‘Le Newerk of Maydeston’

Excavations at St Peter’s Wharf

Maidstone, Kent

Museum of London Archaeology

Mortimer Wheeler House, 46 Eagle Wharf Road, London N1 7ED

Tel: 020 7410 2200   fax: 020 7410 2201   www.museumoflondon.org.uk/archaeology

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Michael Henderson and Heather Knight

Summary

This report presents the results of work undertaken between 2006 and 2009 on a site at St Peter's Wharf, Maidstone, Kent, by Museum of London Archaeology (MOLA), concentrating on those remains, masonry walls and drain, and cemetery burials, that can be identified as forming parts of the hospital of SS Peter, Paul and Thomas the Martyr, founded between 1244 and 1260 but disused by the end of the 14th century, though its chapel still survives. The cemetery burials were concentrated on the western side of the site, those to the east having been disturbed in the 19th century. Detailed osteological analysis of the cemetery population demonstrated a high number of adult males, with women and children also represented. This was comparable to evidence recorded from previous hospital infirmary assemblages.

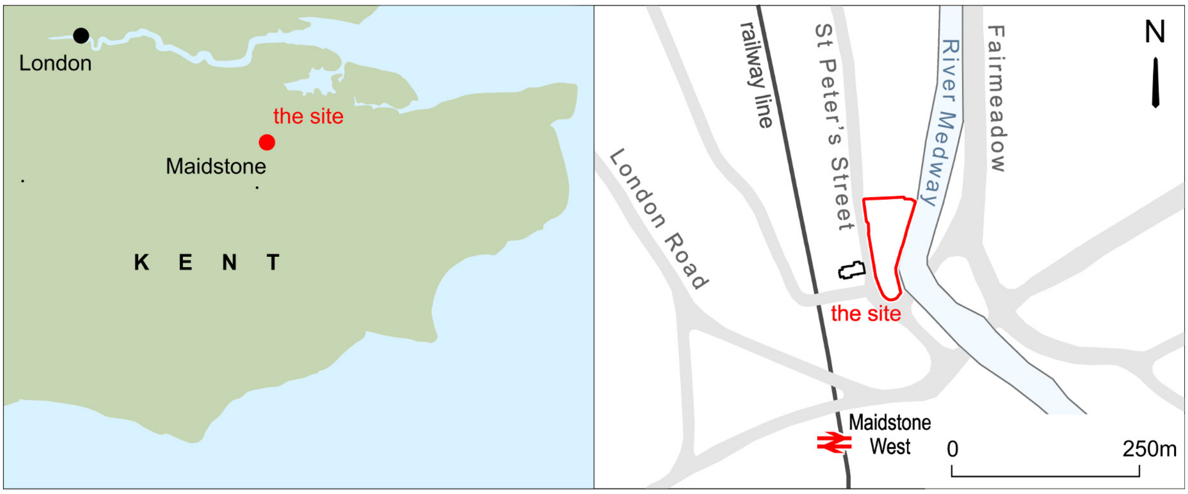

Figure 1: Site location

Introduction

The site at St Peter's Wharf, St Peter's Street, Maidstone, Kent, is in the centre of the town and bounded by St Peter's Street to the west and the River Medway to the east (Fig 1). The approximate centre of the site is at NGR 575642 155670. The various phases of excavation (shown on Fig 2) consisted of a watching brief in 2006 (Ferguson 2007) leading to an evaluation in June/July 2006 (Rahmatova 2008a) and an excavation in July/August 2008 (Rahmatova 2008b). A watching brief in May–July 2009 (Knight 2009) monitored drain trenches. All phases of archaeological work were undertaken by Museum of London Archaeology (MOLA).

The evaluation identified the masonry drain of the 13th-century hospital of SS Peter, Paul, and Thomas the Martyr whilst the excavation phase focused on the inhumation burials in the hospital cemetery, which survived in the north-western part of the site. Much of the rest of the site had been heavily disturbed by the construction of the Maidstone Gas Company's works in 1848 and there was, for example, no archaeological survival in Trenches 1 and 2 (Fig 2)

Figure 2: Areas of archaeological investigation

The archaeological sequence was excavated on a single context system and where referred to directly within this report, archaeological context numbers are denoted [1] etc. All stratigraphic and specialist data were recorded using standard MOLA procedures and subsequently entered into an Oracle database.

More detailed coverage of aspects of the site can be found in the specialist archive reports listed in the bibliography. These reports and the remainder of the site archive (site code KT-SPW06) remain with MOLA awaiting deposition with the appropriate local repository.

In this report, Heather Knight has written the stratigraphic description (building on Nikki Rahmatova's work at assessment) and historical background. Michael Henderson has authored the osteological analysis.

The hospital of SS Peter, Paul, and Thomas the Martyr

Maidstone, a major crossing point on the Medway, was on the pilgrimage route from London to the shrine of St Thomas Becket at Canterbury Cathedral. Becket was beatified in 1173: his shrine rapidly became the most popular in England (Webb 2000, 61) and, as demonstrated by Chaucer's Canterbury Tales written in the last quarter of the 14th century, was still very important two centuries after his death.

The hospital of SS Peter, Paul and Thomas the Martyr was founded by Boniface of Savoy, Archbishop of Canterbury. Although appointed archbishop in 1241, Boniface did not visit England until 1244 and was not actually enthroned until 1249. He died in 1270. Colloquially, the foundation was known as the 'Le Newerk of Maydeston' (new work of Maidstone). The foundation date is variously given as 1244 or 1260 (Lewis 1848, 216). It may be presumed the foundation occurred in 1244 or shortly after though it is possible it post-dates 1249 (Sweetinburgh 2013).

In the 13th century, the term 'hospital' had a meaning more closely reflecting its derivation from the Latin 'hospes' (a stranger or guest). Hospitals provided alms to travellers and the poor as well as the sick and the spiritual needs of its guests, including the provision of the sacraments and a religious burial, were as important as medical care and shelter. The hospital at Maidstone may have aided pilgrims *en route* to Canterbury but Sweetingburgh (2010, 115) argues that the early charters associated with the Maidstone hospital indicate that its benefactors believed they were supporting an institution for the poor and that, in the 13th-century at least, founders and benefactors generally preferred to aid lepers and the local poor rather than itinerants.

Unlike leper hospitals, hospitals for the poor or pilgrims were often sited within a town and intended to be part of it (Sweetingburgh 2004, 98). However, by the later 13th century, Maidstone town centre, on the east bank of Medway was already built up. The hospital was constructed on the opposite bank of the river but, as the bridge to the town was only *c* 100m to the south of the site, it was as centrally located as circumstances permitted. The position of the hospital close to the town might have generated casual alms (Sweetingburgh 2004, 99).

By the end of the 14th century, the hospital had become an almshouse, which, in 1395, was incorporated by Archbishop Courtenay into his new college of All Saints on the opposite side of the river (Hasted 1798, 308; VCH 1926, 232). The closure of the hospital occurs during a period in which hospitals were beginning to be seen more as places to care for the chronically ill rather than the poor and travellers (Magilton et al 2008, 19). The bridging of the Medway at Aylesford, probably in the later 14th century, could also have led to pilgrimage traffic bypassing Maidstone (Knight 2009, 15). However a remnant of the old hospital still stands: its chapel forms the chancel of the church of St Peter immediately west of the site (see Fig 2).

The hospital drain

A substantial drain (Fig 3), built entirely in mortared Kentish ragstone and running east from the hospital complex towards the river Medway, was first recorded in 2006 (Ferguson 2007) and subject to detailed excavation in 2008 (Rahmatova 2008b). The first element of the hospital to be identified, it would have carried foul and storm water to the river. Its superstructure of randomly coursed blocks rose to an arched capping and its internal height from floor to apex was 1.6m (Fig 3). The base of the drain, *c* 1.15m wide, abutted the internal faces of the walls and must have been inserted after they were built. In all *c* 33m of the length of the drain was recorded (see Fig 7). The central section of the drain had been cut through by a later service trench and the drain had been blocked, almost certainly when gasworks were being built in the 19th century.

Figure 3: Medieval stone drain

The hospital buildings

South of the drain, a series of medieval ragstone walls (Figure 4) were recorded in 2009 in a limited area of investigation on the western edge of the site, *c* 30m to the north-east of St Peter's church (Knight 2009). Two parallel east–west walls and a north–south wall defined the eastern side of a rectangular room, *c* 1.9m wide internally and at least 2.9m long. There was no evidence for the room's function. The east–west walls were over 0.6m wide and a probable buttress on the northern side of the northernmost wall suggests that this was an external face. The north–south wall was much narrower, at only 0.36m wide, and was most likely a partition wall within an east–west aligned building. The floor of the room, constructed from post-medieval brick, indicates that the building was in use several centuries after the hospital closed at the end of the 14th century. To the south of the room was a third east–west aligned ragstone wall, in this case 0.5m wide, which may have formed a the south side of a *c* 1.3m wide corridor or cloister walk running along the south side of the building.

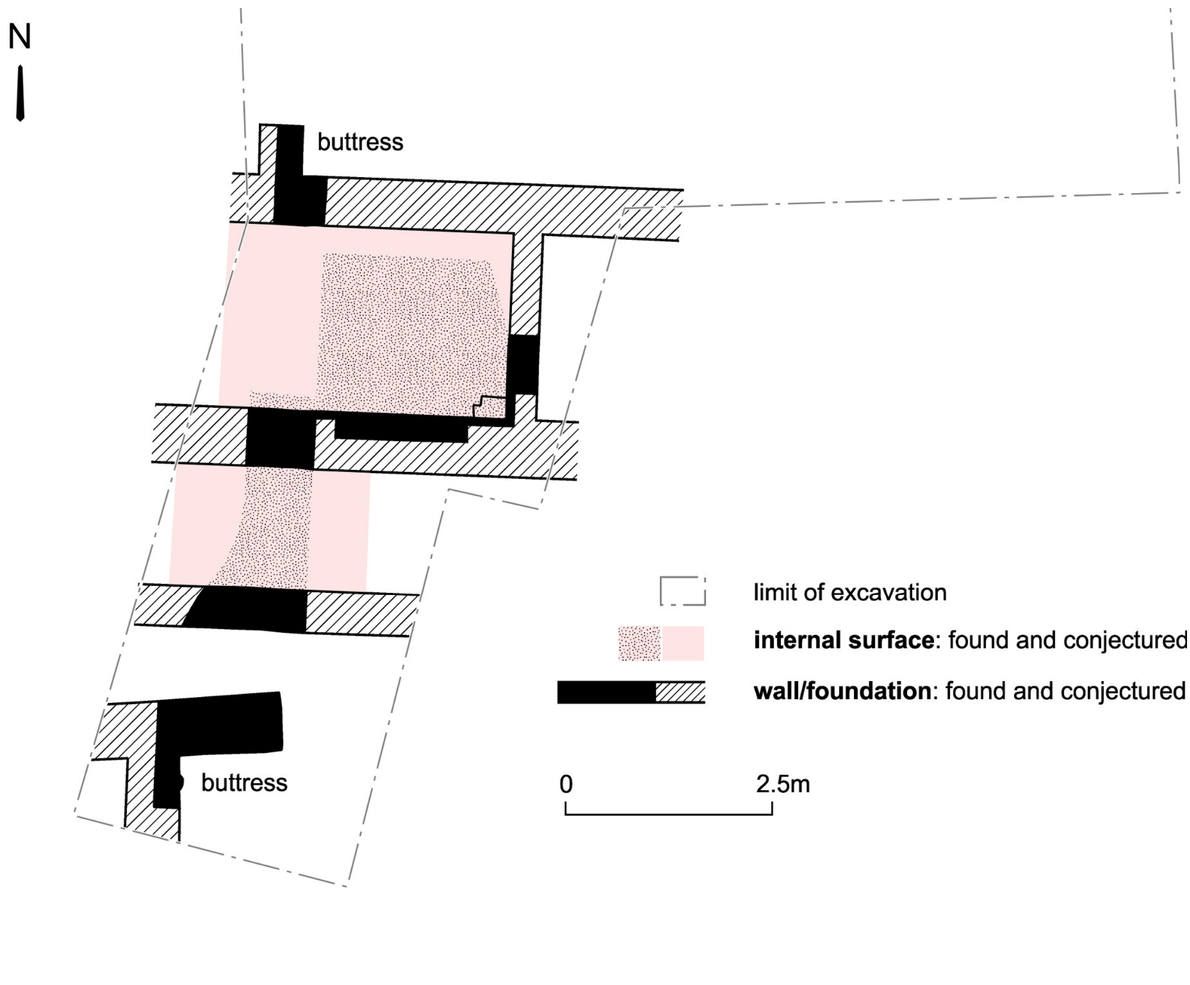

Figure 4: Plan of ragstone walls

The southernmost of the recorded walls, a 1.3m long section of ragstone wall either turning south or buttressed at its western end, was built over an early, undated pit. Although it appears to be contemporary with the three walls to its north, it does not fit easily with them nor is on quite the same alignment.

