Archaeological investigations at Holy Trinity Church, Stratford-upon-Avon, Warwickshire

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With contributions by C Jane Evans, Rob Hedge and Elizabeth Pearson

Summary

An archaeological excavation and watching brief was undertaken at Holy Trinity Church, Old Town, Stratford-Upon-Avon, Warwickshire (SP 2010 5428). It was undertaken on behalf of Holy Trinity Church Parish Office, who is constructing an extension along the southern side of the church, for which a faculty has been obtained from Coventry Diocesan Advisory Committee (DAC) and a planning application submitted to Stratford-upon-Avon District Council.

The investigations excavated and lifted 304 burials of medieval to post-medieval date, although no structural remains or burials were identified to confirm the putative Saxon origins of the church. Few other features were identified during the archaeological works other than modern services, although four brick vaults and a brick shaft were encountered. Only one of the vaults was excavated as it had already been damaged and emptied by the insertion of a water pipe, as had the brick shaft.

The osteological analysis of the inhumated remains appears to reflect the rural nature of Stratford-upon-Avon where industrialisation had a minimal impact on the size and nature of the settlement compared to many other places in the later post-medieval period. The analysis supports the documentary evidence from the post-medieval period which indicates that most males were employed in agricultural labour while females were domestic hands or officially unemployed. The stature of the assemblage, potentially an indicator of health status, remained constant from the medieval period for both males and females, although many diseases and conditions increased slightly from the medieval to post-medieval. However in comparison to other more industrial towns instances of disease remained low and the cleaner air, agricultural lifestyle and access to a good diet for many of the inhabitants has resulted in relatively healthy population.

Report

1 Background

1.1 Reasons for the project

An archaeological excavation and watching brief was undertaken at Holy Trinity Church, Old Town, Stratford-upon-Avon, Warwickshire (NGR SP 2010 5428) (Fig 1). It was commissioned by Holy Trinity Church Parish Office, who is constructing an extension along the southern side of the south aisle, for which a faculty has been obtained from Coventry Diocesan Advisory Committee (DAC) and a planning application submitted to Stratford-upon-Avon District Council (planning ref: 14/03043/FUL).

The proposed development site was considered to include heritage assets and potential heritage assets with archaeological interest, the significance of which may be affected by the application (MWA 1022 and 1026). The excavation was preceded by exploratory investigations across the proposed development area including test pits (Tavener 2012) and evaluation trenches (Vaughan 2014).These confirmed the presence of numerous articulated skeletons, approximately eight layers deep, of 14th to 19th century date. Following the submission of the evaluation report a brief for archaeological works was prepared by the former Coventry DAC Archaeological Advisor (Jonathan Parkhouse) and Warwickshire County Council Planning Archaeologist (Anna Stocks) (Parkhouse and Stocks 2015) for which a project proposal (including detailed specification) was produced (WA 2015).

The project conforms the brief (Parkhouse and Stocks 2015) and to the Standard and guidance for archaeological field evaluation (CIfA 2014a) and Guidance for best practice for treatment of human remains excavated from Christian burial grounds in England (Church of England and English Heritage 2005).

2 Methods

2.1 Personnel

The project was led by Andrew Mann (BA (hons.); MSc), who joined Worcestershire Archaeology in 2004 and has been practicing archaeology since 2001, assisted by Jamie Wilkins (BA (hons.)), James Spry (BA (hons.); MA), Jessica Wheeler (BA (hons.)), Robert Hedge (MA Cantab), Graham Arnold (BA (hons.), Andrew Walsh (BSc (hons); MSc; ACIfA; FSA Scot), Elspeth Iliff (BA (hons.); MSc), Rich Grove (BA; MA) and Tania Kausmally (Ossafreelance). The project was also assisted by staff from Archaeology Warwickshire including Rob Jones (Senior Field Technician), Kevin Wright (Senior Field Technician), Jan Janulewicz (BA), and Rob Billington (BA). The project manager responsible for the quality of the project was Tom Vaughan (BA (hons.) MA, ACIfA). The Osteological analysis was led by Gaynor Weston (Ossafreelance). Illustrations were prepared by Laura Templeton (BA; PG Cert; MCIfA) and Andrew Mann. Elizabeth Pearson (MSc; ACIfA), contributed the environmental report, Jane Evans (BA, MA, MCIfA), and Robert Hedge (MA Cantab) contributed the finds report. Elaine Dunbar (SUERC) prepared the calibrated AMS dates. Wayne Hoban (Reveal Imaging Ltd) undertook the radiography.

2.2 Documentary research

Prior to fieldwork commencing a search was made of the Historic Environment Record (HER). This identified six archaeological monuments within 250m of the church and that three archaeological events have been undertaken previously in the vicinity.

2.3 List of sources consulted

Cartographic sources

- Samuel Winter's map of Stratford (1759).
- Saunder's map of Stratford (1802)

- Board of Health map (1851)
- OS six inch 1886, 1906, 1920, 1922, 1947

2.4 Fieldwork strategy

A detailed specification has been prepared by Worcestershire Archaeology (WA 2015).

Fieldwork was undertaken between 1 June 2015 and 14 September 2015. A single trench abutting the southern aisle of the church was excavated amounting to just over 110m² in area. Two service trenches, extending out from the main excavation area, were also excavated under watching brief. One of these led east to the river (for storm water) and one led west to Mill Lane (for foul water). These shall be subsequently referred to as the River Trench and the Lane Trench respectively. The location of the trenches is indicated in Figure 2.

Deposits considered not to be significant were removed using a 360º tracked excavator, employing a toothless bucket and under archaeological supervision. The mechanical site strip and hand excavation was slowed by there being numerous live, capped and relict services (gas, water and electric) crossing the main excavation area that were not removed/disconnected until late on in the excavation. Subsequent excavation was undertaken by hand. Clean surfaces were inspected and selected deposits were excavated to retrieve artefactual material and environmental samples, as well as to determine their nature. Deposits were recorded according to standard Worcestershire Archaeology practice (WA 2012).

Initially the main excavation area was dug to an impact depth of 37.39m AOD with a deeper trench dug on the external perimeter to 37.24m AOD to incorporate foundations and external drainage and services. However the drainage was redesigned towards the end of the main excavation phase. After discussions with Anna Stocks (Warwickshire Planning Archaeologist) it was decided that the main excavation area would be widened along the southern edge by approximately 0.40m and that a further five service trenches would be excavated across the base of the main excavation area. These trenches were approximately 0.50m wide and between 0.50-0.60m deep. Through most of the new drainage trenches natural sand and gravel deposits, at the base of the churchyard soil, were exposed. Although the new drainage trenches truncated a number of burials, due to their width it was not possible to excavate complete skeletons and therefore only partial remains were lifted. On occasion however where interesting pathologies or burial characteristics were identified the new drainage cuts were widened to expose, record and lift complete burials.

On completion of excavation the base of the main excavation area was covered in terram prior to the construction of the extension.

2.5 Structural analysis

All fieldwork records were checked and cross-referenced. Analysis was effected through a combination of structural, artefactual and ecofactual evidence, allied to the information derived from other sources.

2.6 Artefact methodology, by C Jane Evans and Rob Hedge

The finds work reported here conforms with the relevant sections of *Standard and guidance for the collection, documentation, conservation and research of archaeological materials* (CIfA 2014b), with archive creation informed by *Archaeological archives: a guide to the best practice in the creation, compilation, transfer and curation* (AAF 2011), and museum deposition by *Selection, retention and dispersal of archaeological collections* (SMA 1993).

2.6.1 Recovery policy

The artefact recovery policy conformed to standard Worcestershire Archaeology practice (WA 2012; appendix 2).

2.6.2 Method of analysis

All hand-retrieved finds from the evaluation and excavation were quantified, identified and dated to period, where possible. The finds data from the evaluation (Vaughan 2014) have been integrated into the tables presented below. A *terminus post quem* date was produced for each stratified context. The date was used for determining the broad date of phases defined for the site. All information was recorded on *pro forma* Access database tables.

The inhumations formed the main focus of the excavations, and thus the overall report, so finds (mostly coffin furniture) associated with these was prioritised for analysis. They provided useful dating evidence, assisting with phasing of the complex stratigraphy, and allowed chronological changes in burial practices to be assessed. Also of significance was a find associated with the Anglo-Saxon settlement, the only evidence for activity of this date from the present investigations. Other finds were considered of less significance to the interpretation of the site and were recorded in less detail. Medieval and post-medieval pottery was only recorded to broad class based on the Warwickshire fabric reference series (Soden and Ratkai 1998). Finds associated with modifications to the churches fabric such as medieval glass, tile and building stone, were quantified; decorated pieces are illustrated, for the benefit of future researchers. However, analysis is confined to a brief discussion.

2.7 Human osteology methodology, by Gaynor Weston

The investigations resulted in the retrieval of human remains from inhumated burials and an additional assemblage of disarticulated human skeletal material.

A total of 298 graves were fully excavated resulting in the exhumation of 304 individuals. Due to the high level of intercutting between graves it was not possible to identify all the grave cuts but there was little direct evidence for the stacking of individuals within one grave as is often seen at contemporary cemetery sites.

The archaeological evidence, based stratigraphic relationships between the burials and the date of the church building, suggested that the inhumations spanned a range of dates from the early medieval to the post-medieval period. Radiocarbon dating of a sample of four skeletons revealed a range from 1119 AD – 1455 AD, suggesting that there had been a continuum of burial in the churchyard from the earlier medieval to the late Victorian periods. Unfortunately, however, It was generally not possible to differentiate between later medieval (i.e. 1300-1500) and early post-medieval burials (i.e. 1500- 1650), due to the lack of finds and stratigraphic evidence.

Since the earlier medieval burials could be positively identified stratigraphically and the burials identified as late post-medieval (1650-1900) constituted a small sample size when taking skeletal completeness into account, for the purposes of the osteological analysis of the articulated remains, the burials were split into two samples, namely ‘Early’ (1066-1300) and ‘Late’ (i.e.1300-1900), and reported upon separately. Based on the contextual evidence available, for the purpose of the osteological analysis, 45 of the burials were categorised as ‘Early’ (1066-1300) with the remaining 259 burials being identified as ‘Late’ (1300-1887). A catalogue of the skeletons including information of dating according to burial phase is provided in Appendix 1 should further analysis of the assemblage be required in the future.

The disarticulated inhumated material, comprising of 28,889 fragments of identifiable skeletal elements, had been disturbed by post-depositional events and was collected by hand during the excavation. Osteological assessment of these remains was undertaken separately and is reported on in Section 5.4.12. Upon completion of the analysis, the human skeletal remains were reburied within the Holy Trinity Churchyard in 2016.

2.7.1 The Articulated Assemblage: Methods and Process

The skeletal material was analysed according to the standards laid out in the guidelines recommended by the British Association of Biological Anthropologists and Osteologists in conjunction with the IFA (*Guidelines to the Standards for Recording Human Remains*, Brickley and McKinley (eds) 2004) as well as by English Heritage (*Human Bones from Archaeological Sites:*

Guidelines for producing assessment documents and analytical reports, Centre for Archaeology Guidelines, 2002).

- Recording of the material was carried out using the recognised descriptions contained in Standards for Data Collection from Human Skeletal Remains by Buikstra and Ubelaker (1994). Full recording forms are supplied separately to be archived with any other archaeological recording forms. All skeletal data has been recorded using an MS-Access database(s) which can be found on the CD-Rom deposited with the archive.
- The material was analysed macroscopically and where necessary with the aid of a magnifying glass for identification purposes. Where relevant, digital photographs have been used for illustration and a full digital image archive of all pathologies and any other features of interest has been provided on the CD-Rom deposited with the archive.
- The material was analysed without prior knowledge of associated artefacts so that the assessment remained as objective as possible.
- Comparison of the results was made with published osteological data from contemporary skeletal populations. Data was compared to overall prevalence rate averages from post-medieval sites as reported in Roberts and Cox, 2003. Particular attention was given to comparison of this assemblage with sites from the West Midlands dating to the post-medieval and medieval periods:
- *Centenary Gardens, Stratford-upon-Avon.* A small assemblage of 16 individuals dating to the mid Saxon period (AOC Archaeology 2010).
- St *Andrew's, Worcester (Technical College)*. An assemblage excavated from the former Victorian churchyard of St Andrew's in Worcester city centre, comprising of 24 articulated individuals from inhumation burials and 1703 disarticulated fragments of human bone (Western 2006).
- *Tallow Hill, Worcester.* Excavations in the former cemetery at Tallow Hill in Worcester city centre led to the exhumation of 9 individuals originally deposited in vaults. The vaults date to the mid Victorian period, though some vaults were still in use until 1904 (Ogden n.d.).
- *Old Church of* St *Peter and* St *Paul, Upton on Severn, Worcestershire.* An assemblage of 24 exhumed individuals dating to 1836-1866 from a parish burial ground in a small riverine town (Western 2014).
- St *Martin's-in-the-Bull Ring, Birmingham*. A large late Georgian and early Victorian period assemblage consisting of 505 analysed individuals interred in both vault and earth-cut graves (Brickley, Berry and Western 2006).
- St *Mary's Church, Kempsey, Worcestershire.* A skeletal assemblage consisting of 46 individuals dating to the late Saxon and early Medieval period, with radiocarbon dates of between 870 and 1260AD (Western 2015).
- *Chapter House, Worcester Cathedral, Worcester*. A late medieval assemblage comprising 185 individuals dating to the late Saxon and early medieval period (Waldron 2011).

For analytical purposes, data from the 'Early' assemblage from Holy Trinity, Stratford-upon-Avon, was compared that from medieval assemblages, whereas the data from the 'Late' assemblage was compared to that from 'post-medieval' assemblages, though it is acknowledged that some of the skeletons in the 'Late' assemblage here may pre-date the post-medieval period, traditionally defined as beginning in 1540 AD.

2.7.2 Reasons for the Analysis

Osteological analysis was carried out to ascertain:

- Condition of bone present

- Completeness of the skeleton
- Inventory of the skeletal material
- Sex Determination
- Age Assessment
- Non-metric Traits
- Stature
- Skeletal Pathology
- Dental Pathology

2.7.3 The Disarticulated Assemblage

A total number of 28,889 identifiable bone fragments were recovered as disarticulated elements from 141 stratified contexts. Some fragments were not recorded due to being unidentifiable, mainly due to their very small size. It was not possible to re-associate any skeletal elements that were recovered from separate contexts. As a result, the 28,889 elements were recorded individually and analysed for age, sex and pathology. The condition of the bone was not recorded for each element but overall, the assemblage was observed as being in a 'good' state of preservation, though was unwashed and not fully observable. It was not possible to distinguish between medieval and post-medieval elements; therefore, osteological analysis was undertaken on the assemblage as a whole.

Long bone elements complete with the epiphyseal ends of bone were assessed for age; fused epiphyses being classified as 'adult' and unfused as 'sub-adult'. Those identifiable skeletal elements that were observably very small in size were identified as 'neonate' and recorded separately. Where sufficiently complete, neonate long bones were measured to establish age via long bone length.

2.7.4 Methods and Process

The disarticulated assemblage was analysed macroscopically and recorded using a Microsoft Excel spreadsheet, which can be found on the CD-Rom deposited with the archive. Due to the comprehensive size of the articulated skeletal assemblage and, additionally, the very large size of the disarticulated sample, a strategy was devised to assess the disarticulated skeletal remains within the limited time available that would provide data to complement and enhance that derived from the analysis of the articulated remains. This included the following:

- A total fragment count of skeletal elements was made for each context, where fragments were over *c* 10mm in size.
- An inventory of the count of long bones per context was made according to the part of the bone present in order to establish the minimum number of individuals represented by the sample.
- Age was established in terms of either 'adult' or 'sub-adult' from the stage of development of long bones represented by epiphyseal fusion.
- 'Neonates' were also identified by the overall size and where complete, long bone elements were measured to establish age by assessing long bone length.
- All the disarticulated bone fragments were also scanned for gross pathology, though this may have been restricted by the unwashed state of the bone i.e. it is likely that many cases of periostitis and joint disease were not observable, for example. Each element exhibiting pathological lesions was given a unique identification number, denoted in the report as (1), for example, and photographed.

The minimum number of individuals (MNI) represented by the assemblage was calculated according to the number of parts of long bones in tandem with observations of age at death according to development. A more detailed recording of a sub-sample of the disarticulated demonstrated that the long bones were the most numerous repeated elements in comparison to axial elements. Thus, the long bones formed the basis of the calculation of the MNI and were recorded according to the presence of the 'proximal third', 'middle third' and 'distal third' for the entire assemblage.

Due to the high level of intercutting in the churchyard, it is likely that the disarticulated skeletal elements have been re-deposited a number of times and that the skeletal remains originating from one individual may well be scattered over several contexts. Given this scenario, a calculation of the minimum number of individuals based on differentiating between contexts would produce an artificial and unreliable estimation. Instead, the absolute minimum number of individuals calculated on the basis of the collation of all the data for the whole assemblage was considered a better estimate.

2.8 Environmental archaeology methodology, by Elizabeth Pearson

2.8.1 Project parameters

The environmental project conforms to relevant sections of the CIfA Standard and guidance (2014), and *Environmental Archaeology: a guide to the theory and practice of methods, from sampling and recovery to post-excavation* (English Heritage 2011).

2.8.2 Aims

The aims of the analysis were to recover small animal or human bones (not easily recovered by hand-excavation), items such as gall and kidney stones and small artefacts. As soils were not waterlogged, it was considered unlikely that plant remains and pollen contemporary with the burials would survive. There was also a low likelihood of charred plant remains of relevance to the burials being recovered. For this reason, samples were processed by wet-sieving as described below).

2.8.3 Methods

Sampling policy

Samples were taken according to standard Worcestershire Archaeology practice (2012). A total of 43 samples (each of up to 10 litres) were taken from the site, of which 30 were processed to recover environmental remains and artefacts. All residues were fully sorted.

A single sample of coffin wood (390) was also examined using a low power MEIJI light microscope but it was clear that as the cell structure of the wood was significantly decayed and affected by mineralisation (probably naturally occurring iron deposits and iron deriving from coffin fittings) it was not possible to determine the species of wood used.

Processing and analysis

The samples were wet-sieved on a 1mm mesh, clipped inside a Siraf tank. The residue retained on the 1mm mesh allows for the recovery of items such as small human or animal bones and molluscs. The residues were fully sorted by eye and the abundance of each category of environmental remains estimated.

Discard policy

Remaining sorted residues will be discarded following submission of this report unless there is a specific request to retain them.

2.9 Statement of confidence in the methods and results

The methods adopted allow a high degree of confidence that the aims of the project have been achieved.

3 The application site

3.1 Topography, geology and archaeological context

The site lies on the south side of Holy Trinity Church, which sits on the western bank of the River Avon, in Old Town, Stratford-upon-Avon, at approximately 38.50m AOD. The site is located upon superficial sand and gravel deposits (Wasperton Sand and Gravel Member) that overlay mudstone belonging to the Penarth Group or Mercia Mudstone Group (British Geological Survey online viewer, accessed 4 January 2016).

No prehistoric activity has been located in the vicinity of the church although the well-drained, easily cultivated soils of the Avon terrace gravels had been a focus for prehistoric activity. Many sites of Palaeolithic to Roman date have previously been identified in the valley. The nearest Roman settlement remains to the church are located at Tiddington, *c* 1.5km to the east of Stratford.

During the early medieval period most of the land flanking the River Avon formed part of a large estate, included most of the later manors of Stratford, Luddington, Clopton, Bishopton, Drayton, Milcote, Ruin Clifford, Alveston and Hampton Lucy, under ownership of the Bishop of Worcester. The earliest confirmed mention of Stratford is in a charter of 845 signed by Beorthwulf (Bertulf), King of Mercia. By the late 8th century a minster had been established in the centre of the estate, probably close to the current church. No structural remains of the minster have been located to date but Saxon burials have been located to the immediate north of the churchyard (AOC Archaeology 2010) and settlement remains have been located approximately 150m to the north-west of the church (MWA1031). The burials to the north represent an earlier focus of interment and religious activity in Stratford that could not be linked to the present day church. It is, therefore, unclear as to when the focus of Christian worship and burial moved to the current site. The present Holy Trinity Church dates to AD1210 but was significantly remodelled between 1280 and 1330 with the addition of a larger nave and side-aisles, the tower and the clerestory. The original charters of the town were granted in 1196, at which time the Bishop of Worcester, John de Coutances, set out plans for a defined street layout of Stratford with associated Burgage plots to the north of Old Town where the church is situated.

3.2 Current land-use

The site lies within the churchyard of Holy Trinity Church, although new burials are no longer interred here. Stratford-upon-Avon Cemetery in Evesham Road was opened in 1881 to accommodate new burials after the churchyard at Holy Trinity Church was considered to be filled to capacity (http://databases2.shakespeare.org.uk/main/index/10), though sporadic burials continued to be made at Holy Trinity churchyard. The latest burial noted on inscriptions of the 486 gravestones in the churchyard recorded by the Gravestone Photographic Resource dates to 1956 (http://www.gravestonephotos.com/public/cemetery.php?cemetery=1041), though burial records in the parish registers date from 1558 to 1962.

The main excavation area mostly lay beneath a gravel path that butted the southern aisle of the church, although towards the south the ground rose substantially and became a grassed area of the churchyard containing numerous gravestones. It is likely that the raised area was caused by the continued use of this area through the post-medieval periods as it is suggested that the average grave will displace 2m^2 of soil (Rodwell and Rodwell 1977, 42). The edge of this path had been lined with stone window mullions and disturbed gravestones, which also acted as a revetment to the grassed area beyond. The River and Lane trenches followed gravel and stone paths surrounding the church.

4 The historical background of burial

4.1 Health, disease and medical treatment in the medieval period

Numerous approaches to the treatment of medical conditions were taken in the medieval period, which had changed little from the late Anglo-Saxon practice as described in Bald's Leechbook, a medical text dating to the 9th century. The perceived aetiology of some diseases was complex,

involving both the biological and psychosocial aspects of conditions. A humoral understanding of the body dictated medical practice, whereby a balance between the four humors of the body was to be maintained in order to be healthy, whereas sickness was manifest by an imbalance of one or more of the humors (Sirasi 1990). 'Complexio' was a fundamental tenet of medieval medicine; assessment of the body's 'temperament' revealed the balance of hot, wet, cold and dry elements within it, according to the proper functioning of the four humors blood, phlegm, red/yellow bile and black bile (Sirasi 1990). Several historical traditions of medical practice underpin these medical concepts of treatment, which had absorbed some aspects of Galenic Roman medicine and the perceived wisdom originating in Ancient Greece and Islamic traditions from the near East (Rawcliffe 1998). Vestiges of the humoral approach towards the body and its healing were still evident up to the 19th century, as can be seen in some of the contemporary medical publications.

The human body was perceived as either existing in a state of health or sickness, or a neutral state in between the two; illness was classified as congenital malformation, trauma or complexional imbalance. The primary role of the physician, then, was to maintain health through balancing the humors (Sirasi 1990). Examination of the patient in order to ascertain the root of complexional imbalance consisted of inspecting the colour, odour and consistency of excreta. Phlebotamy was also practiced to assess the characteristics of the blood but the most popular method of assessing the body's state was by inspection of the urine (Fig 3) (Sirasi 1990). Physicians would also palpate any obvious swellings as well as check the pulse. Once a diagnosis had been made, medicines or dietary regime would be prescribed to restore balance between the humors. Balancing the complexion involved not only treating conditions with medicines but involved a great deal of attention on 'non-naturals' such as air, water, drink and especially food (Sirasi 1990). Very often, the physician would offer advice regarding which foods to eat and which to avoid in order to regain health; food and medicinal plants were very much equal components in the pharmacopeia of the physician. In an age where medicine rarely cured disease, a more holistic approach was taken towards managing the body and its healthy state.

Many of the plants described in Bald's leechbook cannot be accurately identified and it is, therefore, difficult to quantify how effective some of these treatments were. However, some of the other plants that can be identified are clearly of high therapeutic value and the way in which certain medicines were being prescribed demonstrates that through empirical knowledge the physician potentially had access to a valuable pharmacopeia. For example, plantain is commonly referred to for use in the treatment of wounds and skin conditions (Cameron 1993). Plantain is now known to contain aucubin and emulsion, which together form an antibiotic capable of acting against staphylococci and streptococci, two bacteria most commonly causing acute infections (Roberts and Manchester 1997) as well as cloistridia, which causes tetanus; furthermore 1ml of 2% aqueous solution of aucubin in the presence of emulsion has the same effect as 600 I.U. of penicillin against the Staphylococcus aureus bacteria (Cameron 1993).

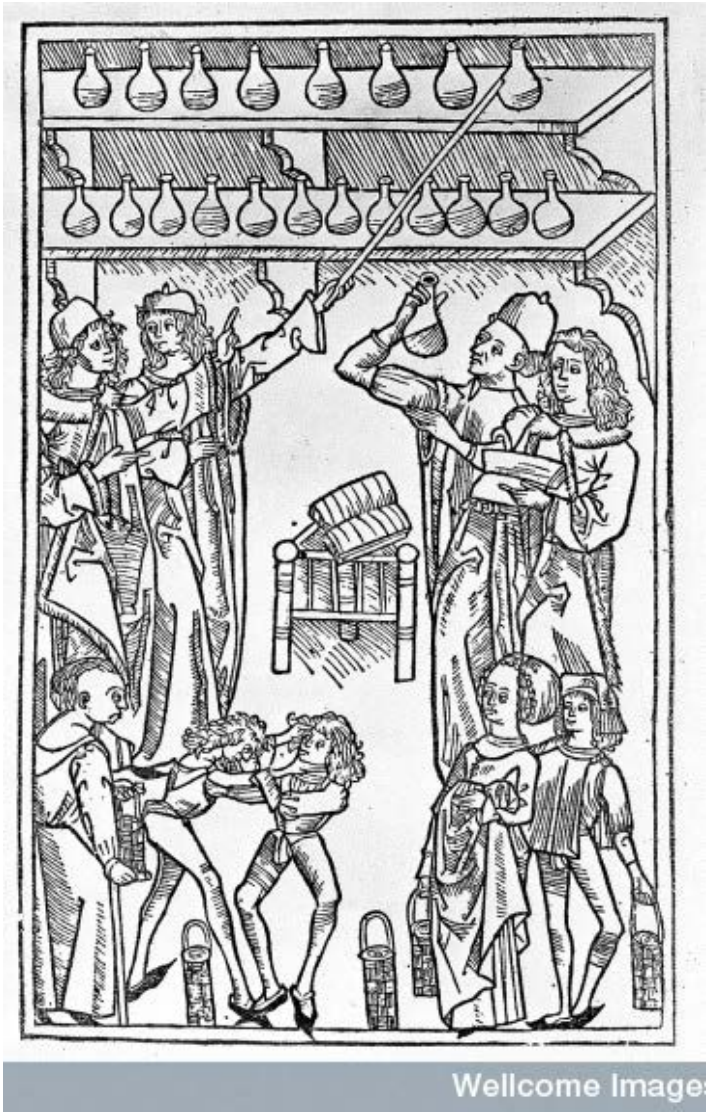

Figure 3: Doctor Inspecting Urine, 1491 (www.wellcomeimages.com)

This is not to say, however, that all treatments were successful or that medicines were used purely for their pharmacological qualities. Medicines comprised not only plants but also animal products including blood, urine and faeces (Cameron 1993; Meaney 1992). It is also known that the understanding of the body as a microcosm of the social and physical surrounding environment led to the use of incantations, amulets and 'magic' in treatments and indeed, invocations were frequently recited to herbs prior to their medical applications (Cameron 1993). Some treatments required the patient to wear an amulet (which could be an everyday object such as a spindle whorl that had been immersed in some potent concoction) but also for the patient to take certain herbal infusions at the same time. Thus, the approach rested on the use of not only the practical application of drugs and salves, empirically observed as being therapeutic, but also in some treatments was intertwined with more ritualistic behaviour of invoking perceived 'magical' powers of these medicines or warding off external threats. Until the recent discoveries of the chemical constituents of herbs and plants such as plantain and lichen, the instructions for the use of some of these medicines had been misunderstood and misconstrued as irrational and bizarre by some authors. Although several treatments described still appear to have no rational grounds, it is clear that others were undoubtedly as beneficial as some medicines available today.

Treatment with drugs, as with the initial attempts of diagnosis of a disease, was carried out taking the underlying physical constitution of the individual into account, including reference to age and sex:

> '*And always observe when you are applying powerful medicines, what the strength is and what the body of the patient is like; whether it is strong and hardy and may bear strong medicines easily or whether it is delicate and tender and thin and may not bear these medicines*. *Apply the medicines according to how you see the bodies, for there is a great difference between a man's and a woman's and a child's bodies and in the constitution of a daily labourer and of the idle, the old and the young and of one used to suffering and of one unused to such things. Also pale bodies are softer and weaker than the dark and red'.* (Cameron 1993 170; Cockayne II, 85, after Crawford 1999, 98)

Though probably receiving the same medicines as adults, it was clearly intended that the dosage should be modified for sub-adults. The leechbook specifies treatments for sub-adult conditions such as 'matter in the neck', children's worms, 'water sickness' and 'scabby head', as well as for teething, children's tapeworm and constipation (Crawford 1999, 98). Interestingly, the leechbook also advises on diet for children:

> '*About children's stomachs, and overfilling them and if they do not digest their food properly and if they sweat and stink. When this is diagnosed, then they will be offered a variety of foods rather than one kind, so that the novelty of food may be good for them*.' (Cockayne II,.241, after Crawford, 1999, 98).

Besides treatments with drugs, both minor and major surgical procedures are described in Bald's Leechbook, which contains chapters categorised by the main methods employed, namely the use of prescribed drugs, bloodletting, surgery and gynaecology and obstetrics (Cameron 1993).

Bloodletting was practiced with the aim of removing bad blood carrying 'factors of disease' though the body. Cameron (1993) observes that many of the conditions for which bloodletting is suggested are in actual fact amongst those which cause abnormal clotting of the blood. It was certainly not seen as a panacea and specific conditions were attached to its practice with regards to timing of bloodletting, such as the seasons and phases of the moon, as well as the concomitant treatment of the patient to ensure their wellbeing and adequate preparation for the procedure (Cameron 1993). Cupping was practiced with the same motive as bloodletting but was restricted to a specific location in the body, one that was usually inflamed, for example, in order to draw out localised infection.

Only a handful of surgical procedures are mentioned in Bald's Leechbook and peculiarly none describe the act of trephination, which is the one of the most commonly observed evidence of surgical intervention in human remains in the period (Roberts and Cox 2003). This may in part be due to the aims of the Leechbook, the author perhaps intending the text to be read by medical practitioners who did not regularly carry out surgery. After the 11th century, surgery was generally not carried out by physicians since the decree of the fourth Lateran council of 1215 forbade clergymen of the order of sub-deacon or above to engage in any activities likely to cause bloodshed (Rawcliffe 1998; Hunt 1999). Rather, it was now an ambiguous speciality of the surgeons and barbers. The three operations Bald describes are cosmetic surgery of hare-lip, amputation of limbs and removal of pus from the pleural cavity (Cameron 1993). By the time of the medieval surgeon, however, several procedures were undertaken including minor surgery on external injuries, cauterization, venesection and cupping for internal injuries, application of ointments to tumours and wounds as well as the removal of cataracts by needle (Fig 4) (Hunt 1999). The evidence of surgical intervention observed in human remains is, therefore, paramount to creating a more informed perspective on medical treatments and it is clear that documentary evidence should be used in conjunction with palaeopathological analyses in order to achieve this.

Figure 4: Delivery by Caesarean Section 1420-1430 and Surgery on Head Wound, 14th century (www.wellcomeimages.com)

Many conditions, particularly mental illnesses and congenital diseases, could not be treated physically or physiologically and help was often sought by way of pilgrimage to places of worship to visit saints, shrines and monks. Some children with disabilities and diseases that were incurable at the time, such as 'pestilence', 'distemper', 'ague' and 'paralysis' are recorded as living at monasteries and nunneries under the care of the resident orders (Crawford 1999, 39). Pilgrimages for adults were also commonplace in the hope that the miraculous healing powers of God for the sick could be imbued through touching relics and shrines, and praying to incumbent saints (Binski 1996, 12). During the medieval period, the physical body in Christian doctrine was the seat of the soul and an outward sign of its state; physical sickness could even bring spiritual healing through endurance (Rawcliffe 1995). In this context, seeking medical aid from monks was a natural step, who were perceived as 'guardians of spiritual and ritual health' (Binksi 1996, 27).

Since the division between the soul and body was not clearly separated in the context of health and a more holistic approach to health and disease was taken, it is not surprising that early hospitals occur as part of religious establishments and that medical licenses were issued by bishops (Lane 2001). Non-religious medical practitioners co-existed alongside these educated elites, some of whom were women, such as Margery, a 'leech' in the manor of Hales, Worcestershire, though their status was seemingly somewhat precarious, with Margery herself in 1302 having been thrown into the river, apparently to determine if she was a witch (Getz 1998). Only during the 13th century did the focus of medical education shift from monastic to the new university establishments of Oxford and Cambridge, though a learned physician at this time was frequently also a man of the cloth, a so called physician-bishop of bodies and souls (Getz 1998).

