (Fig. 4.20) were found affecting her sacrum (S1 superior surface) and her first lumbar vertebra (L1 inferior and anterior surface). Healed destructive lesions with a 'moth-eaten' appearance were also found located at her right frontal bone (forehead), but not clearly visible due to taphonomic damage (Fig. 4.21). These lesions may possibly be associated with '*Lupus Vulgaris'* (tuberculosis of the skin).

## Non-Specific Infection: Periostitis

Periostitis is an inflammation of the bone membrane (periosteum). The condition can form part of a localised event, (e.g. as a result of trauma) or as a secondary condition indicative of an underlying condition, such as an infectious disease. Periostitis has been diagnosed by the presence of plaque-like new bone growth and micro/macroporosity. Just over 4% of males, females and non-adults (CPR2) showed signs of periostitis (Fig. 4.22). For the Wolverton assemblage (CPR1) as a whole, only 2.5% were affected.

Only two individuals showed signs of periostitis, in the form of active lesions affecting their right *os coxae* (pelvis). Inhumation 2202, a child aged between 10 and 12 years, showed a very slight active periosteal reaction located at his/her right ilium (anterior surface). Inhumation 2066, a male aged between 42.5 and 50 years, had an area of active periostitis located at his right external, acetabular rim. No other associated pathological changes were found to affect the skeletons.

## Joint Disease & Spinal Disorders

References used in the diagnosis of joint disease and spinal disorders include Aufderheide & Rodriguez-Martin (2003), Bass (1995), Brothwell (1981), Maat, Mastwijk & van der Velde (1995), Mann & Hunt (2005), Ortner (2003), Resnick (1995), Roberts & Manchester (1995), Rogers (2000), Rogers & Waldron (1995), Rogers, Waldron & Watt (1987) and White (2000). Relevant analytical data can be found in the project archive.

### *Osteophytosis and Osteoarthritis*

Osteoarthritis (OA) is the most common joint disease in both ancient and modern populations, and is characterised by a loss of articular cartilage and a subsequent reaction of the sub-chondral and marginal bone (Rogers & Waldron 1995). Osteoarthritis is primarily an age-related disorder. It is diagnosed through the presence of osteophytes, micro/macroporosity of the joint surface, eburnation (polishing) and, in some severe cases, changes in the morphology of the joint surface (for example; grooving). Osteophytosis (OP) is defined here by using the same criteria as for the diagnosis of osteoarthritis, but where signs of eburnation and grooving are absent. Most skeletons with osteoarthritis affecting some joint surfaces also show signs of osteophytosis affecting other joint surfaces. In the analysis of the Wolverton assemblage, when osteophytosis occurs alongside osteoarthritis (affecting the same skeleton) then osteophytosis has been classified as 'early stage' osteoarthritis. This is because, if the individual had lived longer, it is likely that all the indicators of osteoarthritis would have occurred. Osteoarthritis can also be triggered by traumatic conditions such as poorly-healed fractures, and in younger-age categories, where it is clear osteoarthritis is not due to the onset of age. The specific location of osteoarthritis may hint at the lifestyle of the individual.

### *Osteophytosis (Early OA)*

The results (CPR2) reveal that both males (12.15%) and females (12.15%) were equally affected by osteophytosis. In all, 18.18% of NSAs were affected whilst non-adults remained unaffected by the condition (Fig. 4.23). All the skeletons with OP fell within the 'middle adult' age range (36 to 50 years) and in each case only one joint was affected. No individuals with OP had OA also present.