The cemetery

The cemetery was on the northern side of the hospital buildings and drain. Fifty-five full or partially articulated individuals were excavated (Rahmatova 2008b; Knight 2009) of which 31 were found in 30 clearly defined grave cuts (Fig 5). The large volume of disarticulated human bone, most likely disturbed by the industrial development of the site in the post-medieval period, indicates that the cemetery population was originally at least double this figure. All the graves were aligned east–west with the head to the west (Fig 6, Fig 7). The bodies had been placed in a supine and extended position with the hands on or beside the pelvis and are entirely consistent with medieval Christian burial practice (Gilchrist and Sloane 2005, 152; Roberts and Cox 2003, 222).

Figure 5: Excavation of burials in the north-eastern area of the 2008 excavation

There were at least four phases of burial on the site with some later graves cutting through and disturbing earlier ones. Some graves contained more than one skeleton but none contained evidence for coffins. Cloth shrouds, pinned or sewn together, were the most common form of burial wrapping in this period (Daniell 1997, 156; Gilchrist and Sloane 2005, 106–110). An absence of pins from the St Peter's Wharf cemetery suggests that here the shrouds were sewn. However, ground conditions were such that no evidence of the shrouds material had survived.

No evidence for grave markers was apparent, though this is not unusual: for example, no grave markers were found at the medieval cemetery of the hospital of St James and St Mary Magdalene (Lee and Magilton 1989, 276) or at the medieval cemetery of St Helen's Fishergate, York (Spall and Toop 2005). However, the lack of permanent grave markers does not mean that the graves were not marked in the short-term by either the mound itself, a hearse cloth or by the laying of flowers (Daniell 1997, 146).

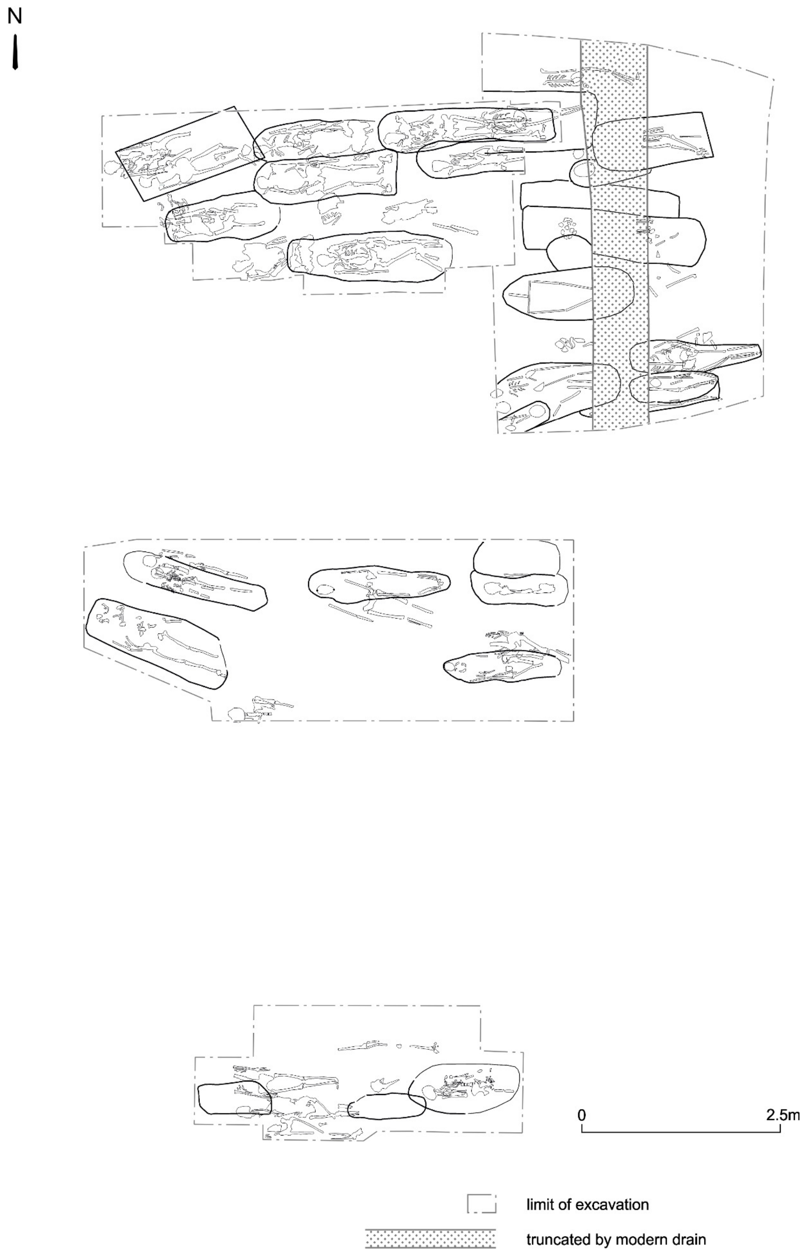

Figure 6: Plan of burials

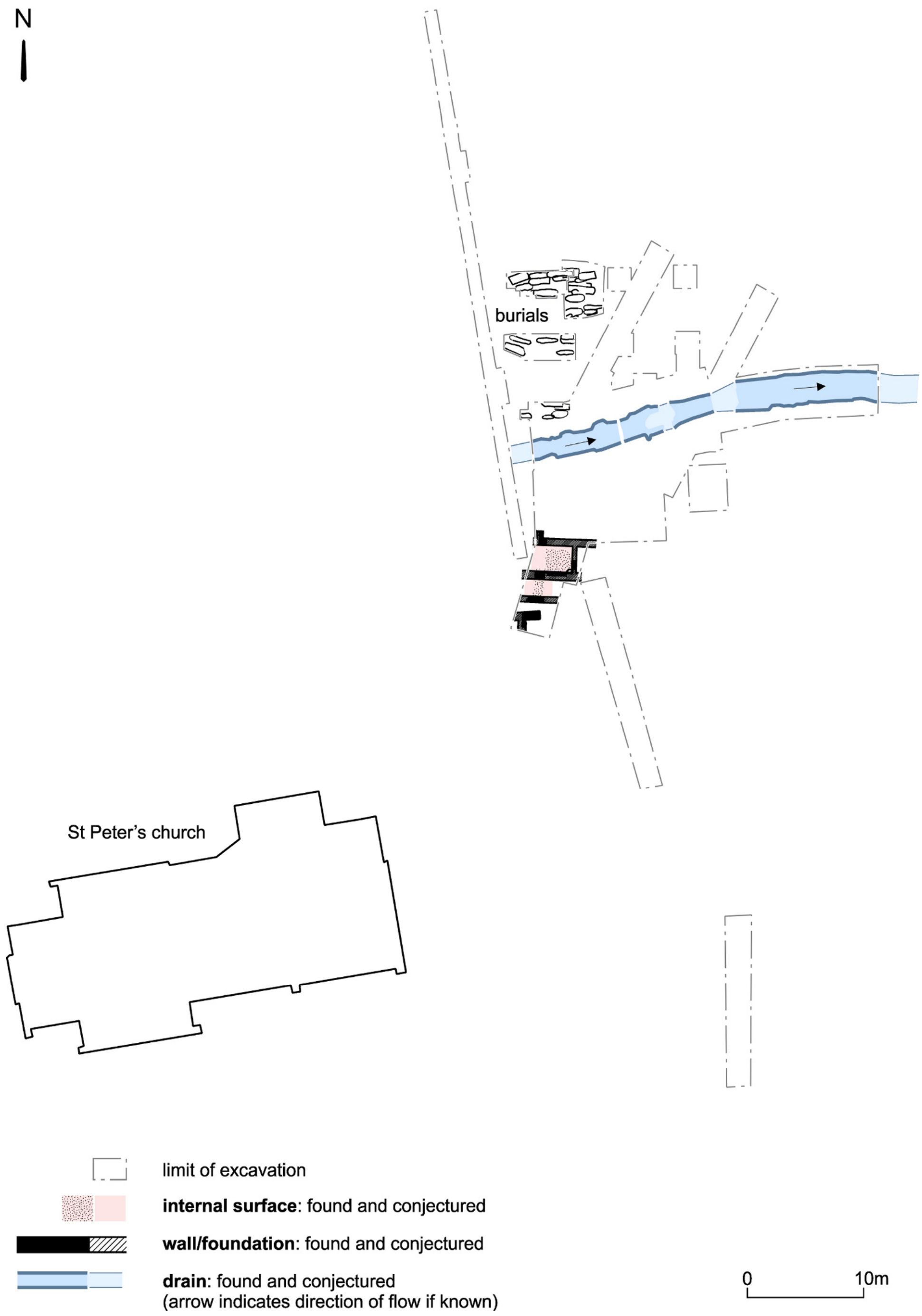

Figure 7: Plan of graves and location of drain and medieval walls

Most of the graves were sealed by a layer of cemetery soil containing disarticulated human bone, which represented a re-levelling and/or reorganisation of the burial ground. As only a few graves postdated this re-levelling, it is likely to have occurred towards the end of the life of the hospital. No dating evidence was obtained from this deposit other than sherds of residual pottery dating from AD 900–1100 and 1125–1250. This pottery suggests some activity on the site prior to the founding of the hospital but a pit found beneath the medieval structures was the only positive evidence of this earlier phase. There were no datable grave goods within the graves themselves. This again is typical of burial practice during the medieval period.

Where pottery contemporary with the use of the hospital was encountered, it was as residual material in later, disturbed contexts. For example, a sherd of pottery from a lid or base of a flaring dish probably manufactured in Maidstone between 1250–1400 came from a 19th-century industrial context (Blackmore 2010).

The cemetery population

Michael Henderson

The detailed osteological analysis of the cemetery population is to be found in the appendix.