The Augustinian Gild of the Holy Cross in Stratford-upon-Avon provided a hospital that had been established by 1269, at which time the Bishop of Worcester granted a license for the fraternity of the hospital to administer goods and alms to the faithful and use of the poor within the fraternity as well as a license to build a hospital in honour of the Holy Cross to be maintained and defended by his bailiffs in the town (Bloom 1907, http://www.british-history.ac.uk/vch/warks/vol2/pp113-115). Research of the early records indicates that by 1292 that the gild owned a chapel, hospital and common hall (Giles *et al* 2012) and it is likely that this served as an important source of physical and spiritual treatment in the town until the late medieval period when the gild disintegrated at the time of the Reformation. Medieval hospitals offered little in the way of medicinal or surgical cures but provided bed rest, warmth, cleanliness and a regimen of an adequate diet and prayer (Getz 1998). Some of the earliest hospitals were leprosariums, functioning as isolation units outside of settlements to control 'contagium' up until the mid 14th century. One such lazar house was St Michael's, Warwick (Lane 2001).

Only after the emergence of epidemic diseases such as plague, syphilis and leprosy, seemingly specific diseases unexplained by contemporary humoral theory, did the exploration of medical

health develop further (Sirasi 1990). The plague reportedly arrived in Stratford on 11 July 1564, resulting in the death and burial of 220 people, estimated to be between one fifth and one seventh of the town's residents (Scott and Duncan 2004; http://www.stratford-upon-avon.co.uk/soahstry.htm). The burial records for Holy Trinity during this year reveal an exponential peak of burials during the summer of this year, rising from the average five burials a month in July to over 80 in September, returning to average figures again only by January 1565 (Scott and Duncan 2004).

4.1.1 Burial Practices in the Medieval Period

Funerary rituals during the late Saxon period would have been varied and complex due to this period seeing the re-introduction of the Christian religion into the country. The archaeological evidence for the period suggests that burial sites and graves show diversity according to the varying nature of the conversion process to Christianity and localised adoption of the new religious practices. As Binski (1996, 51) points out, however, a theoretical shift towards displacing religion from being a 'primary motivation of social expectations' is unhelpful, as religion and society are inextricably linked and 'Christianty's great strength was that it could assimilate and re-articulate ideas, which were both religious and social', as is made testament to by the fact that what are essentially Christian rites have come to dominate funerary practice in England for the past 1200 years. It is, however, important to recognise the diversity of practices in the early Christian faith that manifest themselves in the archaeological record in the face of a possible assumption that the rites of one religious body and the processes of conversion were uniform.

Only from the 10th century are cemeteries consistently located next to churches as churchyards (Buckberry 2010, 11). Possession of burial rites was paramount to the status of a church and at this time, burial of dead normally took place in the place of birth of the individual, whereupon a 'soul-tax' was due to the church (though 'soul-tax' could also be demanded for parishioners upon death even if they were buried elsewhere) (Binksi 1996, 56; Hadley and Buckberry 2005, 122). The form of the burial, however, was not prescribed. The early church, though having no power no apparent desire to dictate the manner of burial (Buckberry 2010, 2), was keen to extinguish contemporary pagan practices and rites. The Christian church viewed pagan rites as praying *to* and worshipping the dead in order to appease spirits for protection according to a cyclical pattern of life-events. Christian doctrine preferred prayers *for* the dead so that the soul could continue along its spiritual, linear journey after death until the Last Things (Binski 1996, 23-24). In this sense, for Christians, the dead were not kept as separate from the living but were integrated into a communal existence with them; prayers were offered up at Mass in church for souls as commemoration. 'Christianity acted slowly, in effect, to de-marginalise the dead' (Binski 1996, 11) and so the dead increasingly were interred in burial grounds within the community during the Saxon period. Later on, Mass rituals specifically for the dead, unsuited to open cemeteries, were performed at the altars of the accompanying churches.

Who was buried in churchyards, how and where, are questions that the archaeological evidence is best poised to answer due to a lack of historical evidence at this time. It is suggested that an elite minority may have first selected church and churchyard burial as a means of expressing their status (Cherryson, 2010 p.54). Over time the practice became increasingly desirable to the lay people, with a growing concern of receiving a proper burial, a concept existing from the time of Bede, in consecrated ground (Binksi 1996, 56). During the 13th century, Bishop of Mende stated that the dead were to be buried with their heads to the west and the feet to the east so that all people, 'regardless of station', were facing the right direction at the Last Things (Binksi 1996, 56), though it is clear from the archaeological evidence it is evident that East-West grave orientation was a well-established practice within churchyards well before this date. St Augustus, in a similar vein, preached that the elaborate funeral rituals and tombs were redundant in the Christian faith (Binksi 1996, 26).

Elitism, however, was certainly a factor in the type and nature of interment and more elaborate burials have been observed to occur in higher frequencies in high status, urban minsters, including St Oswald's Gloucester, Durham and York (Holloway 2010, 86). A lack of legislation dictating the

form of churchyard burial (Hadley and Buckberry 2005, 123) allowed a certain amount of individual expression in interment rites. Variation in burial is demonstrated by the inclusion of substantial charcoal deposits, burial in wooden and lead coffins or plain earth cut graves, as seen at The Chapter House, Worcester Cathedral (Guy 2010), in addition to the inclusion of pillow stones, ordinary stones, stone linings or accompaniment with coins or personal items of adornment (see Hadley and Buckerry, 2005, for a detailed survey). Evidence for above ground markers of both stone and wood has also been revealed. Whilst elaboration in funerary rites spans all ages and sexes (Hadley and Buckerry, 2005; Holloway 2010, 88), at St Oswald's, Gloucester, males were more frequently found with elaborate coffin fittings (Hadley 2010, 104), indicating that social status was an important factor in burial treatment.

However, in churchyard burial, the location of the grave rather than its form appears to be the primary means of conveying prominence within the community. This is particularly apparent taking into account the bio-archaeological evidence in assessing social status. Hadley (2010, 104) notes that males were most often in prominent locations in some parish churchyards dating to the 9th, 10th and 11th centuries. Clustering of more elaborate or non-normative graves has also been identified within cemeteries (Hadley and Buckberry 2010, 144), suggesting status or kin ties. Bio-archaeological evidence also suggests that individuals of lower social status, indicated by high prevalence rates of health stress indicators, were interred in less prominent areas in the churchyard at Raunds (Craig and Buckberry 2010, 138). However, significance was not only conferred on individuals due to socio-economic status.

Also of note is the clustering of infant burials within cemeteries. Although some authors suggest there is an increase of numbers of infants in mid-late Saxon burial grounds (i.e Hadley 2010, 108-9; Crawford 1999, 88) analysis of the data from a recent survey of Anglo-Saxon cemeteries throughout the east of England from Northumbria to Kent (Gowland and Western 2012) suggested no overall average difference in the percentage of infants present within assemblages dating to the Early-Mid (30.0%) or Mid-Late periods (33.7%). What is apparent, however, is a clustering of infant burials on some sites within specific areas of the cemetery, often located close to church walls or even intra-murally (Hadley, 2010, p.109; Hadley and Buckberry 2005, 144-5; Crawford 1999, 88, Thompson 2004, 11). This may mirror an early practice of the Church on the continent where all but the sainted dead, otherwise the 'very special dead' (Binski 1996, 12) were buried extramurally. Souls of the freshly baptised infants were regarded as being pure (Hadley 2010, 109) and may have warranted extra care or protection from proximity to the church. Indeed, Thompson suggests that particular care was taken to the burial of infants, following Aelfric of Eynsham's (*c* 955-1010 AD) distinction of death according to age: death of the old was 'natural', the death of the young 'unripe' and the death of children 'bitter' (Thompson 2004, 10-11). In the medieval period, however, infants were believed to be in Limbo and were buried at the peripheries of churchyards (Binksi 1996, 56).

Christian doctrine emphasises the metaphorical division of the body and soul, with the body reflecting the condition of the soul. In the context of the fact that the soul continues on its spiritual journey after death, funerary rites during this period can be understood to be an extension of healing rituals undertaken in medical practice (Binski 1996, 30). There is no evidence of what funerary rituals took place prior to interment during the late Saxon period, though traditional Christian rites during the medieval period consisted of a ritual cleansing and covering in incense, ivy and laurel (Binksi 1996, 56). The dead were generally laid out and wrapped in a shroud for burial. Transportation of the body was usually in a coffin, even if burial was not. The final rites at the churchyard carried out by a priest were paramount and included the marking of the burial spot with a cross and breaking the ground (Binksi 1996, 56) (Plate 3). Interestingly, an excerpt from Toulmin Smith (1870, *English Gilds,* 212-19, after http://www.british-history.ac.uk/vch/warks/vol2/pp113-115) details a return of the Gild of the Holy Cross at Stratford-upon-Avon, established by 1269, containing a description of some of the funerary rites carried out by the gild for its members:

> *'Among the gild returns of January, 1389, in the Public Record Office, is the full and interesting one made by Nicholas Sumer and Walter Golde, then wardens of this gild. They reported that the gild was begun at a time beyond the memory of man: that there are two wardens who manage and collect the rents, render an annual account, and see that the ordinances are kept; that the wardens are chosen by the members and hold office as long as the gild thinks fit; that many houses and rents pertain to the gild, the holding of which had been recently confirmed by a charter of Edward III; that each brother or sister pays 4*d*. a year; that out of these payments a great wax taper is made and kept alight in the church daily at every mass before the Blessed Cross; that on the death of any gild member the great wax taper and four smaller ones are kept alight before the body and carried to church, and afterwards set before the Cross; that the brethren, under pain of a halfpenny fine, follow every funeral of a gild member; that if any poor man dies, whether of the town or a stranger, without means to pay for a light before his body, the brothers and sisters find four tapers, a sheet, and a hearse cloth; that only those of good behaviour are permitted to be gild members; that when a member dies, the officer summons a third part of the brethren, who watch near the body and pray for his soul throughout the night; that the affairs of the gild are managed by two aldermen and six assistants chosen by the members'.*

The early church under St Augustus was a proponent of his argument that Christians went on the other world irrespective of the burial of their bodies (Binksi 1996, 26). It is perhaps as a result of this belief that the excavation of medieval cemeteries reveals the intercutting of graves and substantial quantities of disarticulated material. Churchyards were 'sites of recycling' (Fig 5) and exhumated elements, usually skulls and long-bones, were often stored in charnel houses (Binski 1996, 55). A reference in the Vestry Minute-Book of Stratford-Upon-Avon dating to 1620 makes note of the 'The Minister's Studye over the bonehouse to be Repayred' (Arbuthnot, n.d.), thus implying that exhuming and collecting charnel was a regular practice at Holy Trinity church. Indeed, a charnel house was once present on the north side of the church. In the medieval period, burial location was defined as the place that the head itself was retained and Binksi (1996, 55) argues that the perpetual existence of an actual grave was not as important as being buried in consecrated ground in the first place. The origins of this attitude and how prevalent this attitude might have been during the late Saxon period is not known but the frequent intercutting of graves observed may well one of the many manifestations of the conversion of the populous to the communal, inclusive burials rites of a Christian community from the exclusive, individualised burial of the dead undertaken in traditional 'pagan' practices.

The physicality of the individual after death and burial presented a challenge to theologians, however. Purposeful exhumation could confer heresy in the medieval period yet at the same time, division of the body, particularly the removal of the heart and intestines, for multiple burial was increasingly popular amongst the aristocracy in an effort to promote widespread commemoration (Binski 1996, p.57). Collecting bones as relics from saintly bodies was an ancient practice and bodily division for this purpose was widely acceptable, a part of the individual representing the whole (Binski 1996, p.15) and the reduction of the body to its bony frame conferring perpetual existence on the dead person represented (Binkski 1996, 64). Nonetheless, medieval medicine rarely involved the opening of the body, which was largely taboo. Prohibition against the boiling or dismembering of bodies had been introduced by the Church to restrain what were considered excessive or Pagan burial practices (Sirasi 1990). As such, autopsies were extremely restricted in number and medical practitioners, still based largely within the confines of contemporary Christian orthodoxy, relied on copies of manuscripts based on ancient Galenic teachings for their anatomical knowledge in combination with the dissection of animals (Sirasi 1990).

Figure 5: Illustration of a medieval Burial from a French Book of Hours (note the skull and long bone disturbed from a previous interment)

4.1.2 Health, disease and medical treatment in the post-medieval period

The post-reformation period saw a continuation in the increase of the secular administration of medical care via a growing number of professional physicians and surgeons, though licenses to practise were still granted by the bishops (Lane 2001). Between 1661 and 1712, 36 such licenses had been granted in Warwickshire, 29 to surgeons and seven to physicians (Lane 2001). One such practitioner in Stratford-upon-Avon was John Hall (1575?-1635), the only physician in the town, practicing from at least 1611, after graduating from Cambridge in 1597 and marrying William Shakespeare's daughter in 1607. Lane's analysis of his case notes dating between 1611 and 1625 suggests he engaged numerous aristocratic clients who were both heavily socially connected and wealthy, working in a 20 mile radius in Warwickshire, Worcestershire, Gloucestershire and Oxfordshire (Solomon 1997). Practising very much according to the humoral regimes of the day, his medicines consisted of crude albeit often exotic ingredients, ranging from spider-webs, earth worms and frog-spawn to Asiatic musk, Armenian clays, East Indian resins and scorpion oil (Solomon 1997).

Another such medical practitioner and also the vicar of Stratford-upon-Avon, appointed as the rector of the Holy Trinity Church in 1662, was John Ward (1629-1681), whose diary from 1648-1679 is preserved and contains notes on medical treatment he provided in the town (Archive and Manuscript Sources in the Wellcome Library, Local History – non-London, 2014). During his studies at the Barber Chyrurgeons' Hall in London, he took a particular interest in diseases afflicting women and children, 'so as to bee readie att them when I come into the country' (Severn 1839, 11). Among the cases he treated in Stratford, he mentions smallpox (in fact, he saw many cases in 1665) for which he administered a 'strong diaphoretik' (antimonie) inducing a strong sweat for a day and half after which the patient recovered (Severn 1839, 236), plague which he treats with poultice so that the bubo 'ripen(s) and 'itt may break and so dissolve itself' (Severn 1839, 237), a fatal case of hydrocephalus, preceded by 'rickets', which he attempted to alleviate by applying 2 vesicatories to the scapula to let a pint of 'moisture' (Severn 1839, 239), a case of a

lady spitting stones out of her lungs, 'quartan ague' (otherwise known as malaria) a case of ague with a swollen belly, cholick, asthma, stones, haemorrhoids, many cases of 'meazils', particularly in a hot summer (Severn 1839, 271), ulcers and in particular leg ulcers, treated by laying the wound open and scraping and scaling the bone (Severn 1839, 273).

Also detailed is a case of breast cancer treated by surgery, undertaken by surgeons Clerk of Bridgnorth and Leach of Sturbridg (Severn 1839, 244), which appears to have been successful, at least initially, though for how long is not clear. After her death in 1666, Ward and a fellow medic, Mr Eedes, undertook a post-mortem examination of the breast and immediate anatomical structures, finding that the re-sected tumour had re-grown but had not spread and affected the ribs. Unfortunately, Ward and Eedes were lacking 'spunges and other things convenient' and so were unable to conduct a full autopsy to examine the state of the uterus (Severn 1839, 246-7).

Only those with the financial means to afford the fees of these practitioners would receive such medical care at this time, though fees were sometimes reduced for the poor (Severn 1839, 107). Subsequently, the late Georgian and early Victorian period saw a number of dramatic changes in the development of the medical profession and the manner in which medical and social aid was administered. While there was a continuation of the medical profession to predominantly consist of practitioners who had undertaken an apprenticeship with a recognised surgeon-apothecary, many now worked on the whole under terms of contract to small hospitals and Guardians of the Poor.

There was a variety of practitioners whom the parish council could call upon for medical treatment besides the surgeon-apothecary, such as midwives and bonesetters, but all were costly; fees were charged according to the severity of the ailment and the complexity of its remedy. Fractured and displaced bones were amongst the most expensive treatments and these were charged for on a scale of the difficult of setting the bone or joint. For example, £3, 3s was charged in Epsom as a set fee by the surgeon-apothecary for the setting of a broken leg or thigh, £2, 2s for a main arm bone and £1, 1s for a fractured clavicle, rib or small bone (Lane 2001). Those who sought Poor Relief would not only have benefited from free medical treatment, generally administered at home, but any food, drink, fuel, bedding and sometimes even clothes required during any period of confinement, if deemed appropriate, all to the cost of the parish. Poor Relief was also administered by small, local Poorhouses to those classified as paupers.

During the late 18th and early 19th centuries, the pressures of a growing population and its increasing need for the ever expanding medical treatments led to a complete revision of the provision of aid to the Poor. This demand for medical attention was concomitant with the rise of a series of socio-economic factors, such as pressure on local communities from population growth and the growing numbers and decreasing tolerance of paupers, whose financial burden upon the community was recognised as becoming increasingly problematic (Lane 2001). A parish workhouse was recorded as present in Stratford-upon-Avon by 1777, housing up to 50 inmates. (Higginbotham 2016). Subsequently, with the introduction of the Poor Laws in 1834, the Stratford-on-Avon Poor Law Union was founded in 1836 and a workhouse built on Arden Street in 1837 that was designed to accommodate up to 200 inmates from the town itself as well as 36 parishes in the vicinity (Higginbotham 2016). Inmates at the workhouse would have had access to medical care directly though the establishment; while the site on Arden Street later became part of the town's hospital in the early 20th century, at this time the workhouse had no hospital of its own, unlike nearby Warwick, for example. Here, a 30 bed infirmary was established in 1848 as part of the new workhouse complex, which expanded over time and eventually became the main hospital of the town (Higginbotham 2016).

From around the 1770's, many larger towns and cities were furnished with the newly established voluntary Infirmaries or hospitals, such as the Worcester Royal Infirmary, the Birmingham General Hospital and the Warneford Hospital, Royal Leamington Spa, Warwickshire, which for the most part provided relief for the poor and were funded by charitable donations. Three parishes in Warwickshire had subscribed to the Birmingham General hospital by 1780 (Lane 2011). Treatments were still crude and consisted of a limited pharmacopeia. Surgical intervention generally consisted of minor excisions (of foreign objects, for example), trepanation (excision of

bone from the cranium to relieve cranial pressure) or amputation. Post-mortem examinations to establish cause of death were more frequently undertaken at the infirmaries. Though financial sponsorship had to be approved of for the inpatients, the infirmary very often housed the best facilities and practitioners in health care at the time. A purpose built hospital was only established in Stratford-upon-Avon, however, only in 1884.

Up to this date, the town was furnished only with the public Stratford-upon-Avon Dispensary, which was founded at 21, Chapel Street in 1823 by the local philanthropist Dr John Connolly (http://discovery.nationalarchives.gov.uk/details/rd/9e577823-a27c-4a6d-b555-1f51ceb7e53d). This later moved to Chapel Lane in 1835. Dispensaries provided similar facilities to an Infirmary but did not house in-patients and were accessed through subscriptions, either privately or through a society or parish. The Stratford-upon-Avon dispensary also provided free vaccinations for the poor (Chitnis 1973). The dispensaries could provide for patients "who were improper objects for the Infirmary" and proved increasingly popular after the 1800's. Usually founded by charitable organisations, medical non-residential treatment was available to the poor for free or for small sums of money. In-patient facilities were often restricted but generally the dispensary could treat large numbers of patients who otherwise may have received no attention at all (Lane 2001). In 1833, 369 outpatients were treated at the Stratford-upon-Avon dispensary, similar to figures in previous years (Wilmot 2015). Between 1838 and 1884, however, the Dispensary was known as Stratford-upon-Avon Infirmary, presumably in reference to its new capability to house at least some in-patients (http://www.nationalarchives.gov.uk/hospitalrecords/details.asp?id=614, https://www.stratford.gov.uk/files/seealsodocs/148842/Stratford%20pages%2092%20to%20124.pdf , 97).

Some inhabitants of Stratford upon Avon would have been a member of a 'friendly society', subscription to which would provide a medical insurance should a member become incapacitated and unable to work. Friendly societies were in existence from the mid 18th century to the late 19th century. Worcester, for example, had 1,189 friendly societies in operation at this time (Lane 2001). In a survey conducted in 1831 by a Select Committee of the House of Lords reporting on the Poor Laws, more than 10% of the population of Warwickshire was found to hold a subscription to a friendly society, one of the highest levels of subscription in the country (Lane 2001). Rather than being 'pauperised', members whose subscriptions were up to date could apply for financial provision to be made through their friendly society until they were able to work and provide for themselves again. Societies would employ a surgeon-apothecary on a contract basis to assess the illness and certify the needs of the individual as well as to provide any necessary medical attention. Some societies also paid a subscription to the local Infirmary so that medical treatment could also be provided there if required. Societies were single sex and often associated with specific trades. Through the medium of the Friendly Society, it was possible for those who may otherwise have been forced into the Workhouse through poverty and sickness to avoid the stigma of pauperism and that of the pauper burial (Lane 2001).

Despite the numerous routes potentially available, medical care for the poor was not always easily accessible, especially since it was necessary to complete an application process for such provisions. In 1846, a case published in the Medical and Surgical Journal for the Provincial Medical and Surgical Association highlighted the plight of the poor in obtaining medical care in Stratford-upon-Avon, where the death of a 3 month old boy was recorded as 'death from neglect', despite the mother having sought medicine and advice from the local chemist for over a month. A post-mortem examination concluded that the child had died from 'inflammation of the lungs' and that the child could have been saved had 'proper medical advice' been obtained (Birmingham Pathological Society 1846, p.591). It was stated that 'it could not be too widely known amongst the poor that medical aid could at any time be obtained by applying to any of the district medical officers of the Union' and that the reporting of the case, although an everyday occurrence, was aimed at drawing public attention to the situation so that 'this most helpless class of victims to a wretched system be preserved from similar suffering' (Birmingham Pathological Society 1846, 591).

The health of any population is largely dependent upon the environment in which people live and their adaptation to it, which in this context will include the size of the population, the nature of the built and artificially modified surroundings, the diet, lifestyle, and occupations of the inhabitants of Stratford-upon-Avon, any genetic propensities towards particular diseases and their social status and access to available medical treatment. Census records from Stratford-upon-Avon dating between 1801 and 1911 indicate that there was only a moderate increase in its population compared to cities and even other towns in the West Midlands, rising from 14,284 to only 21,658 individuals (GB Historical GIS / University of Portsmouth, Stratford on Avon RegD/PLU through time | Population Statistics | Total Population, *A Vision of Britain through Time*. http://www.visionofbritain.org.uk/unit/10043750/cube/TOT_POP), accessed: 3 January 2016; Fig 6).

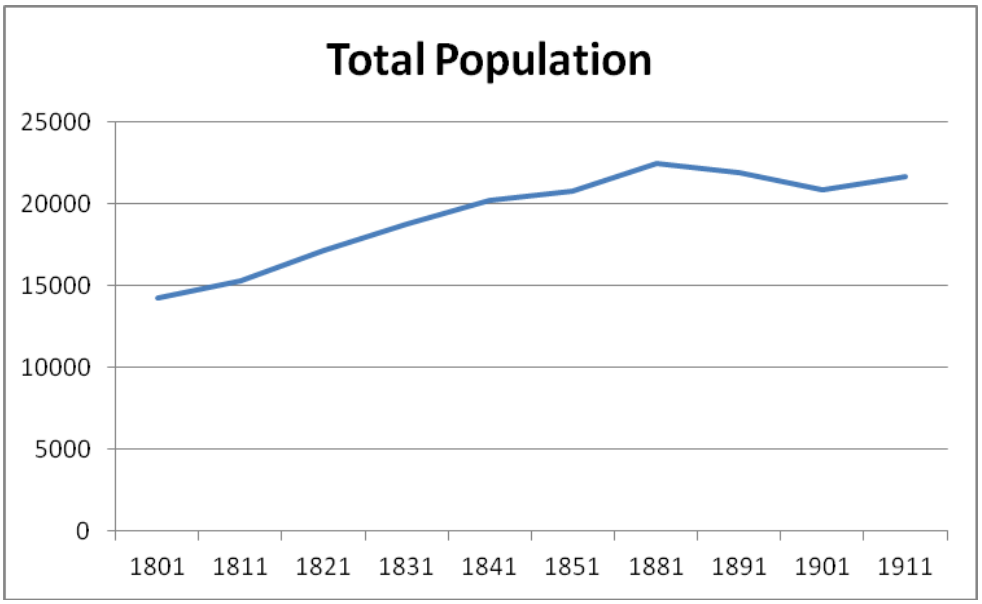

Figure 6: Total Population at Stratford-upon-Avon according to Census Records

Stratford-upon-Avon therefore did not experience the population boom that is often associated with the Industrial Revolution and appears to have remained relatively stable in population during the late Georgian and Victorian periods, only having increased by 7374 people or 51.6% over 110 years. To put it into its regional context, the population increase in Stratford-upon-Avon between 1811 and 1881 was from 15,277 to 22,496 (47.3%), whereas the population at Upton-on-Severn, a similar riparian town, increased from 11,084 to 23,234 (109.6%) over the same period (Western 2014). In comparison, the population of Warwick grew by 188.7% (GB Historical GIS / University of Portsmouth, Warwick RegD/PLU through time | Population Statistics | Total Population, *A Vision of Britain through Time*. http://www.visionofbritain.org.uk/unit/10029715/cube/TOT_POP, accessed 3 January 2016), Worcester by 75.6% (GB Historical GIS / University of Portsmouth, Worcester PLU/RegD through time | Population Statistics | Total Population, *A Vision of Britain through Time*. http://www.visionofbritain.org.uk/unit/10167437/cube/TOT_POP, accessed: 3 January 2016) and Birmingham by 250.9% (GB Historical GIS / University of Portsmouth, Birmingham PLU/Inc/RegD through time | Population Statistics | Total Population, *A Vision of Britain through Time*. http://www.visionofbritain.org.uk/unit/10055891/cube/TOT_POP. accessed: 3 January 2016).

Overcrowding as experienced in many other towns and cities at the time is, therefore, unlikely to have been a major issue in terms of overall health in Stratford-upon-Avon. In fact, the population density (persons per acre) between 1880 and 1910 was well below the national average and remained constant over the period in contrast to the rising national average (GB Historical GIS / University of Portsmouth, Stratford on Avon RegD/PLU through time | Historical Statistics on Population for the Poor Law Union/Reg. District | Rate: Population Density (Persons per Acre), *A Vision of Britain through Time*. http://www.visionofbritain.org.uk/unit/10043750/rate/POP_DENS_A. accessed: 4 January 2016). In Stratford-upon-Avon, it is more likely that individual social status,

working conditions and access to medical care would have been key in the health status of the population. Whilst an individual's health status will vary according to their particular nutritional intake and exposure to disease, these factors are largely determined by accessibility to adequate food, water and health care as well as living and working conditions; financial means would have been critical in determining the nature of the environment to which an individual was exposed.

The most common means of employment in 1881 in Stratford-upon-Avon was agriculture for working males and most employed females worked in domestic service or offices; though the majority of women remained officially unemployed at this time (Fig 7), it is likely that many undertook seasonal and piece work. There was no heavy industry associated with the town and thus the risk of accidents or hazards at work were greatly reduced compared to other local towns and cities. Main trades in the town were associated with sheep farming. As discussed in more detail later on, the mortality profile of the sample from the Evesham Road Cemetery in Stratford-upon-Avon, which opened in 1881, indicates that despite high levels of infant mortality that match Upton-on-Severn, once into adulthood, a relatively higher number of individuals, 46.6% of the total population, reached old adulthood (50+ years) compared to 40.3% of the total population in Upton-on-Severn. The most common age at death in Stratford-upon-Avon recorded in the cemetery sample is between 70 and 79 years.

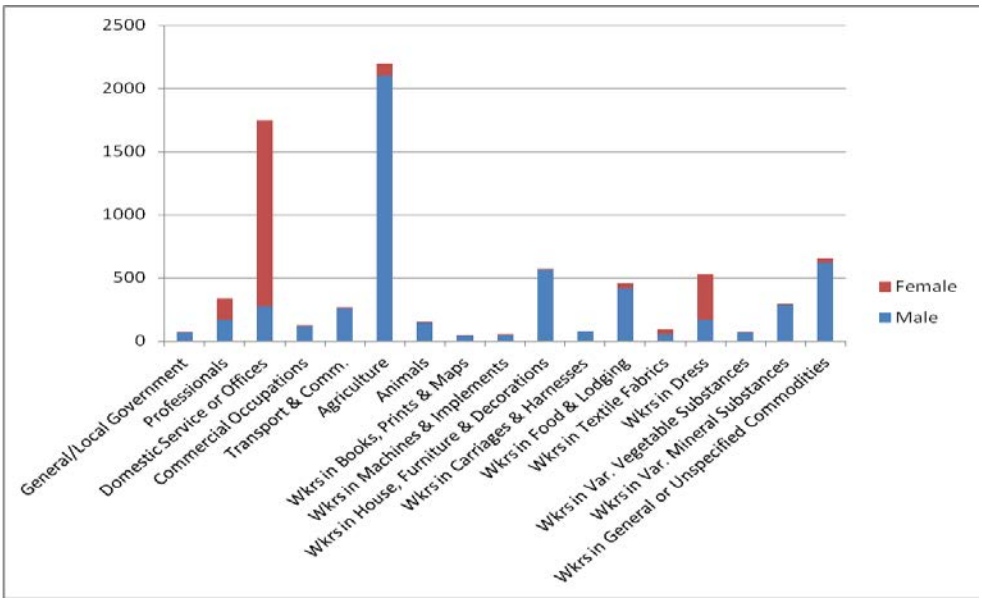

Figure 7: Occupations according to Sex in Stratford-Upon-Avon, 1881

However, throughout the late Georgian and Victorian period, a number of conditions were endemic in Britain and the spread of some was so rife that there resulted epidemic outbreaks. Diseases such as smallpox, typhus, cholera, typhoid, tuberculosis and influenza all took a major toll on English populations living in overcrowded, run-down housing with little provision for sanitation or drainage. Many of these diseases were only eradicated, or at least their prevalence rates dramatically reduced, during the late Victorian period; smallpox vaccinations became compulsory (despite having been available from the early 18th century to those who could afford such an expensive, albeit much less efficient at this time) and the provision of better housing and sanitary conditions, coupled with new medical discoveries, eradicated diseases such as typhoid, cholera and typhus. Many of these diseases were clearly linked with overcrowding from an exponentially growing population; typhus was referred to as "an unerring index of destitution" (Lane 2001). Tuberculosis was endemic in England between 1780 and 1830 and in 1839 was calculated as being the cause of death of 17.6% of the population. Of course, diagnoses at the time may not have been as accurate as in modern day clinical practice but nonetheless, tuberculosis continued to be the most common cause of death amongst young adults until the 1940's (Lane 2001).

Despite the seemingly healthy environment of Stratford-upon-Avon, many of these commonplace illnesses struck the local inhabitants. Examination of the records of the Registrar General

(Decennial Supplement, HM Stationery Office, after GB Historical GIS / University of Portsmouth, Stratford on Avon RegD/PLU through time | Life & Death Statistics | Decennial Cause of Death by Age & Sex, *A Vision of Britain through Time*. http://www.visionofbritain.org.uk/unit/10043750/cube/CoD_DS_1850s, accessed: 3 January 2016) between 1851 and 1860 reveal that of the total 4069 deaths recorded, over 10.8% were diagnosed as being caused by respiratory tuberculosis and a further 13.1% of deaths were caused by undiagnosed lung diseases (Fig 8). Diseases such as cancer were low in prevalence and recorded as causing only 2.4% of deaths, although diagnosis of many such conditions at the time would have been difficult and many cases may have gone undetected: over 50% of deaths were recorded without a specific diagnosis that would be recognised today. Childbirth was the cause of death in only 1.2% of cases. Violence was attributed as a cause of death in 2.7% of cases and occurred most frequently in the under 5 age group. Epidemics were also recorded in Warwickshire, with cholera outbreaks notably occurring in 1831, 1849, 1854 and 1866, causing a total of 585 deaths (Lane 2001).

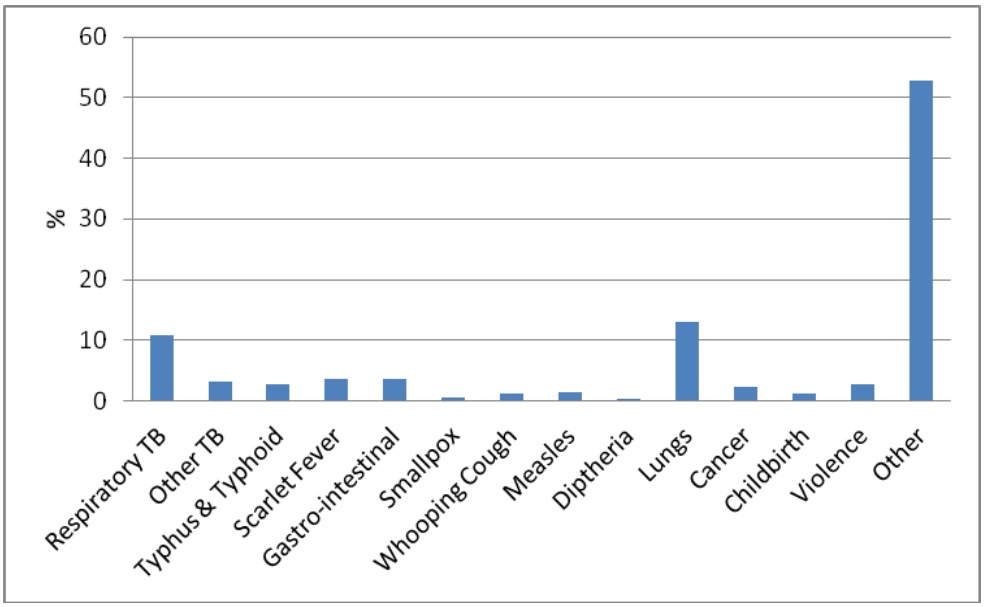

Figure 8: Cause of Death 1851-1860 in Stratford-upon-Avon

Children aged under 5 were particularly vulnerable to infectious disease, with scarlet fever diagnosed as being responsible for 21.9% of deaths in this age group between 1851 and 1860, followed by 11.3% of deaths caused by tuberculosis (respiratory and gastro-intestinal), and measles and lung disease each causing 10.1% of children's deaths in Stratford-upon-Avon.

