Chapter 6: The human bone assemblage

by Ceridwen Boston, Annsofie Witkin, Angela Boyle and Jennifer Kitch

INTRODUCTION

The skeletal remains of 111 individuals contained within decayed lead coffins were collected for osteological analysis. These were divided into two groups: the named sample, which was the larger group and comprised 72 individuals, and the unnamed sample of 39 individuals. As noted in Chapter 1, the named sample was subject of full osteological analysis, whilst the unnamed underwent less detailed analysis that was primarily aimed at understanding the social demography of the group. Due to these different methodologies, the results of the osteological analysis of the two samples are presented separately in this chapter, but combined where relevant and for discussion.

THE NAMED SAMPLE

Methodology

Preservation and completeness

Skeletal preservation may vary considerably between burials as a result of differences within the immediate micro-environment surrounding each skeleton. Preservation is influenced by a wide range of environmental factors (such as the pH of the surrounding soil, the type and presence of a coffin and materials placed within the coffin itself), and complex interactions between these factors often occurs making preservation within and between assemblages highly variable. Indeed, each burial may be seen as existing within its own niche environment (Henderson 1987, 43). The principal factors that affected preservation within the St George's assemblages were the degree of compression, the type of coffin, the use of absorbent material (such as sawdust and bran within the coffin) and the inclusion of lime, all of which may accelerate or retard diagenesis. The age and sex of the skeleton and some pathological conditions (such as osteoporosis) may also influence bone preservation.

Preservation was scored on a scale from: **1** (Poor) to **4** (Excellent). Preservation categories were defined as follows:

1 **Poor** – cortical bone soft, leached, flaking or eroded – not possible to identify most pathologies, poor preservation of trabecular bone, especially diaphyses and less dense bone, such as vertebrae, ribs and pelves.

2 **Fair** – cortical bone displaying some damage (such as demineralisation, flaking and erosion) but some areas of well preserved bone present – limited potential for observing pathology.

3 **Good** – some damage to cortical bone present, but large areas sufficiently well preserved to identify pathology and non-metric traits and undertake metrical analysis; trabecular bone preservation good with most epiphyses and joint surfaces intact, and good representation of ribs, vertebrae and pelves.

4 **Excellent** – cortical bone pristine not having undergone the above destructive changes to either the cortical or trabecular bone, possible to undertake full osteological analysis.

Completeness was also scored on a four point scale, based on the percentage of the total skeleton present. These categories were defined as follows: 1 (5% – 25% complete), 2 (26% – 50%), 3 (51% – 75%), 4 (76% – near complete).

Skeletal inventory

A pictoral and tabular inventory was created for each skeleton. This recording formed the basis of true prevalence calculations of pathological conditions described below.

Dental inventories were made following the Zsigmondy system (as cited in Hillson 1996, 8-9). Dental notations were recorded by using universally accepted recording standards and terminology (after Brothwell 1981).

Determination of sex

Sexually dimorphic traits emerge after the onset of puberty, and hence, can only be ascribed with any degree of accuracy in skeletons aged greater than 16-18 years. The pelvis is the most sexually dimorphic element, exhibiting features that directly relate to functional evolutionary differences between the sexes (Mays 1998; Mays and Cox 2000), most significantly childbirth in females. Blind studies of individuals of known sex reveal that ascribing sex using this element alone had a reported accuracy as high as 96 % (Meindl *et al*. 1985; Sutherland and Suchey 1991).

The skull is the next most sexually dimorphic element, from which sex may be correctly inferred in up to 92 % of cases (Mays 1998, 38). It has been claimed that sex estimation from the cranium alone has an accuracy of 88 %, (St Hoyme and Iscan 1989, 69), whilst there is a 90% accuracy when the mandible is also present (Krogman and Iscan 1986, 112). This observed sexual dimorphism arises as the result of the action of testicular hormones on the bones of the male skull (ibid., 38), which is characterised by a general increase in robusticity and enlargement of muscle attachment sites. Blind studies of sex estimation undertaken on the named assemblage from Spitalfields revealed that in skeletons where complete skulls and pelves were present accuracy was as high as 98% (Molleson and Cox 1993).

Six cranial features and a maximum of ten pelvic features were used for sexing adults. On the cranium, the features used were selected from Ferembach *et al.* (1980) and Buikstra and Ubelaker (1994). Sexually diagnostic features of the pelvis included the greater sciatic notch and preauricular sulcus (Ferembach *et al.*1980), as well several features of the pubic bone described by Phenice (1969).

Measurements used for sexing were the diameters of the femoral, humeral and radial heads, as well as the length of the clavicles and the width of the glenoid fossae (Chamberlain 1994). Cranial and post-cranial metrics may also be used to ascribe sex, but their potential is limited by the considerable variation between individuals and between populations. A substantial zone of intermediate values exists between the two sexes, rendering sexing using metrical analysis alone very unhelpful in these cases. Post-cranial measurements rely on the generalisation that males (under the influence of male hormones) tend to be taller and more robust than their female counterparts. Considerable variation in such sexual dimorphism has been noted between populations. In the St George's assemblage, a large number of males were gracile, thereby increasing the probability of erroneously ascribing female sex to these individuals. As a result, metrics were treated as being of secondary importance in ascribing sex to individuals of the St George's assemblages.

Osteologically, sex may be ascribed with differing levels of certainty, depending on the extent of sexual dimorphism present and the number of sexually dimorphic sites available for study. Sex categories used in this study reflect this uncertainty: possible male or female (??male or ??female) was used where there is marked uncertainty but where there are sufficient traits to tentatively suggest the sex of the skeleton; probable male (?male) or female (?female) was used where some ambivalence or uncertainty exists, but where the sex of the individual could be ascribed with more confidence than those in the previous category; and male or female was used where there is considerable certainty in the sex of an individual. In order to increase numbers for the present analysis, the female, ?female and ??female categories, and male, ?male and ??male categories were conflated to produce single female and male groups.

Estimation of osteological age

Osteological age reflects the biological age of the skeleton and not the chronological age of the individual. The difference between osteological and chronological age, in part, is due to genetic influences, but largely is the result of external factors, such as nutrition and lifestyle, that impact on skeletal growth and subsequent degeneration (Schwartz 1995, 185). Subadults may be aged more precisely than adults, as the growth and maturation sequence of children is fairly predictable and uniform (Scheuer and Black 2000). The development and eruption of both deciduous and permanent dentition are believed to be less affected by environmental factors than skeletal growth (Roberts 1997, 111), and hence, have been used as the most accurate ageing method in this study. Ageing of adults over the age of 18 years was estimated from bony changes at various sites on the skeleton. The age categories employed in this analysis are shown in Table 6.1.

In order to increase the accuracy of age estimations, multiple methods were employed. Age estimation of subadults involved analysis of the following: dental development of deciduous and permanent dentition (Moorees *et al*. 1963 a and b), diaphyseal long bone length (Maresh 1955; Hoppa 1992) and epiphyseal fusion (Ferembach *et al.* 1980; Schwartz 1995). The last was also used on skeletons aged up to 25 years.

Adults were aged using methods relating to the degeneration of the ilial auricular surface (Lovejoy *et al.* 1985), pubic symphysis (Todd 1921a and b; Brooks and Suchey 1990), and sternal ends of the mid-thoracic rib (Iscan *et al.* 1984, 1985). Methods relating to ectocranial suture closure (Meindl and Lovejoy 1985) were also used but were not as rigorously applied as the aforementioned, as the accuracy and precision of this method is not believed to be high (Cox 2003). The dental attrition ageing method of Roden (1997) was also applied to a small number of named individuals. The method was developed on the 19th century burial assemblage of the Newcastle Infirmary, Newcastle-upon-Tyne. Due to the refined diet enjoyed in the 18th and 19th centuries, dental attrition in this time period was greatly reduced when compared to earlier agricultural societies. It was therefore inappropriate to apply methodologies

Table 6.1: Human bone: Age categories

neonate	< 1 year
infant 1	1-5 years
infant 2	6-11 years
adolescent	12-17 years
young adult	18-25 years
prime adult	26-40 years
mature adult	40-50 years
ageing adult	50+ years
subadult	< 18 years
adult	>18 years

devised for prehistoric and medieval populations (e.g. Miles 1962; Brothwell 1981). Roden's method involved ageing of all subadults using the tooth formation standards developed by Smith (1991), and then sequencing them by age. This was used as a reference for sequencing adult dentition in order of increased attrition. The Infirmary population comprised working class individuals but was contemporary with the St George's crypt assemblage. The method has not been widely used and its implementation in this analysis was to test its usefulness in a contemporary but more affluent population.

Certain more recent ageing methods, such as Buckberry and Chamberlain's (2002) revised method using degeneration of the ilial auricular surface, were not available at the time of analysis.

Estimation of stature

The stature of named individuals was calculated by applying measurements of the maximum length of long bones to regression formulae for white males and females devised by Trotter (1970). Measurements of lower limb bones were preferred over those of the upper limb, as these carry less error. In order to reduce the standard error, only calculations using combined femoral and tibial measurements were included in the analysis below.

Comparative assemblages

The results of the osteological analysis of the St George's crypt sample were compared to broadly contemporary skeletal assemblages from England that derived from differing socio-economic backgrounds. This facilitated exploration of the effects of social class on the demographic structure and patterns of health and disease in these populations. The assemblages were from the Newcastle Infirmary (Boulter *et al.* 1997), the Cross Bones burial ground, London (Brickley *et al.* 1999), Christ Church, Spitalfields, London (Molleson and Cox 1993, Cox 1996) and St Luke's Church, Islington (Boyle *et al*. 2005). This selection was determined by the availability of data at the time of writing.

The Cross Bones burial ground is believed to have been in use from the middle of the 19th century, within a 10 to 30 year time span. Around 18% of those buried there died in the workhouse. Overall, the individuals buried at the cemetery were the poorest members of an underprivileged community (Brickley *et al.* 1999, 48).

The human remains from Newcastle Infirmary, Newcastle-upon-Tyne, Northumbria, dated between 1745 and 1845, and represented those who died in the hospital. The more affluent classes of the day were treated privately at home, and medical treatment in public hospitals was reserved for the poor who were eligible for medical care under the Poor Law (Nolan 1997). Hence, the assemblage comprises the city's poor, but is also thought to include a large number of sailors.

The named sample from Christ Church, Spitalfields, was interred within the crypt between 1729 and 1852. Trade directories and burial records indicated that most individuals were artisans and master craftsmen (Cox 1996, 69), many of whom had achieved considerable affluence in the silk trade, but remained resolutely middle class. Very few were professionals or were independently wealthy.

The named sample from St Luke's, Islington, derived primarily those interred within the church crypt, and from extramural family vaults. The crypt was in use between 1740 and 1853. Burials in the cemetery commenced slightly earlier in 1734 (Boyle *et al.* 2005, 34). The place of burial and the elaborate lead-lined coffins were characteristic of middle class interments of the period.

Results

Quantification

A total of 781 coffins was removed from the crypt. Of these, 111 coffins were so poorly preserved that the human remains were removed and analysed prior to

Table 6.2: Quantification of coffins by vault, showing numbers of coffins in the named and unnamed samples

	No. of Coffins	*No. of Named sample*	*%age of vault total*	*%age of sample total (N=72)*	*No. of Unnamed sample*	*%age of vault total*	*Total Studied*	*%age of vault total*
Vault 1	225	11	4.89	15.28	4	1.78	15	6.67
Vault 2	69	4	5.80	5.55	1	1.45	5	7.25
Vault 3	94	10	10.64	13.89	7	7.45	17	18.09
	388	**25**	**6.44**	**34.72**	**12**	**3.09**	**37**	**9.54**
Vault 4	85	24	28.24	33.34	7	8.24	31	36.47
Vault 5	80	11	13.75	15.28	3	3.75	14	17.50
Vault 6	139	6	4.32	8.33	5	3.60	11	7.91
	304	**41**	**13.49**	**56.94**	**15**	**4.93**	**56**	**18.42**
Vault 7	89	6	6.74	8.33	12	13.48	18	20.22
	781	**72**	**9.22**		**39**	**4.99**	**111**	**14.21**

reburial. The assemblage of named individuals that underwent osteological analysis comprised 72 individuals. A skeleton was classified as a named individual if the associated *depositum* plate was legible or partly legible, such that the name and/or the age at death could be discerned. These data are discussed more fully in Chapter 5 above.

The skeletons that comprised the named sample were retrieved from all seven vaults (Table 6.2). All the skeletal remains were recovered from lead-lined coffins. In Vaults 1 to 6, the coffins were neatly stacked and subsequently covered by a layer of sand, which in turn was overlaid by a substantial layer of charcoal. Vault 7 contained redeposited coffins, which had been stacked in a random manner, and some had been upended and folded in two. These had suffered considerably more damage than coffins from the other six vaults (See Chapter 3), resulting in separation of the skeletal remains from their associated *depositum* plate.

Preservation and completeness

The principal factor affecting coffin preservation was compression by overlying coffins in the coffin stacks. More skeletons were retained from the vaults located on the western side of the crypt (41 skeletons from Vaults 4 to 6) than the eastern side (25 skeletons from Vaults 1 to 3). Another factor affecting preservation of the lead shells was damp. Watermarks were clearly visible on the brickwork sealing the western vaults, indicating that these vaults had been much wetter than those on the eastern side. This is likely to account for greater erosion of the lead shells in these vaults, and hence, the greater number of retained skeletons. Moreover, as work progressed, removal methods were refined, with the result that fewer skeletons were retained from those vaults that were emptied last (namely Vaults 2 and 6).

The low retrieval rate of named individuals from Vault 7 (Table 6.2) was due to the destruction of

Table 6.3: Named sample: Completeness and preservation (N = 72)

Completeness	*Percentage of sample (n/N)*	*Preservation*	*Percentage of sample (n/N)*
1 (poor)	1.39% (1/72)	1 (poor)	0% (0/72)
2	12.50% (9/72)	2	27.78% (20/72)
3	30.55% (22/72)	3	59.72% (43/72)
4 (excellent)	55.56% (40/72)	4 (excellent)	12.50% (9/72)

Table 6.4: Named sample: Preservation and location within the crypt

Location	*1 (Poor) (n/N)*	*2 (n/N)*	*3 (n/N)*	*4 (excellent) (n/N)*	*Total percentage of individuals (n/N)*
Vault1	0	2.78% (2/72)	11.11% (8/72)	1.39% (1/72)	15.28% (11/72)
Vault 2	0	1.39% (1/72)	2.78% (2/72)	1.39% (1/72)	5.56% (4/72)
Vault 3	0	4.17% (3/72)	9.72% (7/72)	0	13.89% (10/72)
Vault 4	0	9.72% (7/72)	20.83% (15/72)	2.78% (2/72)	33.33% (24/72)
Vault 5	0	2.78% (2/72)	9.72% (7/72)	2.78% (2/72)	15.28% (11/72)
Vault 6	0	6.94% (5/72)	0	1.39% (1/72)	8.33% (6/72)
Vault 7	0	0	5.55% (4/72)	2.78% (2/72)	8.33% (6/72)
Percentage of total sample	0	27.78% (20/72)	59.71% (43/72)	12.51% (9/72)	100% (72/72)

most coffins during their re-deposition in the vault (see Chapter 3 above); many *depositum* plates became detached during this process. Furthermore, the human remains in many coffins had previously been removed and collected as charnel in fertiliser bags. The result was that it was not possible to identify some individuals from Vault 7 with any certainty.

Overall, 86.11% of the skeletons were more than 50% complete, and 72.22% were well or excellently preserved (Table 6.3). There appeared to be no significant difference in skeletal preservation between the vaults (Table 6.4), nor does there appear to have been a correlation between skeletal completeness and their location in the crypt (Table 6.5). The most poorly preserved remains within

Table 6.5 Named sample: Completeness and location within the crypt

Location	*1 (Poor) (n/N)*	*2 (n/N)*	*3 (n/N)*	*4 (excellent) (n/N)*	*Total percentage of individuals (n/N)*
Vault 1	0	0	1.39% (1/72)	13.89% (10/72)	15.28% (11/72)
Vault 2	0	0	1.39% (1/72)	4.17% (3/72)	5.56% (4/72)
Vault 3	0	2.78% (2/72)	2.78% (2/72)	8.33% (6/72)	13.89% (10/72)
Vault 4	1.39% (1/72)	2.78% (2/72)	12.50% (9/72)	16.66% (12/72)	33.33% (24/72)
Vault 5	0	1.39% (1/72)	2.78% (2/72)	11.11% (8/72)	15.28% (11/72)
Vault 6	0	5.55% (4/72)	1.39% (1/72)	1.39% (1/72)	8.33% (6/72)
Vault 7	0	0	8.33% (6/72)	0	8.33% (6/72)
Percentage of total sample	1.39% (1/72)	12.50% (9/72)	30.56% (22/72)	55.55% (40/72)	100% (72/72)

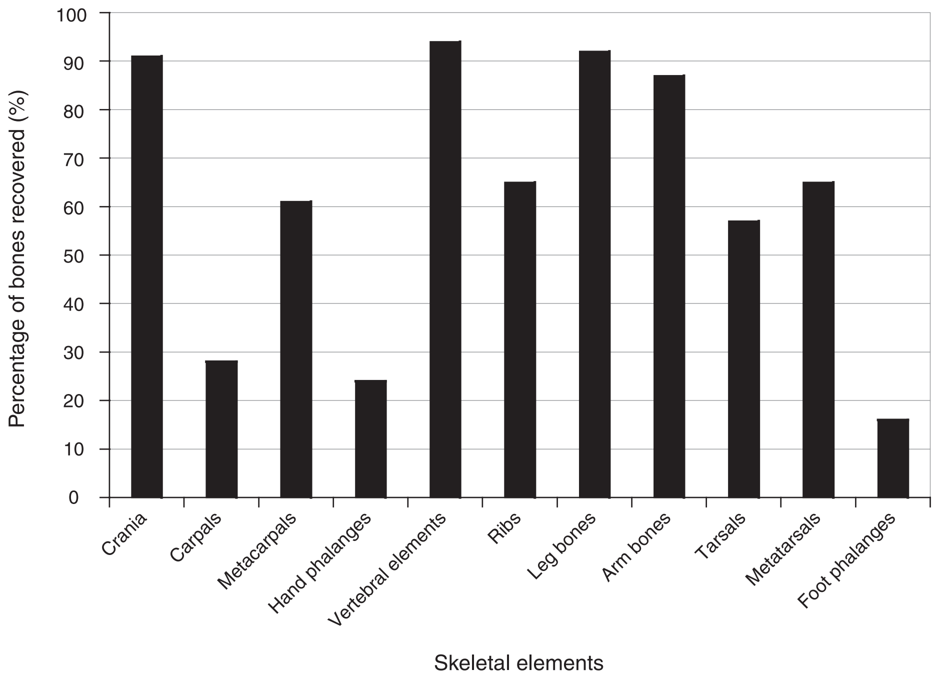


Fig. 6.1 Recovery of skeletal elements (percentage of total bones of each element)

each vault were situated towards the base of the coffin stacks where compression was greatest.