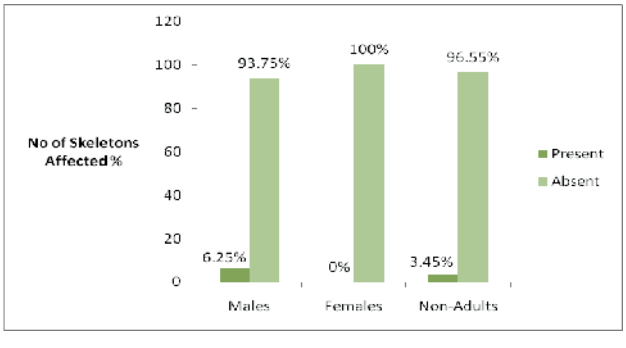


**Figure 4.22** Incidence of periostitis (CPR2)

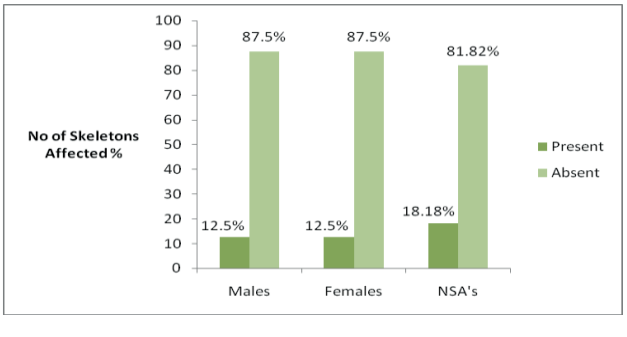


**Figure 4.23** Incidence of osteophytosis (CPR2)

### *Osteoarthritis*

The results (CPR2) reveal that 18.75% of males compared with 12.5% of females suffered from osteoarthritis (Fig. 4.24). None of the NSAs or the non-adults were affected by the condition. In total, 11.76% of the adults were affected. All the skeletons fell within the 'middle adult' and 'middle-older adult' age range (36 to 50+ years). In three cases (not including multiple cases affecting adjacent vertebrae) more than one joint was affected.

The results of the statistical analysis of joints affected by osteoarthritis have been divided into general skeletal locations; the pelvis and legs, the spine, and, the hands and the feet. No skeleton had the joints in their arms or their shoulder girdle affected. Unless otherwise stated, the presence of osteoarthritis has been based on the condition and the joint surfaces being present (TPR). It should be noted that the following results are based on sometimes very small sample sizes, and as such should be regarded with caution. However, the results do show a marked difference in the location of OA between males and females.

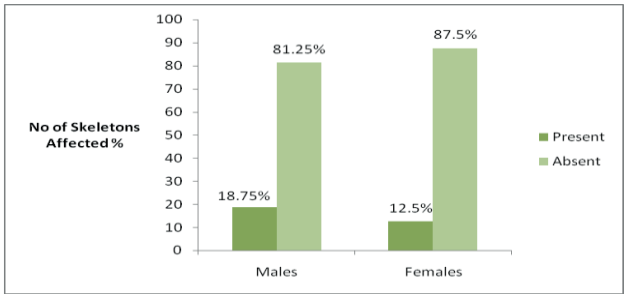


**Figure 4.24** Incidence of osteoarthritis (CPR2)

### *OA Affecting the Pelvis and Legs*

No males within the assemblage were affected by OA in their pelvis and legs. OA was however found in the female assemblage. Analysis (TPR) shows that 12.5% of females had OA located at their left acetabulum (part of the hip socket), and 13.33% had it located at their right acetabulum.

### *OA Affecting the Spine*

No females within the assemblage were affected by OA in their spine. However, OA was found to affect the spinal column in males. Analysis (TPR) shows the commonest location of OA within the spine to have been the cervical vertebrae (neck and upper back), 22.22% of males being affected by the condition. The lumbar vertebrae (lower back) followed with 16.67% of males affected, and 8.33% of males had OA in their thoracic vertebrae (mid back).

### *OA Affecting the Hands and the Feet*

OA was found to affect the hands of both males and females within the assemblage. A TPR of 14.29% of males were affected by OA in one or more of their phalanges (finger joints). Of the female sample, 7.14% were affected by OA in their metacarpals (finger joints). With regard to feet, OA was found to affect 25% of the metatarsals (toes) of the female sample. No male feet were affected.

## Vertebral Lesions – A Case of Possible Spondyloarthopathy?

Analysis of Inhumation 2196, a female aged over 42 years, showed a number of lesions affecting her lower vertebrae. The cause and aetiology of the lesions were not ascertained. The lesions are described here, alongside a consideration of their possible cause. It is hoped that in providing as much information as possible, future researchers may reach a conclusion as to the exact cause of the condition. Due to the doubt over the actual aetiology of the disorder affecting Inhumation 2196, the results have been recorded, but have been omitted from further statistical analysis.