Worth noting is that there is apparent over-representation of males in the Evesham Road Cemetery, where there are 390 men compared to 324 females recorded in the burial registers sample. The excess of males in the burial population is above the slightly higher number of males expected in a population, where the average ratio of males to females is 1.05:1 (Chamberlain 2006). An explanation for the additional males may be in-migration of males or out-migration of females, though neither is reflected in the census records of 1881 where living males numbered 11,110 and living females 11,386. A similar pattern was found in the burial registers for Upton-on-Severn, where an excess of males was recorded. This may in part reflect the riparian location of both settlements, the location of Stratford-upon-Avon on its newly built canal in 1816, possibly leading to in-migration of males along the rivers, in addition to the new railway built in 1859.

On the whole, the causes of death recorded according to sex are evenly split between males and females, though whooping cough, typhus, cancer, disease of the general organs and joints were all more commonly diagnosed as cause of death in females (Fig 9). Violent deaths, diseases of the skin, diphtheria and small-pox were more frequently recorded in males. Since many deaths could not be attributed to a definitive medical cause at this time, it is unclear if these ascriptions reflect an

accurate portrayal of differences in causes of death between males and females. Interpretations based on these observations remains tentative.

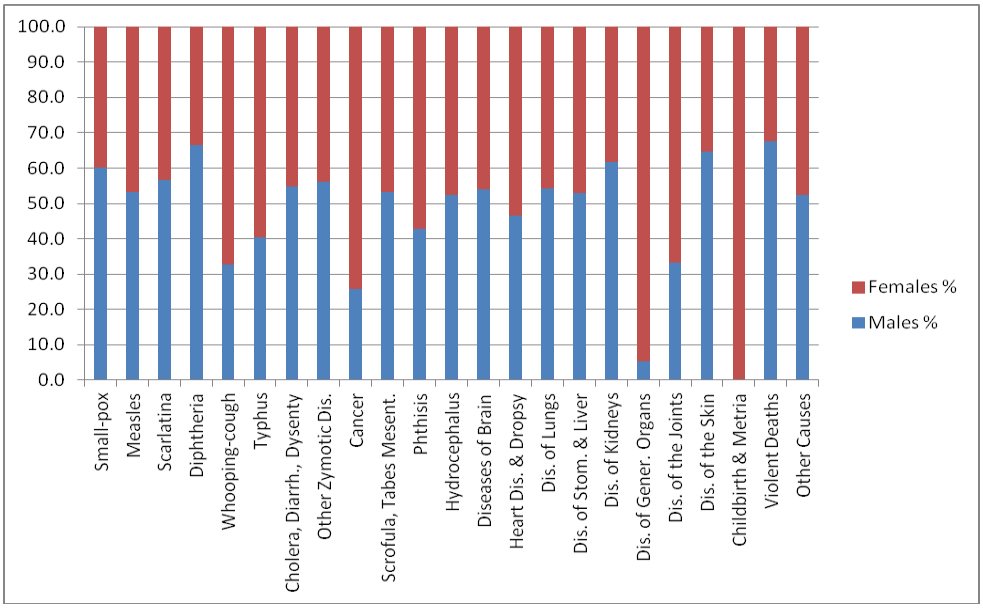

Figure 9: Cause of Death Recorded in Males and Females, 1851-1860

Examination of the burial records dating between 1881 and 1887 from the Evesham Road Cemetery in Stratford-upon-Avon suggests that there were some differences in mortality rates for the sexes according to age group (Fig 10). When looking at each decennial age group and examining the proportion of males and females in each cohort, the younger adult age group comprises more females while the older adult age group comprises more males. This latter observation is contrary to mortality profiles in modern Britain, where life expectancy is higher amongst females. Although some of the young females deaths may be associated with childbirth, the records of the cause of death from the Registrar General suggest that such deaths were low. However, since multiple pregnancies were commonplace at this time and pregnancy results in a lowered cell-mediated immunity for pregnant women, it may be that younger females were more vulnerable to infectious diseases, such as tuberculosis (Yip *et al* 2006), as well as hepatitis and meningitis, particularly in the post-partum period (Singh and Perfect 2007).

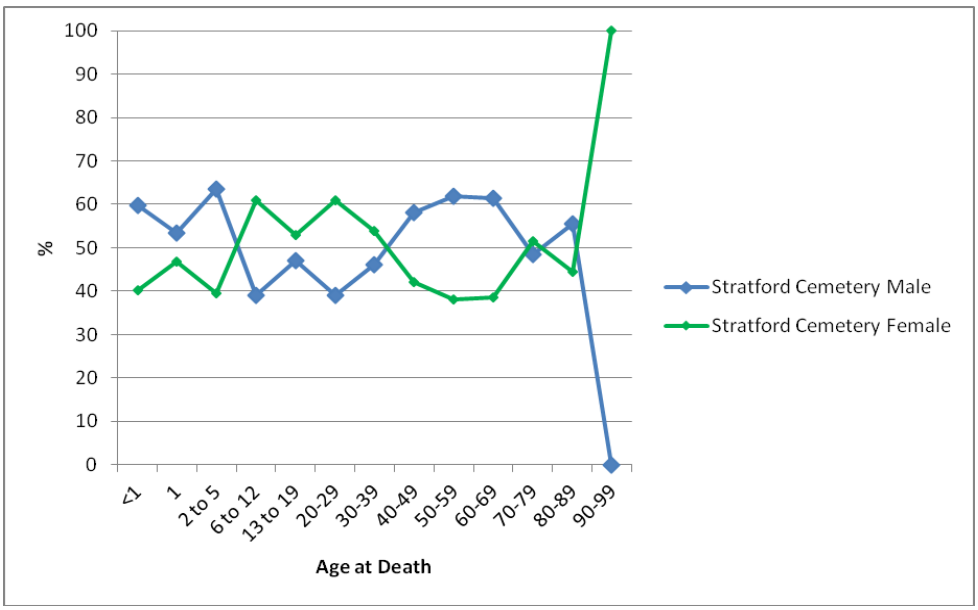

Figure 10: Percentage of Males and Females In Decennial Mortality Age Groups

4.1.3 Funerary practices in the post-medieval period

During the 17th and 18th centuries, there was a move away from the more collective attitude towards death and burial, whereby bones could be exhumed and deposited in communal ossuaries while engaging more spiritual practices of prayer and remembrance to guide the soul to heaven, towards more individual acts of commemoration grounded in the physicality of the body. The location of bodies and the permanence of the display of this became paramount in consolidating an individual's social status and differentiating oneself from others on the basis of an individual's achievements in life. This was made manifest in death through the material grave memorials and furniture provided for the corpse. Funerals now became lavish biographical affairs throughout for those whose social and financial status would allow it, with the newly emerging funerary trade providing a wealth of mortuary paraphernalia to ensure a decent funeral would be conducted and that a grave would be suitable marked and delineated in perpetuity. The horror of the pauper's grave and at being interred in an unmarked communal grave denoted the utter shame of the abysmal fate of the socially deprived.

A decent burial was an extremely important rite and more costly than weddings at this time, requiring a significant financial investment in order to avoid the stigma of the pauper grave. This social statement was of paramount significance; far more people invested in subscriptions to burial clubs than to friendly societies for health cover, for example (Roberts 1989). By this time, winding sheets had been abandoned and bodies were often dressed in shrouds resembling night shirts, bonnets and sometimes facecloths, while a few were accompanied by items of personal adornment (Brickley and Buteux 2006). Most individuals would receive a burial in a lidded coffin, usually made from oak or elm, lined with fabrics and decorated externally with brass, iron and aluminium escutcheons, grips or handles, studs and plates inscribed upon which would be the biographical details of the incumbent (see for example, Brickley and Buteux 2006). Even the construction of the grave could be tailored to accommodate the demands of the paying clients. Graves could be brick lined, like some found at St Martin's, Birmingham, while entire vaults, such as those at Tallow Hill, were constructed to house the bodies of the more wealthy. The vast majority for the lower socio-economic classes, however, were plain earth cut graves, such as those excavated at St Andrew's and the majority excavated at St Martin's, Birmingham. The graves excavated at Holy Trinity Church were also plain earth cut graves, though burial in vaults is known to have occurred within the church itself for the more prominent members of the town.

It was also increasingly desirable that the body remained undisturbed in the grave so that it was intact for the Resurrection; unfortunately, in practice, this was a somewhat short lived aspiration for many due to the population increases and local churchyards over-burdened with burials, leading to the foundation of new burial grounds or privately run cemeteries from the mid 19th century. In many cases, the old parish burial grounds were found to be severely short of space by this point and archaeological excavations often reveal, as was found at Holy Trinity Church, that even relatively recent Victorian burials were frequently disturbed and cut through by later burials and construction works. Fortunately, in 1881, a new cemetery was finally opened on Evesham Road in Stratford-upon-Avon, to alleviate the desperate need for burial space, though a few interments continued to take place at Holy Trinity churchyard until 1956 according to the inscriptions on some of the surviving monuments and headstones present in the churchyard. (http://www.gravestonephotos.com/public/cemetery.php?cemetery=1041&limit=401&scrwidth=1200).

The index of the 486 monuments recorded at Holy Trinity reveals that they commemorate 1087 individuals, the vast majority commemorating more than one individual. Though the complete details of each individual are not always present, most list the biographical details 2 or 3 individuals of immediate family, such as wife, husband, second wife; mother, father; brother, sister; son, daughter; grandson, granddaughter; son-in-law, daughter-in-law; father-in-law, mother-in-law; aunt, uncle; nephew, cousin and great grandson. The maximum number of individuals detailed on one monument is 10. This use of monuments and headstones in general private cemeteries at this time is associated with stacked interments, including the use of vaults, based on relationships of kin.

However, the excavations at Holy Trinity revealed little evidence of maintaining delineated graves in this manner. Only six pairs of human remains appears to have been interred within the same grave cut; sk(103) (middle aged male) with sk(120) (old adult male), sk(1136) (middle aged male) with sk(1135) (adolescent), sk(774) (juvenile) with sk(771) (older child), sk(824) (older child) with sk(825) (older child), sk(846)(old adult possible female) with neonate sk(8461) and sk(1143) (middle adult female) with neonate sk(1144). In this case, despite the presence of multiple individuals listed on one memorial, most remains were interred within an individual grave formed by a new grave cut, often truncating the earlier burials.

The dates of death on the gravestones range from 1616 to 1956, the vast majority dating to between 1851 and 1900 (Table 1). Some of the burials at the Holy Trinity church dating to the mid 17th century would have been conducted by John Ward, the aforementioned medical practitioner and vicar of the church at this time. In his diaries he reports, ‘‘Sir John Clopton’s sonne buried by mee in the vault under his seat, on Saturday night, Aug 11, 1666’. (Severn 1839, 187). There may have been some seasonality to the number of interments in the churchyard in any one year. Ward also observes that ‘The dog days in the year 1668 very hot; inquire the consequence of that heat, and what effect itt had generally upon bodies that yeer. In the heat of the sumer, about July and August, we had in Stratford fewer burials than ordinarie; I have observed itt, too, before: inquire in London weekly bills’ (Severn 1839, 160). As seen earlier, epidemics such as plague and cholera in Stratford would have led to influxes of burials at the Holy Trinity churchyard reflecting peaks of mortality in the population. John Ward is himself interred in near the north wall of the Church (The London and Paris Observer 1839, 281).

Of those 680 individuals whose age and sex are detailed on the churchyard monuments, 342 are male and 338 are female (Table 2). The majority of individuals recorded, 57.5%, are in the old age category (50+ years, n=391), whereas the minority are aged 1 year old or less (2.9%, n=20).

Date	***1600-1650***	***1651-1700***	***1701-1750***	***1751-1800***	***1801-1850***	***1851-1900***	***1901-1956***	***Total***
Number	5	8	19	66	249	408	25	780

Table 1: Distribution of the year of death listed on Surviving Monuments

Age	***<1***	***1***	***2-5***	***6-12***	***13-19***	***20-29***	***30-39***	***40-49***	***50-59***	***60-69***	***70-79***	***80-89***	***90-99***	***Total***
Male	5	9	9	8	18	45	27	27	42	60	61	26	5	342
Female	0	6	13	10	24	32	34	22	43	58	58	35	3	338
Total	5	15	22	18	42	77	61	49	85	118	119	61	8	680

Table 2: Demographic profile of the headstone inscription sample

However, the monuments detail voluntarily donated commemorative inscriptions rather than systematically maintained bureaucratic records of the burial registers. Comparison to the demographic data from the burial records at the Evesham Road Cemetery in Stratford-upon-Avon (dating between 1881-1887 and consisting of a total of 716 individuals) and the burial registers for Upton-on-Severn, Worcestershire (consisting of 756 individuals dating from 1850 to 1865) indicates that neonates and young children are greatly under-represented in the Holy Trinity headstone inscription sample (Fig 11). It appears that the deaths of very young children and neonates were not frequently commemorated via gravestone inscriptions, though it is likely that the numbers of actual interments of neonates and young children at Holy Trinity was similar to the other burial ground samples. It is also interesting to note that the commemoration of 13-19 year

olds and, in particular, 20-29 year olds is higher than the relative number of deaths amongst these age groups in the burial grounds. This may reflect a tendency towards a more outward expression of grief at unexpected early deaths. The differences between the age profiles of the samples obtained from burial registers and that from the headstone inscriptions suggest that certain ideals were pursued in acts of commemoration during the Victorian period at Holy Trinity Church that may have reflected the cultural norms surrounding death and grief at the time but not the physical reality of life and death in Stratford-upon-Avon.

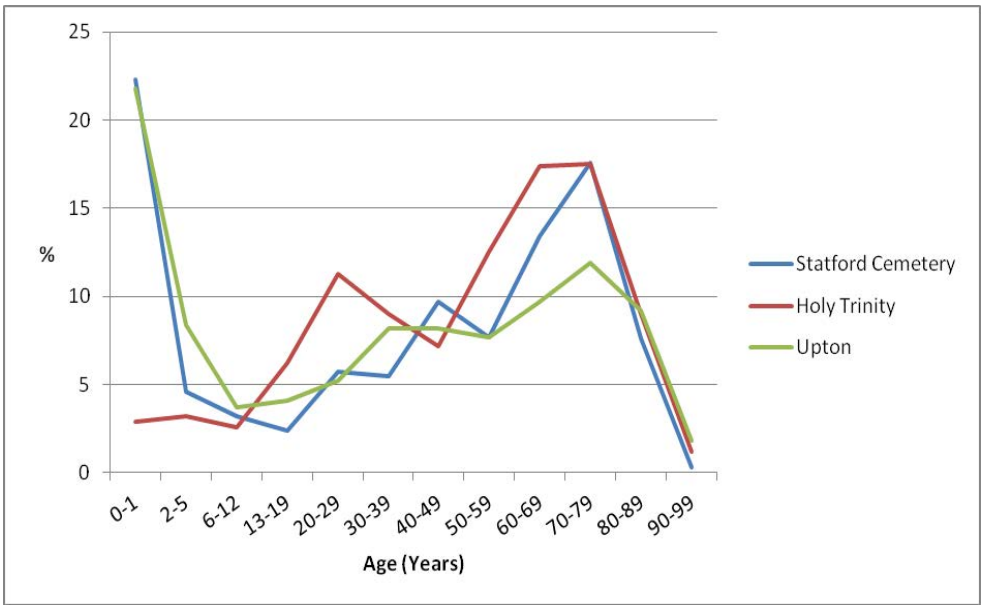

Figure 11: Relative Proportion of Age Groups Represented in the Holy Trinity Headstone Sample compared to Burial Registers from Stratford Cemetery and Upton-on-Severn.

5 Structural analysis

The trenches, features and burials recorded are shown in Figs 12-21.

Excavations at Holy Trinity yielded some 304 articulated skeletons (partial and complete) (Fig 12). This number does however not equate to the total number of burials to have been interred in the excavated area. There will have originally been many more burials, as 28,889 redeposited disarticulated skeletal elements were also recovered during the excavation. Many inhumations will have been destroyed by later burials, later church extensions and modern services that crossed the excavation area. No attempt appears to have been undertaken to exhume any burials prior to the construction of the present church buildings or during the insertion of modern services, and no charnel pits were observed to indicate that encountered bones were systematically collected and reburied in this area, other than simply in the backfill of later graves and features. It is of course possible that some disturbed bones may have been placed in the charnel house that once stood on the north side of the church.

For the most part grave cuts were very difficult to identify as there was little difference (if any) between the general churchyard soil and the grave backfill. In these circumstances associated finds were only assigned to burials once it was confirmed articulated remains had been encountered. As a result the majority of finds in the grave backfill, were only allocated to individual burials from within *c* 20cm above the skeleton. Cuts were more easily identified when they were associated with later post-medieval burials which had not been effected by further intercutting or once the natural sand and gravels had been reached (Plate 1). Where grave cuts had been tentatively identified during the excavation it is likely, in retrospect, that many of these actually represent the edge of decomposed coffins, rather than the true grave cut to receive the burial.

Plate 1: Skeleton (1049) in grave cut (1048) into natural, in the River Trench

Burial density varied considerably across the investigated area. Through the River and Lane trenches burials were mostly of single depth and the churchyard soil was considerably shallower, although this and burial density increased closer to the main excavation area closer to the church. Towards the eastern end of the church there were no burials, although a number of vaults exist in this part of the churchyard (which were not investigated). It is possible this area of the churchyard had been previously cleared of burials, although no empty graves were identified to confirm this. Burial density was greatest in the main excavation area where burials were up to nine interments deep and where considerable grave intercutting had occurred (Plate 2). Depths at which burials were encountered below the modern ground surface varied between the paved areas and below the turfed churchyard that was partially excavated on the south side of the main excavation area. Beneath the paths burials were encountered at only 0.35m below the surface. This shallow depth is unlikely to have resulted from later ground lowering as the threshold to the southern aisle door was of a comparable level to the path. To the south in the raised turfed area of the main excavation area, burials were encountered at approximately 1m below the ground surface. The increased depth is likely to have resulted from this area being continuously used through the post-medieval periods, resulting in an increased depth of soil and as burials of this period appear to have also been buried deeper.

Plate 2: illustrating burial density across the main excavation area

In the main excavation area it also appeared that that later post-medieval coffined burials (Phases 4 and 5) were mostly confined to the south, presumably outside of the path that abutted the southern aisle (Fig 12). Across the main excavation of *c* 110m^2 there were 259 articulated remains, representing 2.4 interments per square metre. Although the figure seems high, burial density at St Peter's Church, Lincolnshire was much higher ranging from 4.1-6.7 burials per square metre (Waldron 2007) and at Hereford Cathedral it ranged from 3.14-9.71 burials per square metre (Boucher *et al* 2015). The true density of burial at Holy Trinity is likely to have been greater as younger more fragile bones will not have survived as well and will have been destroyed by later intercutting. Throughout the River and Lane trenches burial density was *c* 0.75 interments per square metre. Based upon the density in the main excavation area it is possible, albeit cautiously with many caveats, to propose a figure for the articulated burial population in the overall churchyard of approximately 22,500 burials.

Due to the presence of numerous services and later disturbance across the main excavation area which physically separated burials into compartmentalised interment zones, it was difficult to create an overall burial matrix for the site. This was further compounded by areas where few burials or individual burials had taken place which resulted in few stratigraphic relationships. Due to the lack of finds associated with the burials and the heavily re-worked churchyard soils resulting from the numerous intercutting interments, it was also difficult to phase the complex burial ground. Therefore the burials have been broadly chronologically phased based upon their stratigraphic relationships, where available and by four characteristics.

Pre-church burials (Phase 2): burials that have stratigraphic relationships to the church or have stratigraphic relationships to those burials that have been truncated by the church have been phased as pre-church burials. The phase also includes those burials that only contained medieval pottery and were uncoffined.

Medieval to early post medieval (Phase 3): includes those uncoffined burials that could not be assigned to the pre-church group. It is likely that the majority of the burials of this phase were only buried in simple shrouds/winding sheets, perhaps using a parish coffin during the burial ceremony.

As coffins are thought to have been increasingly used from the mid 16th century onwards (Litten 1991), AD 1550 is regarded as the start date for the next phase.

Simple coffin phase c 1550-1750 (Phase 4): this burial phase is characterised by the use of simple coffins, prior to the adoption of elaborate coffin plates and furniture in *c* 1750. Such coffins were identified due to the presence simple iron coffin handles and/or iron coffin nails around the outside of the skeleton.

Elaborate coffin phase c 1750-1881 (Phase 5): the final phase of burials is thought to run from *c* 1750 to the end of regular interments at the church in approximately 1881. This phase is characterised by the use of elaborate coffins using stud decorations and decorative pressed iron and tin depositum plates and handles. It was during this period that manufacturing techniques were developed to raise patterns in iron sheet that advanced the designs of coffin furniture. After which point coffins became more elaborate. It was also during this phase that coffins began to be covered with fabric, applied with studs.

Due to the difficulty of dating the burials these should only be regarded as broad phases and it is likely that some burials have been mis-assigned. This is specifically true of the second burial phase 1322-1550 (Phase 3) as the lack of coffin remains does not necessarily indicate that the burial pre-dates 1550, as later burials also have the potential to be uncoffined. The lack of timber, coffin stains, metal fixings or coffins nails also does not necessarily mean that the burial was uncoffined, but rather that no coffin remains survived. Due to the difficulty in identifying grave cuts it was also impossible to confirm uncoffined graves/burials by the presence of smaller graves which did not allow sufficient room to contain a coffin.

5.1 Radiocarbon dating

Four radiocarbon dates were obtained to answer a number a key questions relating to the burial assemblage (Fig 13). Firstly skeleton (1258) which had been truncated by the south transept and skeleton (228) which had been truncated by a buttress of the southern aisle were dated to establish the date of the skeletons pre-dating the church. This was seen as crucial to establish whether the Saxon burial ground identified to the north of the present churchyard extended this far south. These were also required to establish the length of time burials had been interred in this part of the churchyard, prior to the modifications of the church, including the construction of the tower, transepts and crossing *c* 1210 and the extension of the aisles *c* 1322. The remaining two dates were selected from a 'stack' of intercutting burials in the centre of the main excavation area in order to provide a cross section of the burial ground. The lowest stratigraphically of this group, skeleton (1181), cut the natural sands and gravels and is one of the earliest burials in this part of the site. The upper burial in the stack, skeleton (807) was later truncated by a pair of burials, skeletons (1135 and 1136), which had been interred in elaborate coffins and are thus thought to post-date 1750.

All dates were recalibrated due to the presence of d13C and 15N isotopes using the OxCal Mixed Curve. These can be seen in Table 3 below and in the SUERC certificates (Appendix 2).

Laboratory code	Material	Context	δ13C(‰)	Radiocarbon Age (BP)	Calibrated Date, (95% confidence)
SUERC-65830	Human Bone	Sk (1258) cut by south transept	-19.7	894±32	cal AD 1149-1276
SUERC-65829	Human Bone	Sk (228) cut by south aisle buttress	-19.9	911±30	cal AD 1119-1264
SUERC-65830	Human Bone	Sk (1181) bottom of stack	-19.8	868±29	cal AD 1157-1283
SUERC-65830	Human Bone	Sk (807) top of stack	-19.7	593±31	cal AD 1383-1455

Table 3: radiocarbon dating results

The results indicate that none of the burials were of Saxon date and that burials did not occur in this part of the site until the early 12th century. It also suggests that the 'bone only' burials appear to date to between the early 12th and mid-15th centuries. As the current church was established in *c* 1210 the dating also implies that a number of burials will have been associated with an earlier church building, which has not yet been identified. In the main excavation area burials may have

been interred over previously used areas approximately every 50 years, although this is likely to have been very variable across the churchyard.

Through the main excavation area there appears to be a mix of phases; specifically there are likely to be more pre-church (Phase 2) burials within the assemblage than have been identified. Without getting significant numbers of radiocarbon dates, spanning the entire assemblage, it is not possible to phase the burials further.

The full osteological report on the skeletons can be found in Section 5.4. Tables 4-6 below summarise some of those results to accompany the structural narrative.

	Phase				
Arm Position	**2**	**2b**	**3**	**4**	**5**
1	1	2			
2			6		2
3	4	11	33	13	8
4		1	8	4	8
5	1	5	8	19	18
6			1	1	8
7		1	6		1
8		1	3		
9	5	12	68	19	26
KEY					
1	Arms folded with hands resting together at base of neck, commonly called the prayer positon.				
2	Arms crossed on the chest with hands towards opposing shoulders.				
3	Arms folded at 90^0 across waist.				
4	Arms across pelvis with hands on abdomen.				
5	Arms down straight down sides, either next to or on top of pelvis.				
6	Arms down straight down sides, with forearms beneath pelvis.				
7	Combination of positons 2 and 3. With one hand on chest/shoulder and one hand on waist.				
8	Other combinations of the above.				
9	Unknown.				

Table 4: Skeleton arm position by phase

	Phase				
Sex	**2**	**2b**	**3**	**4**	**5**
Female	2	4	12	3	12
Possible Female		7	18	4	12
Male	3	5	19	12	9
Possible Male		8	23	8	20
Indeterminate			3	2	1
Unobservable	2	9	24	9	5
N/A	4		34	18	12

Table 5: Sex of skeletons by phase

	Phase				
Age	**2**	**2b**	**3**	**4**	**5**
Neonate			1		2
Young Infant			2		
Older Infant					1
Young Child		1	6	2	1
Older Child	3	6	13	6	2
Juvenile	**1**	1	4	4	1
Adolescent		1	8	6	5
Young Adult	1	6	19	5	12
Adult	1	8	49	17	21
Middle Adult	2	7	14	5	17
Old Adult	2	3	14	8	7
Unobservable	1		3	3	2

Table 6: Age of skeletons by phase

5.2 Structural remains

5.2.1 Natural deposits

Natural deposits were encountered in the bases of all the service trenches excavated across the main excavation area and in River and Lane trenches. These consisted of compact reddish-orange sand and gravels (1026) of the Wasperton Sand and Gravel Member. Towards the river these were overlain by alluvial sands, but for the most part the natural was overlain by a loose and friable mid greyish-brown grave soil (301, 950). Across the main excavation area the soil was up to 1.10m thick, but to the south, outside of the paved area it was up to 1.60m thick (although few burials were encountered in the upper 0.60-0.70m in this area). The churchyard soil is thought to have been thicker in this part of the site due to the continued use of this area after the 15th century, when the paved area alongside of the church appears to have no longer been the primary burial area. The churchyard soil was much shallower in the River Trench and Lane Trench where in areas it was only *c* 0.50m thick.

5.2.2 Phase 1: Saxon

The only Saxon artefact located during the excavation was a residual fragment of ceramic loomweight, of doughnut shape, typical of the period. No features of the period were discovered during the excavation. This find could be contemporary with the 9th century minster church and suggests Saxon deposits or features have been disturbed by the construction of the church current church in *c* 1210.

5.2.3 Phase 2 and 2b: Pre-church modifications

Uncoffined pre-church burials

There were 11 burials that had been truncated by the church or were located beneath securely stratified burials of this phase (Fig 12). The number of burials, of pre-church date, interred across the excavation area is likely to have been greater than identified, as indicated by the radiocarbon dates, but without numerous other dates or securely stratified relationships with the church it is difficult to identify them. A further 34 skeletons are however likely to be of the earlier medieval period based upon their lower stratigraphic position and/or association with medieval pottery (Phase 2b). As the burials appear to have been cut by the church foundations there appears to have been no clearance of the ground prior its construction. It is therefore likely that a large number of burials have been completely destroyed without leaving any articulated remains. All of the confirmed burials of this phase were supine and were aligned with the heads at the west and

although there was some slight variation in the axis of the burials there were no clear grouping to indicate that they respected an earlier church alignment.

Many of these earlier burials had been truncated by the foundations of the southern aisle constructed *c* 1322 AD (Plate 3), but an isolated burial (sk1258) identified in the River Trench had also been truncated by the foundations of the south transept (Plate 4), constructed *c* 1210.

Plate 3: (left) Skeleton (671), cut by southern aisle buttress (612)

Plate 4: (right) skeleton (1258), cut by buttress of south transept (1264)

During this phase there is little evidence for the intercutting of burials. It was however apparent that burials overlay each other, for example next to the southern aisle buttress N^{o} 3, there was at least two layers of pre-church burials. Here skeleton (228) which had been cut by the buttress, lay over but did not disturb skeleton (232).

The only finds associated the burial customs of this phase were the pillow stones associated with skeleton (228) (Plate 5). These were the only such head supports identified in all of the burials excavated, suggesting it was a rare and earlier burial characteristic, although it is possible organic pillows were also used that have not survived. The date of this burial and its associated pillow stones appears to fit with the national chronology that suggests they are a 10th-12th century phenomenon (Daniell 1997, 160). No coffin furniture or shroud pins were found with any of the burials of this phase suggesting they had been interred in simple winding sheets, probably tied with cord at the head and feet.

Plate 5: skeleton (228) in prayer position, with one earth muff visible, cut by south aisle buttress N^{0} 3 (612)

The most common arm position of this period is with the arms folded at 90^{0} across the waist (Table 4, Fig 16), which appears to remain the most common position until the post-medieval period (Phases 4 and 5). The three examples of the prayer positon seen during the excavation all belong to this phase (skeletons 228, 1074 and 1203 (Plate 5)) and suggest its use was limited and confined to the earlier medieval period. Although nationally it appears that the prayer position was most common during the later medieval period (Litten 1991, 60). There appears to be little difference between the numbers of males and females buried during this phase but there does appear to be a greater number of young to middle adults represented (Tables 5 and 6, Figs 17 and 18).

5.2.4 Phase 3: Medieval

South Transept c AD 1210

The foundations of the south-east corner of the southern transept (612, Plate 4) seen in the River Trench were the earliest structural remains encountered. The buttress foundations were only partially exposed and consisted of roughly coursed blue lias stone, undressed angular blocks bonded with bluish grey silty clay. The foundations cut through the natural sands and gravels to a depth of 0.45m and extended 0.66m beyond the above ground (visible) buttress. The buttress foundations also cut through the shoulders and head of an earlier burial (sk1258, Plate 4).

Southern aisle extension c AD 1322

The foundations of the southern aisle were exposed across the northern edge of the main excavation area. Both the wall and buttress foundations were of comparable form to the south transept being constructed of roughly coursed blue lias stone, bonded with clay. The southern aisle foundations were however much deeper than those of the south transept, being at least 1.28m

deep, although in the deeper sondages of the evaluation the base of the foundations was not established. It was however apparent that they were of trench built construction. The buttress foundations extended up to 1.20m out from the wall and included up to 4 steps on their southern side (Plate 6), although two of the buttresses had been truncated by later drainage, removing many of the steps. The buttress foundations also included a single 0.15m wide step on their western side. These had cut through a number of burials of Phase 2 and there appears to have been no clearance of the earlier burials prior to the construction of the aisle.

The foundations of the church wall (between the buttresses) were exposed to a depth of 0.70m, and included a 0.15m deep step, although in bay 3, 2 steps *c* 0.09m deep were observed (Plate 7). These were of a similar construction to the buttresses and were keyed into the main wall, indicating they were constructed at the same time.

Plate 6 (left): southern aisle buttress N^{o} 3 (612) exposed during the evaluation

Plate 7 (right): southern aisle buttresses and foundations exposed during excavation

Uncoffined burials c 1322-1550 AD

Many of the excavated burials (133) have been assigned to this phase due to the lack of associated coffin remains, although as mentioned above the lack of coffin furniture does not necessarily imply that the burial was uncoffined. Uncoffined burials were common across the entire excavation area, including the River and Lane trenches (Fig 15). It does however appear, based upon the available evidence, that un-coffined burials outnumbered coffined ones considerably. Coffin-less graves were commonly encountered beneath later simple coffins of Phase 4 or elaborate coffins of Phase 5, indicating that they were likely to belong to an earlier phase of burial. Stratigraphically after the introduction of simple coffins fewer un-coffined burials were identified scattered between coffined examples.

The lack of coffins during this phase is likely to relate to national trends of the period where burials were more likely to be buried in a simple shroud, wrapped around the body and gathered and tied around the head and feet. Although sometimes the shroud was pinned or sewn shut. These dressed bodies would be transported to the grave using a parish coffin that was introduced during

the early16th century, which were not buried, but were reused during burial ceremonies. Although limited coffined burials prior to the 16th century are known, the costs involved with production will have restricted the use of coffins to the more wealthy members of society (Litten 1991, 88).