Poorer preservation was noted in skeletons interred within coffins where the base of the inner wooden coffin had been overlaid with a layer of sawdust or bran. Considerable leaching of the bone mineral was observed, leaving the bone soft and easily damaged by handling. White crystals, or brushite, were clearly observed on the cortical bone surfaces. Similar deleterious effects of sawdust on skeletal preservation was observed in another post-medieval assemblage from Bathford, near Bath (Nawrocki 1995, 54).

The skeletal inventories revealed that most bones were represented, except for the small bones of the wrist, fingers and toes, which were under-represented (Fig. 6.1). The best represented elements were crania and the long bones of the lower limbs. Poor recovery by archaeologists was probably the principal factor underlying the under-representation of small bones – not surprising given the cramped conditions and poor lighting within the vaults during the coffin clearance. Moreover, the removal of the lead coffins sometimes opened up wider gaps in the decaying lead and small bones were lost within the general backfill. When they were located it was not possible to associate them with the correct skeleton.

Demography

Demographic analysis of living populations involves the comparison of statistics of fertility, mortality and migration patterns. The demographic analysis of past populations based on skeletal samples normally concentrates on mortality since, in the absence of historical records, fertility and migrations can only be inferred from the osteological data. Documentary sources add another dimension to the study of population structure of the St George's assemblage and are discussed in Chapter 5 above.

Osteological age and sex

Three adults (skeletons 4047, 4075 and 7006) could not be sexed osteologically, and were redistributed according to the sex given on the coffin inscription, which had them recorded as male, male and unknown. The sex distribution within the total sample 52.77% males (n/N=38/72) and 40.28% females (including one older adolescent) (n/N=29/72). Four younger subadults were not sexed in accordance with accepted practice.

The assemblage of 72 skeletons comprised five subadults (6.94 %) and 67 adults (93.06 %) (Table 6.6). There were no young adults (18-25 years) and only five subadults (< 18 years) (Table 6.6; Fig. 6.2). A total of 51 individuals (70.83 %) lived to an age greater than 40 years, and of these, 25 (34.72 %) were aged over 50 years. Mortality increased with age, becoming more pronounced in the mature male adult category (39.5 %; n/N=15/38), and with 50 % of adult males (n/N=19/38) living beyond 50 + years of age. By contrast, there was considerably lower longevity in the female population, with mortality rising steeply to 37.93 % amongst the prime adult (n/N=11/29) and mature adults (n/N=11/29), and falling away to 20.69% in the 50+ category (n/N=6/29). Hence, there was a considerable difference in mortality pattern between the sexes, with 79.31 % of females dying before reaching the age of 50 years, compared to only 50% of their male counterparts. No women died in young adulthood (the prime childbearing age); all, bar one adolescent, were aged greater than 25 years. This may suggest later marriage in this group, but this was not verified by parish or government marriage records.

The London Bills of Mortality of the first four decades of the 19th century reveal that 50 % of the population died before the age of 21 years, and that of these, 40% died before their fifth birthday (Roberts and Cox 2003, 303). Most adults lived to between 30 and 50 years of age (ibid.). A small

Table 6.6 Named sample: Osteological age and sex (includes two adults who have been assigned sex based on biographical and not osteological data)

	Neonate (0-11 months)	*Young child* (1-5 years)	*Older child* (6-11 years)	*Adolescent* (12-17 years)	*Young adult* (18-25 years)	*Prime adult* (26-40 years)	*Mature adult* (40+ years)	*Ageing adult* (50+ years)	*Total*
Male	-	-	-	-	-	5.55% (4/72)	20.83% (15/72)	26.39% (19/72)	52.77% (38/72)
Female	-	-	-	1.39% (1/72)	-	15.28% (11/72)	15.28% (11/72)	8.33% (6/72)	40.28% (29/72)
Unknown	2.78% (2/72)	-	4.17% (3/72)	-	-	-	-	-	6.95% (5/72)
Total	2.78% (2/72)	-	4.17% (3/72)	1.39% (1/72)	-	20.83% (15/72)	36.11% (26/72)	34.72% (25/72)	100% (72)

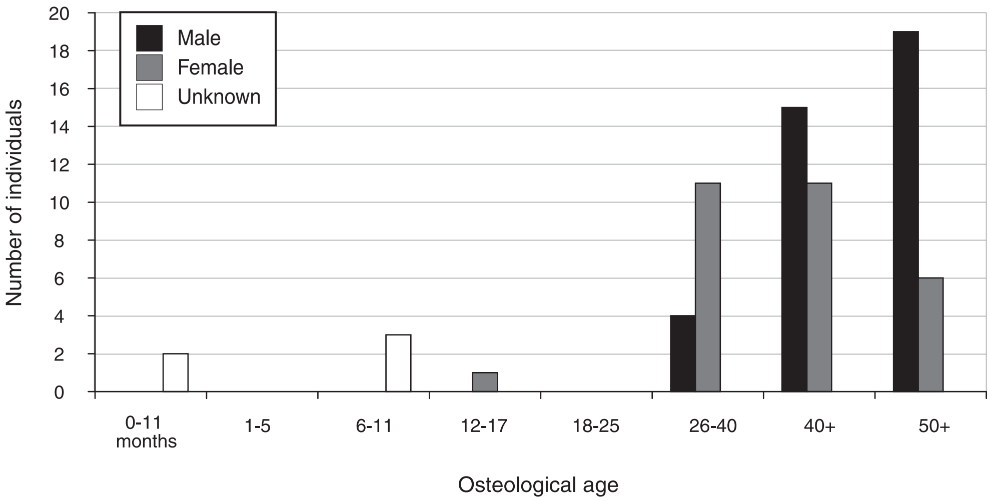


Fig. 6.2 Named sample: Mortality profile based on osteological age (N=72)

proportion (6% in the beginning of the period and 11% at the end) did survive into their 70s and beyond (Roberts and Cox 2003, 304). Osteological analysis of the named sample from St George's crypt reveals a different picture. It shows that 2.8% of the sample had died before they had reached their fifth birthday, 8.34% before they were 21 years old, and 29% of the individuals lived to an age greater than 70 years. The London Bills of Mortality and documented ages are compared in more detail in Chapter 5.

Chronological age and sex

The demography discussed above was undertaken using osteological methodology. It is interesting to contrast the results above with those obtained using the biographical data obtained from the *depositum* plates.

The ages of 14 of the named sample of 72 were not recorded from their coffin plate inscriptions and, for comparative reasons, were redistributed proportionately. The inscriptions revealed that the assemblage comprised five subadults (6.9%; N=72) and 67 adults (93.1%; N=72) (Table 6.7, Fig. 6.3). Forty-four individuals (61.1%; N=72) lived beyond 50 years of age.

Three adults could not be sexed and were redistributed proportionally. Of the total population (N = 72), 56.9 % were male (n=41) and 43.1% were females (n=31). The assemblage therefore comprised more males than females. In the age groups greater than 26 years, there was little difference in mortality rates between the sexes: 83.81% (n/N=26/31) for women and 92.68% (n/N=38/41) for men. It appears that in the mature adult category mortality amongst the females at 19.5 % (n/N=6/31) was greater than that for men, since only one man of the named sample died in that age band. Male mortality in the older age category (70.73%, n/N=29/41) was much higher than that of females (48.39%, (n/N=15/31). Nonetheless, there was a marked increase in females in the 50+ age category when compared to the osteological age and sex data (Fig. 6.4).

Table 6.7 Named sample: Chronological age and sex (redistributed totals) taken from departum plate inscriptions

	Neonate (0-11 months)	*Young child* (1-5 years)	*Older child* (6-11 years)	*Adolescent* (12-17 years)	*Young adult* (18-25 years)	*Prime adult* (26-40 years)	*Mature adult* (40+ years)	*Ageing adult* (50+ years)	*Total*
Male	1.39% (1/72)	1.39% (1/72)	1.39% (1/72)	-	-	11.11% (8/72)	1.39% (1/72)	40.28% (29/72)	56.95% (41/72)
Female	-	-	1.39% (1/72)	1.39% (1/72)	4.17% (3/72)	6.94% (5/72)	8.33% (6/72)	20.83% (15/72)	43.05% (31/72)
Total	1.39% (1/72)	1.39% (1/72)	2.78% (2/72)	1.39% (1/72)	4.17% (3/72)	18.05% (13/72)	9.72% (7/72)	61.1% (44/72)	100% (72)(72)

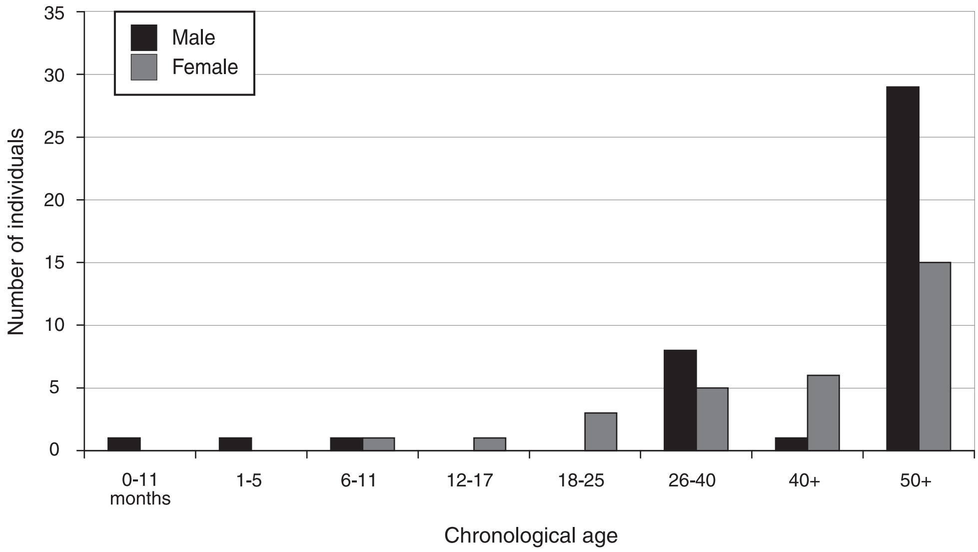


Fig. 6.3 Named sample: Mortality profile based on chronological age (N=72)

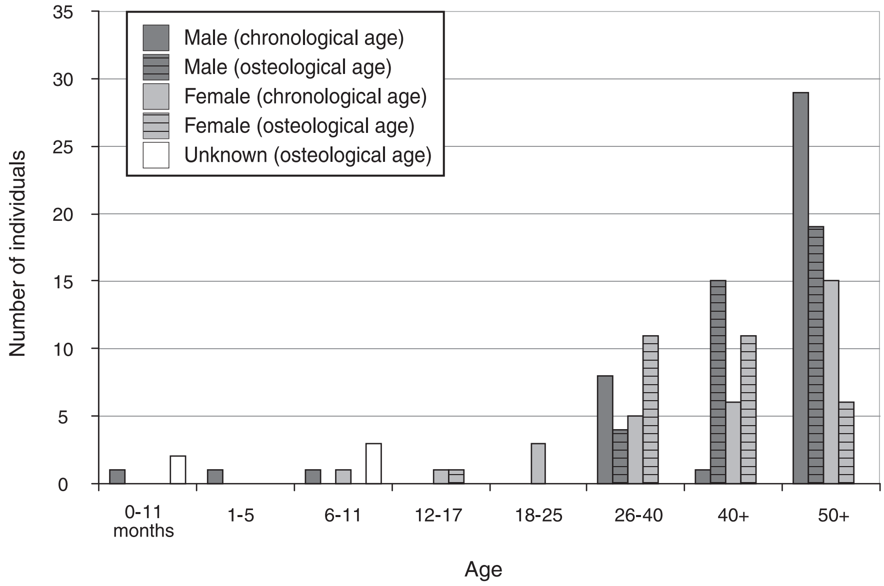


Fig. 6.4 Named sample: Comparison between mortality profiles based on osteological and chronological age (N=72)

Table 6.8: Stature at St George's and in four contemporary skeletal assemblages

	Male (Mean)	*Male (Range)*	*Female (Mean)*	*Female (Range)*
St George's Church, Bloomsbury	1.72	1.52 m-1.85 m	1.60 m	1.49 m-1.72 m
St Luke's Church, Islington	1.70 m	1.55 m-1.93 m	1.58 m	1.49 m-1.72 m
Newcastle Infirmary	1.71 m	1.60 m-1.83 m	1.60 m	1.50 m-1.76 m
Christ Church, Spitalfields	-	1.68 m-1.70 m	-	1.54 m-1.59 m
Cross Bones, Southwark	1.69 m	1.53 m-1.80 m	1.58 m	1.42 m-1.72 m

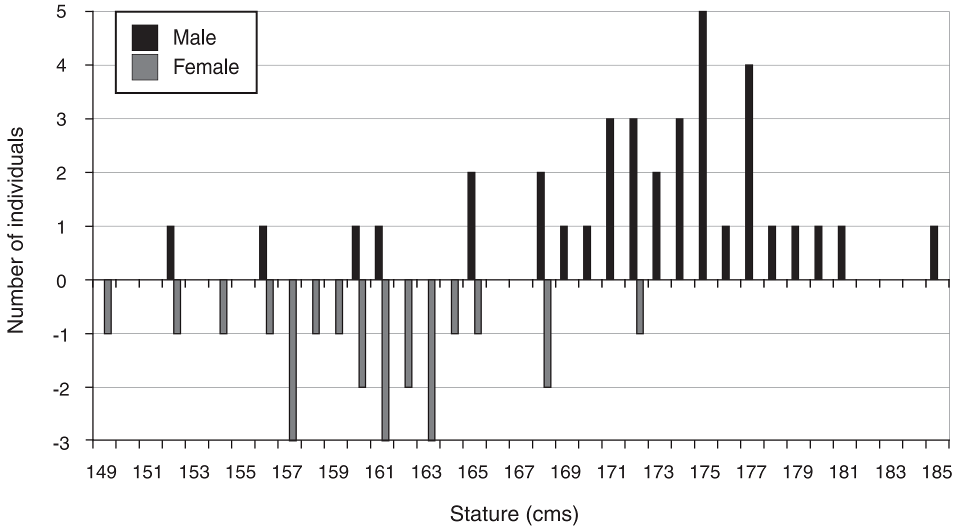


Fig. 6.5 Named sample: Mean stature of males and females (N=15 and 20 respectively)

Stature

Estimated adult female stature (n=20) ranged between 1.48 m and 1.79 m, with a mean stature of 1.60 m. Adult male stature (n=15) ranged between 1.52 m to 1.85 m, with a mean stature of 1.72 m. The wide stature ranges for each sex, and the considerable overlap in individual male and female statures revealed marked height variation within this population (Fig. 6.5). There was a difference of 0.12 m in the mean stature estimation of males and females (Table 6.8).

These means and ranges are broadly comparable with contemporary skeletal assemblages. As might be expected, the mean stature of the St George's crypt sample, which largely comprised fairly affluent members of the artisan and middle classes, was similar to middle class assemblages of Christ Church, Spitalfields, and St Luke's Church, Islington.

Less expected was the fact that mean statures of the predominantly working class burials at the Cross Bones burial ground and the Newcastle Infirmary were also similar (Table 6.8), albeit slightly lower in the former. It might have been expected that there would been a greater difference, reflecting differences in poorer nutrition, living conditions and access to medical care. This, however, does not appear to have been the case. Other factors, such as regional differences in genetic composition of populations may also play a role, particularly when comparing the Newcastle Infirmary population to the London assemblages.

Dental pathology

Dental pathology, such as periodontal disease, caries and ante-mortem tooth loss (AMTL), is most commonly caused by the consumption of carbohydrates (particularly simple sugars) and poor oral hygiene practices. Food residues left on the teeth following consumption of carbohydrates rapidly become colonised by bacteria, and are broken down to form a corrosive acidic plaque. It is this plaque that is responsible for the development of carious lesions on the teeth (Hillson 1996, 269). Plaque may also mineralise, forming a hard unmoveable coating of calculus on the tooth surface, colloquially known as tartar. Periodontal disease is the inflammation of the soft tissues of the mouth, namely the gums, and/or the periodontal ligament and alveolar bone (Levin 2003, 245). Retraction of the gums exposes the vulnerable root of the tooth to attack by acidic plaques, commonly resulting in caries, abscesses and ante-mortem tooth loss.

In the post-medieval period, the consumption of cane sugar gradually increased. In the 16th and 17th centuries, sugar was an expensive and high status luxury available only to the most affluent (Musgrave and Musgrave 2000, 60). However, the development of sugar plantations in the West Indies in the 18th century generated a more readily available and more affordable supply of the commodity to markets in Europe. Sugar consumption gradually spread down the social classes, until by the latter half of the 19th century it was available to all but the most indigent (ibid.). By the early 19th century, sugar was regularly consumed by the middle classes, but was not yet cheap enough to be readily available to the lower classes. However, the St George's population certainly could afford such a luxury, and paid for their pleasure with widespread dental decay.