Pathological analysis revealed a number of erosive lesions affecting Inhumation 2196's lower vertebrae (L2 inferior surface, and superior and inferior surfaces of L4 and L5). The sacrum (S1 superior surface) was also affected (Fig. 4.25). The lesions were originally considered to be related to possible tuberculosis, but closer inspection revealed that they did not resemble typical 'tuberculosis-like' lesions. An alternate theory was the breakdown of the articular cartilage, possibly caused by inflammatory arthritis or similar. In addition to this, ankylosis (fusion) of T11, T12 (complete ankylosis of L1 and T12 at bodies and neural arches) and L1 (partial fusion of T11 and T12 at bodies) was discovered, with early ankylosis also affecting L1 to L2 (Fig. 4.26). In severe cases of vertebral destruction due to tuberculosis, the vertebrae can collapse and ankylosis of the affected vertebrae can occur. In the case of Inhumation 2196, the ankylosis is not due to spinal collapse


**Figure 4.25** Inhumation 2196, L4 vertebra *(l)*, inferior surface and L5 vertebra *(r)*, superior surface


**Figure 4.26** Inhumation 2196, T11, T12 and L1, anterior and posterior views

and the affected vertebrae resembled a condition caused by ankylosing spondylitis in both location and form. Ankylosing spondylitis is one of a number of disorders, collectively called 'seronegative spondyloarthopathies', which can sometimes be difficult to differentiate between within archaeological assemblages, owing to their similar characteristics and often poor preservation and/or lack of completeness of the skeleton involved. The seronegative spondyloarthopathies are erosive, inflammatory polyarthropathies, which involve the entheses (ligament insertion points) and the joint's internal structure (Rogers & Waldron 1995).

Ankylosing spondylitis usually begins by ankylosis of the sacro-iliac joints and works its way upwards, in turn causing the ankylosis of S1 to L5, L5 to L4 and so on. However, in Inhumation 2196 no ankylosis was found to affect either the sacro-iliac joints or the lower lumbar vertebrae (L3 to S1). An alternate diagnoses which was considered was psoriatic arthritis (also a seronegative spondyloarthopathy). The female revealed a substantial loss of bone density (osteopenia) which affected the majority of her skeleton (see *Metabolic Conditions*, below). This is problematic if considering the diagnosis of psoriatic arthritis, as Ortner (2003, 580) states that the bone density of individuals with psoriatic arthritis should be normal, with the exception of the vertebrae. It should however, be borne in mind that the loss of bone density may be related to the individual's age, and not associated with the condition discussed here. Inhumation 2196 also showed evidence of an enthesopathy (a bone growth) affecting the proximal tibio-fibular joint of her left fibula. Enthesopathy is also a feature of psoriatic arthritis.

## Trauma

References used in the diagnosis of trauma include Aufderheide & Rodriguez-Martin (2003), Lewis (2007), Lovell (1997), Ortner (2003), Resnick (1995), Roberts (2000) and Roberts & Manchester (1995).

### *Fractures*

Fractures are amongst the most common pathological conditions seen in human skeletal populations, alongside dental and joint disease (Roberts & Manchester 1995). Evidence of angular or rotational displacement, shortening of affected bones and apposition of the fracture fragments, as well as the specific location of the fracture were recorded during analysis. A fracture (an incomplete or a complete break in the continuity to the bone) can result from either direct or indirect trauma (Lovell 1997). Direct trauma is where a break occurs at the point of impact. Examples of direct trauma are transverse, penetrating, comminuted and crush fractures. Indirect trauma is where a fracture occurs in a place other than the point of impact (Miller & Miller 1979). Examples of indirect trauma are oblique, spiral, greenstick (due to angular force), greenstick (due to compression), impaction and avulsion fractures (Lovell 1997).

Within the entire skeletal assemblage (CPR1), a total of four fractures were identified, affecting three individuals with a prevalence rate of 3.75%. One skeleton had experienced multiple fractures. Of the male sample (CPR2), 6.5% were affected by fractures, compared with 8.33% of the female sample (CPR2). No NSAs or non-adults from

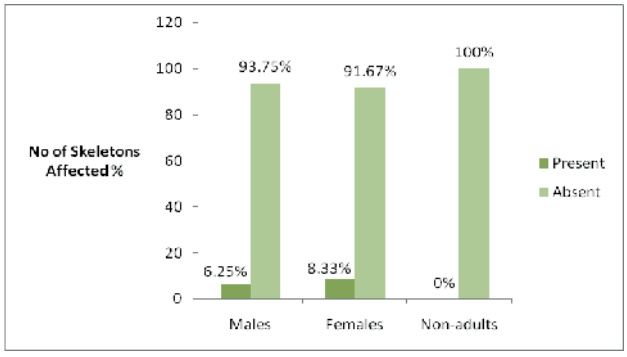


**Figure 4.27** Incidence of fractures (CPR2)

the assemblage were affected (Fig. 4.27). Details of these individuals, one male and two females, appear below.