In some instances it was noted that in apparently uncoffined burials the legs were apart and the elbows projected outwards from the torso (sk798, Plate 7). In these cases it is suggested that although uncoffined the body had not been tightly wrapped in a shroud. It was however more common during this phase to have the arms closely pressed against the sides of the torso (Plate 8) and or have the legs close together as if they had been wrapped tightly. The general trend for arm position during this and the preceding periods was to have the arms folded at 90^0 across waist (Table 4, Fig 16), suggesting this was the preferred position when using a shroud/winding sheet. Generally the bodies were straight and had not been displaced suggesting that the body had been tightly wrapped in a shroud, which had been stitched or tied, owing to the lack of pins in burials of this phase.

Plate 7 (left): skeleton (798) with elbows extended away from the torso

Plate 8 (right): skeleton (837) with arms tight against torso, indicative of a shroud burial

All of the burials of this phase were supine and were aligned with the heads at the west. The vast majority of graves were orientated on the church's south aisle, approximately east to west, but as Figure 12 shows there were a small number of individual variations, with some being aligned on a north-east to south-west or north-west to south-east axis. It has not been established why this occurred but it is possible they were positioned to avoid grave markers associated with previous burials.

There appears to be slightly more male burials during this phase, but there is clearly a greater number of adult interments, although there does not appear to be any pattern to the distribution of burials by age or sex (Tables 5 and 6, Figs 17 and 18).

Paired burials

During this phase three pairs of human remains, that appear to have been interred within the same grave cut, were identified; sk (774) (juvenile) with sk(771) (older child), sk(824) (older child) with sk(825) (older child), sk(846) (old adult possible female) with neonate sk(8461).

Skeletons (824) and (825) were laid next to each other and positioned in the same way with the arms crossing the lower chest (Plate 9) and were conjectured to be siblings. Skeletons (771) and (774) (Plate 10) were also thought to have been buried at the same time. Both are again children and it is also likely they were siblings who died at the same time, although no cause of death could be established. The final pairing is of sk(846) and neonate sk(8461), suggesting that both had died during or soon childbirth.

Plate 9 (left): paired burials sk(824) and sk(825).

Plate 10 (right): Paired burials sk(771) and sk(774).

5.2.5 Phase 4: Simple coffin burials *c* 1550-1750 AD

This phase contained a total of 56 burials, 10 of which can be associated with simple coffins (Figs 12 and 15). It is probable that further simple coffin burials existed within the excavated areas, but were either truncated by later inhumations, or the coffins were so heavily degraded that no evidence remained. It is also worth noting that in the early part of this phase, coffin burials were a new practice and may not have been universally adopted.

During this period no burials appear to have occurred in the Lane Trench and no later burials were interred in this area of the site suggesting the path crossing the western end of the church was purposefully avoided. Burials are common through the main excavation area but occasional interments are seen in the River Trench. Within the main excavation area burials appear to favour the southern half of the area, beneath the grassed churchyard, with fewer examples in the paved area. This suggests that the path around this side of the church was mostly avoided, possibly from later in the period, and that burials were confined to the grassed churchyard, later defined by a wall of disturbed gravestones.

A number of the coffins of the period were identified as being of single break form, a style that was introduced during the latter half of the 16th century (Litten 1991), although no wood suitable for identification survived and little more than staining was visible.

All of the burials of this phase were supine and were aligned with the heads at the west. The vast majority of graves were orientated on the church's south aisle, approximately east to west and within the main excavation area there appears more uniformity to this alignment than had been seen in previous phases. However through the River Trench, unlike the previous phases that were aligned on the church, many burials of Phases 4 and 5 appear aligned more on a north-east to south-west axis, respecting the path more (Fig 12).

Unlike the preceding periods the most common arm position of this phase is with the arms straight down the sides, either next to or on top of pelvis, which may have been introduced as coffined burials became more common (Table 4, Fig 16). There appears to be slightly more males buried during this phase, but as with preceding periods there appears be a greater number of young to middle adults represented (Tables 5 and 6, Figs17 and 18).

Associated finds

The only non-coffin related find that can be attributed to a specific burial is a small copper alloy buckle on the right ilium (pelvis) of skeleton (595) (Section 5.3). Due to its location it is probably from a belt.

Brick Vaults

The only vaulted tomb excavated assigned to this phase is (1269) (Plate 11, Fig 19). The vault had already been emptied, probably during the insertion of later services. This was located next to the south transept and is thought to have abutted its southern wall. The vault was single brick width thick, of regular stretcher bond, 240mm by 110mm by 60mm, and was bonded with a greyish white mortar. The tomb was heavily truncated by later services which caused significant damage to the eastern and western facing walls. The surviving dimensions of the vault measured 2.48m by 0.64m by 0.87m. The floor of the vault was also constructed of brick on bed. No entrance or internal compartments were observed. The entrance is however thought to be on the east side as the iron railings of the vault are depicted on John Jordan's painting *The South East View of Stratford Church* (Fig 22). A faint white wash was observed on the north facing wall of the vault. It was located to the west of centre and measured 0.67m in height and 0.27m in width (Plate 11). This may indicate some form of structure within the vault, perhaps relating to the stacking of burials.

Plate 11: southern wall of brick vault (1269).

Vault (1269) was filled with rubble-packed silty sand which relates to the backfilling of the later service trench. This fill contained frequent ceramic building materials, disarticulated human bone, and significantly, eight tombstone fragments. These fragments could be loosely fitted together to reveal a decorated headstone with names and dates inscribed. It is probable that the surviving script read '*Caste Bodyes of John, Mary, & Samuel, & Thomas*' with more isolated fragments revealing details such as *Aged 80*, *7th 1687*, and *July*. The quantity of names, together with the decoration depicted on this tombstone, perhaps indicates that it was the above ground marker for this brick vault. However, this cannot be inferred with any certainty due to its discovery, residual within the rubble backfill of the service trench.

It is possible to provide a loose date for vault (1269) by analysing the bricks used for its construction. The bricks are hand-moulded and Brunskill (1997, 1407) states that Jacobean, Stuart, and Queen Anne period bricks (1603-1714), tend to remain imperfect in shape though dimensions were often around 9 inches long and 2½ inches in thickness. This would suggest that the vault is possibly 17th to early 18th century in date. Lloyd (1983, 95) also suggests an early 18th century date for bricks of this thickness. Consequently, the fragmented gravestone found within the fill of the vault appears to match the 17th-18th century date indicated by the bricks.

5.2.6 Phase 5: Elaborate coffins *c* 1750-present

71 articulated skeletons belong to this phase, 32 of which were associated with elaborate coffins. Where established these were of single break form although two possible examples of fishtail coffins were also identified associated with skeletons (1143/1144) and (437) (Plates 12 and 13). This form seems to have gone out of use by the late 19th century. This phase also contained seven burials associated with simple coffins, perhaps indicating a continuation of Phase 4 burial practices but this is not that surprising as elaborate coffins would have been expensive, and therefore inaccessible for the majority of the parish. Very little wood survived other than as a powder or as a light stain in the soil and therefore no wood identifications are possible. The smallest coffin which survived of this period was associated with a neonate (390) (Plate 14). Only the base survived and was again of single break from, measuring 57cm x 20cm.

Plate 12 (left): fishtail coffin associated with skeletons (1143) and (1144)

Plate 13 (right): potential fishtail coffin seen as stain, associated with skeleton (437)

Plate 14: coffin base (389) associated with skeleton (390)

The coffins of this period are characterised by the use of stud decorations, which would have held fabric coverings in place (although no fabric survived), decorative pressed iron and tin depositum plates and grips. The majority of identified elaborate coffins were located to the south of the main excavation area, in the grassed churchyard. Press-moulded depositum plates were recorded from a number of graves and examples of these can be seen in Plates 15-19, however many of these were heavily corroded and did not survive being lifted.

The plates had embossed decorations including floral motifs, crowns, angels and shields with painted biographical details presumably in white, though now yellowed and mostly illegible except for sk(969). Two, associated with skeletons (545) and (479) had radiating crowns inscribed 'GLORIA DEO' ('glory to God'), below which is a downward facing bird.

Plates 15 (left) and 16 (right). Depositum plate (547) over sk(545)

Plates 17 (left) and 18 (right): depositum plate (548) over sk(479, not 550)

Plate 18: depositum plate (591) over sk(592)

The majority of burials of Phase 5 were confined to the southern side of the main excavation area, suggesting that burials mostly avoided the footpath running alongside the southern side of the

church although a number appear to have clustered in two areas (Fig 12). As with the preceding period the Lane Trench did not contain any burials and it is likely the path was well established and used at this time. Along the southern side of the main excavation area there appeared to be significant amounts of intercutting of earlier burial and burials of this phase during this period as burials were confined to the grassed churchyard. This is unsurprising as the south side of the church was often the most popular for burial and the area of the grassed churchyard excavated was the closest one could get to the church, so would likely have been repeatedly chosen for burial.

Of particular note during this phase was the occasional observation of burial post-depositional movement. This was not often observed during the earlier phases, as the heads and limbs of coffin-less burials are held more securely by the churchyard soils packed directly around the body. When interred in a coffin however the body is not as constrained and there was more opportunity for the corpse to move. Such movement is typified in skeletons (1135) and (1136), where the shoulder and right arm of skeleton (1136) has dropped and rotated as the coffin below has decomposed (Plate 20). It was also more common during this phase for skulls to have turned to the left or right within the coffin, so that the skulls were no longer facing forwards (Plate 21). This also suggests that the skulls were not restrained within the coffins.

Plate 20 (left): skeletons (1135) (bottom) and (1136) (top)

Plate 21 (right): skeleton (578), note head rotation and coffin wood along right hand side

Although the use of coffins was well established during this period the bodies interred in them will still have been in shrouds and evidence from the distribution of copper pins (which are all found in association with Phase 5 burials) suggests that the body was increasingly prepared and dressed for burial. This is also visible as a result of the copper staining on some bones of this phase (Plates 22 and 23).

Plates 22 and 23: Copper staining from shroud pins? On legs of sk(482)

Stacked burials

There were few graves identified that suggest burials, possibly relations, were in the same grave cut, as stacked interments, despite there being evidence for this being visible in the upstanding gravestones of the churchyard. Most remains appear to have been interred within an individual grave formed by a new grave cut, often truncating burials of the same and earlier phases. Only two pairs of human remains appear to have been stacked within the same grave cut. The lack of soil between skeletons (1135) and (1136) and as the upper skeleton (1136) which had fallen into the void of the lower (1135) suggests that the burials were interred together or with little time between, implying they were probably related (Plate 20). Others include sk(103) with sk(120) which appeared to have shared the same grave cut as sk(103) and was located directly above sk(120) (Plates 24 and 25).

Plate 24 (left): skeleton (103) top of stack

Plate 25 (right): skeleton (120) below. Note gravel filled borehole on right forearm of each

Notable finds

Of particular note from the Phase 5 burials were three coins that appear to have been deliberately buried with the corpse. Three were halfpennies, all very corroded but identified as either Charles II or possibly much later George III halfpennies (Angie Bolton pers comm), providing a broad date range from *c* 1663 to 1820 for the burials with which they were found. All three coins had fragments of textile attached, suggesting that they were been placed over the eyes, associated with a face cloth. Two were with skeleton (437) (fill 438), both displaced to the chest (Plates 25 and 26), and the other with skeleton (888), also displaced. A fourth coin, a silver penny of Elizabeth I, minted between 1558 and 1603 (Angie Bolton pers comm) came from the fill of the grave for Skeleton 523 (fill 524) of Phase 5 and is therefore residual.


Plates 26 (left) and 27 (right): displaced coins over skeleton (437)

Also of note is the discovery of a stone between the teeth of skeleton (357) (Plate 27). Although this may be coincidence, archaeological excavations of medieval and early post medieval graves have also encountered this phenomenon (Daniell 1997, 165). The placement of the stone in those examples may have been intended to prevent talking at the resurrection or to stop the person rising up (*ibid*). Whether this was the purpose in this case, indeed whether it was an intentional act is not known.

Plate 28: stone in the mouth of sk(357)

Lead coffins

A single lead coffin (1183) was identified in a pit (607), possibly dug for the exhumation of burials prior to the construction of a brick culvert (313) that ran around the edge of the southern aisle (Fig 20). The coffin has been placed in to this Phase by its association with pit (607) however the item itself may be of earlier origin. The coffin had been emptied and crushed almost beyond recognition for deposition into the pit (Plate 28) and the original location of the coffin is not known. The coffin only partially survived but measured a minimum of 0.28m by 0.78m at the head end. Its joints had been folded, riveted and at the corners had also been soldered (Plate 29). Soldering and tacking remnants were present approximately 0.28m down from the head end in the centre of the coffin. This is believed to be the location of a former coffin plate, no longer attached. The lid is believed to be a type 2 'piecrust' as identified in the Spitalfields project (Reeve & Adams 1993). Plume (1910, 57) suggests that the lead coffin could have either been designed to line the outer coffin or indeed the inner coffin. It is difficult to provide a date for the lead coffin due to its current state of preservation, however, Plume does indicate that lining the outside of the coffin in lead had gone out of fashion by the late 19th century (*ibid*).

Plate 29: lead coffin (1183) in-situ, in pit (607)

Plate 30: corner detail of lead coffin (1183) showing, folds, rivets and excess solder

Brick vaults and shafts

A single brick burial shaft (741) was identified butting up against the southern aisle of the church in bay 3 (Plate 30, Fig 19). Such constructions were common between 1650-1850 and were often designed to hold numerous stacked interments. Although such shafts were often dug deep enough to accommodate numerous burials, separated by iron bars, it is likely that this burial shaft could only have accommodated no more than 1-2 coffins based upon the depth of the churchyard soil above. The shaft had been emptied, probably prior to the construction of the brick culvert abutting the church. The western (head) end of the shaft had also been truncated by an archaeological test pit dug in 2012 (Tavener 2012). The base of the shaft was constructed of stone slabs onto which a brick wall forming a single break coffin shape was constructed and bonded with yellowish sandy lime mortar. The surviving shaft measured 0.60m wide at the feet and was 1.84m long. Only the base course of brick survived and no articulated bone remained. The brick dimensions measured 235mm by 110mm by 75mm. Brunskill states that following the Brick Tax of 1784, thicker bricks (*c* 3 inches) were produced, and continued to be produced in the Midlands even after the revisions of 1803 (1997, 156). This provides further evidence that this particular burial shaft, dates to the late 18th or early 19th century.

Plate 31: brick shaft (741)

Three brick vaults (1072, 1153, and 1315) were also identified in the River Trench and in the Lane Trench (Fig 19). These were not excavated as they only partially encroached upon by the service trenches, which were subsequently diverted to avoid the need for their excavation. Little can be said about them other than they were of brick construction and bonded with lime mortar. One of these (1315) was encountered 0.25m below ground surface (bgs), beneath a stone plaque on the southern aisle wall. This vault was constructed of brick and had been capped with three large slabs of stone up to 7cm thick. Although the vault was left unexcavated it is thought to contain the remains of Reverend Stephen Nason, his wife Alice Lucy Nason, and their youngest son Major John Robert Nason, as the plaque above reads:

> *In a vault beneath / are deposited the remains of the Rev.d Stephen Nason M.A. / Vicar of this parish twenty four years / and one of his Majesty's justices of / peace for the county, in which offices / he discharged his duty both as a / Minister and a Majistrate with / Fidelity, Firmnefs and integrity. / He died May 31st 1787 / Aged sixty nine years. / Also of Alice Lucy Nason / Relict of the above / and daughter of / Robert Wise Esquire / of Sadhampton Oxon / She died February 15th 1799 / Also of John Robert Nason / their*

youngest son / late Major of the 47th Regiment. / He died / at Norton Lindsey / August 22nd 1831/ Aged 85 years.

Reverand Nason's vault (1315) is visible on John Jordan's painting The South East View of Stratford Church (Figure 22). Also visible on this painting is vault 1154, encountered 0.40m bgs and also unexcavated, on the east side of the south transept. Vault (1072), located further east along the River Trench and 0.30m bgs, cannot be seen on the painting, which may suggest that it was constructed later than 1790, the year of the painting.

Figure 22: John Jordan's view of Holy Trinity c 1790. Showing three of the vaults encountered surrounded by iron railings. Vault (1315) to the left of the southern aisle door, vault (1269) on the southern end of the south transept and vault (1153) on the eastern side of the south transept. Also note the lack of grave stones close to the church corroborating the archaeological evidence which suggests few burials occurred there post 1750.

Brick culvert

Probably during the late 19th century a brick culvert was constructed along the north edge of the main excavation area (Plate 31, Fig 20), around the edge of the south aisle wall. This was constructed of bricks, 240mm by 110mm by 70mm, and had been capped with stone slabs and old gravestones. The construction of this culvert truncated the brick shaft (741) and a number of interments. It is possible that pit (607) which abutted the southern wall of the church, beneath the culvert represents exhumation of burials prior to this construction. The pit measured 0.90m wide, 3.35m long and was 0.43m deep with steep concave sides.

Plate 31: brick culvert (313)

Named burials

There is only one burial identifiable by name from the excavated assemblage, skeleton (969), Elizabeth Smith (Plates 32-33). She was born Elizabeth Wheeler, to Elizabeth and William Wheeler, in Stratford upon Avon in 1789. She had one brother John (born 1789) probably a twin as they were both baptised on the same day, 14 January 1789. She married George Smith in 1806 when she was 17 years old and had a son, William, the same year. It appears that Elizabeth Smith was illiterate as she placed her mark underneath her husband's signature on the marriage certificate. She died on Wood Street, Stratford-upon-Avon on 9 May 1854, aged 65 and was buried on 11 May 1854. Her cause of death is listed as Carcinoma Mammae – Certified and her occupation was listed as needle woman.

Plates 32 (left) and 33 (right): skeleton (969), Elizabeth Smith

Phase 6: AD 1900-2015

Boiler House

Towards the eastern end of the main excavation area there was modern boiler house for the church, which had replaced an earlier brick building (Fig 21). This structure had completely removed all of the burials in this part of the churchyard and partially truncated a number of burials to the west, south and east. The building was constructed of brick and concrete and was a minimum of 2m deep, below the current ground surface. The presence of the boiler house at this location is undoubtedly the reason for so many services. A minimum of seven services, including gas, water and electric crossed the main excavation area and had truncated many of the higher burials, whose disarticulated bones had been re-deposited in the backfill. The most destructive service cut was (394) that ran in an east to west direction to the north of the main excavation area. This water pipe cut measured 0.70m wide and a minimum of 0.70m deep, having reached sufficient depth to expose the natural sands and gravels in places. The destructive nature of these services is exemplified in skeleton (409) which had been cut in half by service trench (394) (Plate 34).

Plate 34: sk (409) cut by pipe trench (394)

Pits

Towards the east of the main excavation area were two small pits (305) and (325). The largest of the two (305) was sub-rectangular in plan with vertical sides and a flat base and measured 1.85m by 1.00m by 0.25m. It had cut through a number of skeletons, and had been filled with loose and friable clinker and ash. The second pit (325) was sub-circular in plan with moderate concave sides measuring 1.12m long, 0.90m wide and 0.30m deep. It had been filled with numerous window stone fragments of Warwickshire grey sandstone. These included 14 dressed, green sandstone masonry similar to those within the window at the east end of the church. These fragments are likely to result from the removal and replacement of the church windows. Both of these features appear to be rubbish pits.

Brick structure

To the east of the modern boiler house was another brick structure (1282) aligned north to south of unknown purpose that had also truncated a number skeletons. This consisted of a pair of parallel walls, double brick thick, bonded with cement, constructed on a concrete slab and capped with corrugated tin sheets and concrete. The bricks were machine made and measured 225mm by 112mm by 85mm. The structure measured 1.12m wide, 0.85m deep and a minimum of 2.90m long. The structure appeared to run towards the southern side of the church but terminated 1.40m south of the boiler house. This construction had the form of a wartime building but was too small to have acted as shelter, so its true purpose remains unknown.

Gravestone wall

Running between the paved area and the grassed churchyard, through the main excavation area, was a small retaining wall constructed of stone window mullions and fallen/displaced headstones. This is likely to be of modern construction but contained a couple of interesting headstones (Plates 35 and 36). One of these is topped with a skull and cross bones acting as a *Memento Mori*, a reminder of our own mortality. The second contains a long list of initials that, unlike the

observations during the excavation, indicates that members of the same family were stacked in the same grave.

Plate 35: gravestone from retaining wall

Plate 36: gravestone from retaining wall

5.3 Artefact analysis, by C Jane Evans and Rob Hedge

The artefactual assemblage recovered is summarised in Tables 7-16.

The assemblage came from 17 stratified contexts from the evaluation and 110 stratified contexts from the excavation. The earliest find was a loomweight dating to the Saxon/ early medieval period, though most finds dated from the medieval period on (Table 7). The majority of finds, particularly the post-medieval metalwork, were associated with burials (Table 8). These mainly comprised coffin fittings, and other finds directly related to the burials. Some finds, however, were residual and derived from occupation in the vicinity or building work on the church. The finds are, therefore, discussed below within four chronological/ functional groups:

- finds associated indicative of possible Anglo-Saxon settlement
- funerary finds associated with the cemetery
- finds associated with domestic activity in the vicinity
- finds associated with demolition/building work on the church

period	material class	material subtype	object specific type	count	weight(g)
saxon/early medieval	ceramic	earthenware	loomweight	1	154
medieval	ceramic	earthenware	floor tile	115	15364
medieval	ceramic	earthenware	pot	60	483
medieval	ceramic	earthenware	roof tile	1	244
medieval	glass	glass	window	1	2
medieval	glass	glass dark	window	53	79
medieval	glass	glass dark green	window	2	2
medieval	glass	glass green	window	1	
medieval	glass	glass pale green	window	1	1
medieval	stone	sandstone	architectural stone	16	90322
medieval	stone	limestone	architectural stone	1	482
medieval	stone	sandstone	architectural stone	1	1502
medieval?	glass	glass dark	window	9	8
medieval?	glass	glass dark green	window	1	1
late medieval/early post-medieval	ceramic	earthenware	pot	3	35
late medieval/post-medieval	ceramic	earthenware	pot	4	17
medieval/post medieval	ceramic	earthenware	brick	6	846
medieval/post medieval	glass	glass green	window	3	
medieval/post medieval	metal	copper alloy	aglet	3	2.5
medieval/post medieval	metal	copper alloy	buckle & fabric	1	7
medieval/post-medieval	ceramic	earthenware	roof tile	3	3185
medieval/post-medieval	glass	glass green	window	29	
medieval/post-medieval	metal	copper alloy	pin	28	11
medieval/post-medieval	metal	lead	window came	7	54
medieval/post-medieval	stone	lias?	tile	1	100
post-medieval	ceramic	earthenware	brick/tile	2	56

post-medieval	ceramic	earthenware	clay pipe	16	45
post-medieval	ceramic	earthenware	pot	12	211
post-medieval	ceramic	earthenware	roof tile	5	1354
post-medieval	composite	wood/copper alloy	unident	1	19
post-medieval	glass	glass pale green	window	8	2.5
post-medieval	metal	copper alloy	coffin stud	1	2
post-medieval	metal	copper alloy	coffin stud?	1	6
post-medieval	metal	copper alloy	coin	2	33
post-medieval	metal	copper alloy	stud?	1	1
post-medieval	metal	copper alloy/ iron	nail	1	5
post-medieval	metal	iron	coffin fitting	3	486
post-medieval	metal	iron	coffin fitting?	1	50
post-medieval	metal	iron	coffin grip	43	5431
post-medieval	metal	iron	coffin grip and plate	28	6883
post-medieval	metal	iron	coffin grip frag	8	187
post-medieval	metal	iron	coffin grip plate	62	379
post-medieval	metal	iron	coffin grip plate frag	22	27
post-medieval	metal	iron	coffin nail	566	2557
post-medieval	metal	iron	coffin nail frag	14	8
post-medieval	metal	iron	coffin name plate	3	374
post-medieval	metal	iron	coffin plate	24	191
post-medieval	metal	iron	coffin plate frag	282	1902
post-medieval	metal	iron	coffin remains	1	426
post-medieval	metal	iron	coffin stud	294	1117
post-medieval	metal	iron	coffin stud small	6	6
post-medieval	metal	iron	corroded frag	24	398
post-medieval	metal	iron	fragment	3	6
post-medieval	metal	iron	nail	33	221
post-medieval	metal	iron	unident	5	969
post-medieval	metal	lead	cloth seal?	1	87

post-medieval	metal	lead	coffin	1	
post-medieval	metal	lead	coffin fragment	2	558
post-medieval	metal	lead	sheet	1	60
post-medieval	metal	silver	coin	1	0.5
post-medieval	metal	tin plate	coffin fitting	1	5
post-medieval	metal	tin plate	coffin grip and plate	9	290
post-medieval	metal	tin plate	coffin plate frag	100	610
post-medieval	metal	tin?	lettering fragment	4	2
post-medieval	organic	wood/iron	coffin base	1	
post-medieval	stone	lias?	roof tile	4	562
post-medieval	stone	slate	roof tile	3	95
post-medieval?	ceramic	earthenware	floor tile	1	34
post-medieval?	metal	iron	key	1	34
post-medieval/modern	ceramic	earthenware	brick	5	13856
post-medieval/modern	ceramic	earthenware	brick/tile	1	2
post-medieval/modern	glass	glass clear	window	19	1
post-medieval/modern	glass	glass dark	window	1	0.5
post-medieval/modern	glass	glass dark green	bottle	1	18
post-medieval/modern	glass	glass green	unident	1	2
post-medieval/modern	glass	glass pale green	bottle	1	12
post-medieval/modern	glass	glass pale green	window	2	3.5
modern	ceramic	earthenware	floor tile	2	328
modern	ceramic	earthenware	land drain	1	3600
modern	ceramic	earthenware	roof tile	1	43
modern	ceramic	stoneware	land drain	1	217
modern	glass	glass clear	bottle	1	372
modern	glass	glass clear	vessel	6	778
modern	metal	tin	can frags	12	50
undated	organic	animal bone	tooth	1	3
undated	organic	clinker	fragment	1	9

undated	organic	shell oyster	fragment	4	15.5
undated	stone	flint	fragment	1	6

Table 7: Quantification of the assemblage by period, class and type

Feature type	material class	count	weight(g)
Alluvium	ceramic	2	10
Backfill	ceramic	1	5
Brick Tomb	ceramic	1	4010
Coffin	glass	2	1.5
Coffin	metal	776	12731.5
Grave	ceramic	89	4694
Grave	composite	1	19
Grave	glass	32	39
Grave	metal	463	4719.5
Grave	organic	4	18
Grave	stone	1	100
Churchyard Soil	ceramic	92	9923
Churchyard Soil	glass	32	82.5
Churchyard Soil	metal	234	3383.5
Churchyard Soil	organic	2	9.5
Churchyard Soil	stone	7	1111
Culvert	glass	4	179
Culvert	metal	1	60
Lead sheet	metal	1	n/a
Modern Layer	ceramic	3	216
Modern Layer	stone	1	1502
Modern Service	ceramic	3	3819
Modern Service	metal	10	235
Pipe	ceramic	13	5293
Pipe	glass	37	n/a
Pit	ceramic	15	5038

Pit	glass	17	
Pit	stone	16	90322
Skeleton	ceramic	2	176
Skeleton	glass	7	7
Skeleton	metal	87	596.25
Skeleton	organic	1	n/a
Skeleton	stone	1	6
Tomb	ceramic	1	3652
Topsoil/Overburden	ceramic	17	1956
Topsoil/Overburden	glass	5	372
Topsoil/Overburden	metal	8	1647
Topsoil/Overburden	stone	1	28
Wall	ceramic	1	1282
Unstratified	glass	4	601.5
Unstratified	metal	16	56.5

Table 8: Quantification of the assemblage by feature type and material class

5.3.1 Mid to late Saxon

A fragment of ceramic loomweight (Fig 23), redeposited in a layer of churchyard soil (301) was datable to 8th–10th century (Walton Rogers 2007, 30 and 106-7). Having a relatively narrow central aperture in relation to the width of the ring of clay, it is typical of middle or late Saxon loomweights, since early Anglo-Saxon weights have a larger central aperture. This find could, therefore, be contemporary with the 9th century minster church that is believed to have been present locally.

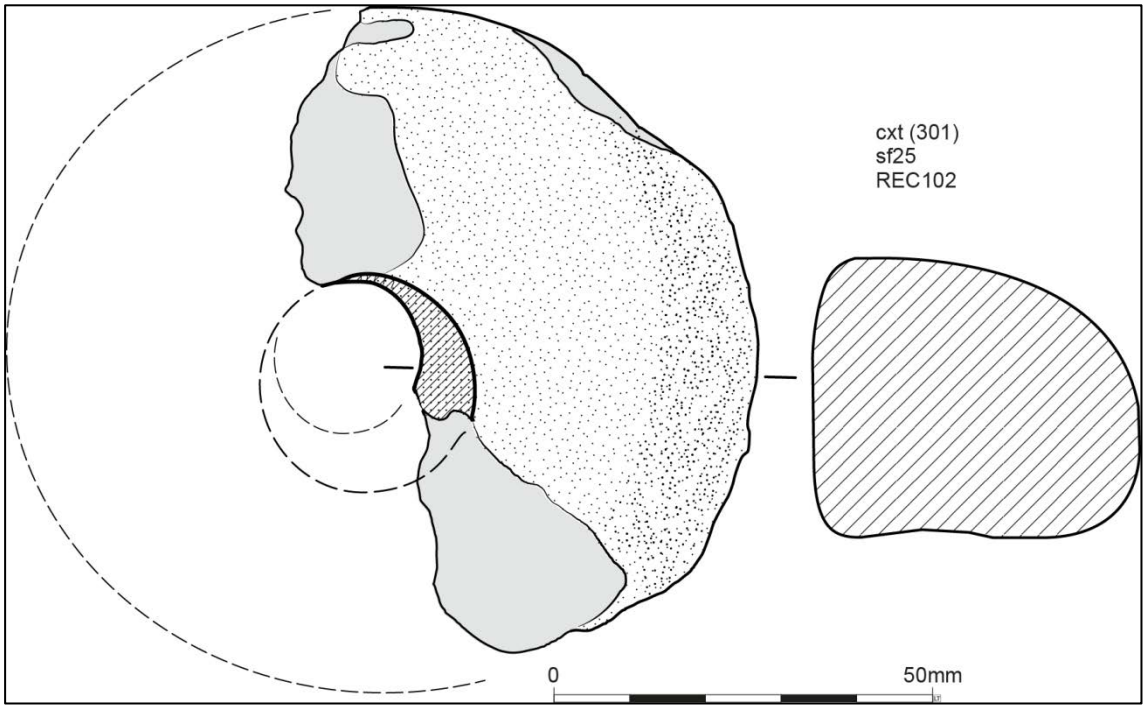

Figure 23: Loomweight in fired clay, with a roughly D-shaped section; burnt on the flat base. External diameter c 100mm, diameter of central aperture c 30mm, height c 39mm, thickness varying from 39-46mm. Layer (301)

5.3.2 Funerary finds associated with the cemetery

The main focus of analysis was on finds associated with the burials. Artefacts associated with the human remains included funerary items such as coffin fittings, shroud pins and coins, but also residual finds from general activity in the vicinity (e.g. pottery, clay pipe fragments) and from the structure of the church itself (e.g. window glass, architectural stone). These finds are summarised in Table 9. Further coffin fittings were associated with graves that were identified in plan but not excavated as they were below the impact level, or were found redeposited in general churchyard soils and topsoil (Table 10).