A wide array of implements used for keeping teeth clean was available in the 18th and 19th

Table 6.9: Comparison of prevalence of dental disease (per tooth) in five contemporary osteological assemblages

Post-medieval assemblages	*Ante-mortem tooth loss (n/N)*	*Abscesses (n/N)*	*Calculus (n/N)*	*Caries (n/N)*	*Enamel hypoplasia (n/N)*	*Dental fillings (n/N)*
St George's Church, Bloomsbury	40.99% (669/1632)	2.82% (46/1632)	70.85% (592/844)	13.39% (110/844)	16.35% (138/844)	0.83% (7/844)
St Luke's Church, Islington	36.10% (1762/4883)	1.78% (87/4883)	46.33% (1042/2249)	9.74% (219/2249)	2.18% (49/2249)	0.27% (6/2249)
Newcastle Infirmary, Newcastle	19.3% (604/3123)	0.9% (29/3123)	55.85% (718/1287)	11% (146/1327)	17% (219/1287)	0.0%
Christ Church, Spitalfields	19.91% (324/1627)	Data not available	Data not available	19.11% (311/1627)	Data not available	0.24% (4/1627)
Cross Bones burial ground, Southwark	17.30% (211/1216)	2.30% 28/1216	Data not available	25.93% (161/621)	Data not available	Data not available

centuries, including toothbrushes with handles made of ornate gold or silver, and ivory toothpicks carried in small, decorated cases (Picard 2000, 154). Tooth powders became increasingly available in the later 18th century. These were made of a wide array of ingredients, many being innocuous, but some included abrasive materials (such as brick dust) and/or caustic substances (including tartaric acid) (Hillam 1990, 5-7; Roberts and Cox 2003, 324). These substances may well have whitened the teeth and striped away calculus, but often also severely damaged the dental enamel beneath. However, habitual cleaning of teeth appears to have been very uncommon in this period, and it is improbable that many people maintained good oral hygiene.

For the purposes of this section, the oral health of the individuals with permanent dentition only is discussed. Subadults with mixed or deciduous dentition were omitted due to the low number of individuals. Of the 68 skeletons with permanent dentition, 62 (91.18%) had jaws present (including permanent *in situ* dentition, loose teeth and maxillae and/or mandibulae with empty or resorbed sockets). In total, 844 teeth were present, 669 teeth had been lost ante-mortem and 119 teeth had been lost post-mortem. Table 6.9 below presents comparative prevalences of major categories of dental pathology of the St George's named sample and other contemporary assemblages. These data are discussed below.

Dental caries

Dental caries involves the destruction of the enamel surface, the dentine (internal part of the tooth) and/or the cementum (outer layer of the roots), and is caused by acid in dental plaque (Hillson 1996, 269). The association of acidogenic bacteria and sugar in the diet is a well established cause of cavitations (Lukacs 1989, 265).

In this study, the size of each carious lesion was classified according to the universally used grading system of Lukacs (1989). However, due to constraints of the project, a more detailed analysis of lesion's location on the crown, its severity and the identity of the affected tooth are not discussed here.

The prevalence of caries was calculated by dividing the total number of caries (including those with fillings but excluding lesions removed by filing) by the total number of permanent teeth present. The results are therefore an approximation, as it is not known how many of the teeth lost post-mortem had carious lesions. The prevalence rate does provide a general indication of the caries rate within the population. A total of 113 caries was recorded in the 844 permanent teeth analysed – a true prevalence of 13.39%. Thirty-nine of the total 62 skeletons (CPR 62.9%) had lesions with a mean prevalence of 2.9 caries per skeleton.

The caries rate in the St George's assemblage was higher than other contemporary assemblages (Table 6.9), such as St Luke's, Islington, and possibly may reflect a greater intake of simple sugars or the greater longevity of this population. It is unlikely, however, that the trend reflects a status difference between the two populations, as conversely, the caries rate in the Cross Bones assemblage (predominantly comprised of paupers) was the highest of all – almost twice the rate of the St George's population.

Ante mortem tooth loss

The loss of permanent dentition before death is the end result of several disease processes. Calculus deposits can irritate the soft tissue and the underlying bone, which can lead to the reduction of the bone (periodontal disease) and ante mortem tooth loss (AMTL) (Roberts and Manchester, 1995, 45). Teeth may also be lost from peri-apical abscesses, which form through the exposure of the pulp cavity as a result of caries or excessive attrition coupled with localised resorption of the alveolar margin. AMTL is regarded as a degenerative disease where the main contributory factors are old age and poor oral hygiene.

The prevalence of ante mortem tooth loss was calculated by dividing the total number of teeth lost ante mortem by the combined total of the permanent dentition, teeth lost ante mortem and post mortem (empty sockets) (n=1632). A total of 669 teeth were lost ante mortem (40.99%). Fifty-three individuals with dentition and/or dental sockets (85.48%; n=53/62) had suffered from ante mortem tooth loss. Of these, three individuals (4.84%) had lost all of their dentition. The mean AMTL per individual was 10.79.

AMTL was more prevalent in this sample than other contemporary assemblages (Table 6.9). Dental decay was probably the most common reason for tooth loss, but another was the deliberate extraction of teeth, either to alleviate toothache, or as a prophylactic elective measure against the pain to come. A third factor was the high proportion of aged individuals within the assemblage.

Dental calculus

Calculus consists of mineralised plaque composed of microorganisms that accumulate in the mouth and become imbedded in a matrix of protein and saliva. Sugar in the diet accelerates this process (Hillson 1996, 254-55). There are two types of calculus: supragingival calculus situated above the gum line and subgingival calculus found below the gum line on exposed roots. More heavy calculus deposits are commonly seen on teeth nearest to the saliva glands (Roberts and Manchester 1995, 55). Regular tooth brushing removes plaque deposits, thereby preventing the formation of calculus.

Calculus deposits were recorded by tooth and by location on the tooth. The size of the deposit was also recorded according to the universal standards set out by Brothwell (1981), in which the deposits were scored as slight, medium or heavy. However, such a detailed data are beyond the scope of this report. The prevalence of calculus was calculated by dividing the number of teeth affected by the total number of teeth present.

A total of 592 teeth of the observed 844 teeth (70.14%) had calculus deposits. Forty-nine individuals displayed calculus (79.03%, n=49/62), with an average of 12.08 affected teeth per person.

Calculus was much more prevalent in this sample than in comparative assemblages (Table 6.9). As regular brushing of the teeth may have prevented calculus formation, it is highly unlikely that these individuals brushed their teeth regularly.

Periodontal disease

The principal predisposing factor in periodontal disease is the accumulation of calculus in dental pockets. The disease begins as gingivitis (an inflammation of the soft tissues), which is transmitted to the jaw itself. Resorption of the bone commences, followed by tooth loss. There are two different ways in which this disease expresses itself. These are horizontal and vertical bone loss. In horizontal bone loss more than one tooth is involved and often the whole of the dental arcade. All walls surrounding the teeth are lost uniformly. In vertical bone loss, the lesion is localised around one tooth or possibly two. The bone loss around the tooth is irregular and generally without horizontal bone loss (Hillson 1996, 263-65). There is a strong link between the increase of age and the increase of the prevalence of periodontal disease in modern populations, which is also the case with archaeological populations. However, the aetiology is multifactoral with genetic predisposition, environment, diet and hygiene all being predisposing factors in the development of the disease.

Periodontal disease was recorded by subdividing the jaws into four quadrants, which were scored independently. The severity of the disease was scored using the grades set out by Brothwell (1981), namely slight, medium and considerable. However, the calculation of prevalence rates in this detail is beyond the scope of this report and only the crude prevalence rates of periodontal disease are presented: 31 of the 62 individuals (50%) had periodontal disease ranging from slight to considerable.

Periodontal disease was observed on 20% of the named individuals of St Luke's Church, Islington (Boyle *et al.* 2005, 210). Again there is a very high prevalence of the disease amongst the St George's named assemblage, which given the relationship between the disease and oral hygiene, is hardly surprising.

Peri-apical abscesses

The development of an abscess may have many starting points. Bacteria may enter the pulp cavity through dental caries, excessive attrition or trauma to the crown, as well as through dental surgery (see Dentistry below). An abscess may also develop when a periodontal pocket forms by the accumulation of bacteria within pulp cavity, and the infection tracks down to the root apex. As pus accumulates within the dental socket and surrounding alveolar bone, local pressure builds, and eventually precipitates the formation of a hole or sinus in the jaw, through which the pus drains into the overlying soft tissue of the gums (Roberts and Manchester 1995, 50). In this advanced stage, the abscess is visible as a small hole on the surface of the maxilla or mandible.

The prevalence of dental abscesses was calculated by dividing the total number of abscesses by the combined total of teeth lost ante mortem, teeth lost post mortem and permanent dentition. In total, 46 (2.82%) abscesses were recorded out of a possible 1632 sockets observed. Twenty-three individuals (37.10%; n=23/62) had abscesses giving an average of two abscesses per person.

The prevalence of abscesses was slightly higher amongst St George's named assemblage than in contemporary assemblages (Table 6.9). Poor oral hygiene probably played a significant role, but as many abscesses were associated with dental work, such as crowns and transplants, it is unclear the extent to which the high prevalence at St George's can be explained by the greater quantity of dentistry observed in this sample compared to other sites of the period.

Dental enamel hypoplasia

Dental enamel hypoplasia (DEH) manifests on the buccal surface of the crowns of teeth as pits, horizontal lines or lines of pits. These defects are caused by thinning of the enamel, and reflect an interruption or slowing of the normal deposition of enamel during crown formation in the first six or seven years of life (Goodman and Rose 1990; Hillson 1996, 165-66). DEH is thought to result from prolonged episodes of illness or malnutrition lasting at least three weeks (ibid.), but food adulterations, used widely in 18th and 19th century London, may also have played a role in the interruption of normal tooth development. Such defects are most apparent when normal dental development recommences following such an insult. Unlike bone, enamel does not remodel throughout life and so remains as a permanent indicator of such stress episodes in the early years of life.

In the named sample the type of defect (groove, line or pit) and the numbers of lines or grooves were recorded on each tooth. This level of detail has not been quantified here. The prevalence of DEH was calculated per crown visible, excluding crowns where the buccal surface was obscured by calculus, or where the tooth had suffered marked attrition or dental work (eg. filing). Of the total number of teeth observed (N=844) 138 displayed DEH (16.35%). DEH was observed in 40 individuals (64.5%; n=40/62), an average of 5.52 teeth per individual. [138/40=3.45 teeth per individual.

The prevalence of DEH within this group was surprisingly high, given their socio-economic status. In comparison, the rate of DEH from the St Luke's, Islington, assemblage was very low (Table 6.9). The average 'per tooth' prevalence in post-medieval British assemblages collated by Roberts and Cox (2003, 327) was 0.6%. The high rate suggested that the St George's named sample suffered more stress in childhood, but as DEH is only evident in those that had recovered from such episodes, it may be argued that the higher prevalence of this defect indicates better survival following such an insult. This would be in keeping with the higher social status of this assemblage.

Dental overcrowding

Overcrowding of the dentition, most commonly involving the incisors and canines, is believed to have a multifactoral aetiology, including both genetic predisposition and environmental factors (Hillson 1996). The degree of overcrowding (slight, moderate and severe) was recorded in the named sample, as well as rotation of the individual teeth. The dentition of five individuals (8.06%; n=5/62) showed overcrowding. In all cases this was slight.

Dental anomalies

A range of dental anomalies may be observed in the human dental arcade, including impacted teeth, congenitally absent teeth (agenesis), supernumerary teeth and the retention of deciduous teeth in adulthood (Hillson 1996). Within the named sample, neither supernumerary teeth nor retained deciduous teeth were present, but a number of individuals displayed impacted and congenitally missing teeth. The prevalence of congenitally missing teeth cannot be established absolutely, as it is not always possible to distinguish between long-standing ante mortem tooth loss and agenesis. Moreover, without radiography, it is not possible to rule out impaction. In edentulous individuals, the absence of the third molar may also be mistaken for ante mortem tooth loss, when in fact the tooth had never developed. It is therefore likely that the total number of congenitally absent teeth has been underestimated.

The teeth recorded as impacted were those that could be observed without radiography. Teeth that were not fully erupted in older individuals were also recorded as impacted. Again, the prevalence of impacted teeth is likely to be underestimated as some may have been recorded as congenitally missing. The location of impacted or congenitally absent teeth was recorded, but this level of detail is beyond the limit of this study. Crude prevalence was calculated for the dental anomalies observed.

Seven individuals (11.29%; n=7/62) had impacted teeth, which, on average affected one or two teeth per person. Sixteen individuals (25.86%; n=16/62) had congenitally absent teeth, the largest number per person being five (skeleton 1052). Third molars were the most commonly missing teeth.

Dental interventions

Until the mid 19th century there was no formal training or qualification for dentists (Gelbier 2005, 446; see also Richards 1968). As part of the pressure from dental practitioners for recognition and improved professional standing the Odontological Society of London and the rival College of Dentists were established in November 1856. The aim was to establish a recognised qualification in dentistry. To this end the College of Dentists founded the Metropolitan School of Dental Science, and the Odontologists founded the Dental Hospital of London in 1858, and the School of Dental Surgery within the Hospital in October 1859 (Gelbier 2005, 447). The first professional qualification in dentistry – the Licence in Dental Surgery (LDS) of the Royal College of Surgeons – dates from 1860.

It was only in the later 18th century that the term 'dentist' came into use (Lindsay 1927, 359). Early dental 'care' was provided by toothdrawers, and by apothecaries and surgeons, for who drawing teeth was just one part of their service (see Bishop, Gelbier and Gibbons 2001a, passim). During the 18th century, dentistry as a distinct profession practiced by itself began to appear, with the emergence of 'operators of the teeth', men such as John Watts of Racquet Court, on the North side of Fleet Street. In 1709 he advertised in Rider's British Almanac:

> Artificial teeth set in so well as to Eat with them, and not to be discovered from Natural, not to be taken out at Night, as is by some falsely suggested, but may be worn years together – also teeth cleaned and Drawn by John Watts, Operator, who applies himself wholly to the said business (quoted in Lindsay 1927, 357)

Watts was later joined by Samuel Rutter. Rutter subsequently worked in partnership with William Green, who in 1756 was appointed 'Operator for the Teeth to King George II'. Thomas Berdmore later worked out of Racquet Court where he was apprentice, then partner, to Green. In 1768 he published *A Treatise on the Disorders and Deformities of the Teeth and Gums*, in which he wrote of

> when first I resolved to devote my whole time and attention to that part of surgery which concerns the dentist's art . . . (quoted in Lindsay 1927, 359)

In 1766 Berdmore became operator for the teeth to George III.

It is estimated 40 dentists operated in London by 1800, and another 20 outside the capital. In 1837 John Gray a surgeon-dentist and member of the Royal College of Surgeons wrote that

> The London Directory contains the names of upwards of one hundred and twenty individuals . . . calling themselves Surgeon-Dentists, while the list of members of the Royal College of Surgeons, published in August, 1836, reduces the number to seven (Gray 1837, 9 footnote)

The *Post Office London Directory, 1841* lists 153 dentists including John Gray himself.

For the privileged, there was an array of treatments on offer. These included fillings, removal of carious lesions, dental implants and various types of dentures using human or artificial teeth. The treatment was expensive, as is clear from an advertisement from 1777 for the services of the eccentric Martin van Butchell (Porter, 2001, 199):

> Van Butchell, Surgeon-Dentist, attends at his House, the upper part of Mount-Street, Grosvenor Square, every day in the Year, from Nine to One o'clock, Sundays excepted.
>
> Name in Marble on the Door. Advice, £2.2s. Taking out a Tooth or Stump, £1.1s. each.
> Putting in artificial Teeth, £5.5s. each. A whole under Row £42. Upper Row £63. An entire set £105. Natural Teeth £10.10s each. The Money paid first. (*St James's Chronicle*, 1 March 1777, quoted in Haslam 1996, 245-46)

Fillings and filings

During the 18th and 19th centuries, the cheapest material used in fillings was tin or lead. From the early 19th century, various forms of amalgams became available. These were based on heavy metals (such as mercury mixed with copper) or silver filed from coins (Hillam 1990, 23). Gold fillings were the most suitable material (being chemically inert) but also the most expensive (ibid.). Pellets of amalgam were placed in the tooth cavity and tamped down with a hot instrument. Four (6.45%; n=4/62) named individuals from St George's had fillings. In total, there were seven fillings, of which all but one was gold. The exception was of grey coloured metal (probably lead, tin or amalgam).

The prevalence of fillings was much higher than in the Christ Church, Spitalfields, and St Luke's church, Islington, assemblages (Table 6.9), although overall only a small number of individuals had undergone this treatment in all three assemblages.

Carious lesions that were not filled were sometimes filed or scraped away using scalpels and files, leaving a smooth surface (Hillam 1991, 23; Picard 2000, 154). This treatment was identified in the dentition of four individuals (6.45%; n=4/62). Seven teeth had been treated in this way.

Dentures

From the early to middle 18th century onwards, dentures were available to those who could afford them. These were made from walrus or hippopotamus ivory plates in which real human teeth were riveted. These were commonly known as 'Waterloo teeth', as originally, it was believed that the teeth had been removed from the mouths of healthy young soldiers killed on the famous battlefield. In reality, most human teeth used in dentures came from the poor, who sold their teeth for a pittance (Porter 2001, 198; Bishop, Gelbier and Gibbons 2001b, 576), and from cadavers obtained from grave robbing (Porter 2001, 198). Indeed, there was a roaring trade in human teeth at this time in history.

Dentures could either be partial or full. There were three main types:

1. Full upper or lower swagged gold dentures with ivory molar blocks
2. Two tooth partial upper or lower dentures (made of walrus ivory)
3. Small swagged partial dentures

The upper and lower plates of a full set of swagged (horseshoe-shaped) dentures were kept in place by springs between the lower and upper plates. The plates were metal, often gold, and hence, were extremely expensive. Human teeth were set into these plates by the means of gold pins.