Inhumation 2140, a male aged between 36 and 50 years, experienced an oblique fracture to his left clavicle (Fig. 4.28). The fracture had been in the process of healing at death, and was damaged either during excavation, or during processing. Inhumation 2020, a female aged between 25 and 35 years, had experienced multiple oblique fractures to her right arm. The fractures were located at her right humerus (mid diaphysis) and the right ulna (distal diaphysis, just above the metaphysis): both were old and well-healed. It is possible that the fractures occurred at the same time. Inhumation 2096, a female aged 21 to 35 years, had experienced a transverse fracture to a right rib (either the 5th, 6th or 7th). The injury was located one-third of the way from the thoracic end of the rib (Fig. 4.29).

Inhumation 2164, a male aged 36-50 years at death, had a large oval wound puncturing the rear of the cranium (left parietal), with radiating fractures, one of which continued through the skull suture to the occipital bone. The blunt edges of the wound and the absence of bone remodelling suggest that the wound was peri-mortem and that a pointed weapon had been thrust into the back of the cranium, presumably being the cause of death.


**Figure 4.28** Inhumation 2140, left clavicle, inferior view


**Figure 4.29** Inhumation 2099, right rib

### *Schmorl's Nodes*

Lovell (1997) explains that Schmorl's nodes are a mild form of burst fractures, resulting from vertical compression that ruptures the inter-vertebral disc through the vertebral end plate, forcing the disc tissue into the vertebral body. Schmorl's nodes can affect both the superior and/or inferior surfaces of vertebral bodies.

Within the sample of males, females and adolescents (TPR), 31.03% of individuals were affected by one or more Schmorl's nodes. Males and females were equally affected, showing a prevalence rate of 27.27% for males and 26.67% for females (Fig. 4.30). Two adolescents were affected by Schmorl's nodes, but are not shown as the sample of adolescents for study (n3) was too small to be representative. A total of 25 individual vertebrae were affected by Schmorl's nodes. More were identified as present, but as the individual vertebra could not be identified due to poor preservation, only the general location was recorded (*i.e.* lumbar or thoracic bodies). Schmorl's nodes were found only to affect the thoracic and the lumbar vertebrae.


**Figure 4.30** Incidence of Schmorl's nodes (TPR)

## Metabolic Conditions

References used in the diagnosis of the metabolic conditions featured below include Aufderheide & Rodriguez-Martin (2003), Lewis (2007), Mann & Hunt (2005), Ortner (2003), Roberts & Manchester (1995) and White (2000).

### *Cribra Orbitalia*

Cribra orbitalia is a term used for pathological changes affecting the orbit (eye socket). These can indicate the presence of iron-deficiency anaemia and also of general ill-health, blood loss through traumatic injury, chronic disease and biological stress. The condition only occurs during the growing period of an individual. In this study, cribra orbitalia has been classed as either 'active' (*i.e.* at time of death) or 'beginning/healing' where the lesions are slight and unable to be distinguished from the condition beginning or healing, or 'healed'. All adults affected had healed lesions.

Analysis revealed that 25.45% of the sample available for study (TPR) were affected by cribra orbitalia during their growth period. Non-adults were the most frequently affected (41.18%), and showed a mixture of active lesions, and lesions either beginning or healing. Males followed, 30.77% showing healed lesions, whilst the female sample showed 15% healed lesions. No NSAs were affected (Fig. 4.31). The non-adults with cribra orbitalia consisted of four children and three adolescents. Of interest is Inhumation 2093, a child aged between 6 and 8 years, who suffered from both active cribra orbitalia and active porotic hyperostosis (see below), both of which were present at his/her time of death.