The analysed assemblage comprised 55 individuals. A large quantity of disarticulated human bone from the site, which emphasises that the burial ground was severely truncated during the subsequent uses of the site, was not subject to further analysis because of its highly mixed and fragmented character. However, assessment indicated that it represented a minimum number of 120 additional burials of which 85 (70.8%) were adults and 35 (29.2%) subadults. It is apparent that the analysed sample represents a minority of the buried population and that the cemetery as a whole could have held a higher proportion of subadults than is apparent from the articulated assemblage.

	Full/partially articulated skeletons	**Defined grave cuts**	**Disarticulated skeletons – no. of contexts**	**Disarticulated skeletons – estimated minimum no of individuals**
2006 evaluation/ 2008 excavation	**31**	17	20	89
2009 excavation	**24**	14	7	31
Total	**55**	31	27	120

Table 1: Summary of the cemetery population

The analysis of skeletal assemblages from monastic burial grounds and of lay populations within parish cemeteries has previously revealed significant patterns of spatial zoning by sex and age, though these vary according to both the function of, and order of, the institution involved (Gilchrist and Sloane 2005, 203–205). As it was not possible to determine the full extent and layout of the burial ground at St Peter's Wharf, the extent to which the characteristics of the analysed sample are representative of the original cemetery population as a whole is unclear.

Of the 55 analysed individuals from St Peter's Wharf, 46 (83.6%) were adults (≥18 years old) and nine (16.4%) were subadults. It was possible to determine the sex of 31 (67.4%) of the adults. There was a pronounced bias towards males, who outnumbered women by 2.9:1.

Other hospital cemeteries such as St Mary Spital, London; St Nicholas, Lewes and St Leonard, Newark have also all shown predominantly male populations (ranging from 45–75%) and low proportions of subadults. These results may indicate the burials of young, adult males, possibly rural migrants, drawn to larger towns and cities (Gilchrist and Sloane 2005, 205). Pregnant women were excluded from some types of hospital and would have been forced to seek alternative refuge: for example higher proportions of female burials and infants have been found at leper hospitals (Gilchrist and Sloane 2005, 206).

The age at death of the buried population ranged from children aged 1–5 years to adults aged ≥46 years. Overall most adults died aged 36–45 years but half of the women were ≥46 years old at death and poor preservation of aging elements within the osteological sample may indicate that this age profile understates the longevity of the hospital population. The stature of 13 of the sexed adults could be determined. The mean stature for men was 1.72m (5ft 8in), and 1.57m (5ft 2in) for women (see appendix Table 5).

These values are quite typical of late medieval populations examined elsewhere (Roberts and Cox 2003, 269).

Bacterial and viral infections would have accounted for high mortality in the medieval period (Ortner 2003). However, overall pathological prevalence rates at St Peter's Wharf were low with infectious bone changes limited to three individuals and no evidence of specific infections such as tuberculosis or leprosy. Many pathological conditions only affect the soft tissues of the body and death could occur long before any disease affected the bone. Bone changes may therefore reflect the survival of healthier individuals who overcame illness and not the true rates of disease in a population (Wood et al 1992). Female [279], aged ≥ 46 years, presented new bone growth to the pelvis and right radius, most likely secondary to fracture. Female [291], also aged ≥46 years, had a plaque of new bone to the visceral surfaces two right ribs indicating the presence of an active chest infection at the time of her death. Male [315], aged 36–45 years, had evidence of a longstanding sinus infection. Allergies, smoke, environmental pollution, upper respiratory tract infections and house dust have been reported as possible predisposing factors for both sinus and chest infections (Roberts and Manchester 2005).

As is to be expected, spinal joint disease showed an increase with age. Females demonstrated a higher prevalence of all spinal joint disease with the exception of Schmorl's nodes (the result of herniation of the spinal discs). Schmorl's nodes often develop as a result of heavy manual labour, particularly if activity takes place from a young age (Rogers and Waldron 1995, 27). They were more prevalent amongst men, though the apparent sex differences may reflect the small overall number of females in the sample and the greater number of females surviving into older age. Osteoarthritis affecting the synovial facet joints of the spine was more common amongst females (18/93: 19.4%) than males (17/298: 5.7%) and women demonstrated a higher frequency of lesions in the cervical, lower thoracic and lumbar regions than males. Male [254] aged 36–45 years had secondary osteoarthritis to the apophyseal joints of the fifth lumbar vertebrae and sacrum. This appeared to be in response to a compression fracture of his eleventh and twelfth thoracic vertebrae, causing increased stresses on his spine. This fracture had also led to bony ankylosis and kyphosis (curvature of the spine). Similar changes were observed in the mid thoracic spine of female [291]. A total of ten adults, seven males and three females had evidence for traumatic lesions. Three males had suffered injuries affecting the soft tissue, at the point of muscle or ligament attachments and two further adults apart from male [254] had compression fractures of the spine.

Degenerative changes to non spinal joints affected three individuals: Male [280] had osteoarthritic changes to the left elbow, female [279] had degenerative changes to the sternoclavicular and left glenohumeral joints and female [3056] had bone changes to the left shoulder diagnostic of rotator cuff disease.

The St Peter’s Wharf population showed lower prevalence rates of dental disease than those typically recorded for the period (Waldron, 2007, 117–119; Roberts and Cox 2003, 265). All dental pathology, with the exception of enamel hypoplasia (a defect in the formation of tooth enamel), displayed an increase with age before a decline into the older age categories. Males suffered a greater number of carious lesions (tooth decay), calculus (hardened plaque), periodontal (gum) disease and tooth loss during their lifetimes than females; though this might indicate a difference in diet between the sexes, the small size of the female dentition sample, particularly in the oldest ≥46 year age range limits the scope for direct comparison.

There were two examples of fractured limb bones. Female [279], aged ≥46 years, had suffered a Colles’ fracture of the right radius, and female [3056], also aged ≥46 years, had a fractured left finger

The most dramatic example of pathological bone change recorded in the St Peter’s Wharf assemblage was that of male [3028], of undetermined age. There was evidence of at least four distinct blade wounds to the cranium from an edged weapon, possibly a sword. These focused on the right side of the cranium and indicate a left-handed assailant. Alternatively, the multiple blows at right angles to the saggital plane may have been made by someone standing to his side. Multiple blows often result from a disorganised fight when the head position varies (Wenham 1989, 137) though it remains possible that the blows were struck when the victim was already on the ground. A deep injury to the back of the head revealed that the blade had penetrated the endocranium and may have made contact with the brain. Such trauma would result in injury to the meninges protecting the brain, blood vessels and associated structures and would almost certainly have been fatal, through shock to the sensory nervous system or blood loss (Wenham 1989, 128). Evidence of weapon related cranial trauma has previously been recorded at numerous cemetery sites including St Mary Spital, St Nicholas Shambles, St Margaret Fyebridgegate, Norwich, St Helen on the Walls, York, St Andrew’s Fishergate and the Cisterian abbey of St Mary Stratford Langthorne, Essex (Powers 2005; White 1988; Stirland 1996; Dawes & Magilton 1980; Stroud and Kemp 1993; White 2004). A healed, circular depressed fracture to the top of the skull implied the survival of an old, wound, the residual effects of which might have included epilepsy, chronic headaches, problems with sight and movement, memory loss and other psychological problems (Wenham 1989, 131). It is possible that he had previously survived an assault, possibly during warfare. Quite how these individuals ended up at the hospital is impossible to determine: they may have died after seeking medical care or have been brought here after death to be buried.

Excavation of the mass grave from the Towton battlefield dated to 1461 revealed that multiple head injuries appear to have not been an uncommon occurrence, with an average of 4.2 wounds per individual. The predominant form of injury was blade wounds to the front and back of the head, suggesting that the head was often the primary target for attack (Novak 2000, 96–99). An overall crude prevalence of 2.1% for weapon related trauma to the cranium has been recorded for the later medieval period (Roberts and Cox 2003, 275).

That individuals often survived battle wounds is evident from nine individuals at Towton that exhibited well-healed cranial injuries (Novak 2000, 94). A male from the medieval hospital cemetery of St Mary Spital, London, had also survived severe sharp force trauma some years prior to death. The injuries were well healed and may indicate some form of surgical intervention and after care (Powers 2005, 12). Previously wounded, sometimes incapacitated individuals may have continued to participate in warfare (Knüsel and Boylston 2000, 172).

Conclusions

The development of towns throughout England in the 11th and 12th centuries led to the founding of many hospitals around urban areas during the 13th century (Schofield 1999, 210; Magilton et al 2008, 36–37). Although hospitals fall into three principal categories – infirmaries, leper hospitals and almshouses – all were essentially flexible and frequently changed their primary role (Gilchrist and Sloane (2005, 205). The demographic profiles of those buried at such sites may provide evidence of specialisation by age or gender. Burial grounds associated with the accommodation of travellers may contain a higher number of young adults whereas an infirmary may reveal a wider distribution of ages and evidence of chronic pathological bone changes (Magilton et al 2008, 33).

Analysis of the human skeletal remains recovered from St Peter's Wharf presented an opportunity to study a previously unknown hospital population, dating from the later 13th century and after, and to compare it with contemporary burial grounds. While analysis was limited by the fragmentary and incomplete nature of many of the skeletal remains, this assemblage provided important demographic and health evidence regarding the local population, contributing to the body of data collected from skeletal remains for this period. Whilst the osteological analysis could not determine the exact function of the hospital, the demographic profile revealed a high number of adults, including some females, who had survived into the older age categories, as well a number of subadult burials. This was comparable to evidence recorded from previous hospital infirmary assemblages.

As towns and markets grew and expanded there was an increase in the quantity and range of foods available to eat (Roberts and Cox, 2003, 241). A diet high in grain products such as bread and ale would have formed the basic staple, although a more varied diet that included fresh meat, poultry, fish, dairy produce and vegetables may have been available to those in towns that could afford it (Roberts and Cox, 2003, 244). Increased rates of dental disease for this period may reflect a lack of dental hygiene rather than diet (Roberts and Cox, 2003, 262).

One of the more severe and interesting examples of pathological bone change observed was that of an adult male who had suffered multiple sharp force cranial trauma with evidence of a previous healed wound. These injuries would have been fatal: they are likely to be the result of interpersonal violence but it is not possible to conclusively say whether the individual was a professional solider or how he came to be buried at St Peter's Wharf.

Acknowledgments

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Specialist Report

The osteology

Nature of the sample

A total of 55 individuals were identified within the sample. In the great majority of cases these individuals were identified as discrete inhumations during excavation. However, six contexts originally classed as disarticulated bone ([3001], [3003], [3021], [3047], [3048], [3051]), were found to contain paired or articulating elements and were subsequently fully recorded. Analysis also resulted in the creation of two new context numbers: [3058] represented elements of a subadult and [3059] comprised a partial adult skeleton, both were separated from the disarticulated remains from cut [3010].

Preservation

Bone preservation was visually assessed and scored as good to poor using a three point grading system (Connell and Rauxloh 2007). The majority of the assemblage displayed moderate levels of preservation (36/55: 65.5%) with skeletons showing some post-mortem erosion to the long bone shafts, joints and some prominences. Eleven contexts were in good condition (11/55: 20.0%) and eight burials were poorly preserved (8/55: 14.5%)(Fig 8).

Black staining was identified in 38.2% contexts (21/55). This was often distributed across multiple skeletal elements and in some cases represented thick deposits of a tar-like substance adhered to the bone surfaces. Adult [309] displayed black staining to both the outer cortical and inner surfaces of the fragmented lower limb bones. Adult female [279] had extensive black stains to all areas of the skeleton that was more prominent to the cranial bones and dentition(Fig 9).