Manufacturers often took considerable pains to achieve a realistic effect with the anterior dentition, but molars were often constructed of roughly carved ivory blocks. Towards the end of the 18th century, human teeth were replaced by models of teeth made of porcelain, which were riveted to the denture plate by means of gold pins. It was not until the latter half of the 19th century that the ivory molar blocks were replaced by porcelain. Once an individual had invested in a gold spring-loaded set, the same denture could be retained for up to forty years. Unlike ivory they did not decay nor did they need replacement because of gum shrinkage (Woodforde 1968).

The springs between the upper and lower plates of swagged dentures were designed to force the plates apart, thereby preventing the upper plate from falling from position when the mouth was opened (Hillam 1990, 16). The springs were often so strong, however, that the wearer had to clench his/her muscles forcefully to shut the mouth again (Picard 2000, 155). Another more alarming effect was the tendency of such dentures to leap involuntarily from the mouth at inopportune moments, much to the hilarity of onlookers. Correct insertion of dentures took dexterity, and poor technique sometimes caused the springs to fail, with unflattering consequences. The vagaries of wearing dentures were mercilessly lampooned by caricaturists of the period, such as Rowlandson (Donald 1996).

The necessity of owning a second pair was explained by John Tomes, surgeon-dentist of the Middlesex Hospital in his book *The Management of Artificial Teeth* (1851) (cited in Woodforde 1968, 65-67). Two whole pages are devoted to the correct way of inserting such a set so as not to damage the springs. Spring failure as a result of incorrect insertion was a fairly common problem and could happen suddenly and without warning, causing the top set to fall out even in conversation. As a result, many people possessed a second pair of dentures, which they carried with them in case of this eventuality. This may explain why the two individuals of the St George's population (one named and one unnamed) who were buried wearing such dentures were interred with a second set.

Another unattractive feature of early dentures was that many were too difficult to fit or to remove easily, and so were worn constantly (Cox 1996, 92; Picard 2000, 155). Oral hygiene was thus not a priority. A dentist to Queen Victoria described a particularly extreme case of a woman whom he fitted with a partial denture. When he saw her again four years later the new teeth were cemented into the mouth with tartar. In her extreme anxiety not to be discovered wearing false teeth, she had not removed them in all that time. The dentist's shock, however, illustrates that her behaviour was not the norm. Nevertheless, it does seem that oral hygiene was not a priority in denture wearers. Moreover, ivory molar blocks began to rot after a short time, causing incredible halitosis (Hillam 1991, 16). Writers of the day describe the 'miasma' issuing from the mouths of wearers. It is thought that fans were used as much to hide bad teeth and dispel bad breath, as to cool the heated brow, or as aids to flirtation (Tomes, 1851, quoted in Woodforde 1968, 51).

A small swagged partial denture was used when only one to three anterior teeth were missing. This comprised a small golden plate to which porcelain or real human teeth were riveted. The denture was held in place by silk ties or metal strips wrapped around adjacent teeth. Partial dentures comprised of ivory blocks were used to replace missing molars, and were designed to serve a masticatory rather than aesthetic function. These blocks were held in place by silk thread tied to remaining teeth.

Only one individual (skeleton 3044) of the named sample was buried with dentures (see Plate 6.7). This older male had two sets, of which one was in a slightly better condition. The dentures were full upper and lower swagged gold dentures with ivory molar blocks and porcelain teeth. Although only one named individual had been buried with his dentures, two more skeletons showed osteological evidence suggesting that they had worn dentures in life. The morphological changes in the alveolar bone can be seen on both the maxilla and the mandible, but were more obvious in the more robust mandible. In each individual the alveolar margin of the bone was more flattened and 'squared', which may be accompanied with a sharp alveolar margin. Most importantly, there is no significant reduction of the symphyseal height at the mental protuberance. Indeed, since the individual still uses the jaws for mastication, the bone does not atrophy through disuse as occurs in edentulous individuals. The total number of individuals who wore dentures in the named sample was therefore three (4.84%; n=3/62). Dentures were also recovered from unnamed burials at St George's (see below), and in other contemporary assemblages, including Christ Church Spitalfields, St Pancras Euston (pers. comm.), and St Luke's Islington.

Dental implants

Towards the end of the 18th century, transplantation of teeth as an alternative to dentures was widely practice (Bishop, Gelbier and Gibbons 2001b, 576 & fig.1 – Thomas Rowlandson, 'Transplanting of teeth'). Incisors and canines were pulled from the mouths of indigent young people with healthy teeth, and immediately transplanted into the mouths of richer and older patients. Transplantation was rarely successful in the long term. Moreover, there was the danger of the spread of disease (such as syphilis) associated with the practice. Finally the increasing availability of porcelain teeth soon made this type of dental intervention redundant (Noble 2002).

Amongst the named sample, transplantation of the crown was also observed in several individuals. This method is not that dissimilar to modern dental implants. The original tooth crown was removed,

Plate 6.1 Skeleton 3027: real tooth crown on a gold peg

leaving the root of the tooth *in situ*. The exposed surface of the root was then filed to a shallow concave U-shape. The new crown transplant was shaped to fit neatly into the root concavity. The new crown transplant was mounted on a metal post (usually gold), and hammered into the root cavity. The root thus served to anchor for the new tooth crown. In an age before anaesthetic, when pain control was limited largely to laudanum and alcohol (Hillam 1991), this must have been an extremely painful procedure.

Three named individuals (4.48%; n=3/62) had transplanted crowns. Only the incisors and the canines were subjected to this treatment, probably because the insertion of the post was only possible on single rooted teeth. The largest number of teeth subjected to the treatment in any one individual (skeleton 3054) was four. Skeleton 3027 had three implants (Plate 6.1). One individual (skeleton 4011) had the shaped root and a central hole but no crown was present. It is possible that instead of a metal post, the crown may have been mounted on a hickory wood post, which had subsequently rotted away. Wooden posts are known from historical records of the period, but do not survive well archaeologically. Not surprisingly, this type of intrusive dental surgery was often caused infection. In the named assemblage from St George's, 50% of implants were associated with apical abscesses.

Skeletal pathology

A wide range of pathologies was observed in the named assemblage, many of them age-related. They fall into the following broad categories: congenital disorders, joint disease, trauma, infectious disease, metabolic disease and neoplastic disease. Also observed were post-mortem surgical interventions and modifications arising from corsetry.

Congenital anomalies

Congenital malformations are pathological changes that occur during foetal development, and abnormalities may be observed shortly after birth or many years later (Roberts and Manchester 1995, 30, 51). Approximately 40% of all abnormalities in live births affect the skeleton. Most of these (90%) are due to genetic anomalies that may be hereditary. Environmental influences, such as maternal rubella, may also cause foetal malformations, such as cleft palate, spina bifida and microcephaly (Roberts and Manchester 1995, 32).

Spina bifida – Spina bifida occulta is a mild congenital defect, which consists of non-union of the neural arches of the sacrum. As the name suggests, this defect is usually asymptomatic, as the area of non-union is bridged by membrane, thus protecting the *cauda equina* of the spinal cord. *Spina bifida occulta* is very common, affecting between 5% and 25% of modern populations (Aufderheide and Rodríguez-Martín 1998, 61), and, like other neural tube defects, has been associated with a deficiency in maternal folic acid, zinc and selenium in early pregnancy (Roberts and Manchester 1995). Five individuals in the named sample (6.94%; n=5/72) displayed this defect. The lesions were slight in most individuals, but all five segments of the sacrum of skeletons 4002 and 5056 were affected.

Cleft neural arch: Skeleton 7045 also displayed non-union of the neural arch, leaving open the neural canal. In this case, the affected element was the 7th cervical vertebra.

Sacralisation – Transitional vertebrae are most common in the lumbo-sacral region, occurring in 3-5% of modern populations (Aufderheide and Rodríguez-Martín 1998, 65). Most commonly affected is the fifth lumbar vertebra, which fuses to the first sacral segment below (ibid.). Six individuals of the St George's assemblage (8.3 %; n=6/72) displayed this condition. In keeping with modern populations, females were more commonly affected than males- four females (1059, 4007, 5046 and 7016) and two males (3085 and 4049). Complete sacralisation of the fifth lumbar vertebra was present in all but one individual (skeleton 4007).

Scoliosis – Scoliosis is a lateral curvature of the spine. Often there are two curves, enabling the cranium to be maintained in the mid-sagittal plane. The aetiology of this condition is multi-factoral and may accompany other spinal malformations, such as hemi-vertebrae and transitional vertebrae (Aufderheide and Rodríguez-Martín 1998, 66). Two adult females (2.77%, n=2/72) had slight scoliosis. Skeleton 7016 also had sacralisation, which may have been a contributing factor in the development of the scoliosis.

Fused vertebrae – One individual displayed fusion of the articular processes of the second and the third thoracic vertebrae. The condition was clearly not due to degenerative changes and is more likely to be developmental rather than caused by trauma. The defect is unlikely to have caused discomfort.

Congenital acetabular dysplasia – Congenital acetabular dysplasia or congenital dislocation of the hip is caused by the partial or complete displacement of the femoral head from its normal position within the acetabulum. The condition is bilateral in 25-50% of the cases (Aufderheide and Rodríguez-Martín 1998, 69-70). In unilateral cases, the left hip joint is more often involved. Females are more commonly affected than males, modern frequency being between 1 and 20 per 1000 live births (ibid.). The condition is often not discovered until the child starts to walk. A swaying gait is characteristic of this condition (Roberts and Manchester 1995, 38). Congenital dislocation of the left hip was present in one adult female (skeleton 3027). The acetabulum was malformed, being small, flat and triangular in shape. The dislocation was complete, with formation of a neo-acetabulum superior to the true acetabulum on the lateral surface of the iliac blade. This new joint surface was considerably eburnated (Plate 6.2), as was the left femoral head. These degenerative changes indicated that the individual had been mobile, but she was likely to have been in considerable and constant pain.

Plate 6.2 Skeleton 3027: Congenital hip displacement

Other slight developmental abnormalities – Two individuals had very slight developmental defects. In skeleton 1013, fusion of the right lateral and intermediate cuneiforms was recorded, and in skeleton 6048, a malformed sternum. The anomalous sternum of skeleton 6048 involved non-union of the first and second segment, and the presence of an additional segment. Neither defect would have caused any discomfort.

Joint disease

Osteoarthritis and degenerative joint disease – The most common joint disease in both modern and archaeological populations is osteoarthritis (OA), a disease that affects any synovial joint in the skeleton. In this disease the cartilage within the joint wears away and bone on bone friction causes the joint surface to be dense and polished or eburnated. The aetiology of OA is multifactoral but increasing age, genetic predisposition, lifestyle and environmental factors

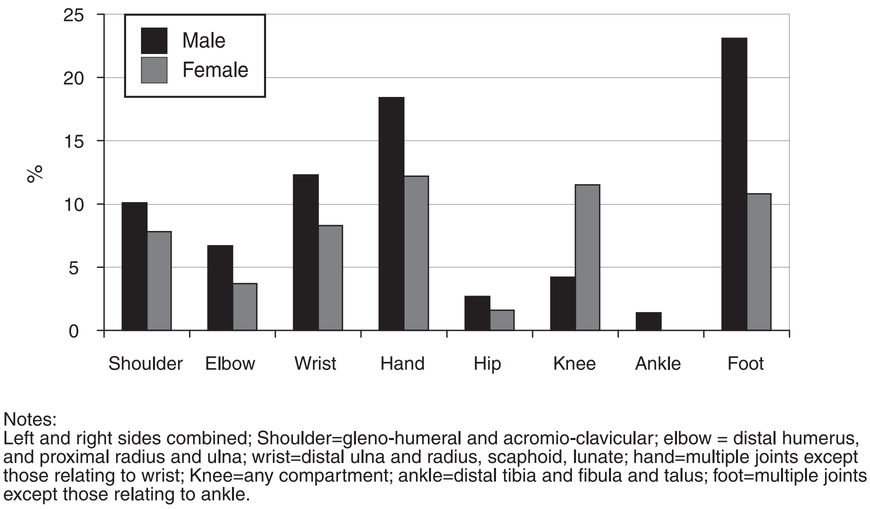


Fig. 6.6 Named sample: True prevalence of osteoarthritis

all play a role in the development of the disease. Osteoarthritis may be diagnosed on dry bone if eburnation is present. It may also be diagnosed if a combination of at least two of the following is present: pitting, bony contour change, and/or marginal osteophyte (new bone on and/or around the joint surface) (Rogers and Waldron 1995). With the exception of eburnation, these changes are not diagnostic of OA if they occur on their own. This is because they may arise in relation to other disease processes, trauma and/or age related wear and tear of the joint. For the present analysis, osteoarthritis was diagnosed based on the presence of eburnation alone following Rogers and Waldron (1995). Porosity and/or osteophytosis were recorded separately and broadly classified as 'degenerative joint disease' (DJD) or 'spinal degenerative joint disease' (SDJD).

A total of 44 adults (61% of the total named assemblage) displayed one or a combination of these changes involving extra-spinal joints. Mild to severe DJD in the form of joint surface pitting and/or marginal osteophytosis was observed joints of 43 adults (64%; n=43/67), which comprised 30 males (79% of adult males; n=30/38) and 13 females (45% of adult females; n=13/29). Extra-spinal joints that displayed eburnation alone involved 26 individuals (39% of all adults; n=26/67), of whom 20 were male (53% of adult males; n=20/38), and 6 were female (21% of adult females; n=6/29).

There was a difference in the distribution of OA between the sexes (Fig. 6.6; Table 6.10). Males displayed far more lesions of the hands, arms and feet whereas females showed higher rates of osteoarthritis of the knee joints. This may be due differences in occupation, but other variables such as genetic predisposition, build, body mass, age and sex are all significant factors in disease development and the location of lesions on the skeleton. See results for OA in the unnamed individuals below.

Table 6.10: Named sample: True prevalence of osteoarthritis in different joints

	Males	*%*	*Females*	*%*
Shoulder	7 / 69	10.1	4 / 51	7.8
Elbow	5 / 74	6.7	2 / 54	3.7
Wrist	8 / 65	12.3	4 / 48	8.3
Hand	12 / 65	18.4	6 / 49	12.2
Hip	2 / 73	2.7	1 / 61	1.6
Knee	3 / 70	4.2	6 / 52	11.5
Ankle	1 / 69	1.4	0 / 50	0
Foot	16 / 69	23.1	5 / 46	10.8

Lefts and right sides combined; Shoulder=gleno-humeral and acromio-clavicular; elbow=distal humerus, and proximal radius and ulna; wrist=distal ulna and radius, scaphoid, lunate; hand=multiple joints except those relating to wrist; Knee=any compartment; ankle=distal tibia and fibula and talus; foot=multiple joints except those relating to ankle.

Spinal degenerative joint disease (SDJD) – SDJD affected 60 individuals (83% of total population, or 89.5% of adults). These comprised 36 males (95% of adult males; n=36/38) and 24 females (83% of adult females; n=24/29). Only two males and five females did not have spinal lesions. Porosity and/or osteophytosis were recorded as slight, moderate and considerable. In the majority of cases the changes were slight (Table 6.11). OA was recorded in 11% of all observed vertebrae.

The crude prevalence of extra-spinal and spinal OA in the post-medieval period was 25% and 13% respectively (Roberts and Cox 2003 352-353). This was comparable with the crude prevalence calculated for the named individuals from St George's crypt. This contrasted with the crude prevalence of both extra spinal and spinal DJD (11%) in post-medieval populations cited in Roberts and Cox (2003, 352), far lower than those of the St George's assemblage. The average age of the adults in this assemblage was 57 years, with 35 of the 52 aged individuals being over 50 years old. The high prevalence of joint disease within this assemblage is therefore probably age-related, rather than reflective of a lifestyle involving strenuous repetitive activities.

Schmorl's nodes – Schmorl's nodes are identified as indentations on the superior and inferior surfaces of the vertebral bodies. These are caused by the herniation of the intervertebral disc through the end plates and are therefore, in effect, pressure defects. Associated with degenerative disease, Schmorl's nodes have also been linked to activity and trauma, especially in adolescence, or metabolic disorders (Jurmain 1999). Twenty-three named adults, all of them male, displayed Schmorl's nodes. The distribution pattern of these defects in the spinal column revealed that all lesions were located in the lower thoracic and lumbar spine (Fig. 6.7)- the most common location of these lesions.