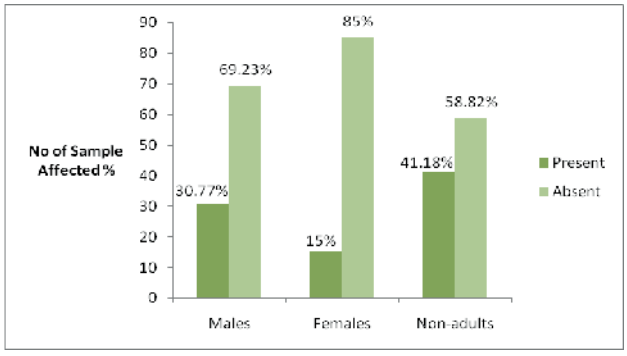


**Figure 4.31** Incidence of cribra orbitalia (TPR)

### *Porotic Hyperostosis*

Porotic hyperostosis is a term used for pathological changes affecting the cranial vault. Like cribra orbitalia, it can be indicative of iron-deficiency anaemia and other conditions. Analysis revealed that 1.54% of the sample available for study (TPR) was affected by porotic hyperostosis. Only Inhumation 2093, a child aged between 6 and 8 years, was found with active porotic hyperostosis lesions (Fig. 4.32). No males, females or NSAs were affected by the condition.

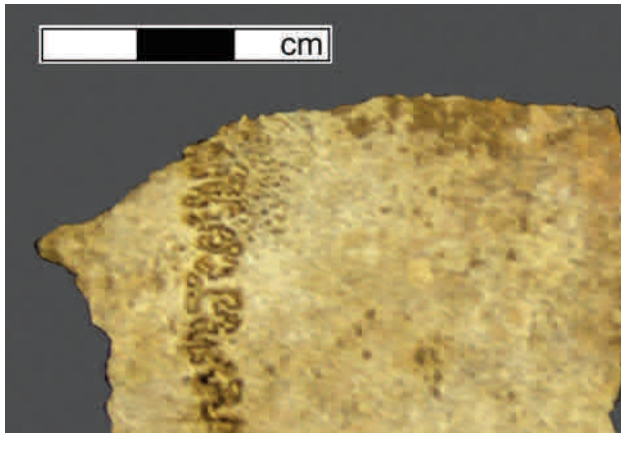


**Figure 4.32** Inhumation 2093, right parietal bone

### *Osteopenia*

Osteopenia is a term used to describe a disproportionate loss of bone mass. It may be caused by osteoporosis, rickets, hyperparathyroidism, cancer and severe malnutrition (Ortner 2003). Only one case of osteopenia was found within the Wolverton assemblage. The affected skeleton, Inhumation 2196, was that of a female aged 42+ years. All of her bones were exceptionally lightweight, and cross-sections of the long bones revealed a marked reduction in cortical bone and an increase in the size of the medullary cavity (Fig. 4.33). Most of her bones also showed signs of porosity, the vertebrae being exception-

ally porous. It is possible that Inhumation 2196 suffered from either Type I post-menopausal osteoporosis or Type II senile osteoporosis.


**Figure 4.33** Inhumation 2196, cross-section of right humerus, proximal

### *Dental Hypoplasia Lines*

Hypoplasia lines are horizontal lines which affect the permanent dentition, and are a result of a disruption of the development of the enamel, owing to biological stress during childhood. Measurement of the lines can indicate the time at which the stress occurred, although measurements rely on modern data for enamel development, and so should be regarded as an estimate only. A total of 35.85% of skeletons (CPR2) had dental hypoplasia lines present, 78.95% of which had more than one hypoplasia line recorded, indicative of re-occurring biological stress. The skeletons were all affected between the ages of 1.5 years and 5.5 years. The most frequent age of onset recorded within the sample was between 2 and 3.5 years (Fig. 4.34).