Blackening of the bone surfaces has previously been associated with the natural taphonomic process of fungus growth within the burial environment (Ubelaker 1997, 82). At St Peter's Wharf, however, the tar-like nature of these deposits is likely to be associated with the 19th-century gas works that later occupied the site. Four contexts (4/55: 7.3%), had extensive soil concretions remaining adhered to the bones.

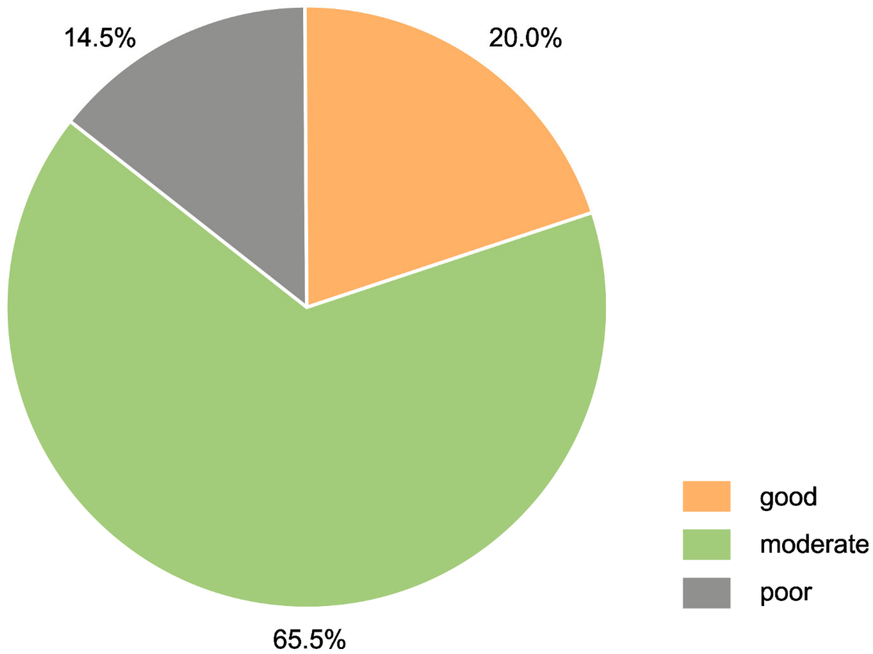

Figure 8: Overall skeletal preservation

Figure 9: Right buccal (cheekfacing) mandible of female [279] showing black substance adhering to bone surfaces

Completeness

The completeness of the assemblage ranged from 5–75%. Many of the incomplete and partial remains were due to disturbance by the later gas works. Approximately 13% of burials (7/55: 12.7%) ranged from 50–75% complete. Four burials (4/55: 7.3%) in the north-west of the site, where most of the excavated burials were concentrated, had over 60% of elements present. The majority of the assemblage (48/55: 87.3%) was less than 50% complete and seven burials (7/55: 12.7%) ranged from 0–5% complete (Figure). Thirty one burials (31/55: 56.4%) were recorded as truncated: intrusive elements were found in 49.1% (27/55) of contexts, indicating the intermixing of some remains. No complete crania were preserved.

This high level of truncation and overall lower levels of completeness limited the amount of osteological data obtainable at analysis.

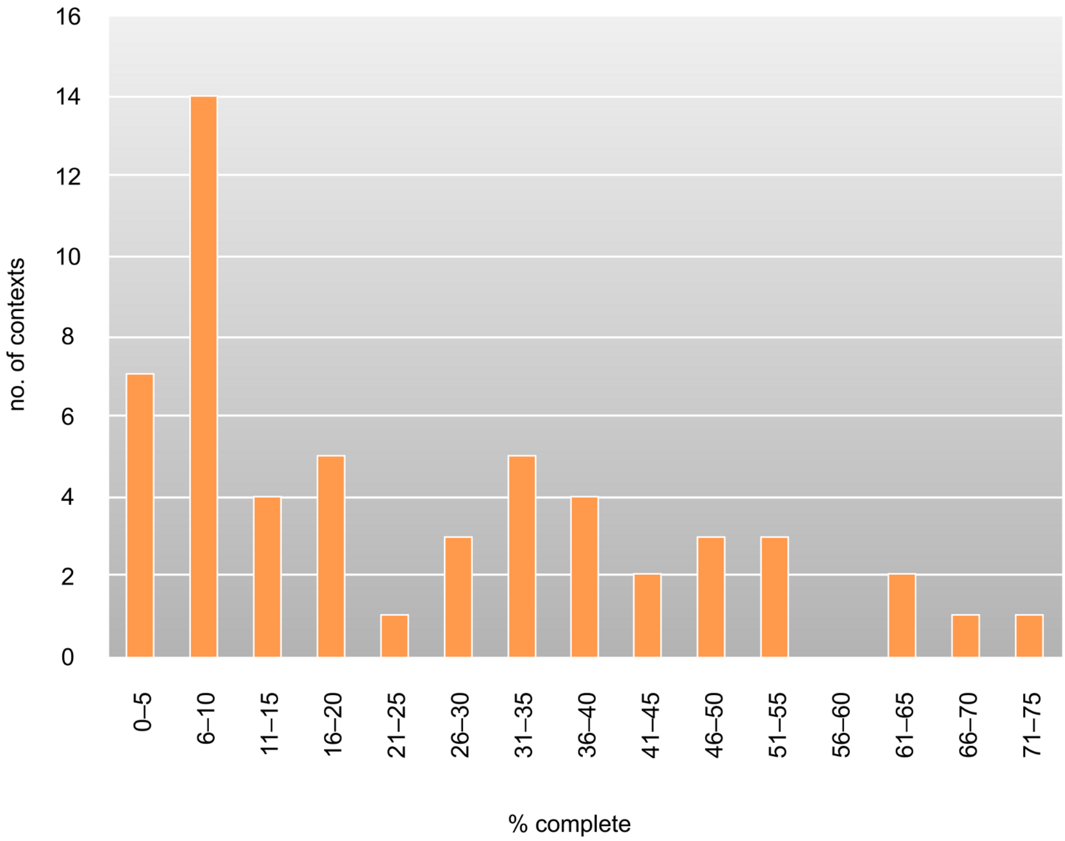

Figure 10: Completeness of assemblage

Methods

All skeletal and dental elements present were recorded along with a separate count of joint surfaces that served as a catalogue of epiphyses for the subadult individuals. Estimates of age at death and sex of adult remains, measurements of cranial and post-cranial elements and the presence or absence of non-metric traits were recorded into an Oracle 9i (v9.2.0) relational database using the established Museum of London standard criteria (Connell and Rauxloh 2007, Powers 2008).

Adult age estimation was determined through observations of the pubic symphysis, auricular surface, sternal rib ends and dental attrition (Brooks and Suchey 1990; Lovejoy et al 1985; Iscan et al 1984; Iscan et al 1985; Brothwell 1981). Adult biological sex was estimated through observations of sexually dimorphic characteristics of the os coxae and skull (Powers 2008). Where these traits were not observable, sex estimates were attempted using metric measurements following Bass (1987). Subadult age (<18 years) was estimated following observations of the stage of eruption of the permanent molars and tooth development, epiphyseal fusion and long bone diaphyseal growth (Moorees et al 1963a; Moorees et al 1963b; Maresh 1970, Gustafson and Kock 1974; Scheuer and Black 2000).

Category	Age group	Description
subadult	perinatal	inter-uterine neonate
	1–6 months	early post-neonatal infant
	7–11 months	later post-neonatal infant
	1–5 years	early childhood
	6–11 years	later childhood
	12–17 years	adolescence
	<18 years	subadult
adult	18–25 years	young adult
	26–35 years	early middle adult
	36–45 years	later middle adult
	>46 years	mature adult
	≥18 years	adult

Table 2 Osteological age categories

Where preservation and completeness allowed longbone measurements to be recorded, stature calculation was carried out on sexed adult remains following the formulae established by Trotter (1970). Measurements of a single bone such as the femur are considered more reliable and with less potential to introduce error (Waldron 2007, 41). When femoral measurements were not possible, additional long bones were used in stature estimates at St Peter's Wharf to create a larger dataset. Calculations of platymeric and platycnemic skeletal indices were calculated following Brothwell (1981, 88).

All pathological bone changes observed were fully documented onto the database with written descriptions supported by digital photographs and illustrative records where necessary. Full details of pathology locations, measurements and other osteological data can be found in the site archive.

Crude prevalence rates by individual (CPR) and true prevalence rates by bone or joint (TPR) were calculated for pathological conditions where appropriate.

Results

Demography

The analysed assemblage comprised 46 adults (46/55: 83.6%) and nine subadults (9/55: 16.4%). It was possible to determine the sex of 31 adults (31/46: 67.4%): 15 males (15/31: 48.4%), eight possible males (8/31: 25.8%), three females (3/31: 9.7%) and five possible females (5/31: 16.1%). The absence or fragmentary nature of many cranial or os coxa elements meant it was not possible to estimate the sex of 15 adults (15/46: 32.6%).

Where sex was attributable, the combining of definite and possible male and female contexts created a pooled sample of 23 males (23/31: 74.2%) and eight females (8/31: 25.8%). This presented a statistically significant larger male sample ($\chi^2 = 14.52$ df = 1, $p< 0.001$) with a male to female sex ratio of 2.9:1. This strong male bias was larger than the expected male to female ratio of live births in a population 1.06:1 (Rousham and Humphrey 2002, 128).

	Subadult	Male	Possible male	Possible female	Female	Undetermined sex	Total
perinatal	-	-	-	-	-	-	0
1–6 months	-	-	-	-	-	-	0
7–11 months	-	-	-	-	-	-	0
1–5 years	4	-	-	-	-	-	4
6–11 years	1	-	-	-	-	-	1
12–17 years	4	-	-	-	-	-	4
subadult	-	-	-	-	-	-	0
18–25 years	-	2	-	-	-	3	5
26–35 years	-	4	3	1	-	1	9
36–45 years	-	7	4	1	-	4	16
≥46 years	-	1	-	1	3	-	5
adult	-	1	1	2	-	7	11
Total	**9**	**15**	**8**	**5**	**3**	**15**	**55**

Table 3 Demographic distribution

It was possible to assign an osteological age category for 44 individuals (44/55: 80.0%): 35 adults (35/46: 76.1%) and all nine subadults. The highest number of adult deaths occurred in the 36–45 year age range (16/35: 45.7%). There was a decline in adult deaths into the older age category ≥46 years (5/35: 14.3%).

The low number of older adults recorded at St Peter's Wharf may reflect the limitations of osteological ageing techniques and the tendency to underage the older age groups (Cox 2000). Historical data from parish registers suggest that the life expectancy of a male peasant ranged from 20–28 years during the 11th and 14th centuries (Roberts and Cox 2003, 226).