Rheumatoid arthritis – Rheumatoid arthritis is an autoimmune disease that affects approximately 1% of modern populations (Roberts and Manchester 1995, 116). It is three times more common in females

Table 6.11: Named sample: True prevalence of affected vertebrae

Skeletal change		*Percentage of vertebrae affected*
SDJD (Porosity and/ or osteophytosis)	Slight	38% (495/1288)
	Moderate	12% (155/1288)
	Considerable	8% (98/1288)
Osteoarthritis		11% (139/1288)

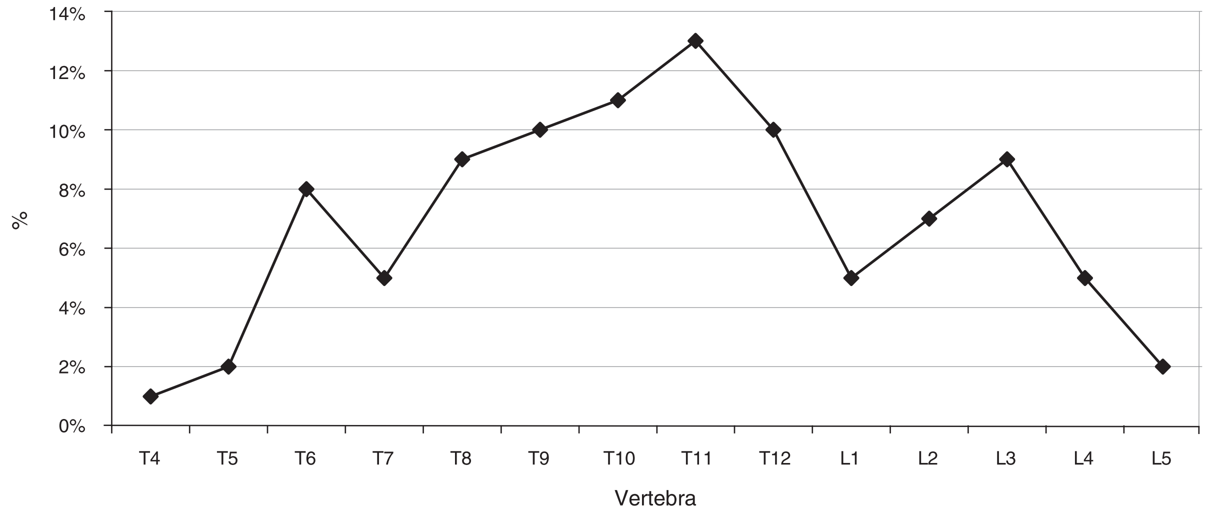


Fig. 6.7 Named sample: True prevalence of Schmorl's nodes on the thoracic and lumber spines.

than in males, with an age of onset in the fourth or fifth decades of life (Rogers and Waldron, 1995, 55-56). Rheumatoid arthritis is a chronic inflammatory disease that affects multiple synovial joints bilaterally, most commonly the hands, feet, wrists and elbows (Roberts and Manchester 1995, 116). The synovial membranes of the joints are initially affected, becoming thickened and granulated. The disease then spreads to the joint cartilage, eventually destroying it. The underlying bone is also eroded and ankylosis (fusion of joints) may occur. The joints become swollen, stiff and very painful. Additional physical symptoms include anaemia, weight loss and fever (Roberts and Manchester 1995, 116; Aufderheide and Rodríguez-Martín 1998, 100). A famous sufferer, who was a contemporary of the St George's population, is thought to have been Samuel Taylor Coleridge. His liberal use of laudanum to contain the led to his opium addiction, and to the penning of such memorable poems as *Kubla Khan – a fragment in a dream* and *The Rime of the Ancient Mariner.* One ageing female (skeleton 5041) in the named assemblage displayed lesions consistent with rheumatoid arthritis of her feet. The tarsals had fused (Plate 6.3). The right hand was also affected. Radiography is necessary to confirm this diagnosis, however.

Diffuse Idiopathic Skeletal Hyperostosis (DISH) – DISH is characterised by the ossification of the anterior longitudinal spinal ligaments causing a flowing candle wax- like new bone formation, which is usually located on the right side of the vertebral bodies (Rogers and Waldron 1995, 48-49). Enthesophytes (new bone formation at major ligament insertion points) and ossified cartilage are also a feature of this disease (Roberts and Manchester 1995, 120). Symptoms are generally mild but include stiffness and aching. Modern prevalence of the disease ranges between 6 and 12%. It affects more males than females, and 85% of cases are aged over 50 years. There appears to be an association between DISH and Late Onset or Type 2 Diabetes Mellitus and obesity (Rogers and Waldron 1995, 48).

Plate 6.3 Skeleton 5041: rheumatoid arthritis of the left foot

Plate 6.4 Skeleton 1041: DISH

Three individuals in the named sample displayed DISH (4.17%, n=3/72). They were all ageing males (8% of all adult males). DISH involving the spine of skeleton 1041 is shown in Plate 6.4. Although this prevalence was lower than in modern populations, the age and sex of the affected individuals of the St George's assemblage was consistent with modern epidemiology of the disorder. It was comparable with contemporary assemblages of similar socio-economic background, however. The prevalence at Christ Church, Spitalfields, and St Luke's, Islington, was 5.79% and 2.28% respectively (Roberts and Cox 2003, 311; Boyle *et al*. 2005, 239).

Trauma

Fractures – Fractures are either caused by an acute injury to the bone, an underlying disease or repetitive stress (Roberts and Manchester 1995, 68). Fractures were identified on 17 individuals (23.6%; n=17/72), of whom 16 were adult and one was adolescent. Of these 13 were male. A total of 21 fractures were observed, the majority (38%) comprising rib fractures (Table 6.12). Feet suffered the lowest fracture rate of all elements. Most of the fractures were well healed and evidently of long standing. Only one individual (skeleton 5049) displayed perimortem lesions. These consisted of two depressed cranial fractures with no evidence of healing.

The crude prevalence rate in the named sample was comparable to the St Luke's, Islington, assemblage, where fractures were present in 16% of the named individuals (Boyle *et al.* 2005, 230). Overall, the fracture rates were low, consistent with other assemblages in the post-medieval period (Table 6.12).

Table 6. 12: Named sample: Summary of fractures by element

Fracture location	*Number of males*	*Number of females*	*Total number of fractures*	*True prevalence of fractures*	*True prevalence of fractures in post-medieval Britain*[1]
Cranium	5.26% (2/38)	3.45% (1/29)	19.06% (4/21)	6.45% (4/62)	0.39% (5/1291)
Radius	2.63% (1/38)	0	4.76% (1/21)	0.81% (1/123)	0.64% (8/1249)
Spine	5.26% (2/38)	0	14.28% (3/21)	0.43% (3/678)[2]	-
Ribs	10.52% (4/38)	6.90% (2/29)	38.10% (8/21)	0.75% (8/1060)	4.23% (88/2081)
Sacrum	2.63% (1/38)	0	4.76% (1/21)	1.61% (1/62)	0.63% (1/160)
Fibula	5.26% (2/38)	3.45% (1/29)	14.28% (3/21)	2.8% (3/107)	0.76% (12/1582)
Foot bones	2.63% (1/38)	0	4.76% (1/21)	0.1% (1/983)	0%
Total number	34.21% (13/38)	13.79% (4/29)	100% (21/21)	-	-

[1] After Roberts and Cox 2003, 302, [2] Thoracic vertebral elements only

Osteochondritis dissecans – *Osteochondritis dissecans* is a fairly common skeletal disorder of the joint surfaces of the major long bones. Physically active young males (such as athletes) are most often affected in the first two decades of life. This disease is due to a significant localised obliteration of the blood supply, causing necrosis of small areas of joint tissue (Roberts and Manchester 1995, 87). Repeated, low-grade, chronic trauma or micro-trauma is thought to play a role in this injury to the blood vessels (Aufderheide and Rodriguez-Martin 1998). The necrotic bone plaque breaks-off from the joint surface and may remain loose in the joint, causing chronic pain and often precipitating osteoarthritis. Alternatively, the fragment may re-attach in its original position or be resorbed, and no further symptoms will be experienced.

Two male skeletons (1037 and 1057) displayed one such lesion, one located on the navicular bone and on the distal humerus respectively. These represented 5.26% of the males and 2.78% of the named assemblage (N = 72).

Infectious disease

Non-specific infection

Periostitis – Periostitis is an inflammation of the periosteum, the lining of bones. This involvement is often secondary to an infection of the overlying soft tissue, but micro-organisms causing the infection may also be blood-borne (in systemic infection), or more unusually, may originate from the compact or trabecular bone beneath. Periostitis may also be associated with local haemorrhage (due to trauma, scurvy or excess vitamin A intake), chronic skin ulcers or varicose veins (Aufderheide and Rodríguez-Martín 1998, 179).

In the post-medieval period, the crude prevalence rate of periostitis has been reported as 26% (Roberts and Cox 2003, 344). The condition was observed in 27 named individuals from St George's (37.5%; n=27/72), of whom 26 were adult and one was adolescent. They comprised 14 males and 13 females. The lesions were active at the time of death in 10 skeletons (13.8%; n=10/72)- six males and four females. The most common location of the lesions was the tibial shaft, was found in 15 individuals (55.55%; n=15/27), and 16% (22/137) of all tibiae (Table 6.13; Fig. 6.8). This may be due in part to the proximity of the bone to the skin and its susceptibility to recurrent minor trauma (Roberts and Manchester 1995, 130). Peripheral vascular disease (sometimes associated with Diabetes mellitus) may also lead to venous or arterial ulcers. Due to poor blood supply, these are slow to heal and may become infected. If the soft tissue damage reaches

Table 6.13: Named sample: True prevalence of periostitis by element (lefts and right sides combined)

	Males	*%*	*Females*	*%*	*Subadults*	*%*	*Total*	*%*
Humerus	2 / 77	2.5	0 / 51	0	0 / 6	0	2 / 134	1.5
Radius	1 / 73	1.3	0 / 50	0	0 / 7	0	1 / 130	0.8
Ulna	1 / 74	1.3	0 / 47	0	0 / 7	0	1 / 128	0.8
Femur	6 / 77	7.7	4 / 58	6.8	0 / 7	0	10 / 142	7.0
Tibia	14 / 76	18.4	8 / 55	14.5	0 / 6	0	22 / 137	16.1
Fibula	6 / 67	8.9	6 / 40	15	0 / 6	0	12 / 113	10.6
Ribs	15 / 663	2.2	20 / 397	5	3 / 46	6.5	38 / 1106	3.4

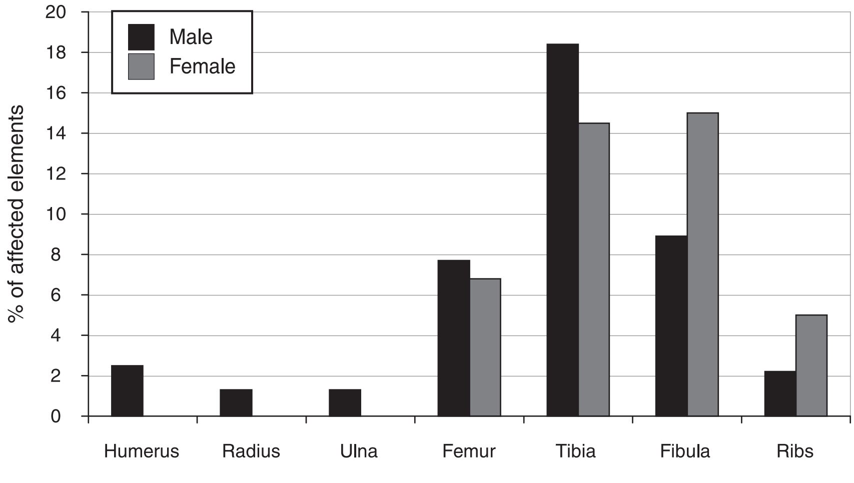


Fig. 6.8 Named sample: True prevalence of periostitis according to element

the underlying bone, an inflammatory reaction of the periosteum may occur. Considering the older age of this sample, this aetiology is probable for some of the lesions present.

Periostitis involved a wider distribution of elements in males than in females (Fig. 6.8). Lesions were identified on upper limb bones of males, but not females. Few were obviously associated with trauma, as very few fractures were observed on these bones (see Table 6.12 above). This may imply systemic disease in the aetiology of periostitis in these individuals, which may include such diverse conditions as syphilis, scurvy, excessive Vitamin A and chronic pulmonary conditions. Further investigation lay beyond the scope of this report.

Males also had more affected tibiae and femora than females. Females showed greater involvement of ribs (all visceral surfaces) and fibulae compared with males. Rib lesions are discussed separately in the following section.

Chronic respiratory disease – The vast majority of respiratory disease leaves no trace on the bones. However, where a lesion (such as a bulla or abscess) approximates the ribs, resorption or new bone proliferation on the visceral surface of the bone may occur (Roberts *et al*. 1998, 56). Traditionally, such lesions were associated with tuberculosis but Roberts *et al.* (1998) concluded that no differential diagnosis was possible without the presence of tubercular lesions in other parts of the skeleton. Acute lobar pneumonia, brochiolectasis (eg in chronic obstructive pulmonary disease, such as asthma, chronic bronchitis and emphysaema), and less likely, metastatic carcinoma, non-specific osteomyelitis and syphilis, are all possible causes.

In the St George's named sample, seven individuals (CPR 10%, n=7/72) displayed new bone formation on the visceral surface of the ribs. These included one older adolescent female (5049), three adult females (3022, 3027 and 7081) and three males (1057, 1077 and 1527), whilst female skeleton 7011 showed similar lesions on the neck of the right ribs. These bony changes to the rib shafts were more common among females (13%; n=4/31) than males (7%; n=3/41). Lesions were active in three individuals (1057, 5049 and 7081).

Maxillary sinusitis – The aetiology of maxillary sinusitis is multifactoral and may be caused by allergies, smoke and upper respiratory tract infections (Roberts and Manchester 1995, 131). In the smoky, polluted air of 18th century London, it's presence is thus to be expected. The observation of the lesions is dependent on access to the maxillary sinus cavities. The vast majority of crania from the named assemblage were intact, and hence, the sinuses could not be examined. Maxillary sinusitis is therefore likely to have been considerably under-recorded in this sample. New bone formation within the sinuses was observed in two adult males (1057 and 3002) and one female (4007), or 4.2% of the total assemblage. This crude prevalence is lower than figure of 6.88% reported for post-medieval British assemblages by Roberts and Cox (2003, 299), possibly reflecting better air quality in Bloomsbury, that made it 'esteemed the most healthful [place] of any in London' (Strype 1720, Bk 4 chap IV, 85).

Ear infection – Ear infections were observed in two individuals, one female (skeleton 4035) and an ageing male (skeleton 1041). The former had otitis externa (infection of the ear canal or external ear). The latter had mastoiditis. This condition was probably the end result of a middle ear infection (otitis media), suffered in the early years of his life. In untreated otitis media, accumulated pus in the middle ear perforates the eardrum and drains from the ear canal. However, in his case, the accumulated pus burst through the bone of the middle ear and settled in the air cells of the mastoid process, where it eventually formed a draining sinus in the external surface of the bone. This is a relatively rare occurrence and is potentially very dangerous, as had the infection drained internally, it may have spread to the brain and surrounding tissue causing encephalitis or meningitis.

Specific infection

Syphilis – Venereal syphilis was long the most serious and dreaded of the sexually transmitted diseases. The disease was first encountered in the western world in the 15th century AD, and rapidly spread across Europe (Roberts and Cox 2003, 340). By the post-medieval period, the 'great pox', or the 'French pox' as syphilis was known in England, had become a significant health problem. Prevention of contagion using early forms of condoms, and treatments using mercury and guaiacum were largely unsuccessful (ibid.). It was really only with the invention of penicillin in the 1930s that any serious inroad was made in the control of this disease. Venereal syphilis is a sexually transmitted infection caused by the bacterium *Trepanima pallidum,* and is the only one of the treponematoses (a group of diseases that includes yaws, pinta and endemic syphilis) that may be fatal. Syphilis is transmitted by sexual contact or may be passed from an infected mother to her foetus. The latter is known as congenital syphilis.

Venereal syphilis acquired in adulthood is a chronic infection characterised by three clinical stages separated by latent stages with no visible symptoms (Arrizabalaga 2003, 316). In primary syphilis, a small painless ulcer or chancre appears on the genitals (and less commonly elsewhere) within 2 – 6 weeks of infection. In most cases, after a brief latent period, there is a secondary stage characterised by widespread lesions on the skin and in the internal organs, a painless rash, fever, malaise and bone ache. These symptoms disappear after a few weeks, but in 25% of sufferers they recur during the first two years (ibid.). The tertiary stage only develops in a third of untreated cases, and only following a latent phase that may vary in length from one year to more than 20 years. It is this tertiary stage that causes profound systemic damage and results in insanity and death. The bacterium causes progressive destruction of a number of systems of the body, including the skin, the mucous membranes, the bones, the heart and blood vessels and the nervous system. Nervous system involvement causes a loss of positional sense and sensation that manifests as locomotor ataxia (a stumbling, high stepping gait), and bouts of insanity, generally known as general paralysis of the insane (ibid.; Roberts and Manchester 1995, 153). Fatality from tertiary syphilis occurs through cardiovascular involvement, such as a ruptured aneurysm, or cardiac valve failure.

Congenital syphilis – syphilis transmitted to the unborn child of a mother suffering from venereal syphilis – occurs in 80% of pregnancies where the mother is infected (Aufderheide and Rodríguez-Martín 1998, 164). The spirochete bacteria are transmitted across the placenta to the foetus after the first 16 – 18 weeks *in utero*. Spontaneous abortion and stillbirth are commonly associated with the condition. Surviving infants frequently manifest with developmental anomalies, such as deafness, cusp malformations of the permanent dentition (Hutchinson's incisors and mulberry molars), interstitial keratitis, impaired cognitive development, periostitis, osteochondritis and osteomyelitis. Syphilitic infection of the scalp, historically described as 'scald head', was a very visual, unsightly manifestation of congenital syphilis.

The London Bills of Mortality attributed between one and 30 deaths per year to 'scald head' in the period between 1740-1810 (Roberts and Cox 2003, 341-2). The true mortality rate of congenital syphilis was probably much higher. Nevertheless, many sufferers of congenital syphilis did survive into mature adulthood. One young adult male (skeleton 6071) had irregular lobulations on the cusps of the first molars, characteristic of mulberry molars, a feature consistent with congenital syphilis.

Lesions consistent with venereal syphilis were present in two adult male individuals from the named sample at St George's (skeletons 3085 and 4069), representing 2.99% of the total adult population (N= 67). This prevalence was higher than most other assemblages of this period. Only Newcastle Infirmary had a higher rate at 3.7%, perhaps not surprising in an assemblage that included a high proportion of sailors. Other middle class assemblages (such as Christ Church, Spitalfields, and Kingston-upon-Thames reported rates of 0.21% and 0.28%, respectively (Roberts and Cox 2003, 341). It is a problem to explain why prevalence of venereal syphilis seen at St George's is higher than in the assemblages of similar socio-economic background. It may be that these individuals chose to spend more money on extra-curricular activities, such as whoring.

Indeed, Bloomsbury was not far distant from the notorious red light district of the West End, which centred on Covent Garden and Piccadilly (Picard 2000). *Harris's List of Covent Garden Ladies*, first compiled by Samuel Derrick in 1757, was an indispensible guide for the well-heeled sexual tourist to the Metropolis in the late Georgian period (Rubenhold 2005). It gives considerable insights into the sex trade of the time, and lists amongst others a Miss Sh-rd of 46 Googe Street,

> a very desirable companion . . . of middle size, inclined to be fat [with] . . . a posterior inclined to be luscious (ibid.).