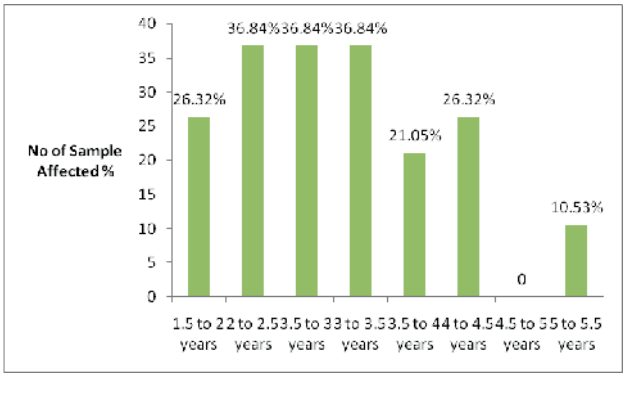


**Figure 4.34** Hypoplasia lines – age of onset (CPR2)

## RESULTS: THE CREMATIONS

Two urned cremation burials were found at Wolverton, Cremation 2252 and Cremation 2437. Cremation 2252 weighed 135g and had reached full oxidisation (more than 600°C). The remains appear to represent one individual, possibly an adult. No pathology or age related changes could be identified, and age and sex could not be established with any degree of certainty. Cremation 24437 weighed 390g and had also reached full oxidisation. The remains represent a young adult, aged between 18 and 35 years, possibly female.

## DISCUSSION

Whilst the osteological analysis of the Wolverton assemblage has created a lot of valuable comparative data, we should consider the limitations of such data. Many non-life threatening diseases are short-lived, so they do not affect the skeleton. Other diseases are so serious that death occurs before bone changes have taken place. For example, diseases such as various cancers rarely affect skeletal material. It should be remembered that the health of the population as represented here is based on the skeletal material alone, and that many disorders and diseases may have been present, yet cannot be assessed or accounted for.

### Mortality

Statistical analysis of the age at death of the sexed assemblage reveals that the majority of males and females passed away during middle age (36 to 50 years). The results imply that more females than males survived into old age, and that slightly more females than males passed away within the young age category (21 to 35 years), possibly reflecting problems during childbearing. Although there is no specific evidence within the Wolverton assemblage regarding obstetric problems, parallels can be drawn from other Anglo-Saxon assemblages. Roberts & Cox (2003, 165–6) draw together evidence for six sites where females were found with associated foetal bones, including Great Chesterford, Essex, where two females were found with foetal skulls in their pelvic areas (Waldron 1988).

The results for the non-adult assemblage reveal that most non-adults passed away during childhood (4-12 years) closely followed by adolescence (13-20 years). Very few deaths were found within the infant category (0-3 years), but this may not be truly reflective of the population on the whole. This may be due to bone loss relating to taphonomic factors and bone loss, and/or through modern disturbance, or that they were simply buried elsewhere.

### Health and Disease

An overview of the health of the Anglo-Saxon population of Wolverton, based on age and sex is provided below. The diet, dental health, joint disease, trauma, infectious disease and lifestyle of the aged males, females and non-adults of the burial population have been investigated. Where viable, comparisons have been made with comparative osteological data. However, in many instances the sample numbers varied between sites and different recording methods were used, so any comparisons drawn should be viewed in this light. Roberts & Cox (2003) compiled

osteological data from 72 Anglo-Saxon cemeteries dating between *c*.410–c.1050, representing a total of 7122 inhumation burials. A number of the sites collated by Roberts & Cox (*ibid*.) are within a 50 mile radius of Wolverton (Table 4.2). Comparable osteological data from these sites is referenced where relevant.

## Stature

Roberts & Cox (2003, 195) calculated the mean stature of 996 males and 751 females from various Anglo-Saxon sites, finding similar results to those of the Wolverton assemblage (Fig. 4.35).