Skeleton Associati	material class	object specific type	count	weight(g)	start date	end date	period
103	glass dark)	window	1	1			medieval
	metal Cu	aglet	1	1			medieval/ post medieval
	metal Fe	coffin grip	1	78	mid 17th	mid 18th	post-medieval
	metal Fe	coffin nail	2	15			post-medieval
	metal Fe	coffin stud	5	6			post-medieval
	metal Fe	nail	30	170			post-medieval
	metal Pb	window came	1	3			medieval/ post-medieval
	stone flint	fragment	1	6			undated

117	metal Fe	coffin nail	8	27			post-medieval
120	metal Fe	coffin nail	10	35			post-medieval
	metal Fe	coffin stud	2	21			post-medieval
125	metal Fe	coffin stud	1	1			post-medieval
210	glass clear	window	1	1			post-medieval
	metal Fe	coffin nail	1	4			post-medieval
	metal Fe	coffin nail frag	5	3			post-medieval
	metal Fe	coffin stud	21	23			post-medieval
303	glass dark)	window	3	4			medieval
331	glass	window	1	2			medieval
	metal Cu	pin	2	0.5			medieval/ post-medieval
	metal Fe	coffin nail	14	102			post-medieval
337	ceramic	clay pipe	1	2			post-medieval
	metal Fe	coffin nail	3	7			post-medieval
343	metal Fe	coffin nail	6	22			post-medieval
	metal Fe	coffin stud	3	3			post-medieval
346	metal Fe	coffin nail	2	4			post-medieval
349	metal Fe	coffin nail	7	31			post-medieval
	metal Fe	corroded frag	5	23			post-medieval
375	metal Fe	coffin nail	3	25			post-medieval
378	ceramic	clay pipe	1	2			post-medieval
	ceramic	pot	1	2	13th	14th?	medieval
	glass pale green	window	1	1			post-medieval
	metal Cu	pin	1	1			medieval/ post-medieval
381	ceramic	floor tile	2	136			medieval
	ceramic	pot	2	7			medieval
	glass dark	bottle	1	18			post-medieval
390	metal Cu	pin	1	0.5			medieval/ post-medieval

	metal Cu	pin/stud with fabric	1	1			post-medieval
	metal Cu	aglet	1	0.5			post-medieval
	organic wood/Fe	coffin base	1				post-medieval
392	glass dark	window	1	3			medieval
	metal Cu	pin	1	0.5			medieval/ post-medieval
409	ceramic	pot	2	2			medieval
	metal Fe	coffin nail	1	3			post-medieval
	metal Fe	corroded frag	4	64			post-medieval
415	Metal Fe	Coffin nail	2	7			post-medieval
421	metal Fe	coffin nail	5	27			post-medieval
437	ceramic	floor tile	3	373			medieval
	ceramic	roof tile	2	163			post-medieval
	composite wood/Cu	unident	1	19			post-medieval
	metal Cu	coin	1	9	1663		post-medieval
	metal Fe	coffin grip and plate	1	234			post-medieval
	metal Fe	coffin grip and plate	1	266	mid 17th	mid 18th	post-medieval
	metal Fe	coffin nail	14	84			post-medieval
	metal Fe	coffin plate frag	18	146			post-medieval
440	ceramic	floor tile	2	245			medieval
	glass dark	window	1	1			medieval
	metal Cu	pin	1	0.5			medieval/ post-medieval
	metal Fe	coffin grip plate	2	23			post-medieval
	metal Fe	coffin nail	5	36			post-medieval
458	ceramic	floor tile	1	46			medieval
	ceramic	pot	1	3			medieval
	ceramic	pot	1	4	1475	1550	late medieval/ post-medieval

	metal Cu	pin	1	0.5			medieval/ post-medieval
	metal Fe	coffin fitting	2	50			post-medieval
	metal Fe	coffin nail	4	27			post-medieval
470	metal Cu	pin	2	1			medieval/ post-medieval
	metal Fe	coffin grip	1	40	mid18th?	mid 19th	post-medieval
	metal Fe	coffin nail	5	34			post-medieval
	metal Fe	coffin plate frag	2	22			post-medieval
	metal Fe	coffin plate frag	5	49	mid 18th	1880	post-medieval
	metal Fe	coffin stud	11	31			post-medieval
479	metal Fe	coffin grip	2	82	mid 18th?	mid 19th	post-medieval
	metal Fe	coffin name plate	1				post-medieval
	metal Fe	coffin plate frag	9	93	mid 18th	1880	post-medieval
482	ceramic	pot	1	11			medieval
	metal Cu	pin	4	2			medieval/ post-medieval
485	ceramic	clay pipe	1	1			post-medieval
	glass dark green	window	1	1			medieval
	glass dark green	window	1	1			medieval?
	glass green	unident	1	2			post-medieval
	metal Fe	coffin grip	2	153	mid 18th	mid 19th?	post-medieval
	metal Fe	coffin nail	13	48			post-medieval
	metal Fe	coffin plate frag	4	4			post-medieval
	metal Fe	coffin stud	3	15			post-medieval
491	glass green	window	1				medieval/ post-medieval
	metal Fe	coffin nail	45	165			post-medieval
	metal Fe	coffin remains	1	426			post-medieval
	metal Fe	coffin stud	55	187			post-medieval

510	metal Fe	coffin grip and plate	12	1212 71	mid 17th	mid 18th	post-medieval
512	ceramic	pot	1	6			medieval
	metal Fe	coffin nail	4	12			post-medieval
523	metal ag	coin	1	0.5	1558	1603	post-medieval
535	Metal Fe	Coffin nail	16	55			post-medieval
545	ceramic	brick	1	6			medieval/ post medieval
	glass pale green	window	1	3			post-medieval
	metal Cu	pin	1	0.5			medieval/ post-medieval
	metal Fe	coffin grip	4	223	mid 18th?	mid 19th	post-medieval
	metal Fe	coffin nail	9	72			post-medieval
	metal Fe	coffin plate frag	70	367	mid 18th	1880	post-medieval
	metal Fe	coffin stud	5	36			post-medieval
	metal tin plate	coffin plate frag	22	29	mid 18th	1880	post-medieval
550	metal Fe	coffin nail	1	3			post-medieval
	metal Fe	coffin stud	8	40			post-medieval
	metal Fe	corroded frag	3	22			post-medieval
	metal tin plate	coffin plate frag	3	5	mid 18th	1880	post-medieval
553	stone lias?	tile	1	100			medieval/ post-medieval
567	metal Fe	coffin grip and plate	3	764	mid 17th	mid 18th	post-medieval
570	metal Fe	coffin nail	1	3			post-medieval
	metal Fe	coffin stud	15	13			post-medieval
573	ceramic	floor tile	2	220			medieval
	metal Fe	coffin grip plate	1	127	mid 17th	mid 18th	post-medieval
	metal Fe	coffin nail	2	8			post-medieval
	metal Fe	coffin stud	2	8			post-medieval
578	ceramic	floor tile	2	176			medieval

	metal Fe	coffin grip	5	260	mid 18th?	mid 19th	post-medieval
592	metal Fe	Coffin name plate	1	na	1827	1862	Post-medieval
595	metal Cu	buckle & fabric	1	7			medieval/ post medieval
605	ceramic	floor tile	4	240			medieval
614	ceramic	brick/tile	1	44			post-medieval
	ceramic	floor tile	3	268			medieval
	metal Fe	coffin nail	2	13			post-medieval
629	organic oyster shell	fragment	1	6			undated
659	ceramic	floor tile	1	39			medieval
682= 125	metal Fe	corroded frag	4	111			post-medieval
698	ceramic	floor tile	1	10			medieval
704	ceramic	floor tile	1	34			medieval
708	ceramic	pot	1	3			medieval
759	ceramic	pot	1	7			medieval
	glass dark	window	4				medieval
771	ceramic	pot	1	11			medieval
780	ceramic	floor tile	1	104			medieval
	ceramic	pot	1	7			medieval
824 / 825	glass dark	window	1	2			medieval
840	ceramic	pot	1	1			medieval
864	ceramic	pot	1	2	13th	14th?	medieval
879	glass dark	window	1	2			medieval
885	metal Cu	coin	1	24	1663		post-medieval
888	ceramic	brick/tile	1	12			post-medieval
	metal Fe	coffin nail	48	156			post-medieval
	metal Fe	coffin stud small	4	3			post-medieval
891	metal Fe	coffin nail	7	12			post-medieval

	metal Fe	coffin stud small	2	3			post-medieval
	metal tin plate	coffin plate frag	1	1	mid 18th	1880	post-medieval
906	ceramic	pot	1	23	17th	17th	post-medieval
	metal Fe	coffin nail	18	56			post-medieval
926	glass dark green	window	1	1			medieval
	metal Fe	coffin grip	1	18			post-medieval
	metal Fe	coffin grip frag	3	33			post-medieval
	metal Fe	coffin nail	178 186	5585 85			post-medieval
	metal Fe	coffin plate frag	1	4			post-medieval
	metal Fe	coffin stud	517	24			post-medieval
	metal tin plate	coffin fitting	1	5	mid 18th	1880?	post-medieval
	metal tin plate	lettering fragment	4	2	mid 18th	1880	post-medieval
931	ceramic	pot	1	3			medieval
	metal Fe	coffin nail	6	38			post-medieval
941	ceramic	pot	3	7			medieval
944	ceramic	pot	1	15			medieval
966	metal Fe	coffin grip and plate	1	373	early 19th	1854	post-medieval
969	metal Cu	pin	1	0.75			medieval/ post-medieval
	metal Fe	coffin grip	1	59	1854	1854	post-medieval
	metal Fe	coffin nail	1	4	1854	1854	post-medieval
	metal tin plate	coffin name plate	1	na			Post-medieval
	metal Fe	coffin plate	21	147	1854		post-medieval
	metal Fe						
	metal Fe						
972	ceramic	floor tile	2	217			medieval
	ceramic	pot	2	1			medieval

1008	ceramic	floor tile	1	106	1300	1500	medieval
1028	metal Fe	coffin nail	4	32			post-medieval
	metal Fe	coffin plate frag	9	32			post-medieval
	metal Fe	coffin stud	10	46			post-medieval
	metal Fe	corroded frag	2	123			post-medieval
1034	ceramic	floor tile	1	38			medieval
	ceramic	pot	1	16	12th	mid 14th	medieval
1044	glass pale green	window	1	0.5			post-medieval
	metal Fe	coffin grip	1	370	mid 18th	1880?	post-medieval
	metal Fe	coffin grip and plate	5	2638	early 19th	mid 19th	post-medieval
	metal Fe	coffin nail	6	20			post-medieval
	metal Fe	coffin name plate	1	374	Mid 18th	1880	post-medieval
	metal tin plate	coffin plate frag	47	198	mid 18th	1880	post-medieval
1049	ceramic	floor tile	1	18	1300	1500	medieval
	ceramic	pot	1	5	12th	mid 14th	medieval
1055	metal Fe	coffin grip	3	152	mid 18th?	mid 19th	post-medieval
	metal Fe	coffin grip plate	39	141	mid 18th?	mid 19th	post-medieval
	metal Fe	coffin nail	2	4			post-medieval
	metal tin plate	coffin grip and plate	9	290	mid 18th?	mid 19th	post-medieval
1065	ceramic	pot	1	2			medieval
1068	glass pale green	window	1	1			post-medieval
	metal Fe	coffin grip	1	54	mid 18th?	mid 19th	post-medieval
	metal Fe	coffin nail	1	3			post-medieval
	metal Fe	coffin stud	1	3			post-medieval
1100	metal Fe	coffin nail	2	11			post-medieval
	metal Fe	coffin stud	12	76			post-medieval

1104	ceramic	brick	1	1196			post-medieval
	ceramic	floor tile	2	435			medieval
1110	ceramic	pot	2	17			medieval
	ceramic	pot	1	25	15th	16th/earl y 17th	late medieval/ early post-med
1135	glass dark	window	2				medieval
	metal Fe	coffin nail		277			post-medieval
	metal Fe	coffin stud	23	99			post-medieval
1136	metal Fe	coffin nail	38	187			post-medieval
	metal Fe	coffin stud	56	325			post-medieval
1139	ceramic	pot	2	12			medieval
1143 / 1144	metal Fe	coffin grip	5	1518	early 19th?	1880?	post-medieval
	metal Fe	coffin grip and plate	1	355	early 19th?	1880?	post-medieval
	metal Fe	coffin grip plate	7	43			post-medieval
	metal Fe	coffin grip plate	13	45	mid 18th?	1880	post-medieval
	metal Fe	coffin nail	8	24			post-medieval
	metal Fe	coffin plate frag	8	147			post-medieval
	metal Fe	coffin plate frag	58	483	mid 18th	1880	post-medieval
	metal tin plate	coffin plate frag	22	370	mid 18th	1880	post-medieval
	glass pale green	window	1	1			medieval
	metal Fe	coffin nail	2	14			post-medieval
	metal Fe	coffin nail frag	9	5			post-medieval
	metal Fe	coffin plate	1	4			post-medieval
1175	ceramic	pot	2	5			medieval
1185	glass dark	window	1	2			medieval
1200	ceramic	floor tile	3	341			medieval
1212	ceramic	pot	4	36			medieval
	metal Cu	pin	6	1.5			medieval/ post-

							medieval
1238	ceramic	floor tile	1	55			medieval
	ceramic	pot	6	44			medieval
	glass dark	window	8				medieval
	glass green	window	3				medieval/ post medieval
	metal Cu	pin	2	0.5			medieval/ post medieval
	metal Fe	coffin nail	6	57			post-medieval
	animal bone	tooth	1	3			undated
1255	ceramic	pot	1	8			medieval
	oyster shell	fragment	2	9			undated
1284	ceramic	pot	2	17			medieval

Table 9: summary of finds and finds dating associated with the human remains

Feature type	context	material class	object specific type	count	weight(g)	start date	end date	period
Grave	130	ceramic	pot	1	23	12th	13th	medieval
	373	glass (pale)	window	2				post-medieval
		metal (Fe)	coffin nail	1	6			post-medieval
		metal (Fe)	corroded frag	3	28			post-medieval
	515	metal (Fe)	coffin grip	2	736	early 19th	mid 19th	post-medieval
		metal (Fe)	coffin plate frag	9	21			post-medieval
	565	metal (Fe)	coffin grip and plate	2	314	mid 17th	mid 18th	post-medieval
	1047	ceramic	pot	1	18	17th	18th	post-medieval
Churchyard soil	301	metal(Cu)	coffin stud?	1	6			post-medieval
		metal (Fe)	coffin grip	3	256			post-medieval
		metal (Fe)	coffin grip	4	911	mid 18th?	1880 ?	post-medieval
		metal (Fe)	coffin grip	4	195	mid 18th?	mid 19th	post-medieval

		metal (Fe)	coffin grip and plate	1	71	mid 18th	1880 ?	post-medieval
		metal (Fe)	coffin grip and plate	7	923	mid 17th	mid 18th	post-medieval
		metal (Fe)	coffin grip frag	2	71			post-medieval
		metal (Ee)	coffin grip frag	2	75	mid 18th?	mid 19th	post-medieval
		metal (Fe)	coffin grip plate frag	22	27			post-medieval
		metal (Fe)	coffin nail	44	194			post-medieval
		metal (Fe)	coffin plate	2	40			post-medieval
		metal (Fe)	coffin plate frag	1	4			post-medieval
		metal (Fe)	coffin plate frag	85	150	mid 18th	1880	post-medieval
		metal (Fe)	coffin stud	44	160			post-medieval
	950	metal (Fe)	coffin fitting?	1	50			post-medieval
		metal (Fe)	coffin grip	1	46	mid 18th?	mid 19th	post-medieval
Topsoil/ overburden	300	metal(Cu)	coffin stud	1	2			post-medieval
		metal (Fe)	coffin grip	1	130	mid 17th	mid 18th	post-medieval
		metal (Fe)	coffin grip and plate	1	171	mid 17th	mid 18th	post-medieval
		metal(Pb)	coffin fragment	2	558			post-medieval

Table 10: summary of finds and finds dating from unexcavated graves, and coffin fittings from churchyard soils and topsoil

5.3.3 Coffin fittings: grips and grip plates

86 fully excavated graves, with associated human remains, produced a variety of iron or tin-plate coffin fittings (Table 9), with other finds coming from unexcavated graves and general soils (Table 10). Fittings included handles or 'grips,' grip plates, breast plates, fragments of escutcheons and other decorative lid motifs, upholstery pins or studs, and nails. Some of these provide useful dating evidence for the burials. The use of coffins in itself provides a broad chronological framework for the burials; medieval burials only very occasionally included coffins (e.g. Litten 1991, fig 42); they were not universally adopted until the second and third quarters of the 17th century (*op cit*, 57). The majority of coffins identified on site were of single break form and only two fish-tail coffins were seen, the best being associated with a mother and child burial (Skeleton 1143/1144, Plate 13). Fish-tail coffins were present in the vaults at St Martins, Birmingham. This form seems to have gone out of use there around 1870 (Hancox 2006, 155). The St Martins report suggests that the use of this type reflects a regional preference; no examples were recorded from Spitalfields but they account for more than half of the coffins recorded at St Martins (*op cit* table 121). Based on this evidence from Holy Trinity, Stratford does not seem to have shared this regional preference. A

substantial portion of a lead coffin lining (1183) was recovered from a modern, probably Victorian, pit (607, fill 608). Other fragments of lead sheet, possibly derived from coffin linings, were found in the brick culvert (127) and the topsoil (300).

All the grips were made of iron, while the grip plates were made of iron or press-moulded tin. All were corroded to some degree, but in most cases enough of the grip, at least, survived for it to be classified. Many of the grips were of the same, simple form (Fig 24.1-2), similar to types illustrated from Hereford Cathedral Close (Boucher *et al* 2015, 72, illus 58). The Hereford examples were dated from the mid-17th century, when coffins came into universal use, to the mid-18th century, when moulded brass and tin grip plates became more common. A similar date range is proposed for the grips and grip plates here, supported by the fact that this type isn't represented in the 18th and 19th century cemetery assemblage from Spitalfields (Reeves and Adams 1993). As at Hereford, these are likely to have been forged by local blacksmiths. The thickening of the grips towards the centre would have been easier to achieve if they were forge moulded, and templates may have been used to produce the grip plates (Adrian Robins pers comm). These simple plates and angular handles were found in a number of graves: grave cut 564 (fill 565), and skeleton 510 (fill 445), neither of which were excavated; skeleton 437 (fill 452), skeleton 567 (fill 575), and skeleton 573 (fill 574). Further examples were recovered from the general churchyard soils (layer 301) and topsoil (layer 300).

Another group of grips had a more curving form (Fig 24.3-4). Though most were badly corroded, a mould mark was seen on one, confirming that these were cast iron. Unlike the grips and grip plates described above, no grips of this form had complete or near-complete grip plates attached, though some had small remnants of grip plates attached or were found alongside press-moulded plate fragments. These thin, press-moulded plates were more fragile than the forged plates described above and tended therefore to survive less well. The use of casting and the association with press-moulded plates suggests a later date; most of the grips in the 18th to 19th century assemblage at Spitalfields were cast iron and had pressed tin grip plates (Reeve and Adams 1993, 86). This curving form is also represented at Spitalfields, where it is dated to c 1763-1837 (Reeve and Adams 1993, Appendix D, microfiche M2-M3). At Holy Trinity, one of the examples was associated with the burial of Elizabeth Smith, who died in 1854 (Fig 24.3). Another (Fig 24.4) was found with skeleton 479 (fill 480), and was associated with a press-moulded and black-painted coffin plate. Other examples were associated with skeleton 470 (fill 471) or were found in the general churchyard soil (950).

A third category comprised a range of more ornate, cast iron grips, probably dating to sometime between the early-mid 18th century, when the commercial trade in coffin fittings expanded, probably to the 1880s, when the churchyard regularly stopped receiving burials. One of these (Fig 24.5), is roughly similar in form to a type illustrated from Spitalfields, dated to 1821-1849 (Reeve and Adams 1993, Appendix D, microfiche M2-M3). This grave, however, was not fully excavated as the skeleton was below the level of impact, so the grip cannot be associated with an individual discussed in the human bone report. A similar form, though far more corroded and not, therefore, illustrated, was associated with the grave of Elizabeth Smith (d 1854), and another, also badly corroded, was associated with skeleton 1044 (fill 1043). Another, more complex cast iron grip type was used on the coffin associated with skeleton 1143.1144 (Fig 24.7). There are no parallels for this type at Spitalfields but it must belong in the same general date range. Another type not paralleled at Spitalfields was a simple, angular, cast iron form (Fig 24.6). Unfortunately this was found in the general churchyard soil (301), so does not have any associated dating.

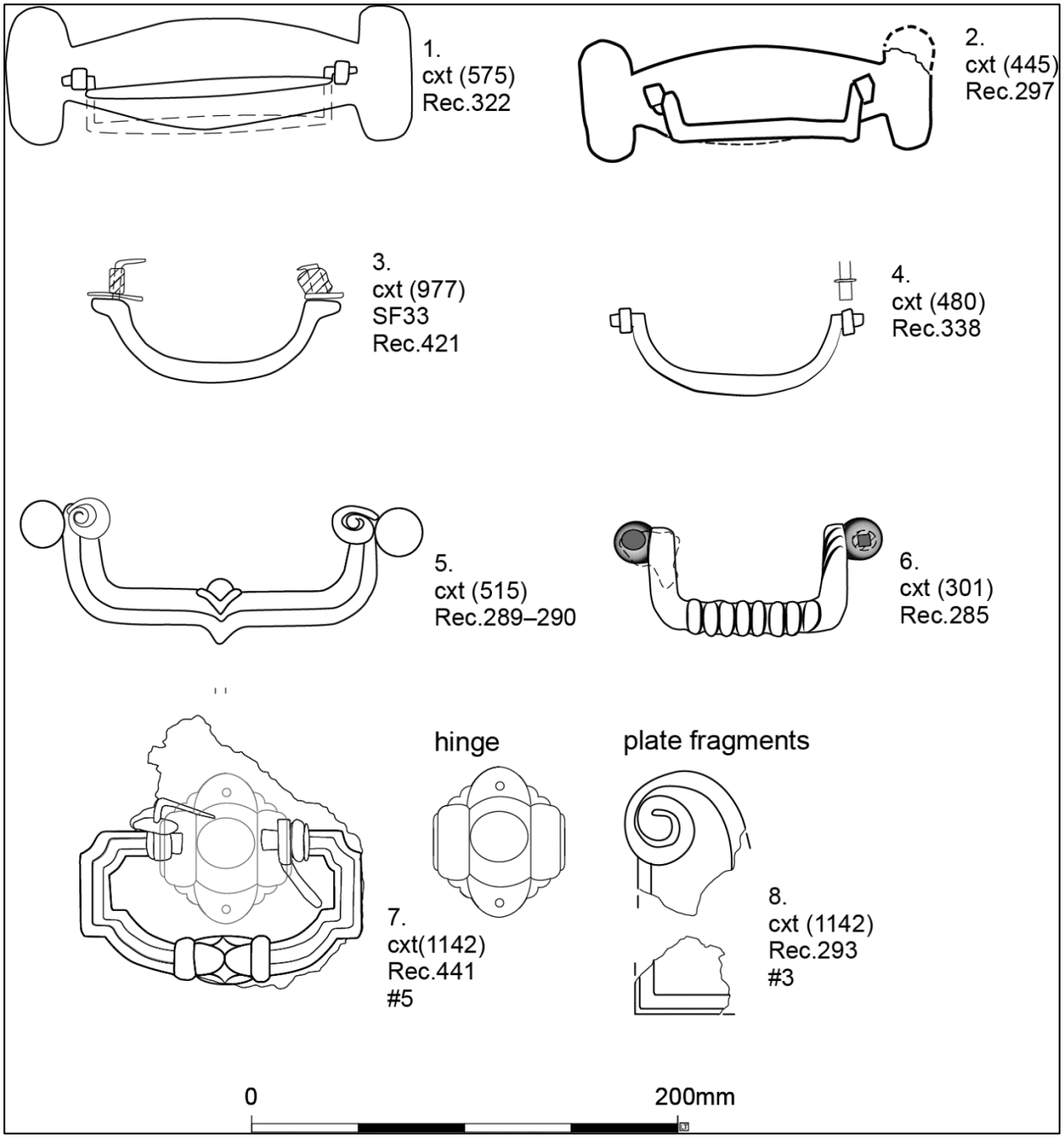

Figure 24: coffin grip plates

1. Coffin grip and plate, skeleton 567, coffin 575. Record no 322
2. Coffin grip and plate, skeleton 510, grave 445. Record no 297
3. Curving, cast iron coffin handle, associated with the burial of Elizabeth Smith, who died in 1854. Skeleton 969, coffin 977, sf 33. Record no 421
4. Shallow curved, cast iron coffin handle associated with skeleton 479, grave 480. Record no 338
5. Ornate, cast iron grip. Grave 514, fill 515. Record nos 289-90
6. Simple, angular cast iron grip. Churchyard soil 301. Record no 285
7. Ornate, cast iron grip. Skeleton 1143/1144, grave 1141, coffin 1142. Record nos 291-293, 336,441

5.3.4 Coffin fittings: depositum plates (breast plates) and other decorative plates

Press-moulded *depositum* plates were recorded from a number of graves. These were photographed *in situ* (Plates 15-19) but were very fragile and mostly fragmented when lifted. These were probably all in tin plate. They had embossed decoration and some had black paint with biographical details painted presumably in white, though now yellowed. The use of pressed or stamped tin plate, often painted or lacquered, is common in the later 18th century, as for example at Spitalfields.

The *depositum* plate associated with Skeleton 545 (coffin 547; Plates 15 and 16) is broadly similar to a type illustrated from Spitalfields (Reeve and Adams 1993, microfiche 38). The motif includes a shield with angels to either side. At the top is a radiating crown inscribed 'GLORIA DEO,' or glory to God, below which is a downward facing bird. Six examples of this type were recorded at Spitalfields, the five legible examples dating between 1779 and 1825 (*op cit* Appendix D, 145). The plate was painted black with yellow writing, probably originally white. The name and date, unfortunately, are unclear.

The *depositum* plate from the interment next to this (Skeleton 479, coffin 548) was badly corroded, but shared the shield and crown motifs and painted decoration (Plates 17 and 18).

The most informative *depositum* plate was associated with Skeleton 969, identifying the individual as Elizabeth David who died in 1854 at the age of 65. This shares the shield motif, within which the biographical details are painted in white lettering on a black background. These details follow the standard format noted at Spitalfields (*op cit* 86) with the name, followed by the date of death and then the age of death. Other aspects of the plate's decoration were less clear. The overall form is perhaps more similar to Spitalfields type 112, rectangular with an arched section at the top. The one example of this form at Spitalfields was dated to 1757 (*op cit* Appendix D, 146). There are scrolled foliage motifs at the bottom of the plate, but it was not possible to determine what motifs were used on the sides and top section.

The *depositum* plate associated with Skeleton 592 (coffin 591, grave 590; Plate 19) was very fragmentary and did not survive lifting, but was recorded on site. The shape was a plain shield, similar to a type dated to 1828 at Spitalfields (*op cit,* microfiche 47). This date is consistent with the evidence from St Martin's, Birmingham, where the shield was the most common form used (Hancox 2006, 158-9, fig 116 type 1). This simple shield type is dated there to between 1827 and 1862, when it rapidly went out of use. Traditionally the use of a shield was associated with burials of boys or young men, though this convention was not rigidly followed (Litten 1991, 109), particularly from the early 18th century on (Hancox 2006, 157-8). The convention was not followed at St Martins or Spitalfields (*op cit,* 158), and the presence of a shield on at least one female burial at Holy trinity indicates that it was not followed here.

A very corroded *depositum* plate was found with the mother and infant burial (Skeletons 1143 and 1144). The form and decoration of this could not be clearly defined. Another very corroded example came from grave 1043 (Skeleton 1044).

A number of other fragments of coffin fittings were recorded (Tables 9 and 10). These included numerous fragments of embossed, press-moulded plate, probably including pieces from escutcheons, lid motifs and other decorative mounts. Four fragments of press-moulded tin/tin plate lettering with black paint were associated with Skeleton 926 (coffin 925), including a D embossed with foliage motifs (Fig 25).

Figure 25: example of press-moulded tin/tin plate lettering, context (925)

5.3.5 Coffin fittings: Upholstery pins and coffin nails

280 upholstery pins or studs were identified (Table 11), characterised by a much shorter shaft than the other nails recorded. All were in iron apart from a single copper alloy example found in the topsoil. These pins or studs had a primarily functional use, to attach the upholstery, but were also used to decorate the coffin. The use of upholstery was common from the mid-17th century; all the coffins at Spitalfields, for example, were upholstered (Reeve and Adams 1993, 83). The examples from Holy Trinity mainly had rounded heads, ranging from 10mm to 18mm in size, but some examples with diamond-shaped or rain-drop shaped heads were also noted. Many of the pins were corroded, some having fused together. They were found in 17 burials, the largest numbers coming from coffins associated with Skeletons 1136, 481, 1135, and 210.

Skeleton Association (associated dating)	material subtype	count	weight(g)	% count
103 (mid 17th-mid 18th)	iron	5	6	2%
120	iron	2	21	0%
125	iron	1	1	0%
210	iron	21	23	8%
470 (mid 18th-1880)	iron	11	31	4%
485 (mid 18th-mid 19th?)	iron	3	15	1%
491	iron	55	187	20%
545 (mid 18th-1880)	iron	5	36	2%
550 (mid 18th-1880)	iron	8	40	3%
570	iron	15	13	5%

573 (mid 17th-mid 18th)	iron	2	8	1%
926 (mid 18th-1880)	iron	5	4	2%
1028	iron	10	46	4%
1068 (mid 18th-mid 19th?)	iron	1	3	0%
1100	iron	12	76	4%
1135	iron	23	99	8%
1136	iron	56	325	20%
Churchyard soil (301)	iron	44	160	16%
Topsoil (300)	copper alloy	1	2	2%
total		280	1096	

Table 11: summary of upholstery pins by burial

Coffin nails were recovered from 37 graves (Table 12). They were sometimes the only coffin fittings associated with a burial. The largest numbers came from the graves of Skeletons 969, 491, 888, 1136 and 1135 (the latter badly corroded, so weighed but not counted).

Skeleton Association	context	count	weight(g)
103	103	2	15
117	117	8	27
120	119	9	34
120	120	1	1
210	211	1	4
331	331	14	102
337	338	3	7
346	346	2	4
349	349	7	31
375	376	3	25
409	410	1	3
421	422	5	27
437	452	14	84
440	441	5	36
458	459	4	27
470	471	5	34

485	486	13	48
491	492	45	165
512	513	4	12
545	236	1	1
545	547	8	71
550	551	1	3
570	571	1	3
573	574	2	8
614	615	2	13
888	889	48	156
891	892	7	12
906	907	18	56
926	925	178	558
969	977	1	4
1028	1029	4	32
1044	1043	6	20
1055	1056	2	4
1068	1069	1	3
1100	1101	2	11
1135	1164	na	277
1136	1134	38	187
1143 / 1144	241	2	14
1143 / 1144	1142	8	24
1238 (nails)	1238	6	57
total		482	2200

Table 12: summary of coffin nails by burial

5.3.6 Artefacts from interments

A small number of other artefacts appear to have been deliberately deposited with the human remains. Fine copper alloy pins were associated with 12 inhumations, presumed to have been used on the winding sheet/shroud or other grave clothes. The pins ranged in length from about 15mm to 55mm (Fig 26), though most were less than 30mm long. A couple of the longer examples were bent, but it is not clear whether this is accidental or a product of their use. Some of these were from graves with no associated coffin fittings (skeletons 392, 482, 602, 1212), suggesting that

coffins either had not been used or, if present, were joined with pegs rather than nails. Both suggest an earlier date. Some of these contained residual sherds from 12th-14th century cooking pots and fragments of medieval tile and glass. One of these graves (Skeleton 390) produced a copper alloy pin and stud, both with fabric still attached, along with a copper alloy aglet from a ribbon or lace end. Other pins were associated with coffin nails and other fittings indicative of a coffin. One came from the grave of Elizabeth Smith who died in 1854. A further copper alloy aglet was found with Skeleton 103 (fill 102), dated to the mid-17th-mid 18th century. Another grave (Skeleton 596) produced a D-shaped buckle with fabric attached (Fig 26), found on the pelvis so presumably from a belt.

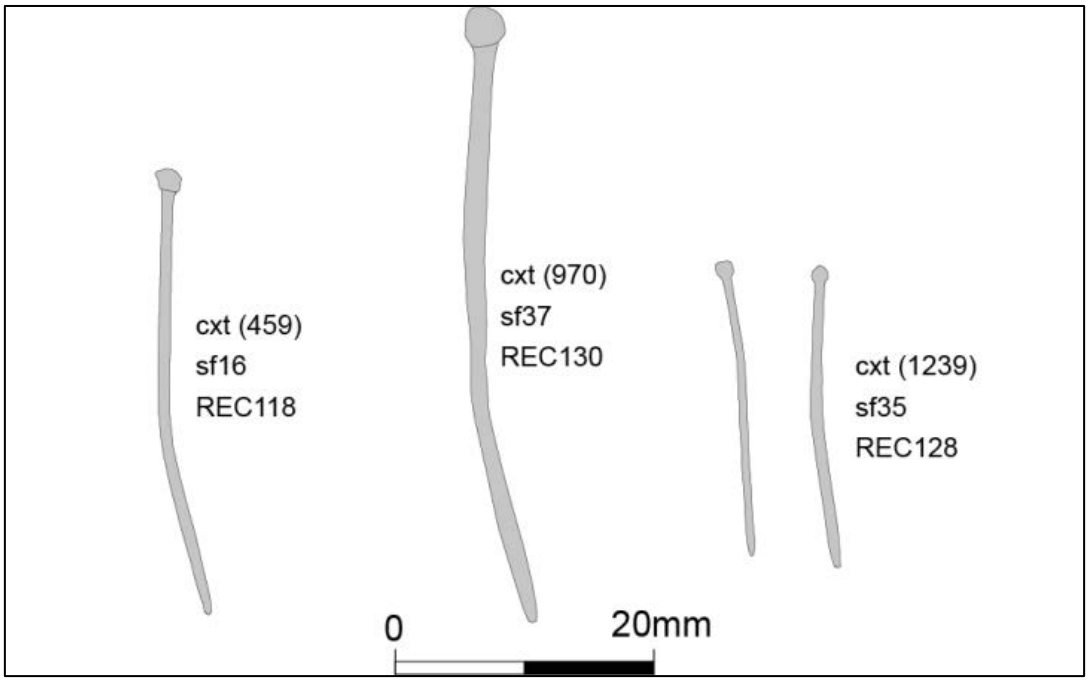

Figure 26: examples of shroud pins

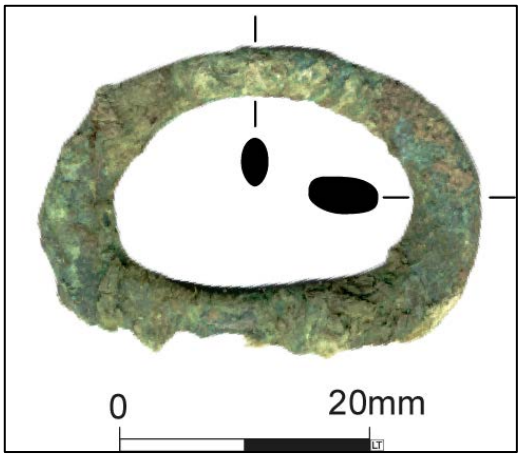

Figure 27: Simple D-shaped buckle in copper alloy, Skeleton 595, 596, sf 20, Record no 105

Skeleton Association (coffin fittings)	count	weight(g)
331 (coffin nails)	2	0.5
378	1	1
390	1	0.5
392	1	0.5
440 (coffin nails and grip plate frags)	1	0.5
458 (coffin nails	1	0.5
470 (coffin grip, plate, stud and nail)	2	1
482	4	2
545 (coffin fittings mid 18th-1880)	1	0.5
969 (coffin fittings, Elizabeth Smith d 1854)	1	0.75
1212	6	1.5
1238 (coffin nails)	2	0.5
total	26	

Table 13: summary of shroud pins by burial (burials with coffin fittings shaded grey)

The only other artefacts that appear to have been deliberately buried with the corpse were four coins. Three were halfpennies, all very corroded but identified as either Charles II or possibly much later George III halfpennies (Angie Bolton pers comm), providing a broad date range from *c* 1663 to 1820 for the burials with which they were found. All three coins had fragments of textile attached, suggesting that they were been placed over the eyes, above a face cloth. Two were with Skeleton 437 (fill 438) (Plates 26 and 27), both displaced to the chest, and the other with Skeleton 888, also displaced. The fourth coin came from the fill of the grave for Skeleton 523 (fill 524). This was a silver penny of Elizabeth I, minted between 1558 and 1603 (Angie Bolton pers comm; Plate 37). This is the only find from the site definitely to have been in use during Shakespeare's lifetime.