This 'most pleasing pupil of pleasure' had several City 'friends' and lawyers from Gray's Inn and the Temple. One wonders if these included any of the many lawyers interred in St George's crypt. Derrick's flattering descriptions of the many ladies of pleasure in various updated editions of his list is in stark contrast to his attitude to a Miss Young of No. 6 Cumberland Court, Bridge Street, who

> has very lately had the folly and wickedness to leave a certain hospital, before the cure of a certain distemper which she had was completed, and has thrown her contaminated carcass on the town again, for which we hold her inexcusable (ibid, 158).

The 'certain distemper' is likely to have been syphilis.

Tuberculosis – Tuberculosis may be spread to humans by the ingestion of infected meat and milk. The strain responsible is *Mycobacterium bovis.* Alternatively, the disease may be spread from person to person by inhalation of airborne bacilli present in expectorated phlegm. The seat of the primary lesion in this form of tuberculosis is most commonly the lungs, and is caused by the strain *Mycobacterium tuberculosis.* The latter route was the more common in the 18th and 19th centuries, the spread of infection being facilitated by high population density, poor nutrition and housing, and the lack of hygiene so prevalent amongst the urban poor. The more privileged and renowned of society were not immune to this terrible scourge, however, famous sufferers including Keats, Anne and Emily Brontë and Chopin (Dormandy 1991), all contemporaries of the St George's population. Since potential sufferers are at their most vulnerable in adolescence, the disease was given a romantic sheen- of young people tragically cut down before their time. The physical symptoms of gently wasting away added to this notion (ibid.). Yet the reality of the disease for the majority of sufferers was far from romantic, and tuberculosis hit the working classes hardest. Amongst the poor, it was the leading cause of death in the 19th century (Humphreys 1997, 137). Bills of Mortality from the late 18th and early 19th century show a mortality rate due to consumption at around 25% (Roberts and Cox 2003, 338).

Bony lesions are not present in the majority of tuberculosis cases. Recent clinical studies have shown that skeletal involvement is found in only 1% of patients, and before the availability of antibiotics, this figure averaged 5% – 7% (Aufderheide and Rodríguez-Martín 1998, 133). Most cases of tuberculosis therefore go unrecognised in palaeopathology. Lesions involving the spine have been reported in 25-50% of cases of skeletal tuberculosis (Roberts and Manchester 1995, 138). These lytic lesions in the vertebral bodies caused by tubercular abscesses eventually cause the spine to collapse, through compression fractures of the vertebral bodies. Where profound hunchback or kyphosis results, these changes are known as Pott's disease.

In addition to the rib lesions discussed above, one prime adult female (skeleton 7011) of the St George's assemblage (1.39%, n=1/72), showed spinal lesions consistent with tuberculosis. The average prevalence calculated from four post-medieval sites by Roberts and Cox (2003, 339) was 0.62%, whilst a higher rate of 1.6% was reported from Newcastle Infirmary, not unexpected in this working class assemblage.

Metabolic disease

Cribra orbitalia and porotic hyperostosis – Cribra orbitalia is widely thought to occur in response to a deficiency of iron during childhood, most commonly the result of inadequate dietary intake of iron, and/or as a result of severe intestinal parasite infestation (Stuart-Macadam 1991, 101). Iron is a central component of haemoglobin, the molecule necessary for the transportation of oxygen in the red blood cells of the blood. Red blood cells are produced within the red bone marrow of a number of bones of the body, which include the diploë of the cranial vault, the sternum and the pelvis. In childhood, the diploë are particularly important, but become a secondary site of red blood cell production later in life. In iron deficiency anaemia, the body attempts to compensate for low serum iron levels by hypertrophy of these bones. In children, this manifests osteologically as an increased porosity and thickening of the diploë of the cranial vault (known as porotic hyperostosis) and of the orbital sockets (Cribra orbitalia). Cribra orbitalia is often used as a generic indicator of physical stress in childhood. The physical symptoms of anaemia are shortness of breath, fatigue, pallor and palpitations (Roberts and Manchester 1995, 167).

The orbits of seven individuals (CPR 9.7%; n=7/72) displayed cribra orbitalia, of which three had active lesions at the time of death (3064, 4039 and 7053). Given the childhood nature of the disease, it is unsurprising that these active lesions were found in subadults- two infants and one adolescent. The true prevalence of the assemblage was 10.5% (n =13/124 orbits). Using Stuart-Macadam's (1991) scoring system, the severity of the lesions were rated as Type 1 in skeletons 4030 and 7043, Type 2 in skeletons 3064, 4013 and 4039, Type 3 in skeletons 6085 and 7053, whilst skeleton 2029 displayed a Type 4 lesion in the left orbit and a much less developed Type 1 lesion in the right.

The crania of one adult male (6048) and one female (2008) displayed porotic hyperostosis- a crude prevalence of 2.8 % (n=2/72) and a true prevalence of 3.2% (N=2/62 crania). The total number of skeletons with lesions that were consistent with iron deficiency was 10 (13.89%, n=10/72). The crude rate of cribra orbitalia in the Christ Church, Spitalfields, assemblage was 34% (Molleson and Cox 1993) and in the named assemblage of St Luke's, Islington it was 9.5% (Boyle *et al.* 2005, 235). Interestingly, the lowest prevalence was noted in the paupers of the Cross Bones assemblage (4.05%). The association between cribra orbitalia and higher social class may reflect infant feeding practices of the day, in which pap or panada was substituted for breast milk early in infancy. This gruel essentially comprised flour and water, and was very deficient in nutrients, including iron. It was also associated with an increased risk of gastric infections from poor quality water (Roberts and Cox 2003, 307). The poor, who through economic necessity were forced to breastfeed longer than their more affluent counterparts, appear to have spared their children some of the illnesses afflicting children of the middling sort.

Rickets – Vitamin D is mainly synthesised by the skin when it is exposed to sunlight, but may also be obtained from foods such as eggs and oily fish. Rickets is caused by a childhood deficiency of this vitamin. Vitamin D is needed for the uptake of calcium, and hence, normal mineralisation of bone. In rickets the bone becomes softened, allowing the bones to distort. Most common is bowing of the weight bearing bones of the legs, but if rickets develops when an infant is crawling, the long bones of the arms may be affected also (Roberts and Manchester 1995, 173). In severe cases, the individual may become markedly knock-kneed, making locomotion difficult and painful. Large nodules of bone may also grow on the end of the ribs producing a concave or pigeon chest. The pelvic bone may also deform, making childbirth impossible later in life. Other symptoms include muscle and joint pain, abdominal pain and muscle spasm (Beck 1997a, 130).

The industrialisation of Britain caused a substantial increase of this condition in urban areas, due to the persistent pall of smoke and smog overhanging the cities. In the overcrowded slums with their overhanging buildings, sunlight was largely blotted out. Children of the poor also had to work indoors for most of the daylight hours and were therefore even more susceptible to developing rickets. To less industrialised people on the Continent, rickets become known as the English disease (Geber pers.comm.). The children of the more privilege

Plate 6.5 Skeleton 5068: rickets and fracture of the fibular shaft

classes were also at risk from the pervasive air pollution, and were not helped by the fashionable infant feeding practices described above (Roberts and Cox 2003, 308).

One ageing adult female (skeleton 5068) had characteristic bowing of the femora and tibiae indicative of childhood rickets (Plate 6.5). The prevalence of 1.8% in the named sample from St George's, compares favourably with rates from the pauper burial ground of Cross Bones, Southwark, and the middle class crypt of Christ Church, Spitalfields, which produce rates of 6.8% and 3.6%, respectively.

Neoplastic disease

Benign neoplasm – The only benign neoplasm present within the assemblage was a button osteoma on the skull of an ageing adult female (skeleton 4007). This type of lesion consists of a small round projection of dense bone commonly situated on the frontal bone. It would have been asymptomatic (Roberts and Manchester 1995, 188).

Malignant neoplasm – In modern studies, 20% of all cancer fatalities spread to bone. This is one of the reasons why malignant neoplasms are rare in archaeological assemblages. In addition, most cancers become more common with increasing age. It is thus reasonable to assume that in archaeological populations, where the mean lifespan was much shorter, cancers would be less prevalent (Roberts and Manchester 1995, 192-193).

Metastatic carcinoma is secondary cancer that has spread from a primary tumour. The primary site in bone metastases is the breast in females and the prostate in males. These cancer spread throughout the body through the blood stream, and secondary sites are therefore most commonly located in trabecular bone of the cranium, vertebrae, ribs, sternum, pelvis and major long bones (Aufderheide and Rodríguez-Martín 1998, 388).

Two individuals (2.8%, n/N=2/72) within the named assemblage displayed lesions consistent with metastatic carcinoma. They were both ageing adult females (skeletons 5043 and 5061), and given their age and sex it is probable they both had suffered from breast cancer. The prevalence from St George's Church is rather high compared to similar assemblages, and probably reflects an ageing population. Only one individual (0.10%) had metastatic carcinoma in the Christ Church, Spitalfields, assemblage (Roberts and Cox 2003, 352).

Post-mortem medical interventions

Craniotomies had been performed on two adult male individuals (skeleton 1077 and 3090) (2.8%, n/N=2/72). This procedure involved the removal of the top of the skull in the horizontal plane in order to examine the brain. There were no skeletal clues as to why the procedure had been carried out.

In the Georgian and Victorian periods, post-mortem dissection was an uncommon procedure, and usually one over which the deceased and their relatives exercised little control. In the 18th century there was a growing need in medical institutions for cadavers on which students might learn anatomy and practice dissection. In 1752, the Company of Surgeons was granted the corpses of all executed felons. However, demand far outstripped supply, and many additional cadavers were supplied to anatomy halls by 'resurrectionists', who raided graveyards, exhuming recently buried corpses and selling them on for a handsome profit (Porter 1997, 318). Public outrage at this practice reached a height in 1829 with the notorious case of Burke and Hare in Edinburgh. The outcome of this outrage was the passing of the Anatomy Act (1832), which permitted the medical profession to take for dissection all 'unclaimed bodies' of those dying without family, or those dying in the workhouse or hospital. As a result of the act, there was a reduction in body-snatching, but the act also served to deepen the fear and shame amongst the poor of dying on the parish (Rugg 1999, 222).

The antipathy to the notion of being dissected was based around religious and social perceptions. The Christian belief in the resurrection of the whole body on Judgement Day led to fears that dissection would damage the spiritual state of the dissected person. A deep-seated solicitude for the corpse causes reactions of revulsion at the indignities imposed on the body during exhumation and dissection. In particular, with regards to female corpses, the physical exposure of the naked body to the gaze of young men was perceived as harrowing, a process tantamount to sexual assault (ibid.).

In view of these almost universal sentiments regarding dissection, it is perhaps puzzling that these two skeletons from St George's crypt had undergone a craniotomy, when clearly they were neither felons nor had died friendless on the parish. It is possible that both men had consented to the procedure, perhaps because of unusually progressive views on medicine and the academic necessity for dissection. Memorial plaques within the church, and documentary sources record the interment of at least five medical doctors within the crypt. However, skeleton 1077 is that of Edward Littledale, Esq., bibliophile (d. 1837), and brother of Right Honourable Sir Joseph Littledale (coffin 1511), judge of the Court of Queen's Bench (*The Gentleman's Magazine* 1842, 319-20). Edward Littledale's address was given as Gray's Inn Square, and his age as 57 years (sic) in the death notice in *The Gentleman's Magazine* (1837, 667). Skeleton 3090 is that of Charles Thomson (b. 1758, d. 1821), Master in Chancery, appointed February 1809 (Hadyn 1851, 241).

Alternatively, some craniotomies may have been the result of autopsy rather than dissection. There is an important distinction to make between dissection and autopsies, the former being very intrusive and destructive to the point of there being no remains left for burial, whereas the latter was minimally intrusive insofar as only the lesion or part of the body which needed to be examined was investigated. Autopsy was carried out to primarily establish cause of death, but also in order to further knowledge of a particular ailment or lesion. Indeed, forensic medicine emerged in medical journals as a separate field in the early part of the 19th century (Crawford 1991, 203). As such, it may very well be possible that the legislation that covered dissection of unclaimed paupers did not cover autopsies, as they were distinctly different interventions. Indeed, the two individuals with craniotomies from St George's crypt died in 1821 and 1837, respectively before and after the passing of the Anatomy Act.

The craniotomy performed on Charles Thomson may well have been part of an autopsy. The *Gentleman's Magazine* of July 1821 recorded how 'suddenly at his house in Portland Place, Charles Thomson, esq, ... had had a paralytic stroke, and had been in a declining state for some time past...'. It is probable that the craniotomy was performed to investigate his stroke.

A less probable alternative explanation is that these craniotomies were performed on the sly without the consent of the deceased or their relatives. Such craniotomies are fairly easy to hide from the incurious if the dissection of the skin is concealed beneath the hair. It is possible that their families may have interred them remaining none the wiser of these interventions. The presence of this type of post-mortem intervention in post-medieval assemblages is not unusual with a national prevalence of 1.62% (Roberts and Cox 2003, 315).

Social modification – the effects of corsetry

The right and left ribs of one ageing adult female, Catherine Warren (skeleton 7016), displayed a deformity of the rib shafts, such that the angle of each of the lower ribs was very exaggerated or acute, presenting as squaring and flattening anterior-posteriorly. The lower part of the rib cage was affected bilaterally. The abnormally acute angulation of the ribs may have been caused by the habitual wearing of a tight-laced corset.

Corsets of the latter half of the 18th century were known as stays. Amongst the less affluent, stays were often of leather and were frequently worn without an overlying fabric covering. These stays, made malleable by sweat and oil from the skin, did not prove an impediment to household duties, allowing considerable movement (Picard 2000, 216). More expensive stays were of different construction and were very much more restrictive. The more expensive corsets were usually highly decorated and worn as an outer garment with or without shoulder straps. In the 18th century, stays or corsets were worn by aristocratic men and women and increasingly by the growing middle classes.

More expensive adult female stays consisted of panels that were reinforced by thin whalebone to make the garment very stiff. Stays moulded the upper body to resemble an inverted cone with the purpose to achieve a thin waist and a flattened anterior-posterior profile. Some women undertook tight-lacing in order to achieve this fashionable shape. Although a moderately laced corset was unlikely to have caused any physical harm, a tightly laced corset would have compressed the lower ribs, narrowing the ribcage. This would have compressed the inner organs, often leading to physical discomforts, such as dizziness, nausea, breathing difficulties, heart palpitations and indigestion. When a corset was laced this tightly, fainting was not uncommon (Werner *et al*. 1998, 94).

There appeared to be conflicting opinions in 18th century medicine about the effects of tightly laced corsets on women's health. For example Nicholas Andry, paediatrician and Professor of Medicine in the College Royal, and Dean of the Faculty of Physick, Paris, suggested that every child should wear a corset from the age of five years (Andry 1743, quoted in Schwarz 1979, 553). Other practitioners were much more critical of corsetry on health. A late 18th-century publication by von Sömmerring (1793) included an engraving depicting constriction of the abdomen and the lower ribs by tight lacing (reproduced by Fee *et al* 2002; see also Schwarz 1979, fig. 3) as an aid in demonstrating the deleterious health effects of this fashion.

Constrictive fashions that emphasised a narrow waist changed with the advent of the French Revolution, and were replaced by long loose fitting dresses with waistlines just beneath the bust (the so-called Empire line), reminiscent of the dress of Classical Greece and Rome. It is however unlikely that everybody in this interim period stopped wearing stays. Some women may have been physically unable to go without them due to atrophied back muscles. Many older men and women in the Regency period chose to retain outdated fashions of their youth, including wearing stays, wigs, hair powder and patches long after they had gone out of vogue.

Classically inspired loosely draped dresses and less restrictive underwear, however, lasted only *c.* 20 years, but by 1815 corsets were very much back fashion. Corsets of the early 19th century became so rigid and constrictive that they alarmed medical professionals of the day. This was in part due to invention of the metallic eyelet by a French army doctor during the Napoleonic Wars, which allowed the corsets to be clinched even tighter without damaging the fabric.

Skeleton 7016, the ageing adult female with rib deformations, died aged 78 years in 1834. She probably started wearing stays in her youth in the early 1770s. Although all females were expected to wear corsets from an early age, this individual was the only one in the assemblage displaying these rib deformities. It may have been that she was particularly fashion conscious, lacing her stays tightly from an early age. Strict mothers often compelled their daughters into tight lacing from late childhood or early adolescence, and Catherine Warren may well have been one of these unfortunate girls. Tight lacing would explain why not all females show the characteristic rib deformations and explain the rarity of the lesions. Similar changes in rib morphology were noted in one female from St Luke's, Islington (Boyle *et al*. 2005) and one from the late Georgian Quaker burial ground in Kings Lynn, Norfolk (skeleton 30547) (Mahoney 2004).

THE UNNAMED SAMPLE

Introduction

The unnamed sample comprised 37 individuals whose age and sex could not be identified from *depositum* plate inscriptions. In addition, the named skeletons of John Rigge (6055) and Benjamin Wood (4032) were erroneously included in the unnamed sample (Table 6.14). These 39 skeletons underwent low-resolution osteological analysis using methodologies described below.

The lack of legible *depositum* plate inscriptions in these burials, and hence the anonymity of these 39 skeletons, is entirely a factor of taphonomy and did not indicate different treatment of the dead in the named and unnamed assemblages. Crushing and tearing of the lead shells occurred as a result of compression by overlying coffins in the coffin stacks, and during later spatial re-organisation within the vaults, the latter being most evident in Vault 7. Corrosion of the lead due to water seepage was present in the lower stacks of Vaults 4 and 5, and contributed to the weakness and collapse of the lead shells on lifting.