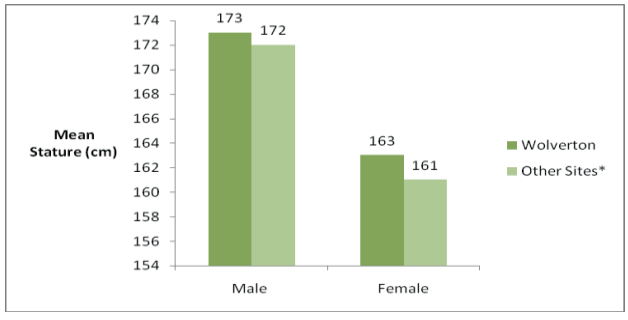


**Figure 4.35** Stature of males and females from Wolverton, compared with other Anglo-Saxon assemblages

## Diet

Cribra orbitalia, porotic hyperostosis and dental enamel hypoplasia are osteological expressions of metabolic disorders, partly related to diet and malnutrition, found within the Wolverton assemblage. Roberts & Cox (2003) suggest that although cribra orbitalia has a variety of potential causes, it is often associated with settled communities and an agricultural subsistence economy. Of the Wolverton assemblage, 28% (TPR) showed signs of cribra orbitalia, compared with 24.6% from other comparative sites Roberts & Cox (2003). Further work by Lewis (1999) on the non-adults from the Raunds (Northants) assemblage suggests 55% (TPR) were affected by cribra orbitalia. Initial results have shown that 35.85% (CPR2) of the Wolverton assemblage was affected by dental enamel hypoplasia, compared with 18.8% (CPR) from other sites (Roberts & Cox 2003). Data from Raunds Furnells (Northants) suggests 11.9% (CPR) of the population were affected. Lewis (1999) also found 32% (TPR) of non-adults affected by enamel defects. To enable comparison with Roberts & Cox (2003), the number of occurrences compared with the number of teeth has also been calculated, giving a total 4.84% (TPR) hypoplasia defects affecting the Wolverton population. This data can be compared with the 7.4% (TPR) from other sites (Roberts & Cox 2003), and with 1.9% (TPR) St Paul's Square, Bedford (*ibid*.).

## Dental Health

During the Anglo-Saxon period, dental health and dental hygiene were little understood. Dental disease can also be a reflection of dietary quality (Roberts & Cox 2003). The original data analysis of the dental health of the Wolverton assemblage was based on both the maxilla and the mandible being present for study, and on the number of individuals affected/not affected (CPR2). Roberts & Cox (2003) based their calculations on the number of teeth affected/not affected or sockets affected/not affected (TPR). Further calculations on the Wolverton dental data have been provided to enable comparisons between the Wolverton data, and that of Roberts & Cox (2003). Where necessary the calculations will state whether CPR or TPR has been used.

Within the Wolverton assemblage 33.3% (CPR2) of the sample had one or more teeth affected by dental caries, with the suggestion that females were slightly more affected by caries than the males. The TPR results for dental caries within the Wolverton assemblage reveal a slightly smaller percentage of individuals affected, 3.91% compared with 5.2% (TPR) for various sites (Roberts & Cox 2003). The results for other sites are similar: 3.2% (TPR) at Berinsfield (Oxon), 4.4% (TPR) at Empingham (Rutland), 4.4% (TPR) at Raunds Furnells and 3% (TPR) at St Paul's Square, Bedford (*ibid*.). The Wolverton males, females and non-adults have also been compared in this manner. The Wolverton results reveal that 2.59% (TPR) of non-adult teeth, 4.78% (TPR) of female teeth and

**Table 4.1** Selected Anglo-Saxon cemetery sites within a 50-mile radius of Wolverton (*after Roberts & Cox 2003*)

| *Site name and location* | *Approx. distance from Wolverton (miles)* | *References* |
|---|---|---|
| Berinsfield, Oxon | 30 | Boyle *et al* (1995) |
| Bidford-on-Avon, Warks | 30 | Brash (1923–4), Brash *et al* (1935) |
| Didcot, Oxon | 30 | Boyle *et al* (1995) |
| Empingham 2, Rutland | 45 | Mays (1996) |
| Great Chesterford, Essex | 50 | Waldron (1988) |
| Marina Drive, Dunstable, Beds | 10 | Matthews (1962) |
| Oakington, Cambs | 40 | Taylor *et al* (1998) |
| St Paul's Square, Bedford | 15 | Isaac & Roberts (1998) |
| Raunds Furnells, Northants | 25 | Powell (1996) |

3.67% (TPR) of male teeth were affected by caries. This confirms the suggestion from the earlier calculations that the female population showed a higher prevalence of caries than the male.

Within the Wolverton assemblage, 9.38% (CPR2) of the males and females were affected by dental abscesses. The TPR revealed that 0.72% (TPR) of the males and females were affected. Roberts & Cox (2003) cite 3.92% (TPR) with reference to data from various sites. The results from other individual sites are similar: 2.9% (TPR) at Berinsfield, 4.3% (TPR) at Raunds Furnells and 0.3% (TPR) at St Paul's Square, Bedford. The Wolverton results also reveal that 0.21% (TPR) of female sockets and 1.08% (TPR) of male sockets were affected by abscesses. Calculus was found in 58.3% (CPR2) of the Wolverton assemblage. Females were more affected than males, whilst non-adults were less affected. Collated data (Roberts & Cox 2003) suggests that calculus affected 35% (CPR). The results for Great Chesterford (Essex) suggest 21.5% (CPR) and 41.5% (CPR) at Raunds Furnells. In all, 6.25% (CPR2) of Wolverton assemblage showed signs of periodontal disease, and only females were affected. This is very low compared to the collated data (Roberts and Cox 2003), which suggests that periodontal disease affected 27% (CPR). Other sites also show a higher rate of periodontal disease compared with the Wolverton assemblage. The results for Great Chesterford suggest 26.9% (CPR), for St Paul's Square, Bedford 16.1% (CPR) and 42.9% (CPP) at Raunds Furnells.