Plate 37: silver penny of Elizabeth I, minted between 1558 and 1603, context 524

Another find of interest was a folded, lead, decorative plaque found in the general churchyard soil (Fig 38), which could not be identified with certainty but could be a pilgrims badge, a seal matrix, or a cloth seal (Angie Bolton, pers comm). It could not be attributed to a specific grave, though there were lots of intercutting graves in the vicinity, but it is likely to relate to funerary practices on the site. Folded over tokens, sometimes inscribed with a name or message, are known from burials elsewhere, for example a folded 'love token' was found in a childs grave at Bow Baptist church burial ground in Tower Hamlets, London (Richardson 2013, 97). 'Love tokens' were usually made from legal tender coins that had been rubbed or sanded smooth and then engraved. The token here does not fit neatly into this category; it is not a coin, there is no evidence for deliberate smoothing or an inscription. The folding of the token must, however, share the same significance. The plaque is unusual in being decorated in high relief with. The flower motifs suggest a late 17th to 18th century date (Angie Bolton, pers comm).

Plate 38: Folded, decorative plaque, Churchyard soil 301, Record no 299

5.3.7 Finds associated with domestic activity in the vicinity

Medieval and post-medieval pottery

Most of the pottery appears to have been re-deposited, with over half of the assemblage (Table 14; 61% by count) coming from graves. For this reason it was only recorded to broad fabric groups, using the Warwickshire type series (Soden and Ratkai 1998), with diagnostic forms being noted for dating purposes but not quantified.

Feature type	count	weight(g)	period
Alluvium	1	8	medieval
Backfill	1	5	late medieval/early post-medieval
Grave	44	273	medieval
	1	25	late medieval/early post-medieval
	1	4	late medieval/post-medieval
	2	41	post-medieval
Churchyard soil	12	141	medieval
	1	5	late medieval/early post-medieval
	5	94	post-medieval
Pipe	2	24	post-medieval
Pit	1	4	medieval
	2	7	late medieval/post-medieval
	2	6	post-medieval
Topsoil/overburden	2	57	medieval
	1	6	late medieval/post-medieval
	1	46	post-medieval
total	79	746	

Table 14: pottery by feature type and period

Most sherds (76% by count) dated to the medieval period, with sandy cooking pots (SQ) by far the most common type (Table 15). These will include a range of fabrics dating broadly to the 12th to14th century. A single sherd in a shell and limestone tempered ware (SC) was found in the churchyard soil (301). There were very few medieval jugs, all in sandy glazed wares (SG). Two body sherds from 13th to 14th century Brill/Boarstall ware (Fabric SG20) were found in separate graves, associated with skeletons 1238 (fill1239) and 864 (fill 865). The first of these was associated with another sherd of sandy glazed ware (SG), not identified to source but not Brill/Boarstall. The sherds of late medieval sandy oxidised ware (SLM) dated to the 15th to 16th or early 17th century. These were represented by sherds from open forms, such as bowls and possibly a dripping dish. One was associated with a grave (Skeleton 1110, fill 1111) but the others came from the churchyard soil (301) and the backfill of a construction cut (fill 1153).

Only a handful of sherds of post-medieval pottery were recovered. The six sherds of early Midlands black ware (Fabric MB01) dated to the 17th century. Where identifiable, these were all from drinking vessels, including bases from two mugs. Only one of these was associated with a grave (Skeleton 906, fill 907), the others coming from fills associated with pits (fills 608, 497), a pipe (fill 952) and the churchyard soils. The two sherds of later tradition Midlands black ware (Fabric MB02) were both from pancheons, dating to the 17th to 18th century. One came from an unexcavated grave (1046, backfill 1047) but the other was from the topsoil (300). The other sherds of post-medieval pottery came from churchyard soils (301, 950). The Midlands Purple (MP) dated

broadly to the 15th to 17th century, the Midlands Yellow (MY) to the mid-16th to early 18th, and the Pearlware to the late 18th to mid-19th century.

period	fabric code	fabric common name	count	% count	weight(g)	% weight	average weight
medieval	SC	shell & limestone cooking pot	1	1%	19	3%	19
	SG	sandy glazed jug	1	1%	12	2%	12
	SG20	Brill/Boarstall ware	2	3%	4	1%	2
	SQ	sandy cooking pot	56	71%	448	60%	8
late medieval/ early post-medieval	SLM	late Medieval sandy oxidised ware	3	4%	35	5%	12
late medieval/ post-medieval	CIST	Cistercian ware	4	5%	17	2%	4
post-medieval	MB01	early Midlands blackware	6	8%	69	9%	12
	MB02	Midlands blackware later tradition	2	3%	64	9%	32
	MP	Midlands purple	1	1%	52	7%	52
	MY	Midlands yellow	1	1%	21	3%	21
	PLW	Pearlware	1	1%	1	0%	1
	stoneware	stoneware	1	1%	4	1%	4
total			79		746		9

Table 15: pottery by period and fabric group

Clay pipe

Sixteen fragments of clay pipe were recovered, mainly stems and mainly associated with the topsoil, general churchyard soils and other modern deposits. Three stem fragments were recovered from graves, associated with skeletons 337, 378 and 485. The only near-complete bowl was found in a modern layer (200). This long bowl has curving sides and a lip nearing parallel with the stem. The base of the bowl is missing so it is uncertain whether this originally had a flat base or a spur. The type broadly dates from c 1660 to c 1730 (Oswald 1975, fig 3G, 7-9, fig 4G 20). The only other bowl fragment was too small to be diagnostic and was found in the topsoil (300).

Other finds

Other finds relating to general activity comprised a post-medieval key, found in the churchyard soil (301), and fragments of bottle glass, one from a grave (Skeleton 381, fill 382) and the others from the topsoil and churchyard soil (300, 301).

5.3.8 Building materials, by Rob Hedge

The last category of finds comprised assorted building materials derived from the church, re-deposited during rebuilding. Finds included architectural stone from the windows, along with fragments of lead came and window glass, some of the latter painted; fragments of medieval floor tile; fragments of general brick and tile, not closely datable; fragments of roof tile; and fragments of

modern land drain (Table 16). The fragments of sandstone windowframe, window glass and lead came were probably deposited in the mid-20th century when renovation work was undertaken on the south clerestory. The modern drain included a complete, horseshoe-shaped land drain (cf Tarlow 2012, fig 2.7) dating to the late 18th to early 19th century, found in service trench 1273 (fill 1277). Brief summaries of the medieval tile and glass and the building stone are included below.

object specific type	period	material class	feature type	count	Weight (g)
architectural stone	medieval	stone	Pit	16	90322
	medieval	stone limestone?	Churchyard Soil	1	482
	medieval	stone	Modern Layer	1	1502
brick	medieval/ post medieval	ceramic	Grave	1	6
	medieval/ post medieval	ceramic	Churchyard Soil	5	840
	post-medieval/ modern	ceramic	Brick Tomb	1	4010
	post-medieval/ modern	ceramic	Grave	1	1196
	post-medieval/ modern	ceramic	Pit	1	3716
	post-medieval/ modern	ceramic	Tomb	1	3652
	post-medieval/ modern	ceramic	Wall	1	1282
brick/tile	post-medieval	ceramic	Grave	2	56
	post-medieval/ modern	ceramic	Pipe	1	2
floor tile	medieval	ceramic	Grave	32	2925
	medieval	ceramic	Churchyard Soil	56	7544
	medieval	ceramic	Modern Layer	1	163
	medieval	ceramic	Pipe	6	2078
	medieval	ceramic	Pit	8	961
	medieval	ceramic	Skeleton	2	176
	medieval	ceramic	Topsoil/Overburden	10	1517
	modern	ceramic	Topsoil/Overburden	2	328

	post-medieval?	ceramic	Churchyard Soil	1	34
land drain	modern	ceramic	Modern Service	1	3600
	modern	ceramic	Modern Service	1	217
roof tile	medieval	ceramic	Churchyard Soil	1	244
	medieval/ post-medieval	ceramic	Pipe	3	3185
	modern	ceramic	Modern Layer	1	43
	post-medieval	ceramic	Grave	2	163
	post-medieval	ceramic	Churchyard Soil	2	847
	post-medieval	ceramic	Pit	1	344
	post-medieval	stone	Churchyard Soil	4	562
	post-medieval	stone slate	Churchyard Soil	2	67
	post-medieval	stone slate	Topsoil/Overburden	1	28
tile	medieval/post-medieval	stone	Grave	1	100
window	medieval	glass	Skeleton	1	2
	medieval	glass dark		1	2
	medieval	glass dark	Grave	17	10
	medieval	glass dark	Churchyard Soil	24	62
	medieval	glass dark	Pipe	5	na
	medieval	glass dark	Skeleton	6	5
	medieval	glass dark green	Grave	2	2
	medieval	glass green	Topsoil/Overburden	1	na
	medieval	glass pale green	Coffin	1	1
	medieval/ post medieval	glass green	Grave	3	na
	medieval/ post-medieval	glass green	Grave	1	na
	medieval/ post-medieval	glass green	Pipe	28	na
	medieval?	glass dark	Churchyard Soil	6	8
	medieval?	glass dark	Pipe	3	na
	medieval?	glass dark green	Grave	1	1

	post-medieval	glass pale green	Grave	4	2
	post-medieval	glass pale green	Churchyard Soil	1	0.5
	post-medieval	glass pale green	Topsoil/Overburden	3	na
	post-medieval/ modern	glass clear	Grave	1	1
	post-medieval/modern	glass clear	Pipe	1	na
	post-medieval/ modern	glass clear	Pit	17	na
	post-medieval/ modern	glass dark		1	0.5
	post-medieval/ modern	glass pale green	Coffin	1	0.5
	post-medieval/ modern	glass pale green	Grave	1	3
window came	medieval/ post-medieval	metal Pb		1	5
	medieval/ post-medieval	metal Pb	Grave	1	3
	medieval/ post-medieval	metal Pb	Modern Service	5	46

Table 16: summary of building materials by type and feature type

Medieval floor tile

A total of 118 pieces of floor tile were recovered, with a total weight of 15.7kg; all bar three pieces were medieval in date. Most were extensively worn and fragmentary, making identification difficult. A brief summary of key features of the assemblage follows.

Six of the tiles exhibited traces of two-colour decoration, of which four are shown in Plates 39: 22 of the remainder were either plain glazed, in several shades of mid and dark green, yellow, and black. The remainder had no visible traces of glaze remaining on the upper surface, but many of these exhibited traces adhering to the edges and undersides, indicating that the glazed surface had been worn away through use, and it is likely that the entire assemblage was originally glazed.

The tiles ranged in thickness from 16mm to 36mm, though most fall within a range of 21mm-28mm. Some of the thicker fragments appear 'blown' as a result of poor firing, although one 36mm example appears to be intentionally thick.

Several forms are evident: square 'pavement' tiles and triangular edging tiles are predominant, with one small example of a narrow rectangular edging tile. One example exhibits a more complex stepped diagonal shape, but the crude nature of the cut edge suggests that this represents an alteration 'in-situ'. With few complete examples it is difficult to ascertain original sizes: one plain green-glazed example measures 122mm square, and is 26mm thick. Another plain yellow-glazed square tile was 127mm wide and 27mm thick (Plate 40). The three triangular examples with at least one intact edge are in the form of isosceles right triangles with opposite/adjacent edges measuring 108-110mm (Plate 41).

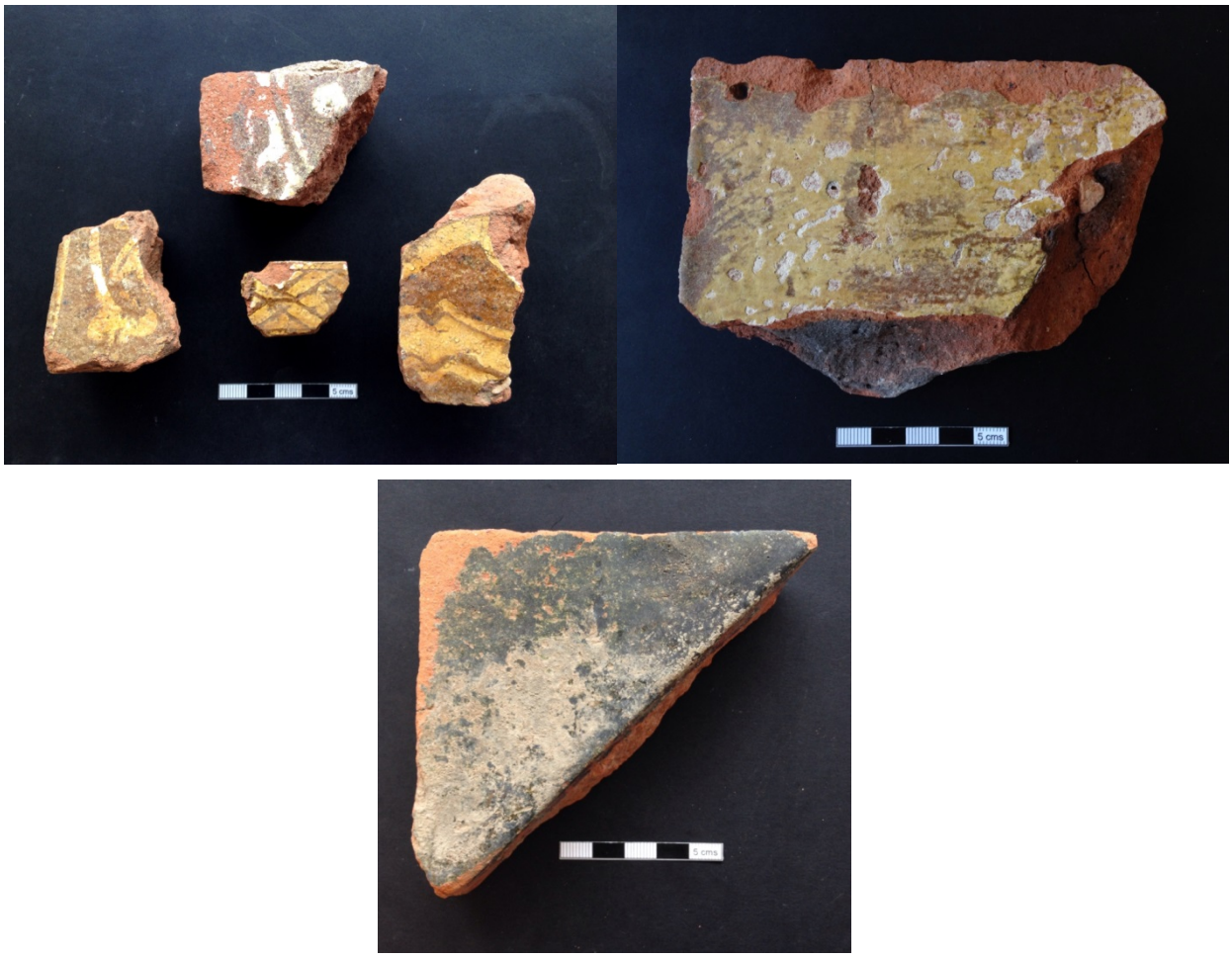

Plate 39 (top left): Medieval decorated floor tiles
Plate 40 (top right): Medieval plain-glazed square floor tile
Plate 41 (bottom): Medieval plain-glazed rectangular floor tile

Where visible, and not obscured by mortar or splashes of glaze, the undersides all appear to be sanded; none display signs of keying. The majority have bevelled edges, angling in towards the base to allow the tiles to be set edge-to-edge without mortar showing. The majority of bevelled edges are at around an 85° degree angle to the upper surface, although several of the plain-glazed square tiles have edges bevelled sharply at around 65-70°.

Many of the tiles show signs of reduction in the centres and in the middle of the upper surfaces (Plate 42). This is generally thought to be an indication of a pre-15th century date (L Griffin, pers comm).

Among the decorated pieces, the sole example which could be definitively ascribed to a known pattern is a fragment of edging tile (Plate 43) from context (1050), which matches Eames' design 1251, previously known from Hailes Abbey in North Gloucestershire, where it is dated to the early 14th century. Eames (1980) notes that tiles in designs identified at Hailes have also been recovered from sites including Bordesley Abbey in Worcestershire, and Tanworth and Kenilworth Abbey in Warwickshire, concluding that *'in the early decades of the 14th century some very beautifully designed and well-made inlaid tiles were being made and were used in North Gloucestershire, Worcestershire and Warwickshire'* (Eames 1980, 166).

Plate 42 (left): Worn floor tile: reduction in centre and upper surface, indicating likely pre-15th century date

Plate 43 (right): Early 14th century edging tile, Eames design 1251

The examples at Bordesley appear to have been fired at Bordesley itself (Hughes, Stopford and Wright 2001); this origin also accounts for some of the examples found at Hailes, though others were fired locally. This indicates that tiles of this design were produced at various locations throughout the region in the early 14th century for ecclesiastical markets. It is known that the north aisle of Holy Trinity saw extensive reconstruction between 1312 and 1316, and the south in 1332; either of these phases of works would account neatly for the presence of tiles of a Hailes design.

It is noted that medieval tiles are reported to survive within the church, on the floor of the sanctuary, alongside 19th century replicas (Horsler 2010, 65). Without close inspection, it is difficult to verify this: however, those examples photographed in Horsler (*ibid*) appear from the fresh condition, crisp patterns, and designs, to be of 19th century origin. Several examples of 19th century replicas were discovered in the course of these works (Plate 44); although fragmentary, one is readily identifiable as matching one of the designs from the sanctuary.

Plate 44: 19th century replicas of medieval floor tiles

A detailed examination of the range of fabrics was not possible within the constraints of this project. All were sandy, with occasional small to medium-sized quartz inclusions. Many of the plain glazed tiles with heavily-bevelled edges contain occasional small iron-rich (slag or ironstone) inclusions, and are presumed to be a distinct fabric. A third fabric, hard fired with the addition of small red grog-like inclusions, accounted for several small undiagnostic fragments.

Given the limitations of this analysis, it is recommended that the assemblage be retained to allow for further study. Specifically, a comparison of fabrics to other assemblages containing Hailes-type designs in the region, such as Kenilworth and Bordesley, may prove fruitful.

Window Glass

A total of 128 small fragments of window glass were identified, along with 7 pieces of lead window came. None of the latter were sufficiently intact to be diagnostic. The condition of the glass was generally poor. 68 pieces of medieval glass were identified, along with 32 fragments ascribed a broad medieval or post-medieval date. The remainder were later post-medieval (8) or post-medieval/modern (22).

All of the medieval glass appears to be non-durable green potash glass, and the majority was much-degraded: almost all fragments were de-vitrified and many were extensively pitted. In thickness, they ranged from 2-4mm. Eighteen fragments show traces of reddish-brown painted decoration, characteristic of English glass-painting between the 12 and 15th centuries. One small piece (S.F.6) appears to show a two-colour decoration, with reddish brown paint and what may be the badly-degraded remnants of a white enamel: this would indicate a date not earlier than the 16th century.

Of the single-colour decorated examples, a number are illustrated in Figure 26: of particular note are fragments from S.F.11 containing small elements of several painted inscriptions; although not readily identifiable, they are stylistically consistent with a 13th to 15th century date.

Two unillustrated examples from context (950) are worthy of mention: one contains a possible trefoil reserved against a red-brown wash, and the other a diamond pattern in red-brown paint. Precise dating is rendered difficult by the condition and size of the fragments, although parallels for the former could be drawn to the style of decoration and trefoil-like design in 13th to 14th century painted glass from Victoria Road, Winchester (Cool 2008, 299). The latter resembles cross-hatched decoration on glass quarries from Deansway, Worcester (Brown 2004, 452: fig 252:11), of 14th century date.

Although the condition is poor, several of the better-preserved examples of plain green medieval glass resemble the late 15th century glass surviving in the north clerestory of the church, illustrated in Horsler (2010, 42-5).

Given the limitations of this analysis, it is recommended that the assemblage be retained to allow for further study.

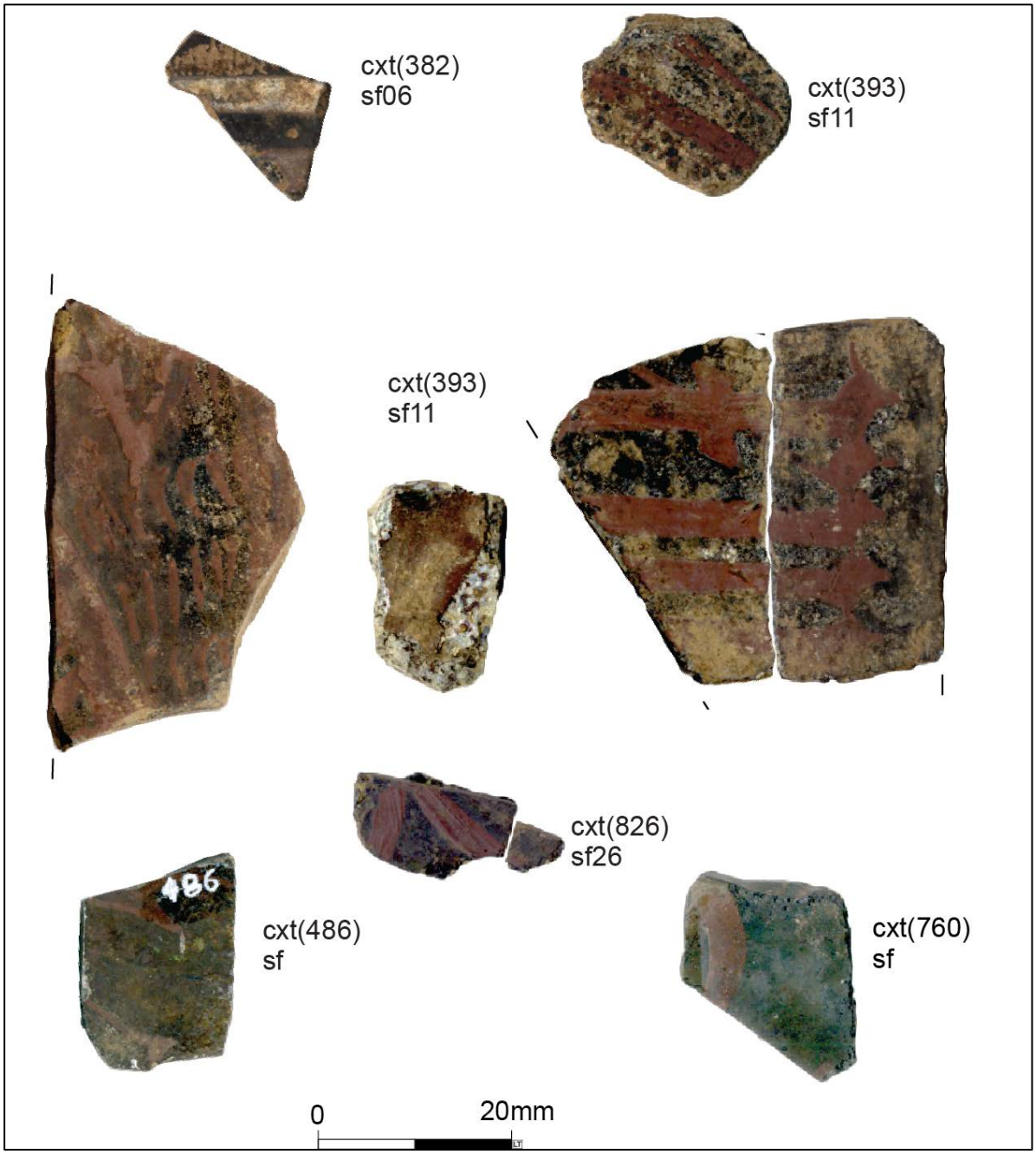

Figure 26: examples of painted window glass

Building stone

A total of eighteen fragments of architectural building stone, weighing 92.3kg, were recovered. Of these, the majority (sixteen pieces) came from pit (325), and appear to represent elements removed during the replacement of windows. Most comprised mullion fragments (Plate 45), but a spandrel (Plate 46) and a ledge fragment were also present. Several different forms of tracery were evident; the stonework is Perpendicular in style.

Plate 45: Fragment of sandstone window mullion

Plate 46: Fragment of green sandstone spandrel

The restoration of the late-15th century Perpendicular windows of the south clerestory during the mid-20th century may account for this material. Several different phases, and sources of stone, are evident, although a detailed analysis was not possible within the constraints of this project. Seven mullion and spandrel fragments in soft, abraded green-grey sandstone (Plate 47) may represent the original 15th-century masonry. Also present were nine unabraded mullion and ledge fragments of crisp, reddish-grey mica-rich sandstone; these appear relatively recent in origin, although extensive chisel marks attest to the removal of glass windows that had evidently been installed into

the mullions' central grooves. Mason's layout marks are evident on a number of these latter pieces (Plate 48).

Plate 47 (left): Well-weathered green sandstone tracery, probably from late 15th century South Clerestory
Plate 48 (right): Detail of mason's layout marks and traces of pigment: centre line (top) and cross (bottom centre)

The two remaining examples comprise an undiagnostic fragment of green sandstone tracery, and a small decorative piece of oolitic limestone, possibly a tomb fragment.

5.3.9 Artefactual synthesis

The most unexpected and interesting find was a loomweight dating to 8th-10th century, which provided a glimpse of life associated with the 9th century minster church.

Analysis of the burial finds provided useful dating evidence for the interments examined, allowing the complex sequence of burials to be phased. The long sequence of use of this site allowed the changing burial practices to be assessed. The coffin fittings revealed the changing modes of production and fashions in this poorly studied class of material. The 17th-18th century burials used forged fittings, probably made in small local workshops, similar to contemporary material published from Hereford Cathedral Close (Boucher *et al* 2015). The 18th -19th century fittings reflected the expanding commercial trade in funerary artefacts. Manufacturing techniques changed, with increasingly ornate cast and press-moulded fittings which had parallels with contemporary finds from Spitalfields (Reeve and Adams 1993). In one case, a breastplate provided the name and date of death of the individual interred. There were very few objects interred with the burials; a handful of pins and aglets associated with shrouds; 4 coins, displaced but presumed to have been placed on the eyes of the deceased; and a folded love token. All these finds add to the slowly growing body of evidence for post-medieval burial practices in Britain.

The other finds were of less significance; Fragments of building stone, glass and tile attest to multiple phases of rebuilding and renovation work at the church, with the medieval floor tile indicating possible links to an early 14th century decorative tradition previously identified at a number of other ecclesiastical sites across north Gloucestershire, Worcestershire and

Warwickshire. A background scatter of pottery and clay pipe reflects more general domestic activity in the vicinity.

5.4 Human osteology analysis, articulated remains, by Gaynor Western

A total number of 304 inhumated articulated individuals were exhumated from churchyard at the Holy Trinity, Stratford-upon-Avon. The burials spanned from the early Medieval to the Post-Medieval periods (c.1066 – 1880). From the dating evidence, the burials were split into two groups for the purposes of the osteological analysis in order to allow the data to be comparable to other contemporary assemblages. The 'Early' burials numbered 45 while there were 259 'Late' burials in total.

In addition, a large assemblage of disarticulated elements was also excavated and is reported on separately below. Only one individual, sk(969) could be identified from an associated coffin name plate. All the other articulated individuals were anonymous.

5.4.1 Condition of the skeletal material

The condition of the skeletal material was analysed macroscopically assessed and graded according to those guidelines set out by Brickley and McKinley (2004). Since most of the skeletons exhibited more than one grade of state of preservation, these categories were simplified into 3 main groups of preservation: Good (grades 0-2), Fair (grades 2-4) and Poor (grades 4-5+).

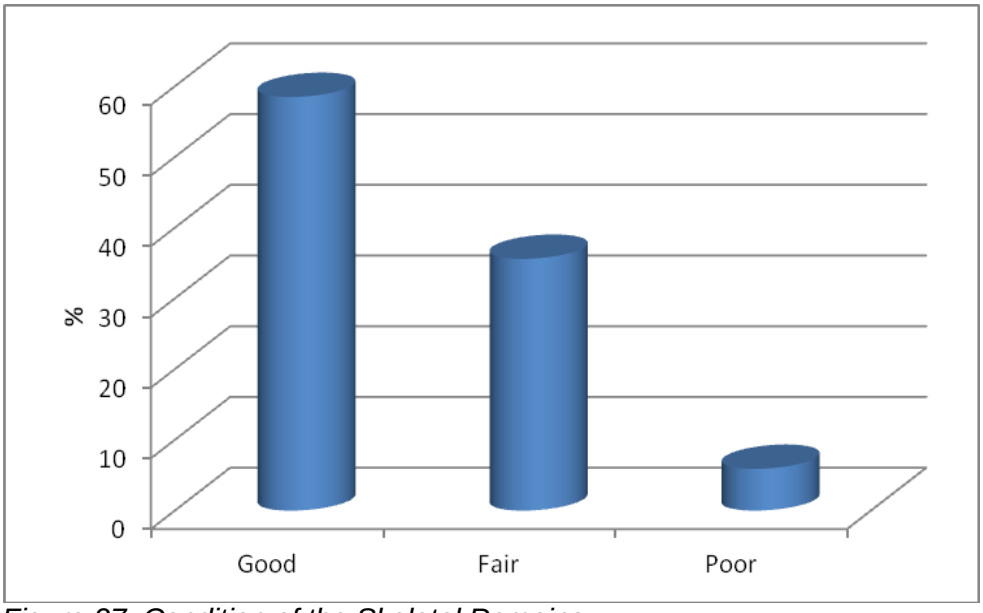

Figure 27: Condition of the Skeletal Remains

Overall, 58.5% (n=178) of the skeletons analysed were classified as being of 'good' condition, with 35.6% (n =108) being considered to be in a 'fair' state of preservation and 5.9% (n=18) being assessed as in 'poor' condition (Figure 27). The human skeletal remains were generally sufficiently preserved to allow observation of joint and bone surfaces for the analysis of pathological conditions as well as metric analysis for both the assessment of stature and morphometric variation in adults in addition to age assessment in sub-adults. Age was not a factor in the state of preservation, with 60 sub-adults having been recorded as being in 'good' condition compared to only three observed as being in a 'poor' state of preservation.

The state of preservation was not affected by the chronological age of the remains overall, with a similar representation of 'fair/good' condition and 'poor' condition of the skeletal remains present in both the Early and Late assemblages (Table 17).

Condition	Early (n)	Early (%)	Late (n)	Late (%)
Good	30	66.7	148	57.1
Fair	15	33.3	93	35.9
Poor	0	0.0	18	7.0
Total	45	100.0	259	100.0

Table 17: Comparison of the Condition of the Skeletal Remains from the Early and Late Samples

5.4.2 Completeness of the Individuals

This is a guide to the overall completeness of the individual's skeletal remains and is calculated according to the percentage of the bones present in relation the total number of bones in a complete human skeleton. Completeness of remains is gauged through an assessment of the amount of material representing different areas of the body. A complete skeleton comprises: Skull = 20%, Torso = 40%, Arms = 20% and Legs = 20%. Each area of the skeleton was assessed and then placed into the following four categories of completeness: 75%>, 50-75%, 25-50%, <25% (Buikstra and Ubelaker 1994).

Recording the completeness of the individual can allow an insight to be gained into how much post-depositional activity has occurred as well as to assess how much information can potentially be gained from the remains. Figure 28 below illustrates that only 17.1% (n = 52) of the skeletons excavated from Holy Trinity churchyard were more than 75% complete, while 18.8% were 50-75% complete (n=57), 22.7% were 25-50% complete (n=57) and 41.4% of individuals were only represented by <25% of the skeleton (n=126). Although sub-adult skeletal remains are generally less robust than adult remains (Henderson 1987), age was not a significant intrinsic factor in the completeness of the remains from Holy Trinity churchyard, given that only 22.6% of those individuals being represented by 50% or less of the skeleton were aged as sub-adult. This corroborates the earlier observation made that the condition of the remains was not related to age. The lack of completeness seen in large numbers both in the adult and sub-adult remains, therefore, is likely to have been determined by post-deposition truncation and intercutting of graves rather than environmental conditions on site.