No true difference existed either in the richness of the coffin furniture or in the social and economic standing of the individuals comprising the two groups. In many respects, such as palaeodemography and some pathology rates, they may be regarded as a single population. The difference between the two lies in the osteological methodology employed in their osteological examination, which limited the comparisons of prevalences of skeletal pathology and non-metric traits.

Methodology

Unlike the named sample, which was fully analysed, the unnamed skeletons only underwent low-resolution osteological analysis. As with the named sample, age, sex and stature were fully estimated. An inventory of each skeleton was created to allow the calculation of true prevalence of pathological conditions. Bone preservation and completeness were recorded, as was dentition. Dental pathology prevalences were calculated per tooth in accordance with accepted practice. The skeletons were not formally examined for pathology or for non-metric traits, but those pathologies or traits noted in the course of osteological examination were recorded. Any non-metric traits noted are not reported here, but this information has been retained in the archive. Skeletal pathology is presented here, but the true prevalence may be under-reported as a result of this methodology. Bone measurements (with the exception of maximum long bone length used in stature estimation) were not undertaken on this sample.

Age, sex and stature were estimated using the same osteological methodology as the named assemblage, described above. Recording of preservation and completeness, dentition and dental pathology were likewise undertaken in the same manner.

Results

Preservation and completeness

Bone preservation within the unnamed sample varied considerably from poor to excellent. Preservation was rated on a four-point scale, from 1 (poor) to 4 (excellent) as described above for the named sample. Thirteen skeletons were poorly preserved, the bone having demineralised and becoming soft and crumbly to touch. In a number of

Table 6.14: Unnamed sample: Summary of the age, sex, stature, completeness and preservation (N = 39)

Coffin No.	*Osteological Age*	*Age category*	*Osteological Sex*	*Stature*	*Preservation*	*Completeness*
1084	40-44 y	mature adult	male	168.07	1	3
1097	35-50 y	prime adult	male	167.08	1	3
1129	14-15 y	Adolescent	subadult		3	3
1142	50+ y	ageing adult	possible male	164.06	1	4
2042	30-40 y	prime adult	female		1	3
3007	20-24 y	young adult	female	171.49	4	4
3013	30-40 y	adult	male	174.83	2	2
3017	12-13 y	Adolescent	subadult		3	2
3044	45-51 y	mature adult	male	179.51	3	4
3083	37-44 y	prime adult	female	164.68	1	4
3087	44-48 y	mature adult	male		1	3
3093	44-54 y	mature adult	male	181.33	1	4
4029	24-31 y	prime adult	female	154.53	2	3
4032	35-42 y	prime adult	male	167.68	3	4
4052	adult	adult	female	166.20	1	2
4054	33-46 y	prime adult	male		1	2
4061	59-71 y	ageing adult	male	163.52	3	4
4068	63-71 y	ageing adult	female	157.87	3	4
4077	35-44 y	prime adult	male	167.03	3	4
5028	40-50 y	mature adult	female	155.64	4	4
5042	60+ y	ageing adult	possible male		1	3
5051	adult	adult	female	162.04	1	3
6055	50+ y	ageing adult	male	171.45	3	3
6059	40-49 y	mature adult	female		1	1
6060	40-44 y	mature adult	male	171.71	3	3
6111	14-15 y	Adolescent	subadult		3	4
6129	50+ y	ageing adult	male		1	2
7001	50+ y	ageing adult	female	161.87	1	2
7003	24-27 y	prime adult	female	166.83	2	2
7004	60+ y	ageing adult	female		2	2
7005	65-78 y	ageing adult	male	159.62	2	4
7007	20-24 y	young adult	female	164.30	3	3
7008	65-78 y	ageing adult	male	170.67	3	2
7009	65-78 y	ageing adult	male	162.85	2	2
7010	25-50 y	mature adult	female	146.19	3	4
7017	50+ y	ageing adult	male	172.79	1	1
7049	45-54 y	ageing adult	male	168.33	4	3
7053	11-13 y	Adolescent	subadult		4	3
7062	35-45 y	mature adult	male	167.03	4	3

cases, crystal formation (brushite) was observed on the bone surface, giving it a shimmering appearance. These changes were most noticeable in skeletons where the coffin had been filled with large amounts of sawdust or bran, and where the coffin had been exposed to prolonged wet conditions. Of the remainder of the sample, the preservation of six skeletons was rated as fair (2), 13 as good (3) and five as excellent (4).

All attempts were made to recover the elements of each skeleton from both within the coffin and the vault. For many skeletons, small bones, such as carpals and phalanges, were missing. This is probably due to a combination of poor retrieval of these elements in the sub-optimal lighting of the vaults, and the poorer preservation of these small, less robust bones. Completeness of the skeleton was scored on a four-point scale, 4 representing 76-95% completeness; 3 representing 50-75%; 2 representing 25-49% completeness, and 1 representing less than 25%. Preservation and completeness of each skeleton is summarised in Table 6.14 above. Most skeletons were grade 3 (50-75% complete).

Composition of the sample

Distribution of sex and age

Thirty-nine skeletons were analysed, of which 35 were adult (Table 6.15; Fig. 6.9). All adults in the sample could be sexed. Fourteen females (40%), 19 males (54.29%) and two possible males (5.71%) were identified. The predominance of males is not well understood, but may be an artefact of the fairly small sample size, but is consistent with the sex distribution recorded from *depositum* plates.

There were no infants or young children in the assemblage, but four subadults were aged between 12 and 14 years. The absence of the very young, may be explained by better preservation of the smaller infant and child coffins, which could be lifted intact from the vaults. A large proportion of these small coffins were positioned in the upper layers of the coffin stacks and hence, suffered less crushing and distorting than many of the adult coffins. As a result, no infant or child coffins were breached and hence, no skeletons were available for analysis.

There were only two young adults (5.56% of the total sample), both of whom were female. A number of infant bones were discovered in the adult coffin of one of the young woman (skeleton 7003), suggesting that she and the infant may have died as a result of the complications of pregnancy or childbirth. Unfortunately, due to the disturbed nature of the bones, it could not be established if the infant bones had still been *in utero*, or if the deaths of mother and child had occurred peri-natally or post-natally. Childbirth was a leading cause of mortality amongst women of childbearing age (women in the young and prime adult age categories). Labour was a hazardous undertaking for both mother and child, but complications following childbirth also accounted for many fatalities. By the early 19th century, pueperal fever, or streptacoccal septacaemia following childbirth, was responsible for the death of 5-20% of maternity patients in most major European hospitals (Carter 2003, 266). Medical doctors were found to be the most important vectors in the spread of the infection between patients, often transmitting the bacteria from decaying cadavers examined during anatomy sessions to their maternity patients (ibid.).

The number of individuals in each age category increased with increasing age, peaking in the ageing adult category (50+ years). This age group comprised 33.33% of the total unnamed sample. Due to the limitations of ageing methodology available to osteologists, there are few reliable means of ageing

Table 6.15: Unnamed sample: Osteological age and sex (N = 39)

	Neonate (0-11 months)	*Young child (1-5 years)*	*Older child (6-11 years)*	*Adolescent (12-17 years)*	*Young adult (18-25 years)*	*Prime adult (26-40 years)*	*Mature adult (40+ years)*	*Ageing adult (50+ years)*	*Adult >18 years*	*Total*
Male	-	-	-	-	-	10.26 (4/39)	15.38 (6/39)	25.64 (10/39)	2.56 (1/39)	53.87 (21/39)
Female	-	-	-	-	5.13 (2/39)	10.26 (4/39)	7.69 (3/39)	7.69 (3/39)	5.13 (2/39)	35.90 (14/39)
Unknown	-	-	-	10.26 (4/39)	-	-	-	-	-	10.26 (4/39)
Total	-	-	-	10.26 (4/39)	5.13 (2/39)	20.51 (8/39)	23.08 (9/39)	33.33 (13/39)	7.69 (3/39)	100 (39)

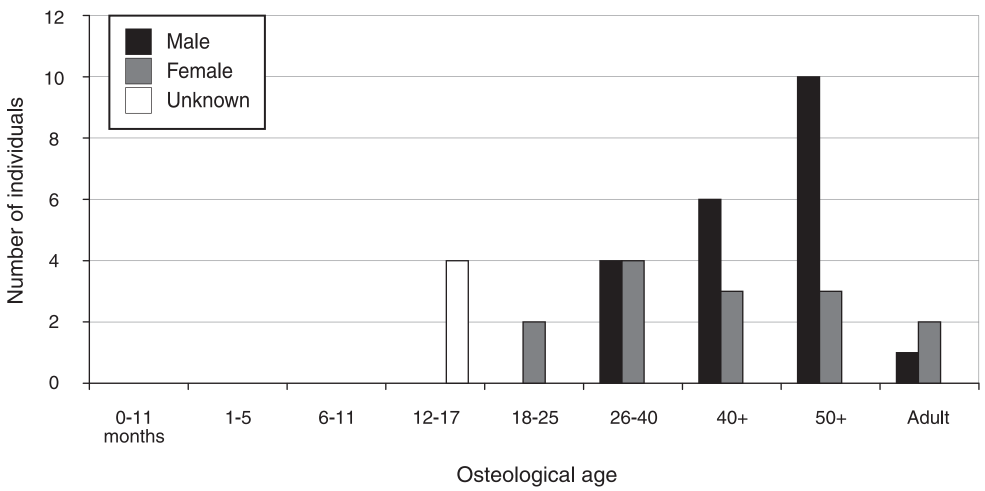


Fig. 6.9 Unnamed sample: Mortality profile (N = 39)

older individuals precisely. Under-ageing of skeletons is a well-recognised methodological problem in osteology (Mays 1998, 50). Sternal rib end degeneration is the only macroscopic method for estimating ages greater than 60 years. Using this method, five individuals (skeletons 4061, 4068, 7005, 7008 and 7009) were aged to greater than 60 years, and three were older than 70 years when they died.

The overall age profile of the unnamed sample was that of an ageing population. This correlates with the osteological age distribution of the named sample and is also consistent with biographical data (see Chapter 4).

Stature

It was possible to estimate stature in 28 of the 35 adults of the unnamed assemblage. The mean stature of males (N = 16) was estimated at 1.715 m

Table 6.16: Unnamed sample: Summary of the skeletal pathology (N = 39)

Skeleton No	*Age category*	*Sex*	*Infection*	*Joint disease*	*Congenital*	*Trauma*	*Metabolic*	*Interventions*
1084	40-44 y	male		OA, SDJD				
1097	35-50 y	male						
1129	14-15 y	subadult						
1142	50+ y	possible male		OA, SDJD, DJD				
2042	30-40 y	female		OA, SDJD				
3007	20-24 y	female						
3013	30-40 y	male						
3017	12-13 y	subadult						
3044	45-51 y	male	partly healed periostitis femoral shafts	SDJD		Right 4th metatarsal haematoma		
3083	37-44 y	female						
3087	44-48 y	male						
3093	44-54 y	male		OA; SDJD				
4029	24-31 y	female						
4032	35-42 y	male						
4052	adult	female						
4054	33-46 y	male		SDJD				
4061	59-71 y	male	active periostitis R tibial shaft	OA; SDJD				
4068	63-71 y	female		OA; DJD				
4077	35-44 y	male						craniotomy
5028	40-50 y	female		SDJD				
5042	60+ y	possible male		OA; SDJD				
5051	adult	female		DJD; SDJD				
6055	50+ y	male		DJD				
6059	40-49 y	female		OA				
6060	40-44 y	male						
6111	14-15 y	subadult					Cribra orbitalia	
6129	50+ y	male		OA;DJD;SDJD		3 fractured right ribs		
7001	50+ y	female		DJD; SDJD				
7003	24-27 y	female	possible childbirth complications					
7004	60+ y	female		SDJD				
7005	65-78 y	male		SDJD				
7007	20-24 y	female						
7008	65-78 y	male		OA		crush fracture L3; scoloisis		
7009	65-78 y	male		SDJD; DJD				
7010	25-50 y	female		OA; DJD; SDJD				
7017	50+ y	male						
7049	45-54 y	male		SDJD, DISH				craniotomy
7053	11-13 y	subadult						
7062	35-45 y	male						

or 5ft 6in. Average adult female stature (N = 12) was estimated at 1.658 m or 5ft 3in. Skeleton 1142, the only possible male with measurable long bones, had an estimated stature of 1.641 m or 5ft 4in. Average male stature of the unnamed sample was equivalent to the mean male stature (1.71 m) of the crypt and lower churchyard of St Bride's, London (Roberts and Cox 2003, 308), and two centimetres taller than the Christ Church, Spitalfields, population (Molleson and Cox 1993, 24; ibid.). It was the same as the average stature for men from 12 post-medieval sites cited by Roberts and Cox (2003).

The mean female stature of the unnamed group was approximately 10 centimetres taller than their Christ Church, Spitalfields, counterparts (Molleson and Cox 1993, 24), and five centimetres taller than the average female stature of 12 post-medieval populations cited in Roberts and Cox (2003, 308).

Skeletal pathology

Although the skeletons of the unnamed sample were not formally examined for pathology, evidence of trauma, infection, joint disease and metabolic disorders were noted on cursory inspection. Table 6.16 summarises these data. Explanations of the pathology described below may be found in the named assemblage report.

It is important to reiterate that because the skeletons were not formally examined for pathology, a number of more subtle bone modifications may have been overlooked, and hence, disease prevalences may be erroneously low. This is especially true for periostitis and well-healed, well aligned fractures. Thorough examination of vertebrae for pathological conditions was undertaken, however, and hence it is unlikely that the prevalence of SDJD and spinal OA were underestimated.

Infection

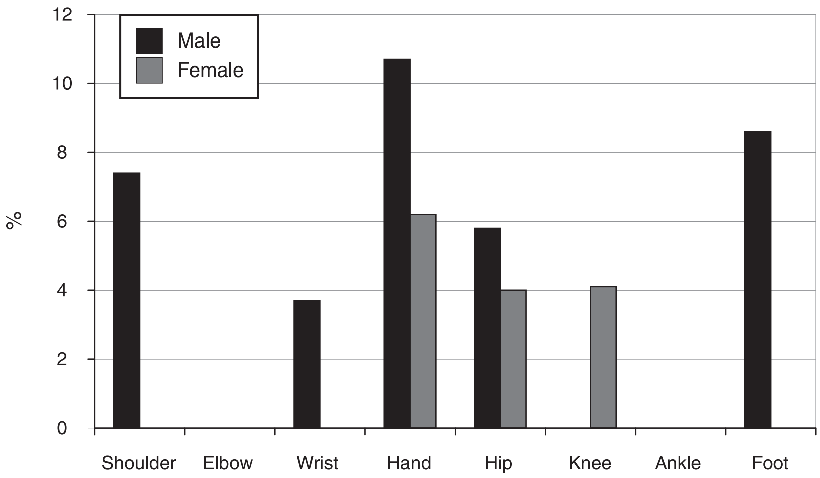
Periostitis was observed on two elements only, one femur (TPR 6%) and one tibia (TPR 3). The lesions involved male skeletons 3044 and 4061. On skeleton 3044, a considerable area of partly healed new bone was present on the anterior cortical surface of the distal two-thirds of the left and right femoral diaphyses. This was probably due to the presence of a non-specific infection. Healed new bone formation was also observed on the lateral diaphysis of the right fourth metatarsal of the same skeleton. The underlying cause may have been localised trauma or the ossification of a small haematoma, but the presence of periostitis may suggest a more systemic aetiology for these lesions.

Skeleton 4061 also had experienced localised and non-specific periostitis. A small area of healed new bone growth was present on the anterio-medial aspect of the mid-shaft of the right tibia.

Joint disease

Osteoarthritis and degenerative joint disease (DJD) – Twenty-one individuals (53.85%), twelve males and nine females, showed degenerative joint changes, (identified by the presence of porosity and osteophytosis on the joint surface).

DJD affected the spine in 17 adults of the unnamed assemblage (CPR 48.6 % of adults). Most commonly affected extra-spinal joints were the clavicle (particularly the sterno-clavicular joint) and the carpals and metacarpals of the hands. The last two affected more males than females. Porosity and/or osteophytosis were observed on the extra spinal joints of eight individuals (four males and four females) and the spinal joints of 17 individuals (11 males and six females).



Notes:
Left and right sides combined; Shoulder=gleno-humeral and acromio-clavicular; elbow = distal humerus, and proximal radius and ulna; wrist=distal ulna and radius, scaphoid, lunate; hand=multiple joints except those relating to wrist; Knee=any compartment; ankle=distal tibia and fibula and talus; foot=multiple joints except those relating to ankle.

Fig. 6.10 Unnamed sample: True prevalence of osteoarthritis

Table 6.17: Unnamed sample: True prevalence of osteoarthritis in different joints

	Males	%	Females	%
Shoulder	2 / 27	7.4	0 / 24	0
Elbow	0 / 35	0	0 /25	0
Wrist	1 / 27	3.7	0 / 22	0
Hand	3 / 28	10.7	1 / 16	6.2
Hip	2 / 34	5.8	1 / 25	4
Knee	0 / 35	0	1 / 24	4.1
Ankle	0 / 28	0	0 / 20	0
Foot	2 / 23	8.6	0 / 19	0

Lefts and right sides combined; Shoulder=gleno-humeral and acromio-clavicular; elbow=distal humerus, and proximal radius and ulna; wrist=distal ulna and radius, scaphoid, lunate; hand=multiple joints except those relating to wrist; Knee=any compartment; ankle=distal tibia and fibula and talus; foot=multiple joints except those relating to ankle.

Osteoarthritis (OA) was identified from eburnation only OA was present in 11 individuals (CPR 31%; 11/35 adults)- seven males (33.3%, 4/21 males) and four females (28.6%, 4/14 females). In common with the named sample, it is most probable that the high prevalence of these bony changes was associated with the older age distribution within the sample. All but one individual (skeleton 2042), who only manifested with DJD, had an average osteological age above 40 years.