	Female		Male		Undetermined		Total	
Age (years)	n	%	n	%	n	%	n	%
18–25	0	-	2	9.5	3	37.5	5	14.3
26–35	1	16.7	7	33.3	1	12.5	9	25.7
36–45	1	16.7	11	52.4	4	50	16	45.7
>46 yrs	4	66.6	1	4.8	0	-	5	14.3
Total	**6**	**100**	**21**	**100**	**8**	**100**	**35**	**100**

Table 4 Adult age at death distribution

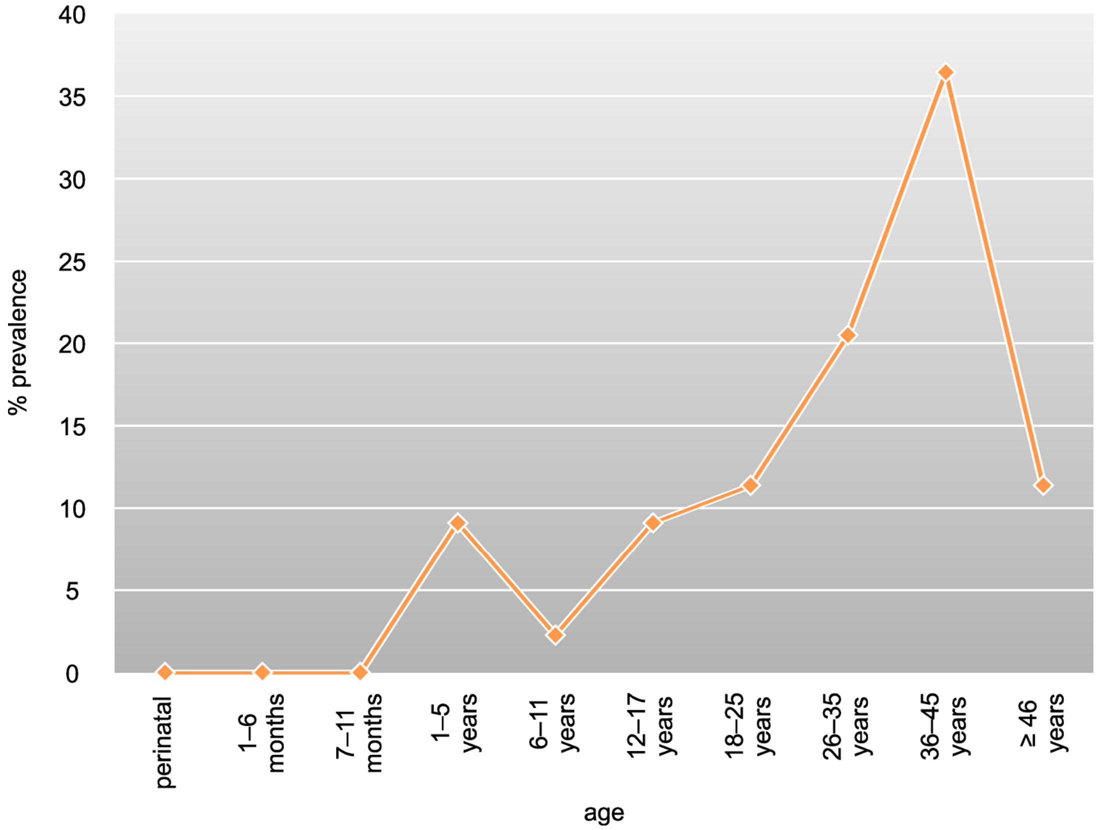

Fig 11 Distribution of aged individuals

When the sexes were separated, males continued to show a high mortality in the 36–45 year age category (11/23: 47.8%). However, while there was an even rate of deaths for females aged 26–45 years, the majority of female deaths occurred in the older ≥46 year age range (4/8: 50.0%). This result may be due to the small female sample size rather than an accurate representation of the cemetery population.

The highest number of deaths in the subadult sample occurred in the 1–5 year age range (4/44: 9.1%; 4/9: 44.5%). One subadult was aged 6–11 years (1/44: 2.3%; 1/9: 11%) and four were aged 12–17 years (4/44: 9.1%; 4/9: 44.5%).

Immature bone can potentially survive well when buried in the same conditions as adults (Lewis 2007, 37). Nine burials contained the intrusive elements of subadult remains and a minimum number of 35 non-adults were recorded amongst the disarticulated bone at assessment. This suggests that a higher number of subadults (a minimum number of 53) were originally present amongst the buried population. The paucity of subadults recorded at analysis may be a product of truncation or because they were perhaps interred in a different zone of the cemetery (Gilchrist and Sloane 2005).

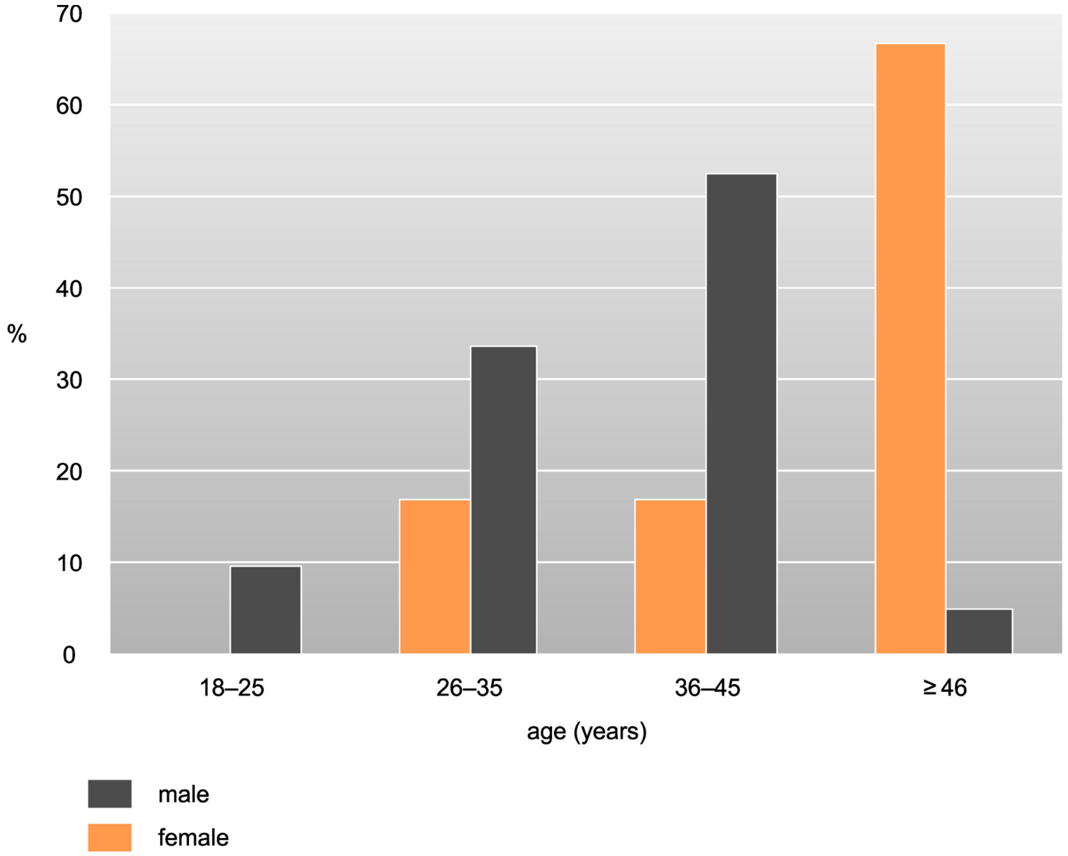

Figure 12: Adult age distribution by sex

Biometric data

STATURE

Measurements of maximum long bone lengths enabled stature to be calculated for 13 of the sexed adults.

The mean male stature ranged from 166.5–180.8cm (mean 172.0cm) and females ranged from 151.7–162.8cm (mean 156.6cm).

These heights are comparable to those reported for the later medieval period with an average male stature recorded as 167–174cm and females recorded as 162–167cm (Roberts and Cox 2003, 269). These ranges were also comparable to the parish church population from St Peter's, Barton-upon-Humber (females 147–169cm males 151–185cm), and the Augustinian priory of St Mary Merton, Surrey (females 162–167cm, males 161–183cm) (Waldron 2007, 41; Miller and Saxby 2007, 269).

Context	Sex	Element (all right side)	Measurement (mm)	Mean stature (cm)	Max (cm)	Min (cm)
217	Male	Humerus	306	166.5	171.1	162.0
232	Male	Humerus	325	172.0	176.6	167.5
250	Male	Femur	437	166.9	170.9	163.0
264	Male	Femur	452	170.4	174.3	166.5
266	Male	Humerus	318	170.0	174.6	165.4
269	Male	Femur	447	169.2	173.2	165.3
272	Male	Humerus	338	175.8	180.4	171.2
279	Female	Humerus	290	155.4	159.9	151.0
284	Female	Femur	395	151.7	155.4	147.9
3022	Male	Humerus	339	176.1	180.6	171.5
3030	Male	Femur	458	171.8	175.7	167.8
3047	Male	Femur	497	180.8	184.8	176.9
3053	Female	Femur	440	162.8	166.5	159.1

Table 5 Adult stature

SUBADULT GROWTH

A comparison of longbone diaphyseal growth and dental age was possible for one subadult [258] aged 12–17 years. Diaphyseal age was estimated at 12 years compared to a dental eruption stage of 15 years. This suggested that full growth potential was not reached at the time of death and may be linked to childhood disease and nutritional stress although no traces of pathological bone changes were recorded in this individual.

SKELETAL INDICES

Measurements of proximal femoral and tibial shafts were compared to determine any morphological variations.

Platymeric index

The degree of femoral antero-posterior flattening was calculated for the left and right femora of 24 adults (24/46: 52.2%) using the platymeric index. The mean adult right and left femoral shapes for both sexes were platymeric displaying a degree of antero-posterior flattening .

	n	Right femur	n	Left femur
Male	9	81.0	12	82.3
Female	4	82.3	6	80.3
All adults	15	82.5	21	80.2

Table 6 Platymeric indices

Platycnemic index

The degree of transverse flattening to the tibia was calculated using the platycnemic index for 14 adults (14/46: 30.4%). Male left and right tibiae were on average within the eurycnemic range displaying a low degree of transverse flattening. The mean female tibial indices were mesocnemic .

	n	Right tibia	n	Left tibia
Male	5	75.0	6	71.7
Female	2	66.7	3	66.4
All adults	9	70.0	12	69.0

Table 7 Platycnemic index

Non-metric traits

The presence and absence of a series of non-metric traits was recorded for all adults (Powers 2008). These represent non-pathological variations in skeletal morphology and have previously been used in studies of biodistance, to measure the relative similarity or presence of genetic relationships between skeletal populations (Tyrrell 2000, 301).

Cranial Trait	**Present**		**Absent**		**Total observable**	
Metopism	1		12		13	
	Left	Right	Left	Right	Left	Right
Lambdoid wormians	1	0	0	0	1	0
Supraorbital foramen	3	0	8	10	11	10
Supraorbital groove	7	7	3	3	10	10
Parietal foramen	0	2	2	1	2	3

Table 8 Cranial non-metric traits

	Post Cranial Trait	**Present**		**Absent**		**Total observable**	
	Manubrio-corpal synostosis	1		4		5	
		Left	Right	Left	Right	Left	Right
	Acromial articular facet	1	0	1	3	2	3
	Septal aperture	1	0	13	17	14	17
Atlas	Posterior bridge	0	1	5	6	5	7
	Accessory sacral/iliac facets	4	2	9	10	13	12
	Acetabular crease	1	0	18	17	19	17
	Third trochanter	2	2	14	13	16	15
	Hypotrochanteric fossa	1	1	18	14	19	15
Tibia	Medial squatting facet	2	2	4	6	6	8
	Lateral squatting facet	2	1	4	7	6	8
Calcaneus	Facet double	1	2	6	3	7	5

Table 9 Post-cranial non-metric traits

Palaeopathology

CONGENITAL DISEASE

Developmental abnormalities were recorded in two adult males (2/46: 4.3% adults). In both cases the deformities affected the post cranial skeleton.