## Joint Disease

Within the Wolverton assemblage a number of adults had joints affected by osteoarthritis. The total for the entire adult assemblage was 11.76% (CPR): it affected males more frequently and the disease was found to be more common within the middle to older age categories. This result is reflected by Roberts & Cox (2003), where the combined data on osteoarthritis reveals 8.82% (CPR), with males more frequently affected. Within the Wolverton assemblage, the spines of males were most frequently affected, but none was found in females. The collated data (Roberts & Cox 2003) indicates that spinal osteoarthritis affected a 6.12% (CPR) with more males affected. This is reflected by the Wolverton result of 7.15% (CPR).

## Trauma

Within the Wolverton assemblage fractures were recorded for 3.75% (CPR) of individuals. The collated data (Roberts and Cox 2003) suggests 5.9% (CPR). At Wolverton, fractures were found to affect one clavicle, one humerus, one ulna and one rib. Fractures to the clavicle have been found at Berinsfield, a fractured humerus and ribs were found at Great Chesterford and a rib fracture was also found at St Paul's Square, Bedford. In addition, one individual exhibited a large puncture wound to the skull which appeared to be peri-mortem and was probably the cause of death. Schmorl's nodes are often purported to represent severe wear and tear on the spine, primarily through lifting, bending and carrying heavy loads incorrectly. Schmorl's nodes are relatively common in skeletal assemblages, and tend to increase with age. Within the Wolverton assemblage 31% (TPR) were affected by Schmorl's nodes, whilst Roberts & Cox (2003) found 16.6% (TPR) from collated sites. The evidence from Wolverton suggests that both females and males were equally affected.

## Infectious Disease

Evidence for infectious disease within the Wolverton assemblage comes from the identification of possible tuberculosis, osteomyelitis and periostitis. Within the Wolverton assemblage, 4.35% (CPR) for possible 'early stage tuberculosis' and 9.68% (TPR) for possible 'early stage spinal tuberculosis' were found. The CPR for Wolverton is higher than that found by Roberts & Cox (2003); 0.9% (CPR) and for Raunds Furnells 0.6% (CPR) for tuberculosis. This discrepancy is due to a difference in categorisation, where previous researchers have only identified definitive, advanced cases of tuberculosis. However, as with all bone diseases there is always an early stage of the infection, where the bone changes are more subtle and not as advanced, and which should not be overlooked. The problem of the classification of 'early tuberculosis' and 'advanced tuberculosis' is discussed in Jacklin (2009, 21), with reference to Roberts (pers. comm.), who felt the classification of 'early stage tuberculosis' was a useful concept. It is also important to consider that tuberculosis only affects the skeleton in 5-7% of cases (Resnick 1995), and the true prevalence rate for tuberculosis within assemblages cited may be higher than indicated. No definitive, advanced cases of tuberculosis were identified within the Wolverton assemblage.

The Wolverton results reveal 2.5% (CPR) of individuals were affected by periostitis. Some of the periosteal reactions may have been associated with infectious diseases, such as tuberculosis and other more virulent undiagnosed disorders. Some periosteal reactions were associated with localised infections and some with non-specific infections. Osteomyelitis affected 2.5% (CPR) of the Wolverton assemblage, similar to the results achieved by Roberts & Cox (2003), with 1.34% (CPR) for their collated site data on osteomyelitis. Within the Wolverton assemblage one individual shows signs of possible poliomyelitis (1.25% CPR). Evidence for five possible cases of poliomyelitis from other Anglo-Saxon sites is discussed by Roberts & Cox (2003). The main identifying factor for the disease in all cases was wasted and atrophied limbs.