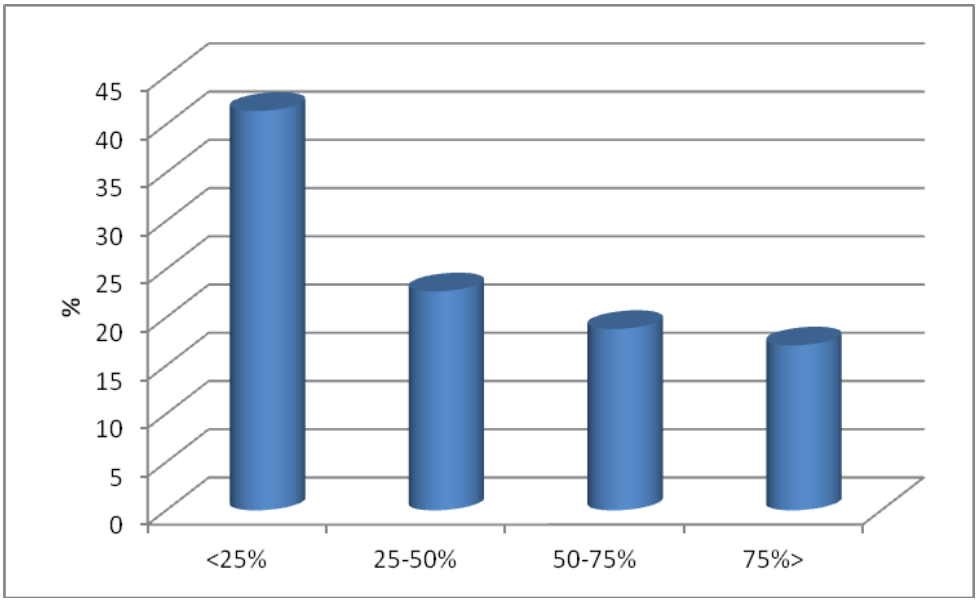

Figure 28: Completeness of Skeletal Remains

Completeness	*Early (n)*	*Early (%)*	*Late (n)*	*Late (%)*
<25%	17	37.8	109	42.1
25-50%	7	15.6	62	23.9
50-75%	9	20.0	48	18.5
75-100%	12	26.6	40	15.5
Total	45	100.0	259	100.0

Table 18: Comparison of Completeness of the Skeletal Remains from the Early and Late Periods

As with the state of preservation of the skeletons, there was no direct relationship between the chronological age of the skeletal remains and their completeness (Table 18). The most frequently recorded category of completeness for both Early and Late burials was '<25%>' and perhaps contrary to expectations, when compared to the total number of skeletons in each sample, relatively more complete Early skeletons were exhumed than Late remains. This may well indicate that some areas of the churchyard were more intensively used than others in the later phases of burial, whereby medieval skeletons remained undisturbed by later burials in less frequently used areas of the churchyard.

5.4.3 Age and Sex Assessment

Establishing the age and sex of individuals from an archaeological assemblage not only provides an insight into the demographic profile of the population but can also be used to inform us of patterns in pathological distributions in the group. Sex was assessed using the criteria laid out by Buikstra and Ubelaker (1984) in the analysis of morphological features of the skull and pelvis. In addition, metric data was also used where possible, taking measurements of sexually dimorphic elements such as the femoral and humeral head (Bass 1995). Categories ascribed to individuals on the basis of this data were 'Male', Possible Male', 'Indeterminate', 'Possible Female', 'Female' and 'Unobservable'. Sex was ascribed on the basis of metrics alone where no sexually dimorphic traits were observable. Where sex was not observable be either metric or morphological observations, it was recorded as 'Unobservable'.

No sexing of sub-adult material was attempted due to the lack of reliable criteria available. Age of sub-adults was assessed, however, using both dental development (Smith 1991, Schaefer *et al* 2009) and eruption (Ubelaker 1989) as well as long bone lengths (Schaefer *et al* 2009) and epiphyseal fusion (Scheuer & Black 2004). These methods can usually provide a reasonably accurate age estimation due to a relatively narrow range of variation in normal subadult development. Thus, sub-adults can be placed into the following age categories: Foetal (<36 weeks), Neonate (0-1 month), Young Infant (1-6 months), Older Infant (6-12 months), Younger Child (1-3 years), Older Child (4-7 years), Juvenile (8-12 years) and Adolescent (13-19 years).

Assessment of adult age at death, unfortunately, results in much less specific age estimates due to a much greater individual variation in the features exhibited by the examined elements at particular ages (Cox 2000). Age estimation of adults was assessed from analysis of the auricular surface (Lovejoy et al 1985) and the pubic symphysis (Brookes and Suchey 1990). Each of these methods examines the deterioration of these surfaces and categorises them accordingly. This deterioration is due in part to due to the health status of the individual but can also be influenced by life-style and so the variation produced by these factors results in much wider age categories: Young Adult (20-34), Middle Adult (35-49) and Old Adult (50+) (Buikstra and Ubelaker 1984). Grading of dental attrition was not used as a supplementary age assessment technique due to the observation that dental attrition during the post-medieval periods does not correlate well with that found in older archaeological assemblages upon which such age assessment methods (i.e. Miles 1963) are based (See Brickley, Berry and Western 2006 and Ogden n.d.). This is thought to be due to the refinement of foods and food preparation methods during the later historical period. Dental attrition does, therefore, not provide a reliable method for age estimation in Victorian populations.

5.4.4 Demographic Profile

The total Early assemblage consisted of 45 individuals, 13 of which were identified as sub-adult (28.9%) and the remaining 32 of which were classified as adult (71.7%). As illustrated in Figure 9 below, of the observable sub-adults, one was identified as 'Young Child', nine as 'Older Child', two as 'Juvenile' and one as 'Adolescent'.

In the Late assemblage, 64 of the 259 individuals were assessed as being sub-adult (24.1%), while 195 individuals were identified as adult (75.9%). Of the sub-adults, three were classified as 'Neonate', two as 'Younger Infant', one as 'Older Infant', nine as 'Younger Child, 21 as 'Older Child', nine as 'Juvenile' and 19 as 'Adolescent'.

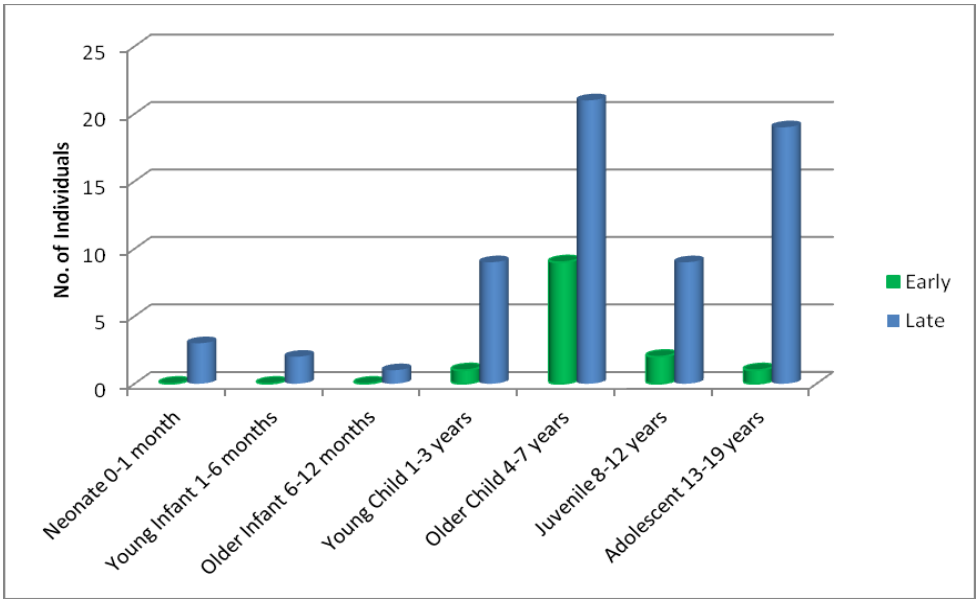

Figure 29: Age Profile of the Sub-Adult Populations

In both the Early and Late groups, more older sub-adults were present than younger ones (Fig 29). In both groups, 'Neonates', 'Young Infants' and 'Older Infants' were poorly represented and 'Younger Children' were also present in low numbers in the Early population. In comparison to the information provided by the historic demographic data regarding infant deaths and burial registers, these age groups are under-represented in the archaeological skeletal assemblage. As indicated by the analysis of the condition and completeness of the skeletons, this is not likely to be due to taphonomic factors on site but rather the intensity of burials and post-deposition truncation of graves in the churchyard.

A large number of the adults in both the Early and Late assemblages could be assigned an age and sex category, despite the incomplete nature of the remains. In the Early population, sex could be ascribed to 30 individuals and an age category to 22 individuals. A total of 22 individuals could be categorised according to both age and sex. Overall, 56.7% of individuals were identified as 'Male/Possible Male' (n=17, N=30) and 43.3% were 'Female/Possible Female' (n=13, N=30). Females, therefore, are slightly under-represented in the Early assemblage. Eight individuals were identified as 'Young Adult' (36.4%, N=22), nine individuals as 'Middle Adult' (40.9%, N=22) and five individuals as 'Old Adults' (22.7%, N=22). It is likely that 'Old Adults' are slightly under-represented, though it is not possible to corroborate this with historical documentation. The demographic profile of the group whose age and sex could both be ascribed indicates that there were fewer females than males in the 'Young Adult' and 'Middle Adult' categories but more females in the 'Older Adult' category (Figure 10). Old adult males, therefore, appear to be under-represented in the Early skeletal sample. This is also likely to be true of the young and middle aged females, though the extent to which this bias has been artificially created by the small sample size is unclear.

Overall, in the Late assemblage, 151 adults could be ascribed a sex, 90 of which were 'Male/Possible Male' (59.6%) and 61 of which were 'Female/Possible Female' (40.4%). As with the Early population, females appear to be under-represented. An age category could be assigned to 100 individuals; 35.0% were identified as 'Young Adults' (n=35), 36.0% as 'Middle Adults' (n=36) and 29.0% as Old Adults (n=29). Again, fewer older adults are present in the assemblage overall. Consistent underestimation of the age of death of adults using osteological methods has been noted to be particular problematic in the identification of middle and old adults (Molleson and Cox 1993). This was also the case at Holy Trinity, where sk(969), known to have been 65 years of age at death, was provisionally estimated as a 'Middle Adult' based on the observation of one auricular surface, though no further evidence for age at death was available for this individual. It may well be that the under-representation of old age adults is at least in part due to osteological aging techniques rather than an actual lack of older individuals in the assemblage.

Of the 195 adults, 90 could be assigned both and age and sex category. Although males and females are approximately equally represented in the young adult age group, there are fewer females than males in the middle adult and old adult age groups (see Figure 31). Sex distribution amongst a population may vary with age and migration but generally populations are found to have a ratio of 1.05 Male: 1 Female, males having a slightly higher mortality rate in all age categories in modern populations (Chamberlain, 2006). It is possible that the bias towards males in the Early and Late assemblages is purely the product of sampling. However, it is interesting to note that there is also an over-representation of males in the Evesham Road Cemetery, where there are 390 men compared to 324 females recorded in the burial registers, a ratio of 1.2:1 males to females. It may be that the apparent surplus of men in the assemblage is due in some part to in-migration via the traditional riverine market trading and seasonal agriculture labouring in and around the town. Comparison of the demographic profile of the post-medieval archaeological assemblage to the Stratford Cemetery sample (Fig 32) indicates a strong degree of correlation in the composition of the two groups, with more old males and young females present both. However, it is clear that a much greater proportion of the cemetery sample consists of old adults.

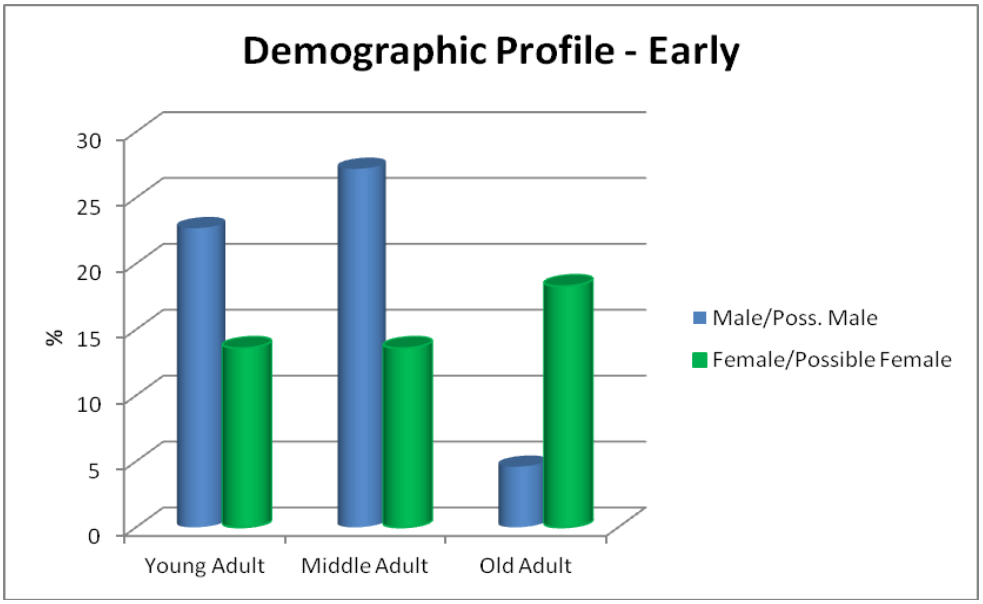

Figure 30: Demographic Profile of the Early Skeletal Assemblage

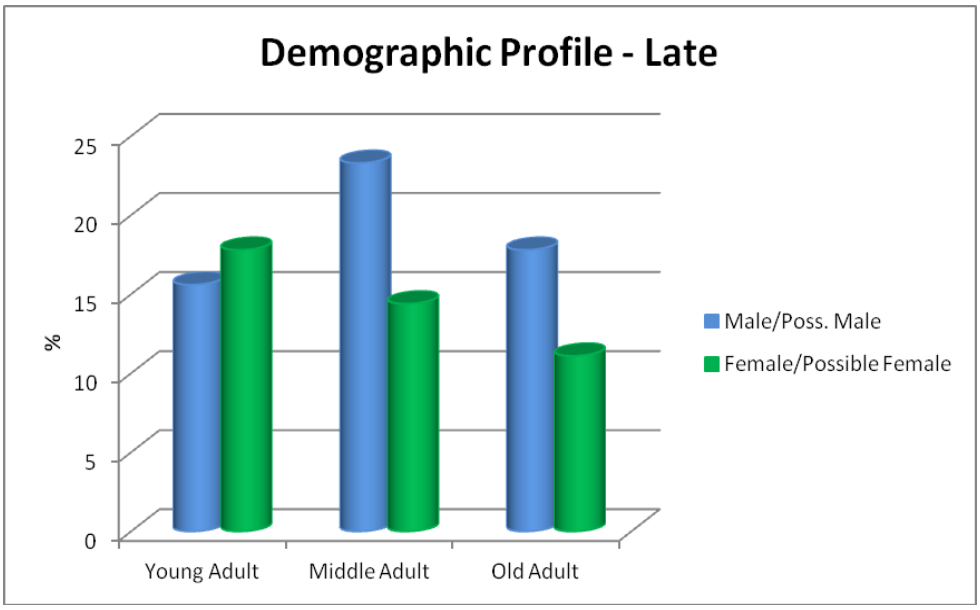

Figure 31: Demographic Profile of the Late Skeletal Assemblage

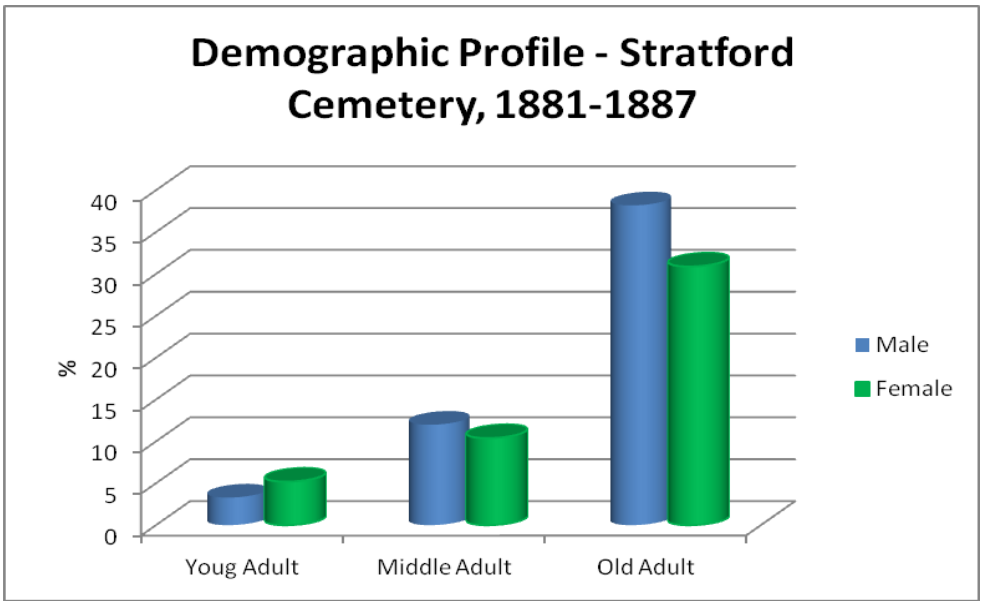

Figure 32: Demographic Profile of Evesham Road Cemetery 1881-1887

5.4.5 Non-metric Traits

Non-metric traits are morphological features that occur both in bone and dentition. These features have no specific functional purpose and occur in some individuals and not in others. The origins of non-metric traits have now been shown to be highly complex, each having its own aetiology and each being influenced to differing extents by genetics, the environment and by physical activity. A review of the current literature suggests that the undetermined specific origins of these traits and the fact that there is more genetic variation within populations than between them can prevent useful conclusions regarding their presence or absence in skeletal remains from being drawn (Tyrell 2000).

The observability and presence of any non-metric traits observed in the assemblage have been recorded in the database provided on the CD-Rom deposited with the archive. Non-metric traits have been recorded for these skeletons in order to allow future comparisons with findings from other post-medieval burial grounds.

5.4.6 Stature and Metric Analysis

Stature of adult individuals can be reconstructed from measurements of long bones of the skeleton. Since the long bones of sub-adults have not yet fully developed it is not possible to provide an estimate of stature for immature remains. Stature is the result of many factors including genetics and environmental influences (Floud *et al* 1990), such as malnutrition and poor health. Height can be used as an indicator of health status and there is a wide range of literature on the relationships between height, health and social status. Estimated stature was calculated by taking the measurements of the individual long bones and using the formula provided by Trotter (1970). Variation in estimated stature can be up to 3cm.

Complete long bones were present in 24 Early individuals for whom stature could therefore be estimated. Twelve of these individuals were male and twelve were female. In the Late population, stature could be estimated for 131 individuals, 66 of whom could be identified as male and 50 of whom as female.

Stature	*Early (N)*	*Early (Avr)*	*Early StDev*	*Late (N)*	*Late (Avr)*	*StDev*
Male	12	1.72m	6.8cm	66	1.71m	5.3cm
Female	12	1.59m	3.4cm	50	1.59m	4.9cm
Total	24	1.66m	8.5cm	131	1.65m	8.0cm

Table 19: Average Stature Estimations for the Early and Late Populations

As is shown in Table 19, the average stature for males and females, and therefore the whole population, of the Early and Late populations were almost identical, with female averages remaining the same from one period to the next while the average male stature decreased by only 1cm. This may indicate that any environmental and genetic contributions towards average height in the Stratford populations remained stable over time. The total range of stature for females from the Early period was 1.54m to 1.67m and for males, 1.61m to 1.82m. In the Late period, the total range of stature estimation for females was 1.48m to 170m and for males, 1.60m to 1.84m.

Roberts and Cox (2003, 220) report that the average height for males from the early Medieval period in Britain is 1.72m for males and 1.61m for females. The Early males from Stratford, therefore, on average attained the same height as the national medieval average whereas the average for females is 2cm shorter. Unfortunately, only two individuals from Kempsey were sufficiently well preserved to obtain stature estimations and the sex of one of these individuals was unobservable. One male was assessed as attaining a height of 1.71m (Western 2015). The mean stature for males from The Chapter House, Worcester Cathedral was 1.72m with a total range of 1.65m-1.80m and for females, the average stature was 1.58m, with a total range of 1.47m–1.68m (Waldron 2011), practically identical to that for Holy Trinity, Stratford.

In the post-medieval period, Roberts and Cox (2003, 308) report that the average height for males in Britain is 1.71m and for females is 1.60m. The estimates from the Late assemblage from the Holy Trinity churchyard are, therefore, very similar. The overall average stature estimate for the Upton-on-Severn is slightly taller, at 1.68cm, though this estimate included only 2 females (Table 6). The average stature estimation for males at Upton-on-Severn was 1.70cm and for females 1.58cm (Western 2014), which is again very similar to the Holy Trinity sample and the national average for the period. The mean stature for males from St Andrew's burial ground, Worcester was slightly shorter at 1.67m (N=7) though approximately the same for females at 1.57m (N=6) (Western 2006). In comparison, the mean stature at Tallow Hill for males was 1.67m (N=2) compared to 1.62m (N=4) for females (Ogden n.d.).

St Andrew's parish is known to have been of generally low socio-economic status compared to the middle class occupants of the vaults at Tallow Hill. Unfortunately, the sample sizes are small and only tentative inferences may be drawn from the data but the stature estimations may indicate that the males from Holy Trinity, Stratford-upon-Avon and Upton were more likely to be taller than their

counterparts in the St Andrew's, possibly reflecting a healthier childhood in a rural environment. The females from the middle class vaults at Tallow Hill are taller than the females from Holy Trinity, Upton and St Andrew's, and this may reflect their higher socio-economic status. The average height for males from St Martin's-in-the-Bull Ring, Birmingham was 1.71m (St Dev. 0.06, N=173) and for females was 1.59m (St Dev. 0.06, N=124) (Brickley, Berry and Western 2006), with no statistical difference observed between individuals in earth cut graves compared to those interred in higher status vaults, highlighting the role that biological variation plays in the overall stature obtained by an individual in addition to the potential socio-economic factors discussed above.

Stature	*Male*	*Female*	*Average*
Holy Trinity, Stratford	1.71	1.59	1.65
Upton-on-Severn, Worcs.	1.70	1.58	1.68
St Andrew's, Worcester	1.67	1.57	1.62
Tallow Hill, Worcester	1.67	1.62	1.65
St Martin's-in-the-Bullring, B'ham	1.71	1.59	1.65

Table 20: Stature Estimations for the Late Holy Trinity Assemblage and post-medieval West Midlands' Assemblages

Craniometric data was also recorded for a limited number of individuals where preservation allowed and is available on the CD-Rom deposited with the archive

Morphometric analysis was also undertaken on the femora and tibiae, where sufficiently well preserved to establish the platymeric and platycnemic indices respectively. These values reflect the cross-sectional shape of the proximal femur and tibia, acting as an indicator of flatness (Bass 1995). Analysis has shown some variation of these values between populations while variation can also related to pathological changes to bone where the diaphysis has undergone remodelling (i.e. residual rickets). The data has been recorded on the database for future comparison with other populations but has also been referred to in relation to some pathological cases in this report.

5.4.7 Diet From Stable Isotope Analysis

Stable isotope analysis was undertaken on a small sample of four individuals as part of the AMS dating analysis undertaken by SUERC. These individuals were found to range in date from 1119AD to 1455AD. Values of $\delta^{15}N$ relative to air and $\delta^{13}C$ relative to VPDB were obtained for sk(228), sk(1258), sk(807) and sk(807) from human bone samples.

Differences in nitrogen and carbon isotopic values are indicative of variation in the composition of diet relating to the intake of terrestrial and marine foods, more specifically protein. Marine environments provide enriched $\delta^{13}C$ and $\delta^{15}N$ compared to terrestrial environments and therefore the isotopic values or marine and terrestrial foodstuffs vary. These isotopes are taken up by human bone after dietary consumption and their values can be detected through stable isotope analysis (Mays and Beaven 2011). Isotope values from bone reflect an individual's diet over the past few years of life, while values from teeth relate to dietary intake during the formation of the tooth crowns during childhood (Tykot 2004).

The results of the analysis are presented in Table 21 below.

sk	$\delta^{13}C$ %0	$\delta^{15}N$%0	*C/N ratio (Molar)*
228	-19.9	11.7	3.3
1258	-19.7	10.3	3.2
807	-19.7	10.4	3.2
1181	-19.8	11.3	3.3

Table 21: Stable Isotope Values

Values of $\delta^{13}C$ are virtually identical for all 4 individuals. The $\delta^{15}N$ values show more variation, though the values for sk(1258) and sk(807) are only slightly above a terrestrial diet. However, the $\delta^{15}N$ values for sk(228) and sk(1181) are indicate that more marine protein was present in the diet of these two individuals.

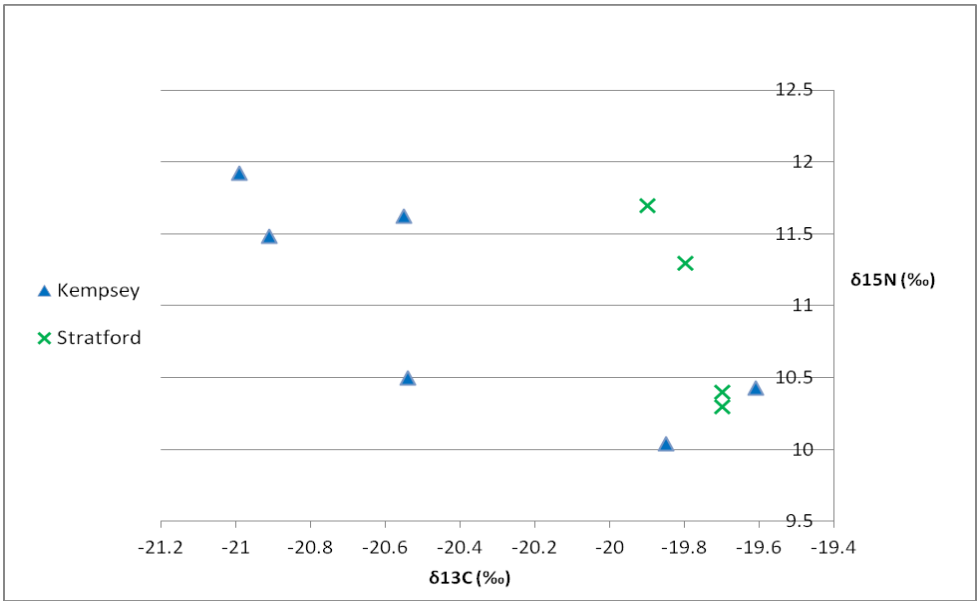

Figure 33: Comparison of Stable Isotope Values from Kempsey and Stratford

Diet Source Values	$\delta^{13}C$ ‰	$\delta^{15}N$‰
Terrestrial Plants	-21.8	4.9
Terrestrial Animals	-20.5	9.9
Eel/Freshwater Fish	-22.5	12.2
Salmonoids/Marine Fish	-13.5	13.0

Table 22: Food Sources and Their Isotopic Values after Mays and Beaven (2011)

Comparison to the average values given by Mays and Beaven (2011) for food sources suggests that the isotopic values from Stratford (Table 22) are indicative of a diet containing more marine protein sources than individuals from Kempsey, Worcestershire. Their research suggested that there was little difference in δ15N values between marine and freshwater fish but that there was a significant difference in δ13C values. Comparing the Stratford and Kempsey to the isotopic values to the data from inland, riverine and coastal Saxon sites, the diet at Kempsey appears to be more typical of that of riverine sites, whereas Stratford is more similar to the coastal δ13C vales and riverine δ15N values (Mays and Beaven 2011). Overall, the diet at Stratford appears to have been largely terrestrial but with some marine foodstuffs included. It should be borne in mind that marine foodstuffs may consist of not only marine fish but also aquatic plants such as seaweed, which may have been consumed indirectly if these formed foodstuffs fed to animals that were then subsequently consumed by humans (Mays and Beaven 2011).

Though we have little historic evidence for foods eaten on a daily basis in Stratford-upon-Avon during the medieval period, accounts detailing feasts held by the Gild of the Holy Cross at Stratford-upon-Avon provide in depth records of food purchased for the feasts during the 15th century, providing evidence of a wide range of foodstuffs that could be obtained at this time should the occasion warrant it (Woolgar 2016). These included geese and pullets fattened on peas and barley, capons (reserved for gentlemen), veal, mutton, rabbit and piglets, goats, dairy foods such as cheese, cream and milk, eggs for making tarts and flans, and a variety of spices and flavourings, often purchased in London, such as pepper, saffron, figs, raisins, almonds, ginger, mace, sanders and cloves. Later, by the end of the 15th century, other flavourings became popular including turnsole, fennel and aniseed and there was an increase in the demand for sugar (Woolgar 2016).

Fish consumption was a popular on feast days in many monastic and religious orders. For example, at the feast of St John the Baptist in 1411 in Winchester, fresh and salt water fish, mullet, bass, ray and fresh conger, as well as side eels, were served with beans and peasecods, spices, onions and cheese (Woolgar 2016). There is no documentary evidence of the accounts of the Gild in Stratford, where goose dinners appear to have been the most popular. However, it is documented that sea-fish could be obtained inland as items of long distance trade; for example, herring was widely available via market stalls in Worcestershire in the early 15th century and eel pasties are documented as being available in market centres in the early 14th century (Dyer 1998).

5.4.8 Skeletal Pathology

Palaeopathology is the study of diseases of past peoples and can be used to infer the health status of groups of individuals within a population as well as indicate the overall success of the adaptation of a population to its surrounding environment. Pathologies are categorised according to their aetiologies; e.g. congenital, metabolic, infectious, traumatic, neoplastic etc. Any pathological modifications to the bone are described. The size and location of any lesion is also noted. Distribution of lesions about the skeleton should be noted to allow diagnosis. A differential diagnosis for any pathological lesions should also be provided. This report presents a summary and discussion of the pathological changes observed; detailed observations recorded for each pathology can be found on the CD-rom included in the archive.

An insight into the nature of skeletal disease present in a population can be gained through examination of the prevalence rates of each type of disease. Prevalence rates can be calculated as a percentage of the count of each case of pathology recorded in relation to the total number of individuals present, known as the Crude Prevalence Rate (CPR), or in relation to the total number of observable and repeated skeletal elements present that could have potentially been affected by the condition, known as the True Prevalence Rate (TPR).

The TPR of a disease is much more accurate and representative of the rate of pathology since this method implicitly controls for the condition and completeness of the skeletal material under analysis. Well preserved skeletal elements are by default more likely to exhibit pathological changes and therefore, comparing prevalence rates derived from poorly preserved assemblages to those from well preserved assemblages can be problematic. The CPR only gives a crude estimate of the disease prevalence rate and where skeletal assemblages have undergone a high level of post-depositional disturbance or are poorly preserved, the CPR can be misleading. However, CPRs are perhaps more representative in the calculation of prevalence rates of diseases which result in pathological changes that are disseminated or generalised throughout the skeleton where lesions are interrelated. Additionally, CPR's are commonly the only comparative data available from many skeletal reports. Where possible and appropriate, both types of rates will be presented here, though it should be remembered that the TPR rates for small assemblages are still only approximate indications of the true rate of each disease.

Not only must be the condition of skeletal remains be taken into account when considering evidence for pathology in archaeological populations but also the fact that more skeletal pathologies are likely to be present in older individuals, who have lived long enough to sustain chronic disease processes. This relates to the phenomenon known as the 'osteological paradox'

whereby those exhibiting skeletal lesions are thought, in actual fact, to represent comparatively 'healthier' individuals in life than those individuals exhibiting no lesions who may well have succumbed to either more virulent diseases that leave no trace in the skeleton or to have died before a potentially observable disease affected the skeleton (Wood *et al* 1992).

Congenital and Developmental Conditions

A disease classified as 'Congenital' is defined as a disease that was present at birth. Several diseases that were considered 'Congenital' are now considered 'Developmental', such as hip dysplasia which is now recognised to develop from the presence of a dislocation or instability of the hip at birth. Most of the diseases considered to be 'congenital' have an underlying genetic component in their aetiology although some are due to environmental factors present prior to birth i.e. diseases transmitted from mother to foetus of a non-genetic origin.

Table 23 below records a summary of the congenital and developmental pathologies observed amongst this population. Overall, 23 elements were recorded as having congenital or developmental pathologies, five of which occurred in the Early population, affecting 4 individuals, while the remaining 18 elements were from the Late assemblage and affected 15 individuals.

In the Early assemblage, one individual, sk(903), a young adult male, was observed to have hypoplasia of the ventral aspects of the 8th to 12th thoracic vertebrae, leading to a reduction in height and wedging of the vertebral bodies. Schmorl's nodes, secondary DJD and osteophytes were also present. There was no evidence of a compression fracture and the lumbar vertebrae were normal. Secondary osteoarthritis was present on the zygapophyseal joints of 4th to 9th thoracic vertebrae, as a result of the additional stress from the kyphosis of the lower thoracic spine. Ventral hypoplasia occurs as the result of a developmental defect in the vertebrae when there is a delay in the development of the chondrification centres, leading to reduced ossification in the affected (i.e. anterior) half and wedging of the body (Barnes 1994).