There was bifurcation of the anterior third of the second and third left rib of male [264], aged 36–45 years. A single rib head and neck were present but the rib separated into two shafts towards the sternal third. This may also be related to the fusion of the first and second thoracic vertebrae in this individual. A strong genetic link has previously been suggested for such rib defects (Barnes 1994, 72).

Male [217] aged 18–25 years displayed unilateral spondylolysis at the right neural aspect of the fifth lumbar vertebrae. The inferior aspect of the right apophyseal facet was fragmented and there was evidence of healing to the fracture margins indicating non-union or failure to fuse of the pars interarticularis. This condition may cause pain in the lower back region but can also remain completely asymptomatic (Roberts and Manchester 2005, 107). A crude prevalence rate of 2.9% (92/3185) has been recorded from early medieval skeletons (Roberts and Cox 2003, 208–9).

NEOPLASTIC DISEASE

Male [264] aged 36–45 years presented a circular, raised area of smooth sclerotic bone to the posterior aspect of the right parietal (7.6mm maximum diameter), consistent with a button osteoma. These benign tumours, more commonly found in men than women and with a higher prevalence in the 4th to 5th decades of life (Aufderheide and Rodríguez-Martín 1998, 375).

INFECTIOUS DISEASE

Non-specific infectious bone changes were identified in three adults (3/46: 6.5% adults): one male (1/23: 4.3%) and two females (2/8: 25.0%).

Older female [279] aged ≥46 years had a plaque of sclerotic bone growth to the anterior aspect of the left ischium indicating the presence of a healed infection. Healed remodelled bone was also present to the dorsal (posterior) aspect of the distal right radius and may represent a secondary bone response to a Colle's fracture (see also 'Trauma' below).

Female [291] also aged ≥46 years presented fine plaques of woven new bone growth to the visceral surfaces of two right ribs. This suggested the presence of an active infection at the time of death. Such lesions have been linked to an inflammatory response to pulmonary infection by a specific disease such as tuberculosis (Roberts and Manchester 2005, 190).

Spicules of sclerotic bone were identified at the internal aspect of the left maxillary sinus of male [315] aged 3–45 years. The healed nature of this bone formation indicated a chronic, longstanding sinus infection (sinusitis). A crude prevalence rate of 13.3% has been recorded for the late-medieval period (276/2076) (ibid 2003, 233).

TRAUMA

Traumatic injuries had been suffered by ten adults at St Peter's Wharf (10/46: 21.7%): seven males (7/23: 30.4%), and three females (3/8: 37.5%).

Three males had suffered traumatic soft tissue lesions (3/23: 13.0%). Male [232] aged 26–35 years had possible soft tissue ossification at the left lateral aspect of the second sacral vertebrae. This was located at the attachment point of the sacroiliac ligament to the margins of the auricular surface and pre-auricular surface of the ilium.

There was a large lesion into the cortical bone surface of the inferior right clavicle of male [272] aged 36–45 years. This was at the insertion point of the costoclavicular ligament that acts to strengthen the sternoclavicular joint to elevate the upper arm and stabilise the shoulder. Such cortical defects predominantly occur in young individuals and may suggest the use of the arm in a strenuous fashion (Knüsel 2000, 114).

Pronounced spurs of bone were present at the insertion point of rectus femoris on the anterior right patella of robust male [280] aged 36–45 years. The anterior patella surface and subchondral bone was uneven with marginal osteophyte formation.

Three adults (3/46: 6.5%) had compression fractures located in the spine. Fractures to the vertebrae are commonly caused by indirect trauma, pre-existing disease and stress (Lovell 1997, 158). Hyperflexion injuries from vertical forces may result in mechanical failure and anterior wedging (McRae 2003, 351).

Male [254] aged 36–45 years had fractures to the eleventh and twelfth thoracic centra. These had collapsed into each other resulting in secondary ankylosis at the intervertebral and apophyseal joints with well healed, smooth margins. This had resulted in a kyphosis curvature of the lower spine with approximately 20° anterior-posterior angulation. Secondary degenerative osteoarthritis between the joints of the fifth lumbar vertebrae and sacrum most likely represented a biomechanical response to the stresses placed upon the spine by such deformities.

Male [266] also aged 36–45 years had a possible fracture at the level of the seventh thoracic vertebrae. The centrum was slightly wedged and there were severe degenerative changes between the sixth and seventh intervertebral joints with sclerotic, pitted bone and marginal osteophytes.

Female [291] aged ≥46 years had a possible fracture at the level of the seventh throracic vertebrae, this appeared more concave than the other vertebrae. Secondary degenerative joint disease had resulted in fusion with the eighth thoracic centra below, sparing the apophyseal facets. There was also a slight anterior-posterior kyphosis of the midspine.

Two females displayed evidence of fractured limb bones (2/8: 25.0% females). Female [279] aged ≥46 years had a Colles' fracture to the right distal radius. This had healed with good alignment although approximately 10° dorsal displacement was visible. A large area of indented bone was present to the anterior surface, superior to the distal joint surface with a slight plaque of healed bone to the posterior aspect. In modern cases this fracture most commonly occurs in adult females over 40 years, and usually results from a fall onto an outstretched hand (Lovell 1997, 161).

Female [3056] ≥46 had a possible fracture to the midshaft of the left second metacarpal. No fracture line was visible although the dorsal aspect of the shaft appeared thickened with a flattened, course surface. There was also slight antero-posterior angulation of the midshaft and approximately 4mm shortening when compared to the opposing finger. Metacarpal fractures often result from longitudinal compression impacts such as a blow with a fist (Lovell 1997).

The most interesting/dramatic injuries were seen in male [3028] who had suffered multiple peri-mortem sharp force injuries to the cranial vault with further evidence of possible healed blunt force injuries (1/46: 2.2% adults, 1/23: 4.3% males). While post-mortem damage had resulted in the heavy fragmentation of the cranium, it was possible to distinguish between older injuries associated with trauma where the broken edges had stained a darker colour and more recent, irregular breaks from later damage.

A fine, linear cut mark ran superior–inferiorly at an oblique angle across the right frontal bone, approximately 52.2mm superior of nasion. This had a V-shaped cross section and penetrated only the outer surface of the cortical bone (31.9mm in length and 2.6mm at the widest aspect). The lesion had one clean, smooth edge and one rough uneven side. The frontal bone had fractured, possibly as a result of the force of the blow and a semi circular flake of bone had been detached from the inferior aspect of the cut.

A large, rectangular, scooped out flake of bone was detached from the right frontal, approximately 64mm superior of the right orbit and 11mm to the left of the temporal line (41.3mm in length, 15.7mm breadth and 2.6mm depth). This revealed areas of polished underlying trabecular bone. Fine parallel striations running superior–inferiorly across the lesion may represent imperfections to the surface of the bladed weapon. Repeated glancing blows down onto the right frontal may have caused the bone to fracture with detachment of the underlying bone.

The right temporal and inferior parietal bones were heavily fragmented and it was not possible to piece all of these together. Linear cut marks were present on several fragments including the greater wing of the right sphenoid and squamous temporal. These revealed smooth, polished cuts with terminal fractures that had removed areas of cortical bone.

The top of the cranium revealed a semicircle of depressed bone to the outer surfaces of the right and left parietals, posterior of bregma. The cross section of this lesion revealed a flattened region with both tables driven together and remodelled. A corresponding area of depressed bone was present to the endocranial surface. This may represent an earlier injury caused by blunt force trauma from a rounded object. The survival of this was evident from the healed nature of the lesion.

A linear, V-shaped cut mark ran at an oblique angle transversely across the right and left parietals (17.9mm in length and 2.9mm) penetrating only the outer surface. Post mortem erosion had obliterated the right aspect of the lesion and it was not possible to determine how far this ran onto the right parietal. The lesion had a clean, smooth anterior surface and rough posterior side, similar in dimensions to the linear cut at the right frontal, suggesting the injury was caused by the same weapon.

An extensive linear cut mark ran horizontally across the posterior parietals just superior of the supraoccipital. The cut had an oblique angle with a clean, polished anterior surface that deeply penetrated the endocranium. The supraoccipital had broken off due to post-mortem damage, however, the superior surface of this made up the corresponding posterior side of the cut. This was rough and uneven with a hiatus between the superior and inferior pieces of bone most likely the result of fragmentation from trauma and erosion. A semicircle of sliced bone with the cortical surface removed revealed underlying polished trabecular bone to the left aspect of the lesion and may indicate the initial contact point of the blade. Terminal fractures were present to the inferior right temporal and two areas of sliced cortical bone were located to the posterior of the foremen magnum.

The absence of post cranial elements limited observations as to the full extent of injuries suffered. The linear nature of the lesions, without large irregularities, defined clean edges and a cut surface that was flat, smooth and with some polishing suggested a long sharp bladed weapon, possibly a sword (Lewis 2008; Wenham 1989, 127). These clean cut surfaces with no evidence of healing indicate the injuries were received immediately before or shortly after death when the bone retained its full organic structure.

Figure 13 Adult male [3028] showing shape force injuries to the cranial vault

The cut marks show one side of the injury to be smooth and flat with the opposing side irregular. This suggests that the blade entered at an obtuse angle. There was some displacement of bone to the acute angled sides, with the outer surfaces flaked and detached and the underlying broken surface remaining. Large areas of bone that had broken away may have been detached from beneath the blade as it passed through (Lewis 2008; Wenham 1989, 132). An injury can not be produced by a blade that is shorter that its own length unless there is a slicing action. The posterior cut had minimum length of 104mm suggesting a longer blade such as a sword. There was also an absence of terminal fractures to most of the cuts that would imply the use of a thicker blade such as an axe (Wenham 1989, 132).

JOINT DISEASE

Spinal joint disease

Spinal joint disease represents the most frequently identified pathology observed in the post-cranial skeleton and can occur through chemical and degenerative changes to the vertebral joints related to increased biomechanical stresses and advancing age (Roberts and Manchester 2005, 139).

The true prevalence of spinal joint disease by observable vertebrae can be seen below .

The most frequently occurring spinal pathology was intervertebral disc disease, diagnosed as course pitting to the superior and inferior intervertebral surfaces (Rogers and Waldron 1995, 27). This demonstrated a higher prevalence amongst the female sample compared to males.

		SN		IVD		OA		OP		Fusion	
		Affected	**%**	**Affected**	**%**	**Affected**	**%**	**Affected**	**%**	**Affected**	**%**
Male	298	34	11.4	41	13.8	17	5.7	7	2.3	1	0.3
Female	93	9	9.7	27	29.0	18	19.4	16	17.2	1	1.1
Adult	449	54	12.0	75	16.7	37	8.2	24	5.3	2	0.4

Table 10 True prevalence of spinal joint disease by joint

Schmorl's nodes had a distribution in the lower weight bearing region of the thoracic and lumber spine, with a higher prevalence in the male sample (34/298: 11.4) compared to females (9/93: 9.7%). These lesions represent the herniation of the vertebral disc resulting in a depression to the intervertebral surface. This has been associated with higher stresses placed on the spine, often through activity from a young age (Rogers and Waldron 1995, 27).