Distribution of osteoarthritis across the skeleton indicated that in the unnamed Sample, the hands (TPR 9.1%) were most commonly affected, followed by the feet (TPR 4.8%), the hip (TPR 5.1%), the shoulder (TPR 3.9%), the wrist (TPR 2%), and the knee (TPR 1.7%). Males suffered more from OA in all the above joints, with the exception of the knee, which affected one female. (Fig. 6.10; Table 6.17). This pattern broadly echoes the distribution of lesions in the named sample. The predominance of OA in males at St George's differs from modern western populations where OA occurs with more frequency and severity in females (Denko 2003, 235). This difference, in part, may be explained by the greater longevity of males in this assemblage. It should be borne in mind, however, that the assemblages of St George's were fairly small.

Diffuse idiopathic skeletal hyperostosis (DISH) – DISH was observed in one individual from the unnamed sample (skeleton 7049). Thoracic vertebrae 4 to 12 were fused together along the right side, displaying the dripping candle wax appearance characteristic of this disease (Rogers and Waldron 1995). Vertebrocostal joints of the right ribs 7, 8, 10 and 12, and left ribs 7, 8, 9 and 12 showed pronounced ossification of the costal cartilage, resulting in the fusion of these joints. The sterno-clavicular joints were likewise fused. No other osteoblastic changes, such as enthesopathies, were noted on other parts of the skeleton.

The age of male skeleton 7049 (45-54 years) is typical of most DISH sufferers, where age of onset of the disease usually occurs from 50 years onwards.

Trauma

There was relatively little evidence for trauma. The fourth right metatarsal of skeleton 3044, an adult male, displayed new bone formation, probably secondary to localised trauma or an ossified haematoma. Without radiography, a differential diagnosis cannot be made. Adult male skeleton 6129 had fractured three mid-thoracic ribs on the right side, whilst one fracture of the right rib was found in skeleton 3087. This gives a true prevalence of 3.96% of right ribs, or 2.1% of all ribs present. Slight thickening of the shafts was evident adjacent to the necks of the three ribs of skeleton 6129, and on a shaft fragment in skeleton 3087. The lesions were well healed and evidently of long standing. Rib fractures are usually the result of a direct blow to the ribcage, or a direct fall onto the affected side (Roberts and Manchester 1995, 77). Interestingly, skeleton 3087 appeared accident prone, as his left clavicle and left humerus displayed healed fractures, also.

Skeleton 7008 had suffered a crush fracture of the body of the third lumbar vertebra. Crush or compression fractures result when a sudden excessive force is applied to the bone in the vertical plane and the bone is compressed along the plane of impact (Ortner and Putchar 1981, 56, forming a wedge shaped vertebral body. In many cases, this condition occurs in individuals where the bone is already weakened by underlying osteoporosis of the spinal column (ibid.). It was not possible to determine, through macroscopic analysis alone, whether skeleton 7008 had osteoporosis. Widespread osteophytosis of vertebral bodies C4 to L1 was, however, present. The body of L3 was compressed on the left side. This wedging resulted in a left sided displacement of the spinal column, or scoloisis.

Metabolic disorders

The bone of the upper lateral right eye socket of adolescent skeleton 6111 displayed a mixture of small and large foramina, characteristic of Type 3 cribra orbitalia (Stuart-Macadam 1991, 109). In skeleton 6111, another symptom of childhood stress, dental enamel hypoplasia, was also present. Marked lines of thinned enamel were evident on 27 out of 28 tooth crowns. The number of lines per tooth varied between one and five, indicating at least five prolonged episodes of illness or malnutrition in the first six to seven years of life. Adolescent 6111 appeared to have suffered chronic or recurrent and prolonged episodes of ill health for much of his or her short life.

Craniotomy

The skulls of two male skeletons (4077 and 7049) had undergone post-mortem craniotomies. In both cases, the skull had been opened in the horizontal plane with the incision through the frontal, parietal and occipital bones. Skeleton 7049 had further skeletal evidence of dissection: seven ribs and the manubrium of the sternum had been sawn through in order to open up the thoracic cavity to reveal the heart and lungs.

The number of craniotomies in the St George's assemblages was unexpected (see discussion above), but, given the number of medical doctors buried in the crypt, it is possible that at least some volunteered their bodies to science. The breast-plate (8122) of a John Scott M.D., who died on the 30th of July 1849, aged 66 years, was found loose in one of the northern vaults. Although it is highly speculative to tie this name to the skeleton of the older of the two unnamed dissected skeletons, it nevertheless interesting to note that at least one unnamed male skeleton in the crypt was that of a medical practitioner. It seems probable that skeletons 4077 and 7049 were either medical doctors or individuals who placed a very high value on the advancement of medical knowledge.

Dental pathology

The results and prevalence of dental diseases are summarised in Table 6.18 below.

Caries and abscesses

Thirty-eight carious lesions were recorded in the 470 teeth present (8.09%). This prevalence is comparable with caries rates from the broadly contemporary burial group from St Bartholomew's church, Wolverhampton (8.10%), but is lower than those cited from contemporary middle class crypt populations of St Nicholas', Sevenoaks (14.07%) and Christ Church, Spitalfields (17.99 %) (cited in Roberts and Cox 2003, 326).

The rate of abscess formation was 4 out of a total of 865 sockets present (0.462%). This prevalence is broadly comparable to those found at St Bartholomew's church, Wolverhampton (0.35%), and at St Nicholas' church, Sevenoaks (0.4%) (ibid.).

Periodontal disease

Bony changes as a result of periodontal disease were observed in 14 individuals with existing jaws (38.8%, N=36). The severity of the retraction of the alveolar bone was graded as slight, moderate or considerable (Brothwell 1981). Three individuals manifested with slight retraction, one with slight to moderate, seven with moderate, one with moderate to considerable, and two with considerable periodontal disease.

Ante mortem tooth loss (AMTL)

Thirty of the 36 individuals with extant maxillae and/or mandibles had suffered the loss of least one tooth before death (83.3%). Total AMTL was observed in five skeletons (3044, 4068, 7001, 7004 and 7005). The prevalence of AMTL per socket was 32.83% (284/865). The high rate of tooth loss probably reflects poor oral hygiene and the aged nature of the unnamed population, since dental disease is accumulative with age. It was impossible to distinguish between those teeth lost as a result of caries, and those deliberately extracted by a tooth-puller or dentist. The rate of AMTL amongst the unnamed sample was broadly comparable with St Nicholas's Church, Sevenoaks (37.95 %) and the Quaker cemetery of Kingston-upon-Thames (34.61%), but considerably higher than the rate from Christ Church, Spitalfields (12.5%) (ibid.). This discrepancy may be due to the larger proportion of subadults in the last population, compared to the St George's crypt sample.

Calculus

Calculus was observed in 17 of the 20 individuals examined in the unnamed sample (85%). The prevalence per tooth was 60.08% (162/266). This is higher than the mixed class population of St Luke's church, Islington (Boyle *et al* 2005) (46.33%) and the working class population of the Newcastle Infirmary (55.85%) (ibid.).

Dental enamel hypoplasia

Dental enamel hypoplasia (DEH) was recorded on 12 individuals in the unnamed sample. Seventy-eight of a total of 216 tooth crowns with clearly visible buccal surfaces displayed DEH (36.11%). The number of lines varied between one and five lines per tooth. In the majority of cases, the lines were clearly visible but not marked. An exception was adolescent skeleton 6111, where the DEH lines were very numerous and very marked, suggesting at least five episodes of prolonged ill health in childhood.

Dental interventions

The wealthy upper-middle class assemblage within St George's crypt displayed a considerable amount of dental work, including the filing of carious teeth, the filling of caries with various metals (such as gold, mercury amalgam and lead), and the use of prostheses, such as crowns, bridges and dentures. Dental treatment is discussed more fully in the named sample report above.

In the unnamed sample, two full sets of dentures, and three partial dentures were discovered buried with their owners. Of these, three had gold plates onto which human or porcelain tooth crowns were riveted (skeletons 3044, 4032 and 7010) (Plate 6.6, skeleton 4032). One partial denture was formed from a block of carved ivory (skeleton 7008).

Table 6.18: Unnamed sample: Summary of the dental pathology and dental interventions

Coffin No	*Abscesses*	*Calculus*	*Caries*	*DEH*	*Crowding*	*Peridontal disease*	*AMTL*	*Teeth present*	*PMTL*	*Not present*	*Total sockets*	*Dental interventions*
1084										32	0	
1097	0		3	6	present		7	22	3	0	32	V-shaped notches
1129	0	10	3				0	27	1	4	28	
1142	0	4	0			slight	8	7	2	15	17	
2042	0	9	5	4			8	11	2	11	21	
3007	0		0				3	22	7	0	32	
3013								0		32	0	
3017	0		0				0	20	1	11	21	
3044	0						32	0	0	0	32	2 full gold sets
3083	0	11	1		present	moderate	3	16	0	13	19	
3087	1	15	2	5		moderate	3	20	0	9	23	
3093	2	6	1	6		moderate to considerable	7	22	2	1	31	U-shaped notches
4029	0	4	4	3			1	7	0	24	8	
4032	1	14	2	8	present	slight to moderate	1	27	4	0	32	partial gold denture
4052							0	0	0	32	0	
4054	0	14	0	7	present	moderate	7	21	1	3	29	
4061	0	4	3			considerable	21	8	3	0	32	
4068	0						27	0	0	5	27	
4077	0	18	0	6	present	slight	3	20	0	9	23	
5028	0	21	3	1		moderate	4	21	5	2	32	
5042	0	1	0			moderate	16	1	7	8	24	
5051	0	23	0	5		slight	2	23	0	5	27	
6055	0	2	0	1		moderate	6	6	0	20	12	
6059	0	0	0				7	3	2	18	14	
6060							0	0	0	32	0	
6111	0	0	1	26			0	28	0	4	28	Pb or Hg amalgum filling
6129	0						0	0	0	0	32	
7001	0						16	0	0	16	16	
7003	0	0	0			moderate	1	13	0	18	14	
7004	0						32	0	0	0	32	
7005	0						29	0	0	3	29	
7007	0				present		0	5	10	17	15	
7008	0	0	0				12	3	1	16	16	anterior ivory block
7009	0		2			considerable	5	18	4	5	27	
7010	0	3	4				15	8	6	3	29	partial gold denture
7017	0		1		present		0	20	2	10	22	
7049	0	3					6	22	4	0	32	
7053	0		0				0	26	0	6	26	
7062	0		3				2	23	4	1	31	
Prevalence	4/865	162/266	38/470	78/216	7	14/35	284/865					
Percentage	0.462%	60.09%	8.09%	36.11%		40%	32.83%					

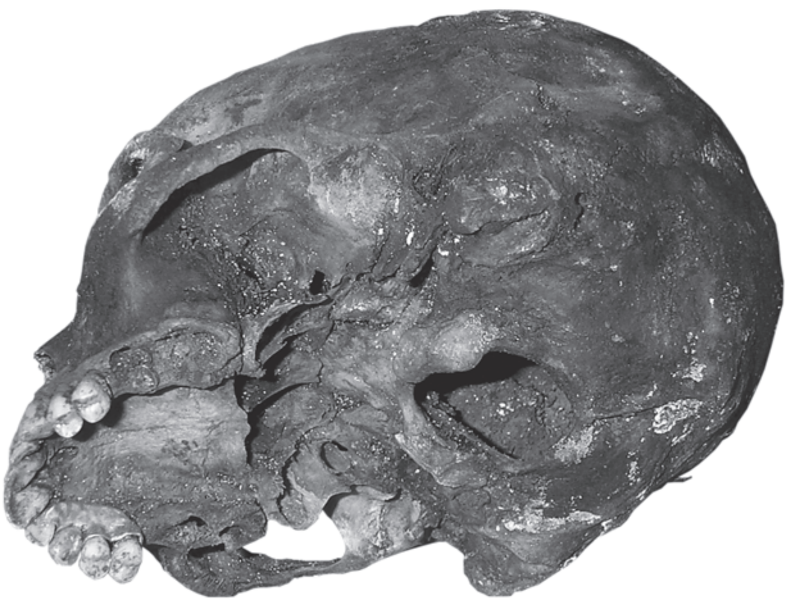


Plate 6.6 Skeleton 4032 wearing a gold partial denture

Plate 6.7 Skeleton 3044 wearing one set of swagged dentures. A second pair was found within his coffin

Skeleton 3044 was buried wearing a full set of dentures (Plate 6.7). An extra pair of dentures had been placed within his coffin. Both pairs of dentures were constructed of a gold plate onto which porcelain teeth had been riveted by means of gold pins. The upper and lower dentures were joined by gold springs.

U- and V-shaped notches cut into the enamel and underlying dentine at the cemento-enamel junction were observed on the teeth of skeletons 1097 and 3093 respectively. They appear to have been cut in order to facilitate the attachment of ligatures to hold partial dentures in place.

One individual (skeleton 6111) had a single filling of grey metal (probably lead or mercury amalgam) in his right first mandibular molar.

DISCUSSION OF THE NAMED AND UNNAMED SAMPLES

Demography

The mortality profile for the entire assemblage (111 individuals) reflects an ageing population consisting largely of adults (Fig. 6.11). Subadults are under-represented (Tables 6.6 and 6.15). The longevity of the population probably reflects the affluence, and hence, the better health and living conditions enjoyed by this population. These results are comparable with the age at death distribution established using *depositum* plates (see Table 6.7 and discussion above), bearing in mind the under representation of infants in the osteological sample as a result of preservation.

A large proportion of the assemblage comprised males, 53% (n = 59/111) compared to 39% (n = 43/111), which were female. There is an observed tendency for female skeletons, particularly the skull, to become more masculine in appearance following the menopause, and this may lead to bias in sex estimation in favour of males in skeletal assemblages (Mays and Cox 2000). However, for the present assemblage, this result would seem to reflect a reality because the sex distribution given by *depositum* plates also reflects a bias towards males (see Table 6.7).

Interestingly, greater longevity is reflected among males than females, and these differences do not immediately appear due to death during childbirth, as only two females in the osteological sample were attributed to the young adult category. There is a sharp rise in female mortality, however, in the prime adult age category. It is interesting to consider the extent that this may reflect a social practice of pregnancies and childbirth among females of prime adult ages in this community. A memorial plaque within the church commemorates Mary Madden, who died in childbirth, and the death of her newborn son five days later. She was only 26 years old. However, the absence of young females in the osteological sample is not borne out by the total population (N=621) whose sexes are known from the coffin plate inscriptions. Here, 19 young females (2.81%) were identified. Differences in the number of young females according to osteological data and biographical data probably reflect inadvertent bias implicit in the small sample size.

Health status

Overall, the demographic structure, oral and skeletal health, and evidence of expensive dentistry within the entire assemblage are consistent with an affluent population. These individuals enjoyed a comparatively low childhood mortality rate, and a large proportion of the adult population lived into old age, many dying beyond their 70s. They were nevertheless susceptible to many illnesses. Some experienced diseases associated with fine living and expensive taste. One such disease was DISH, another was dental decay. Dental disease was widespread in this population, and a number had taken recourse to painful and expensive dental treatments of the day, such as fillings, implants, dentures and filings, despite their many inadequacies. Implants often invited new problems, such as dental abscesses. The emphasis on slender waists in women appears also have created new health problems for a few women, with tight-lacing causing deformation of the ribs in one female.

Fashionable infant feeding practices may underlie the higher prevalence of iron deficiency anaemia in this population than that found amongst the poor of the city. Again, the affluence of this

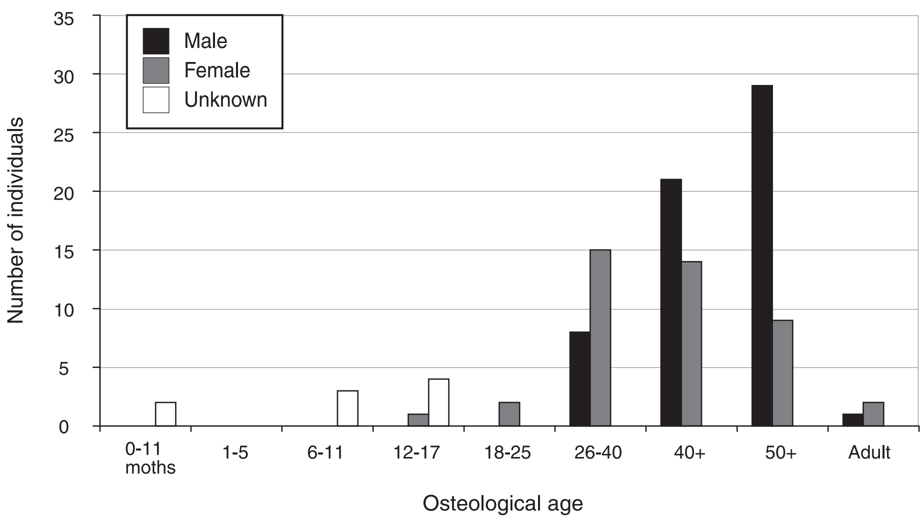


Fig. 6.11 Named and unnamed samples combined: Mortality profile based on osteological age (N=111)

Bloomsbury set would have enabled them to pay for a nursemaid to care for the child, replacing breastmilk with gruel at a very tender age, to the detriment of the child's health.

Although Bloomsbury was famed as one of the more genteel and healthier parts of the city, its residents could not entirely escape the health effects of living in the overcrowded, polluted and poorly planned and regulated city that was late Georgian London. Evidence for infectious diseases, such as tuberculosis, was present in the assemblage, as well as the much feared French Pox. Indeed, a gentleman did not have to stray far from the church in his search for vice, both in less salubrious areas, such as the Rookery (Plate 4.3), or in more elegant establishments in Bloomsbury itself. Some paid for these pleasures dearly.

Many of those interred within St George's crypt survived to old age, and suffered the many the aches and pains that flesh is heir to, with high levels of age-related pathologies, such as degenerative joint disease, osteoarthritis, dental decay and tooth loss. This ageing population also displayed another disease common to older populations – cancer – a disease rarely seen elsewhere in the palaeopathological record.