Osteoarthritis affecting the synovial facet joints was distributed throughout spine with a higher prevalence amongst females (18/93: 19.4%) than males (17/298: 5.7%). Females demonstrated a higher frequency of lesions in the cervical, lower thoracic and lumbar regions than males. Male [254] aged 36–45 years had secondary osteoarthritis to the apophyseal joints of the fifth lumbar vertebrae and sacrum. This most likely was in response to the compression fracture of the eleventh and twelfth vertebrae that caused increased stresses on the spine(se also 'Trauma' above).

The formation of marginal osteophytes is a mechanically induced condition and is related to increased stresses placed on the spine (Roberts and Manchester 2005, 140). This was recorded throughout the spine of individuals from St Peter's Wharf with a higher prevalence amongst females (18/93: 19.4%) compared to males (17/298: 5.7%).

Two adults had fused vertebrae (2/46: 4.3%) resulting from osteophytes growing together and uniting. This comprised one male (the first and second thoracic) and one female (seventh to eighth thoracic).

All spinal joint disease showed an increase with age up until the 36–45 year age range after which there was a decline, however, this may be related to the smaller sample size in the ≥46 year age category. Osteoarthiris and osteophyte formation in the spine may be related to normal age related changes and not pathological processes if other abnormalities are not identified (Rogers and Waldron 1995, 25).

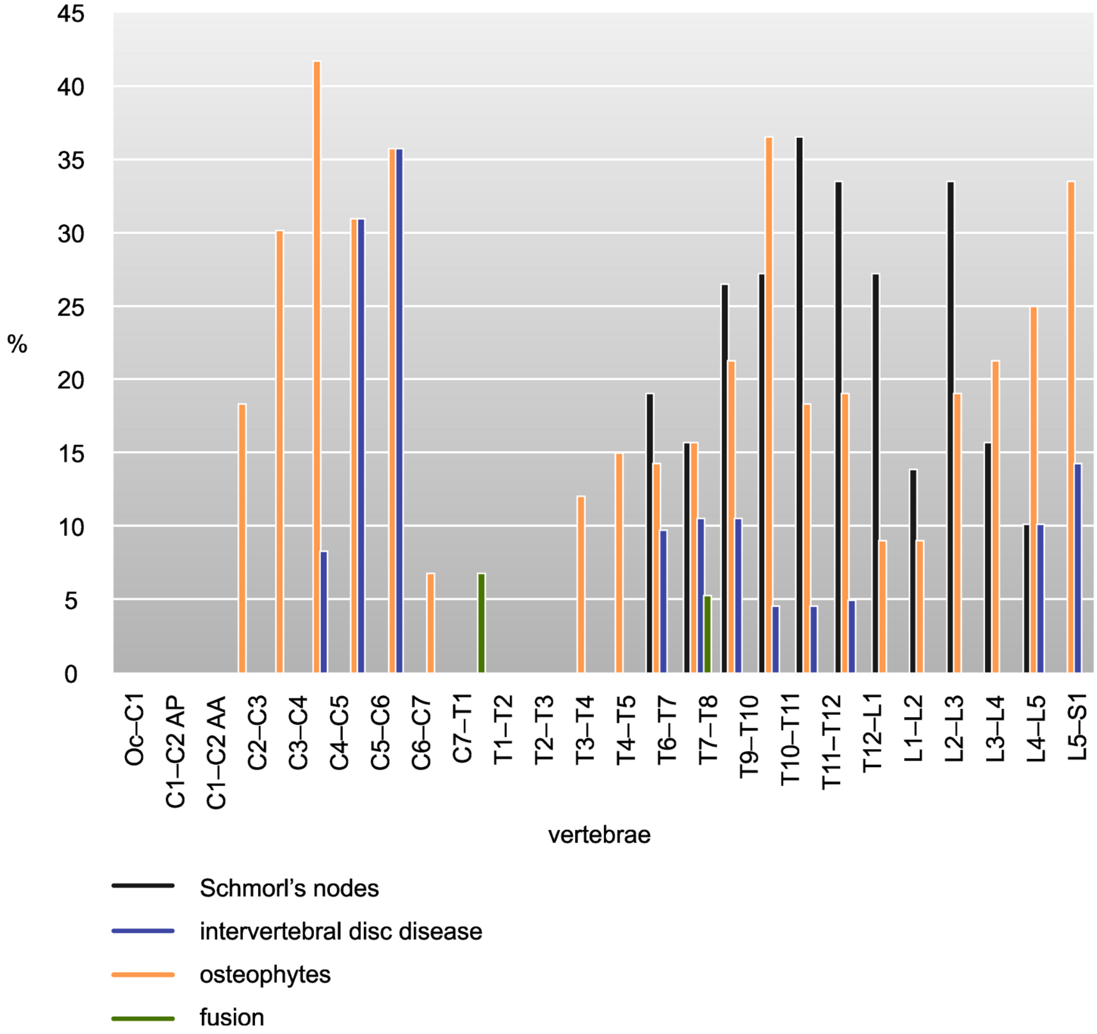

Figure 14: True prevalence of spinal joint disease by vertebral joint from St Peter's Wharf

<u>*Extra spinal joint disease*</u>

Bone changes resulting from degenerative joint disease were identified at extra spinal locations in three individuals (3/55: 5.5%, 3/46: 6.5%): one male (1/23: 4.3%) and two females (2/8: 25.0%).

Osteoarthritis is the most commonly occurring joint disease observed in archaeological skeletons. These changes at the synovial joints have been linked to increasing age, genetic predisposition, obesity, activity and environmental factors (Roberts and Manchester 1995: 105–6). Two adults were affected 2/46: 4.3%) one male (1/23: 4.3%) and one female (1/8: 12.5%).

Male [280] aged 36–45 years had changes to the left humeroradial joint (elbow) with porosity, osteophytes and eburnation considered pathognomic of a diagnosis of osteoarthritis (Rogers and Waldron 1995). This individual also had severe pitting to the acromioclavicular joints and degenerative joint changes throughout the spine. Female [279] aged ≥46 years had degenerative changes to the sternoclavicular and left glenohumeral joints. Osteoarthritis was also present in the cervical vertebrae and costo-vertebral joints.

Female [3056] aged ≥46 had degenerative changes to the left shoulder joint diagnostic of rotator cuff disease. There was marked porosity with osteophyte growth at the lesser trochanter of the left proximal humerus. The tendons of supraspinatus, infraspinatus, teres minor and subscapularis make up the rotator cuff muscles that act to stabilise the glenohumeral joint. Age related changes may predispose these tendons to injury through trauma. Such injuries are common in those over 40 with males more often affected than females. This can result in shoulder pain, stiffness and weakening but may also remain asymptomatic (Resnick 2002, 3075–87).

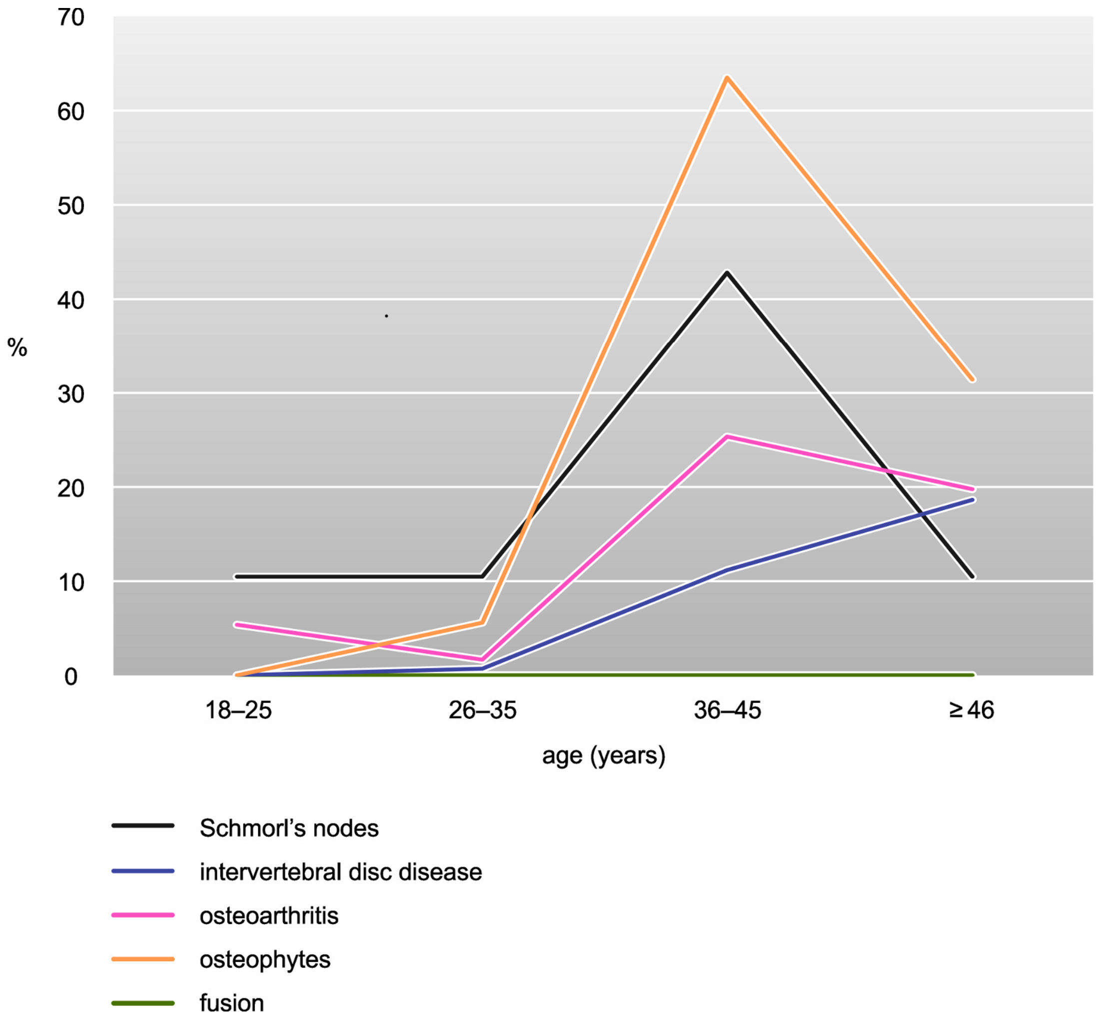

Figure 15: Adult vertebral pathology by age

DENTAL DISEASE

A total of 51 deciduous teeth and 57 tooth sockets and 80 permanent teeth and 84 sockets were observable in the subadult sample. There were 380 permanent teeth and 453 tooth sockets observable in the adult sample. Sixty four deciduous 88 permanent teeth had been lost post mortem (152/511: 29.7%).

Dental calculus, the build up of mineralised plaque to the surfaces of teeth was the most prevalent form of dental disease recorded, affecting 34.5% of adults (19/55) and 22.2% of subadults (2/9). There was a much higher crude prevalence amongst males (14/23: 60.9%) compared to females (2/8: 25.0%).

Eight adults had lost teeth during life (8/46: 17.4%): seven males (7/23: 30.4%) and one female (1/8: 12.5%). Males also displayed a higher rate of carious lesions and periodontal disease than females. Subadult [216] aged 12–17 years had a carious erosion at the occlusal (biting) surface of the first left mandibular molar.

Hypoplastic defects were observed in the enamel of two subadults (2/9: 22.2%) and five adults (5/46: 10.9%).

Three males (3/23: 13.0%) had periapical abscesses: male [250] and male [315] had abscesses at the socket of the right maxillary lateral incisor. Male [303] aged ≥46 had externally draining lesions at the sockets of the maxillary and mandibular first molars. This individual also displayed severe dental wear, caries and periodontal disease. The crown of the maxillary left first molar was worn down to the root revealing a smooth polished surface.

Adult male [3030] aged ≥46 also displayed severe dental wear to the maxillary molars, premolars and incisors.

Subadult [247] aged 1–5 years had a Carabelli's cusp to the erupting crown of the lower right first molar.

The crude and true prevalence rates for observable dental pathology are listed in Table 11 and 12.

	Subadult	n.9	Male	n.23	Female	n.8	Adult	n.46	Total	n.55
	Affected	%	Affected	%	Affected	%	Affected	%	Affected	%
Caries	1	11.1	8	34.8	0	-	8	17.4	9	16.4
Calculus	2	22.2	14	60.9	2	25.0	17	37.0	19	34.5
Enamel hypoplasia	2	22.2	2	8.7	1	12.5	5	10.9	7	12.7
Periodontal disease	0	-	7	30.4	1	12.5	9	19.6	9	16.4
Periapical abscess	0	-	3	13.0	0	-	3	6.5	3	5.5
Antemortem loss	0	-	7	30.4	1	12.5	8	17.4	8	14.5

Table 11 Dental pathology crude prevalence

	Subadult			Adult			Total		
	n.	Affected	%	n.	Affected	%	n.	Affected	%
Caries	131	1	0.8	380	20	5.3	511	21	4.1
Calculus	131	12	9.2	380	123	32.4	511	135	26.4
Enamel hypoplasia	131	5	3.8	380	14	3.7	511	19	3.7
Periodontal disease	141	0	-	453	32	7.1	594	32	5.4
Periapical abscess	141	0	-	453	6	1.3	594	6	1.0
Antemortem loss	141	0	-	453	44	9.7	594	44	7.4

Table 12 Dental pathology true prevalence

OTHER PATHOLOGICAL CONDITIONS

Cribra Orbitalia

Male [254] aged 36–45 years had lesions of scattered fine foramina to the roofs of the left and right orbits evident of cribra orbitalia (1/55: 1.8%, 1/46: 2.2% adults, 1/23: 4.3% males). This may be related to a deficiency of iron in the diet reducing the amount of haemoglobin formed in red blood cells that carry oxygen around the body and causing anaemia. Excessive blood loss, chronic disease, parasitic infection and gastrointestinal infection may also play a part in this condition (Roberts and Manchester 2005, 226).

Bibliography

Aufderheide A C, and Rodríguez-Martin C, 1998 *The Cambridge encylopedia of human paleopathology*, Cambridge

Barnes E, 1994 *Developmental defects of the axial skeleton in palaeopathology*, Colorado

Bass W M, 1995 (1971) *Human osteology: a laboratory and field manual*, 4 edn, Missouri Archaeol Soc Spec Pap 2, Columbia

Blackmore L, 2010 The pottery from St Peter's Wharf, St Peter's Street, Maidstone, Kent (KT-SPW06) unpub MoLAS report

Brooks S T, and Suchey J M, 1990 Skeletal age determination based on the os pubis: comparison of the Acsádi-Nemeskéri and Suchey-Brooks methods, *J Hum Evol* 5, 227–38

Brothwell D R, 1981 (1963) *Digging up bones: the excavation, treatment and study of human skeletal remains*, 3 edn, London

Connell B, and Rauxloh P, 2007 (2003) A rapid method for recording human skeletal data (2nd edition). Museum of London

Cox M, 2000 'Aging adults from the skeleton' in Cox M, and Mays S, (eds*) Human osteology in archaeology and forensic science*, London. 61–81

Dawes J D, and Magilton J R, 1980 *The cemetery of St Helen-on-the-Walls, Aldwark*, The Archaeology of York 12/1, London

Daniell C, 1997 *Death and burial in medieval England 1066–1550*, London

Ferguson B, 2007 St Peter's Wharf, St Peter's Street, Maidstone: Archaeological watching brief report unpub MoLAS report

Gilchrist R, and Sloane B, 2005 *Requiem: the medieval monastic cemetery in Britain*, MoLAS London

Gustafson G, and Koch G, 1974 Age estimation up to 16 years of age based on dental development, *Odontologisk Revy* 25, 297–306

Hasted E, 1798 *The History and Topographical Survey of the County of Kent*, Vol 4

Iscan M Y, Loth S R, and Wright R K, 1984 Age estimation from the rib by phase analysis: white males, *J Forensic Sci* 29, 1094–1104

Iscan M Y, Loth S R, and Wright R K, 1985 Age estimation from the rib by phase analysis: white females, *J Forensic Sci* 30, 853–63

Knight. H. 2009 St Peter's Wharf, St Peter's Street, Maidstone, Kent: A supplementary post-excavation assessment and updated project design unpub MOLA report

Knüsel C, and Boylston A, 2000 'How has the Towton project contributed to our Knowledge of medieval and later warfare?' in *Blood Red Roses: the archaeology of a mass grave from the Battle of Towton AD 1461* (eds V Fiorato, A Boylston and C Knüsel), Oxford, 169–189

Knüsel C, 2000 Activity-related skeletal change, in in *Blood Red Roses: the archaeology of a mass grave from the Battle of Towton AD 1461* (eds V Fiorato, A Boylston and C Knüsel), Oxford, 103–118

Lee F, and Magilton J, 1989 The cemetery of the hospital of St James and St Mary Magdalene, Chichester – a case study, *World Archaeology* 21(2), 273–82

Lewis J E, 2008 Identifying sword marks on bone: criteria for distinguishing between cut marks made by different classes of bladed weapons, *J of Archaeological Science* 35: 2001–2008

Lewis M E, 2007 *The bioarchaeology of children: perspectives from biological and forensic anthropology*, Cambridge

Lewis S, 1848 A Topographical Dictionary of England

Lovejoy C O, Meindl R S, Pryzbeck T R, and Mensforth R P, 1985 Chronological metamorphosis of the auricular surface of the ilium: a new method for the determination of adult skeletal age at death, *American J Phys Anthropol* 68, 15–28

Lovell N C, 1997 Trauma analysis in paleopathology, *Yearb Phys Anthropol* 40, 139–70

McRae, R, 1999 *Pocketbook of orthopaedics and fractures*, London

Magilton J, Lee F, and Boylston A, 2008 *Lepers outside the gate: excavations at the cemetery of the hospital of St James and St Mary Magdalene, Chichester, 1986–87 and 1993*, CBA Research Report 158, London

Maresh M M, 1970 Measurements from roentgenograms, in *Human growth and development* (ed R W McCammon), 157–200, Springfield, IL

Miller P, and Saxby D, 2007 *The Augustinian priory of St Mary Merton, Surrey: excavations 1976–90*, MoLAS Monogr Ser 34, London

Moorees C F A, Fanning E A, and Hunt E E Jr, 1963 Formation and resorption of three deciduous teeth in children, *American J Physical Anthropol* 21, 205–13

Moorees C F A, Fanning E A, and Hunt E E Jr, 1963 Age variation of formation stages for ten permanent teeth, *J Dental Res* 42, 1490–1502

Novak S A, 2000 'Battle-related trauma' in *Blood Red Roses: the archaeology of a mass grave from the Battle of Towton AD 1461* (eds V Fiorato, A Boylston and C Knüsel), Oxford, 90–102

Ortner, D J, 2003 (1981) *Identification of pathological conditions in human skeletal remains*, 2 edn, London

Powers N, 2005 Cranial Trauma and Treatment: A Case Study from the Medieval Cemetery of St. Mary Spital, *London Int J of Osteoarchaeology* 15, 1–14

Powers N (ed) 2008 Human Osteology Method Statement, Museum of London on-line publication

Rahmatova N, 2008a St Peter's Wharf, St Peter's Street, Maidstone: An archaeological evaluation report, unpub MOLA report

Rahmatova N, 2008b St Peter's Wharf, St Peter's Street, Maidstone: A post-excaction assessment and updated project design, unpub MOLA report

Resnick, D, 2002 (1981) *Diagnosis of bone and joint disorders*, 4 edn, London

Roberts C A, and Cox M, 2003 *Health and disease in Britain: from prehistory to the present day*, Stroud

Roberts C, and Manchester K, 2005 (1995)*The archaeology of disease*, 3 edn, Stroud

Rogers J, and Waldron T, 1995 *A field guide to joint diseases in archaeology*, Chichester

Rousham, E K, and Humphrey, L T, 2002 The dynamics of child survival, in *Human population dynamics: cross-disciplinary perspectives* (eds H Macbeth and P Collinson), Biosocial Soc Symposium Ser, 124–40, Cambridge

Scheuer, L, and Black, S, 2000 *Developmental juvenile osteology*, London

Schofield J, 1999 'Landscapes of the Middle Ages, Towns 1050-1500' in Hunter J, and Ralston I, (eds) *The Archaeology of Britain, An introduction from the Upper Palaeolithic to the Industrial Revolution* 210–227

Spall C A, and Toop N J (eds), 2005 Blue Bridge Lane & Fishergate House, York. Report on excavations: July 2000 to July 2002 APC Monogr. Ser 001

Stirland A, 1996 Patterns of trauma in a unique Medieval Parish Cemetery, *Int J Osteology* 6, 92–100

Stroud, G, and Kemp, R L, 1993 *Cemeteries of the church and priory of St Andrew, Fishergate*, Archaeology of York 12/2, York

Sweetinburgh S, 2004 *The role of the hospital in medieval England* Dublin

Sweetinburgh S (ed), 2010 *Later medieval Kent* Woodbridge

Sweetinburgh S, 2013 in Henderson, M. And Knight, H. 'Le Newerk of Maydeston' , *Arch. Cant.* 133, 117

Trotter, M, 1970 Estimation of stature from intact limb bones, in *Personal identification in mass disasters* (ed T D Stewart), 71–83, Washington, DC

Tyrrell, A, 2000 Skeletal non-metric traits and the assessment of inter- and intra- population diversity: past problems and future potential, in Cox, M, and Mays, S, *Human osteology in archaeology and forensic scienc*e, London, 289–306

Ubelaker D H, 1997 'Taphonomic Applications in Forensic Anthropology', in *Forensic Taphonomy: The Postmortem Fate of Human Remains* (Haglund W D, and Sorg M H) 77–87

Waldron T, 2007 *St Peter's, Barton-upon-Humber, Lincolnshire: A parish church and its community, volume 2 The Human Remains*, Oxford

Webb, D, 2000 *Pilgrimage in medieval England* London

Wenham S J, 1989 'Anatomical interpretations of Anglo-Saxon weapon injuries' in in *Weapons and warfare in Anglo-Saxon England* (ed S Chadwick Hawkes), Univ Oxford Comm Archaeol Monogr 21, 123–139, Oxford

White, W J, 1988 *Skeletal remains from the cemetery of St Nicholas Shambles, City of London*, London Middlesex Archaeol Soc Spec Pap 9, London

White W, 2004 'Human Bone' in Barber B, Chew S, Dyson T, White W 2004 *The Cistercian abbey of St Mary Stratford Langthorne, Essex,* MoLAS Monogr Ser 18, London

VCH, 1926 *The Victoria history of the county of Kent: Vol 2*, London

Wood J W, Milner G R, Harpending H C, and Weiss K M, 1992 The osteological paradox: problems of inferring prehistoric health from skeletal samples, *Curr Anthropol* 33(4), 343–70