Three cases of spondylosis were noted in the Early population, with one individual, sk(834), an old adult male, having spondylosis of both the fourth and fifth lumbar vertebrae (Plate 49). The other case in sk(762), a possible male adult, affected only the fifth lumbar vertebra, as is most common. Generally, spondylosis is believed to result from repeated stress to the affected lumbar vertebra, usually the fourth or fifth, which has a predisposing congenital weakness, causing fracture (Roberts and Manchester 1997, 78). More recent research has shown that incidence of the defect, which consists of fibrous tissue, increases with age and can be found radiographically in up to 10% of adults (Salter 1999, 372-3). The pars interarticularis, which forms the inferior part of the neural arch of the vertebra, is separated from the main vertebra. Spondylosis causes no signs or symptoms in the majority of individuals though it may be an indicator of a lifestyle involving excessive stresses being placed on the lower spine.

Plate 49: Spondylosis of the Fourth and Fifth Lumbar Vertebrae, sk(834)

One further developmental defect in the spine of sk(1074), a male middle adult, was noted, consisting of the lumbarisation of S1 and sacralisation of C1. These anomalies in the development of the spine represent a caudal shift in the developmental borders that generally dictate the form of the developing vertebra. The spine generally consists of three groups of vertebrae (7 cervical, 12 thoracic and 5 lumbar vertebrae), classified according to their morphology, which develops according to the area of spine they are in; hypothetical 'borders' separate the spine into these three groups of differently shaped vertebrae. If the border shifts either cranially (towards the top) or caudally (towards the bottom) a vertebra that would normally belong in one group will, as a consequence of this border shifting, now be in the group either above or below, depending upon the direction of the border shift. The vertebra affected is known as a transitional vertebra and will take on the morphological characteristics of this group. An individual can, therefore, have 6 lumbar vertebrae and 11 thoracic vertebrae rather than the usual 5 and 12 respectively. Barnes (1994) suggests that there is a highly genetic component to the border shifting and that patterns of shifting may vary considerably between populations. It should be noted, however, that developmental border shifting in the spine is a fairly common phenomenon.

Pathology	***No. of cases***	***No. of observable elements***	***TPR***	***CPR (N=195)***
Spondylosis	2	173	1.2%	1.0%
Sacralisation 1st Coccyx	1	85	1.1%	0.5%
Lumbarisation	2	64	3.1%	1.0%
Flaring Ribs	2	*84	2.4%	1.0%
Os acromiale	3	146	2.1%	2.1%
Lumbar Ribs	1	*84	1.2%	0.5%
Cervical Ribs	1	*84	1.2%	0.5%
Developmental Hip Dysplasia	1	173	0.6%	0.5%

Table 23: Summary of Congenital and Developmental Conditions in the Late Adult Population
(*Number of Individuals with Observable Elements).

In the Late population, five cases of such border shifts resulting in developmental anomalies in the spine were observed, involving sacralisation of a the 1st coccyx vertebra (sk(381)), a transitional

13th thoracic/1st lumbar vertebra (sk(120)), six lumbar vertebrae with sacralisation of L6 (sk(1136)) and two cases of lumbarisation of S1 to L6, one of which was partial (sk(992), sk(1238)). Also related to border shifts in development was the presence of bilateral lumbar ribs in sk(1212) and one cervical left rib in sk(1120). Interestingly, two individuals, sk(458), a young adult male, and (sk406), a middle adult male, also exhibited flaring ribs (Plate 50). Barnes (1994) suggests that flared ribs are the result of segmentation errors during development and have a high genetic component in their aetiology, occurring almost twice as often in males than in females. Spondylosis, as described above, was also observed in two individuals, sk(1100), a possible female adult, and sk(505), a middle adult male.

Plate 50: Flared Rib, sk(406)

Os acomiale, a developmental condition affecting the shoulder by separation of the tip of the acromion from the remainder of the process, was noted in three in individuals, one involving the left side (sk(682), a male adult) and two affected on the right side (sk(581), a young adult female, and sk(505), a middle adult male) (Plate 51). The separation of the tip of the acromion arises from a developmental failure to fuse to the rest of the acromion of the scapula, which usually occurs at around 18-20 years of age, and in essence forms a separate ossicle. The exact aetiology is unknown, though it is a common condition and is generally found incidentally in clinical contexts, due to being asymptomatic (http://radiopaedia.org/articles/os-acromiale). Interestingly, a high prevalence of os acromiale was found in the skeletons from the Tudor battleship, the Mary Rose, thought to be the remains of archers; it was, therefore, suggested that the stress on the shoulder joint from practising long bow archery from an early age may have been a contributory factor to its aetiology (Stirland 2000).

Plate 51: sk(505) Os Acromiale

The most notable developmental condition present was an example of developmental hip dysplasia (DDH) in sk(461), a young adult of unobservable sex (Plate 52). The right hip was dysplastic, manifest by the presence of triangular acetabulum. Some porotic bone was also present on the lateral aspect of the ileum superior to the acetabulum. There was also secondary atrophy of all the right leg bones. The atrophy of the leg indicates nerve damage and disuse of the leg, hence there being little reactive bony development in forming a pseudoarthrosis. The greater sciatic notch was very broad. The femur was severely atrophied, the head being small and mushroom shaped, flattened particularly on the medial aspect. No secondary joint disease was present. The fibula and tibia are also atrophied. A small cystic lesion was present on the fibular head articular surface. The right calcaneus was small but appeared normal in morphology. Unfortunately, no left leg was present for comparison. DDH is now recognised to occur as a result of ligamentous laxity, sometimes in combination with abnormal position in utero, affecting females more than males at a ratio of 8:1 (http://radiopaedia.org/articles/developmental-dysplasia-of-the-hip). Breech presentation of the neonate may also cause DDH and DDH may also be associated with oligohydramnios, where the amniotic fluid volume is less than expected for gestational age. Family history may also be a factor in its incidence.

Plate 52: Development Hip Dysplasia, sk (461)

Generalised and Disseminated Conditions

There are a number of diseases that are classified as generalised and disseminated condition and many of these are associated with metabolic or endocrine disorders.

Metabolic disorders are generally associated with a lack of a particular vitamin in the diet or an imbalance of a hormone that is essential to maintaining normal functions of organs in the body and an adequate health status. A lack of intake of vitamins can occur for several reasons. It may be that the individual simply has insufficient access to a particular vitamin in their diet, such as a lack of Vitamin C arising from a lack of fresh fruit, leading to scurvy (Roberts and Manchester 1997). It may also be the case that an individual has acquired or inherited a condition preventing the body from absorbing a particular vitamin, even if it is in plentiful supply in the diet. For example, anaemia can be caused by a high intake of lead into the body or by a number of genetic disorders, such as thalassaemia or sickle-cell anaemia.

Other metabolic and endocrine conditions, such as osteoporosis, are very often caused by a change in the level of the production of hormones vital for producing or maintaining bone. In this condition, too little bone is produced; bones become rarefied (thinned) and brittle, making them vulnerable to fractures. The condition is frequently seen in the elderly, particularly post-menopausal females (Salter 1999). The majority of diseases seen in the skeleton that have an underlying metabolic aetiology are generalised conditions, in that the mechanism for producing and maintaining bone is abnormal and, therefore, all bones are affected. This is also the case with conditions such as osteomalacia and rickets, where the body is deprived of vitamin D, most commonly from lack of exposure to the sunlight though sometimes from dietary deficiencies or due to an underlying medical condition. The lack of vitamin D results in the body being unable to produce sufficient mineralised bone and therefore bones become ‘soft’ and bow (Brickley and Ives 2008).

Disseminated conditions such as Paget’s disease, on the other hand, display pathological changes in discrete localised areas and unaffected bones are normal. Examples of these diseases are recorded in the archaeological record but are much rarer than the majority of the metabolic conditions. Cribra orbitalia (recorded here according to categories set out by Stuart-Macadam 1991), commonly the result of anaemia, is denoted by the presence of porosity in the eye orbits resulting from the expansion of the trabeculae in the bone produced by the body’s expansion of the marrow to increase production of red blood cells (Roberts and Manchester, 1997). This response to anaemia that occurs during childhood (Aufderheide and Rodriguez-Martin 1998). A recent review of the clinical literature highlights that only megaloblastic or haemolytic anaemias directly result in erythropoietic hyperplasia, associated with a dietary lack of vitamin B or specific parasitic infections arising from polluted water such as giardiasis, diphyllobothriasis (Walker 2009:115) or possibly malaria (Gowland and Western 2012).

In total, 37 cases of generalised and disseminated conditions were recorded in the whole assemblage. Two of these were found in the Early population and the remaining 35 were observed in the Late assemblage.

In the Early population, only one individual, sk(228), an old adult female, exhibited generalised conditions. This individual had minor changes in the left eye orbit associated with cribra orbitalia (grade 1). The right orbit was unobservable. sk(228) may also have suffered from osteoporosis. Reduction in height of the ninth thoracic vertebra was observed in addition to biconcavity of the surface, which is typical of the condition. However, the spine was poorly preserved and no further lesions were observed.

Pathology	*No. of Cases*	*No. of Individuals*	*No. of Observable Elements*	*TPR*	*CPR (N=259/*64)*
Cribra Orbitalia	24 (15 adult)	13 (8 adults)	133 (99 adult) 34	18.0%	5.0%
Osteoporosis	3	3	105	2.9%	1.2%
Osteomalacia/Healed Rickets	7	3	512	1.4%	1.2%
Rickets (Subadults)	-	2	-	-	*3.1%
Hypertrophic Osteoarthropathy	-	1	-	-	0.4%
Cribra Femora (Subadult)	3	2	83	3.6%	*3.1%
Paget's Disease	1	1	152	0.7%	0.4%
Bladder Stones	1	1	-	-	0.4%

Table 24: Summary of Generalised and Disseminated Conditions in the Late Assemblage

In the Late population, cribra orbitalia was observed in 6 males/possible males and three female/possible females (Table 24), (Plate 53). Three were middle adult, two young adults and two were old adults. Amongst the subadults affected, one was 6-8 years, one 4-6 years, one 5-6 years and one 12-14 years (3 older children and one juvenile). The true prevalence rate of cribra orbitalia at Holy Trinity of 18.0% is lower than that from Upton-on-Severn (TPR 27.3%, CPR 16.7% (Western 2014), although slightly higher than the TPR of 12.5% was recorded in the population from St Andrew's, Worcester, (Western 2006) while no cases of cribra orbitalia were recorded in the assemblage Tallow Hill (Ogden n.d.). The true prevalence rate is much higher, however, than the 9.6% for St Martin-in-the-Bull Ring (Brickley, Berry and Western 2006). An average CPR of 8.95% was recorded by Roberts and Cox (2003) at a national level for post-medieval populations. This may indicate that parasitic infestation commonly linked to polluted waters, leading to megaloblastic and haemolytic anaemias associated with cribra orbitalia, may have been relatively high at Stratford. Conditions associated with intestinal parasitic infestations that could lead to cribra orbitalia, such as giardiasis, have been consistently associated with house flooding in some populations (Molina *et al* 2011). Historically and recently, periodic winter flooding of the River Avon at Stratford has occurred from at least Tudor times (Bayliss and Reed 2001), causing considerable damage to the infrastructure of the town and on occasion, drownings. (http://www.stratford-upon-avon.co.uk/soahstry.htm). This flooding may have also have caused the intermittent pollution of clean water sources.

Plate 53: Cribra Orbitalia sk (636)

One further condition known as femoral cribra and associated with anaemia was noted in two sub-adults, sk(1188), aged between 16-21 years at death and in sk(1287), aged between 14 and 17 years at death. In the former case the lesion was noted bilaterally, whereas only one proximal femur was observable in sk(1287). As the name suggests, femoral cribra is thought to be a similar response in bone to anaemia as cribra orbitalia, but affecting the femur rather than the eye orbit. Interestingly, sk(1287) was suspected of having an osteosarcoma or Ewing's sarcoma, a cancerous condition that is associated with anaemia, as discussed in more detail below. In sk(1188), diffuse but fine woven bone periostitis was also present but only on one tibial fragment. No skeletal changes were noted on any of the other skeletal elements. It should be noted that several causes of femoral cribra have been suggested besides anaemia, such as activity related stresses (Smith-Guzman 2015).

Osteoporosis is frequently associated with spinal defects resulting from the compression fractures of the vertebrae. Vertebrae are high in cancellous (spongy) bone content and following a rarefaction (thinning) of the bone are particularly susceptible to micro-fractures, caused by a failure to bear the compression from the normal weight of the spine. The collapse of the underlying bone structure may lead to the eventual fracturing of vertebral bodies resulting in compressed wedge-shaped vertebrae (Brickley and Ives 2008). Wedge-shaped vertebrae were observed in sk(421), an adult of indeterminate sex, sk(668), a middle aged adult of indeterminate sex, and sk(870), an old adult male (CPR = 1.2%, TPR = 2.9%; based on the total number of adult individuals with observable lower thoracic vertebral bodies). Compression of 10th thoracic vertebra and secondary ankylosis to T11 was noted in sk(421) (Plate 54). The 1st and 5th lumbar vertebrae were noted as resembling two 'codfish vertebrae' in sk(668). Unfortunately, the spine was poorly preserved but there was obvious concavity to the inferior body surfaces co-occurring with shortening of the bodies. No thoracic vertebrae survived. In sk(870) similar changes were noted in the 5th lumbar vertebra but again the spine was poorly preserved.

Plate 54: Compression Fracture with Ankylosis, sk(421)

Three cases of osteoporosis were also noted at Upton-on-Severn, though the sample size was a lot smaller and contained several old aged adults, so the true prevalence rate of 25.0% and crude prevalence rate of 12.5% are much higher, as would be expected, than that recorded at Holy Trinity. No clear cases of osteoporosis were reported from Tallow Hill (Ogden n.d.) or St Andrew's, though a CPR of 2.84% was reported from St Martin-in-the-Bull Ring, Birmingham (Brickley, Berry and Western 2006). True rates of osteoporosis in past populations are likely to have been much higher than reported in the osteoarchaeological literature due to the lack of radiographic analysis undertaken, which is used to diagnose clinical cases of osteoporosis at a much earlier stage.

Three individuals at Holy Trinity, all males, exhibited pathological changes associated with healed rickets. One individual, sk(406), a male middle aged adult, exhibited pronounced lateral bowing to the proximal tibiae and fusion of the right fibular head to the tibia, manifest by a large lamellar bony outgrowth at the proximal joint (Plate 55). The left fibula was only partially complete. The pronounced bilateral *genu valgus* deformity resulted in secondary osteoarthritis of the knees and feet. The changes were bilateral. In sk(578), slight anterior bowing of the proximal thirds of the femora was observed in addition to lateral bowing of the proximal tibiae. However, no bony buttressing or remodelling of the diaphyses was present though the femora were platymeric. In sk(792), lateral bowing of the left tibia was observed in the proximal third but, again, no bony buttressing or remodelling of the shaft itself. Such bowing and remodelling have been noted as indicative of residual rickets and osteomalacia (Brickley and Ives 2008). Rickets occurs due to a lack of vitamin D during childhood and although the condition may heal in later life, residual defects can still be present in the skeleton. Osteomalacia is similarly caused by a lack of vitamin D, concentrations of which decrease with age and is noted specifically in elderly individuals with osteoporosis and post-menopausal females (Brickley and Ives 2008, 87, 154).

Plate 55: Rickets and Secondary Osteoarthritis, sk(406)

It can, therefore, not only be difficult to differentiate residual rickets and osteomalacia manifested by long bones deformities in adults but also between osteomalacia and osteoporosis, particularly given that osteomalacia and osteoporosis are both age-related conditions. Although pseudofractures are considered pathognomic of osteomalacia, these are rarely recorded and it is likely that in its earlier stages, changes resulting from osteomalacia are either non-specific or unobservable macroscopically. It is also probable, however, that such non-specific defects in the skeleton are multi-factorial in aetiology and that individuals suffering from osteoporosis may also have osteomalacia and *vice versa* to some extent. None of these individuals were observed to exhibit changes that may have been caused by osteomalacia or osteoporosis in the spine. No evidence for pseudofractures, synonymous with osteomalacia (Brickley and Ives 2008), was present. The bowing deformities throughout the skeleton may well indicate a case of healed rickets rather than osteomalacia.

Two cases of what may have been active rickets were observed in the Late sub-adult assemblage from Holy Trinity. One older infant, sk(888), aged between 6 and 12 months old at death, exhibited enlarged and porotic flaring sternal ends on six ribs (Plate 56). Expansion of the anterior rib ends at the costochondral junctions, giving the appearance of a ‘cupping and brush-like structure’

(Özkan 2010), may be diagnosed as the 'rachitic rosary' appearance during life, a clinical sign of rickets. The 'rosary' forms as a result of a lack of mineralisation at the joint and overgrowth of the costochondral joint cartilage, forming a row of nodules down each side of the chest. The condition may also occur in scurvy, hypophotophasia and chondrodystrophy (http://radiopaedia.org/articles/rachitic-rosary). Rickets can be caused by a lack of exposure to sunlight but also by a vitamin D deficient diet. Nutritional rickets has been observed in infants in some populations most commonly as a result of exclusive breastfeeding without supplementation (Özkan 2010). No other changes were noted. In sk(891), a younger child of 2-4 years old, anterior bowing of the femora was present in the mid diaphysis, though the metaphyses were normal and did not exhibit any roughening or cupping (Mays *et al* 2006). Of the total number of sub-adults present with ribs and/or femora (N=50), the TPR of rickets within the Late population was 4.0% (n=2).

Plate 56: Flared Rib with Roughened, Porotic Appearance, Possibly Representing a 'Rachitic Rosary' Lesion, sk(888)

Since rickets is often caused by a lack of Vitamin D, which is absorbed through UV rays in the atmosphere, it is generally associated with the polluted metropolitan cities of the Industrial Age, such as Birmingham and London. Thus, a high prevalence rate of rickets was found amongst the sub-adult population at St Martin's-in-the-Bull Ring, Birmingham (CPR 13.1%) and it was also present in 8.9% (CPR) of adults as a residual condition, with an overall CPR of 7.5% for the whole population (Brickley, Berry and Western 2006). The overall CPR for residual rickets and osteomalacia (the adult form of vitamin D deficiency) at Holy Trinity was 1.9%, whereas at Upton the CPR was 8.3% (Western 2014). Osteomalacia was recorded in one elderly female from St Andrew's, Worcester (CPR = 5.3%) along with one case of juvenile rickets (CPR = 33.3%) (Western 2006). No cases of rickets or osteomalacia were noted at Tallow Hill (Ogden n.d.). The average CPR at the national level for rickets in post-medieval populations is reported as 3.65% (Roberts and Cox 2003). One case of rickets was also noted in the Saxon assemblage from the Centenary Gardens, Stratford-upon-Avon (AOC Archaeology 2010, Brickley and Ives 2008).

Overall, the rates of rickets and/or osteomalacia from Holy Trinity, Stratford, are very low compared to other local assemblages, especially that of St Martin's, Birmingham, as would be expected. If the cases observed among the adults are residual rickets, it may be a possibility that these individuals migrated out of urban areas after childhood. The potential presence of rickets among the sub-adults, however, might suggest that it is also possible that different cultural practices of child nurturing played a role, since the swaddling and exclusive breastfeeding of infants also reduces their exposure to sunlight and thereby Vitamin D (Brickley and Ives 2008, Özkan 2010).

Extensive periostitis was observed in sk(491), a juvenile aged between 9 and 10 years at death (Plate 57). Porotic woven bone formation was seen on most of the long bone elements and appeared as one or 2 separate layers on the bone surface, in some cases laminating and peeling

away from the underlying cortex. It is not clear to what extent taphonomy was a factor in the lamination of the outer layers of the long bones (though this was not seen in any other of the skeletal remains in the assemblage) or whether the periostitis was laminar. The periostitis was generally quite extensive and was bilateral, occurring on the humerii, ulnae, radii, femora and also the left tibia and fibula, with the right tibia and fibula being unobservable. Porotic woven bone formation was also observed on the neural arches of two thoracic vertebrae and iliac blades. Unfortunately, these were also poorly preserved and it was not possible to determine either the identification or extent of the lesion. In addition, woven bone periostitis was present on the left anterior scapula (right not observable), left clavicle and left rib shafts (right not observable). Also present was extensive porotic woven bone deposition on the endocranial surface of the cranium, which was well preserved. The frontal, parietal and occipital bones were all affected, indicating an extensive meningeal inflammation. Some macroporosity was also present in the orbit roofs but it appeared that post-mortem damage had exposed some of the underlying trabecular structure. The metacarpals have a woven bone appearance to their anterior surface but no lamination. This may be normal appearance for a developing sub-adult. Metatarsals also appear porotic and some lamination is present.

Since the changes observed in sk(491) affect multiple skeletal elements, the lesions represent a systemic condition. In this case, the changes may be associated with hypertrophic osteoarthropathy (HOA). This condition presents with bilateral periostitis or new bone formation, also known as laminar periostitis, which is symmetrical in the skeleton and generally affects the areas of long bones in the region of the joints as well as peripheral bones in the hands and feet (El-Khoury 2013, Vandemergel *et al* 2004). It is a progressive condition whereby the new bone formation becomes increasingly thickened and multi-layered. In more progressive cases, axial elements such as the ribs, clavicles, scapulae and pelvis can also be involved; characteristic of the condition is the symmetrical involvement of elements (El-Khoury 2013). There are two types of HOA; the disease occurs either as a primary, idiopathic condition or secondary to an underlying disease, most commonly one affecting the lungs (pulmonary), such as cancers (i.e. non-small cell carcinomas and adenocarcinon accounting for 80% of all cases) (El-Khoury 2013) or more rarely, infections such as tuberculosis (Roberts and Buikstra 2003). Clinically, the condition is painful and is associated with clubbing of the fingers (El-Khoury 2013). Differential diagnoses include thyroid acropachy, leukemia and hypervitaminosis A (El-Khoury 2013).

Plate 57: Laminated Periostitis and Lesions on the Ribs, Clavicle and Femur sk(491)

A strong correlation between the presence of bilateral periostitis and cancer has been noted clinically, with 61.3% of cases with bilateral periostitis in the lower and upper limbs being associated with cancer (Vandemergel *et al* 2004). Although HOA is rare in sub-adults, cases have been noted: for example, HOA was found in one 7 year old child secondary to a chronic post-measles lung abscess (Barclay *et al* 1970). It is not clear if the endocranial inflammation is a separate condition to that causing the periostitis in the long bones or whether all the lesions represent a systemic infection. A differential diagnosis could be scurvy, though the common changes observed in the maxilla and sphenoid, for example, were not present in this individual (Brickley and Ives 2006).

One case of possible Paget's disease was observed and confirmed by radiographic analysis. The right ilium/ischium sk(485), an old adult of overall indeterminate sex (though with some observable female morphological features), exhibited bone remodelling on the posterior aspect in the area of the acetabulum (Plate 58). The bone was slightly raised and has porotic appearance across the entire surface between the acetabulum and the greater sciatic notch. Approximately 15mm medial to the acetabulum in this porotic area was a circular lytic lesion measuring 16mm S-I x 15mm M-L. The lesion was smooth walled with a lamellar bone surface. An osteophyte was present on the superior aspect of the acetabular articular surface as well as macroporosity, representing degenerative joint disease of the hip. Immediately posterior to osteophyte the surface is

macroporotic and has a sponge appearance with some microporosity also present. Overall, the ilium felt very heavy and the localised area appeared a little expanded.

Plate 58: *Macroscopic Changes, Right Os Coxa (485)(Posterior, Anterior)*

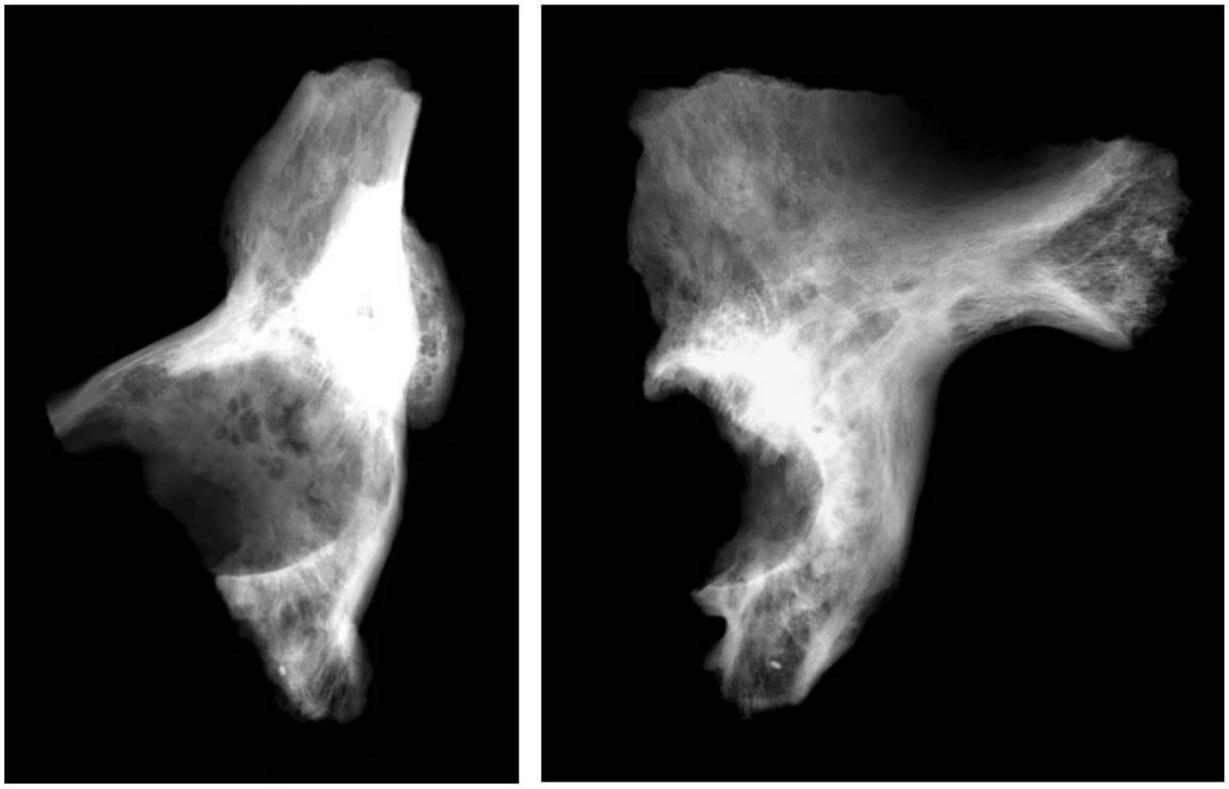

Plate 59: *Radiographs of Right Os Coxa, sk(485), (A-P, M-L)*

Radiographically, the bone changes consisted of a moth-eaten, mixed radio-opaque and –lucent lesions with several sub-circular lucencies, reflecting mixed lytic and sclerotic lesions. One larger

radiolucent lesion appears in the iliac crest outlined by an opaque sclerotic rim (Plate 59). These changes are consistent with several conditions, such as secondary blastic metastases, osteosarcoma, chronic osteomyelitis, tuberculosis, fibrous dysplasia, Non-Hodgkin lymphoma (histiocytic type) or Paget's disease (Burgener *et al* 2006, http://rad.washington.edu/about-us/academic-sections/musculoskeletal-radiology/teaching-materials/online-musculoskeletal-radiology-book/sclerotic-lesions-of-bone/). No similar changes were observed in the right femur; neither the left os coxa nor any other lower limb elements were present. Although the vertebrae and pelvis are common sites for skeletal metastates since these elements are rich in red marrow (http://radiopaedia.org/articles/skeletal-metastases), the lack of similar changes in the contiguous femur suggests that metastatic cancer is less likely as a diagnosis. No sinus was observed, which might be expected in a case of osteomyelitis. The classic ground-glass appearance and focal areas of calcifications associated with fibrous dysplasia was also absent. The extensive remodelling observed that is restricted to a single observable element in this individual is more suggestive of a diagnosis of Paget's disease, though the element itself was not significantly enlarged. However, in the early stages of the disease, though bones feel heavier than normal, there may be no overall change in size (Waldron 1993). Characteristic radiographic changes of Paget's disease include accentuated trabecular bone as well as lytic lesions and in addition, the pelvis is commonly the earliest site of skeletal changes from the condition, with unilateral involvement most frequently involving the right side (Brickley and Ives, 2008).

Paget's disease is a condition that causes disseminated bone changes, only affecting a few elements within the skeleton; typically the skull, vertebrae and pelvis. Changes consist of bone formation and loss, overall leading to larger but weaker bones with a mixed radio-opaque and radio-lucent appearance. Clinically, Paget's disease is rare in modern population in individuals under 55 years old and is associated with elevated alkaline phosphatase (ALP) in the blood, which is a by-product of osteoblast (bone forming) activity (Ralston 2013). Bone pain is common and the condition can also lead to a loss of hearing if the bone around the inner ear is affected (Ralston 2013). The disease can be caused by a slow virus infection, such as paramyxoviridae or associated with respiratory syncytial virus and canine distemper virus (Brickley and Ives 2008). Additionally, two genes are associated with Paget's disease. The first, SQSTM1, is primarily associated with a hereditary form of the condition, where a mutation of the gene is found in 40-50% of people with the inherited form of the disease. However, 10-15% of affected people without any family history also have a mutation of the gene (Ralston 2013). Paget's disease is also associated with mutation of a second gene, RANK, though the research here indicates that although there is an important hereditary role in the occurrence of Paget's disease, it is genetically heterogeneous (i.e. no one single gene causes the condition) (Haslam et al 1998). Medical data also suggests that severity of the disease has decreased over time and that this may reflect improvements to our living environments, in particular a more sedentary lifestyle that has reduced mechanical loading on the skeleton and subsequently the number of pathological fractures (Ralston 2013).

Three bladder stones (or calculi) were recovered from an environmental sample taken in the pelvic area of sk(682), an adult possible male (Plate 60). The stones weighed 2g, 2g and 1g and measured 1.4cm, 1.5cm and 1cm at their maximum length respectively. The stones were tested and reacted to hydrochloric acid, indicating that they consisted of calcium salts to at least some degree. Bladder outlet obstruction is the cause of 70% of bladder stones in adults and occurs more commonly in males, particularly when they have prostate enlargement, which causes the obstruction (Dunnick *et al* 2013). In these cases, the stones consist of calcium oxylate and/or calcium phosphate. If renal stones are obstructed from passing, they grow in size in the bladder and can cause pain in the pelvic area, though many patients are asymptomatic (Dunnick *et al* 2013). Bladder calculi can take several forms and sizes but those with roughened surfaces such as the ones recovered here known as 'mulberry stones' (Dunnick *et al* 2013).

Plate 60: Bladder stones (sk682)

Inflammatory Disease

Inflammation occurring to the bones can be observed macroscopically, or with the naked eye, at three levels; one involving the outer surface of the bone, known as periostitis, a second called osteitis where the inner cortex is involved and thirdly, when the whole transverse section of the bone is involved to the extent of the development of a draining sinus (*cloaca*), known as osteomyelitis. Inflammation can occur as a result of many causes; for the most part, inflammation is associated with infection. It should be remembered, however, that whilst infection will always create an inflammatory reaction, conversely inflammation does not necessarily indicate the presence of an infection; many pathological processes can potentially result in inflammation. Some infections produce a particular distribution of lesions around the skeleton allowing a specific diagnosis to be given to certain infectious conditions, such as syphilis and tuberculosis. Most infections resulting in an inflammatory reaction are, however, non-specific. The presence of woven bone deposits indicate that a lesion was active at the time of death whereas remodelling lamellar bone suggests the lesion had healed prior to death.

In total, 72 skeletal elements exhibited inflammatory lesions in the whole assemblage, six elements from four individuals in the Early assemblage and 68 elements from 43 individuals in the Late assemblage.

In the Early assemblage from Holy Trinity, Stratford-upon-Avon, only four individuals exhibited lesions associated with inflammation (CPR=8.9%). Thick woven bone periostitis was present on both tibiae of sk(671), a female old adult, indicating that the inflammation was active at the time of death. The porotic and striated woven bone periostitis was present on the right middle and distal tibia, on the anterior and posterior side, with the heaviest periostitis located on the medial aspect. Similar lesions were present on the left tibia but the distal portion was missing post-mortem.

sk(1169), a possible adult male, exhibited striated lamellar bone periostitis on the lateral aspect of the mid diaphysis of the left tibia. Unlike woven bone, lamellar bone is indicative of a healed inflammatory lesion. The new bone formation was quite extensive and created an undulating surface. Also present on the mid left fibula on the medial aspect of the diaphysis but here the bone deposit consisted of smooth, lamellar bone with an undulating surface.

In sk(1139), a young adult possible female, a minor lytic lesion was present on the anterior and superior border of the body of L4 co-occurring with the formation of a slight osteophyte. The area was ill-defined but localised and appeared to consist of subchondral erosive lesions. Given that this was a young individual, it may be the case that the lesion was associated with infection rather than degeneration of the spine, though a traumatic origin cannot be ruled out. The area affected measured 2cm M-L by c. 1cm A-P and was centrally located. No other vertebrae were affected.

One sub-adult also exhibited changes consistent with an inflammatory disease: an extensive bone deposit was present on the endocranial surface of the occipital squame of sk(941) (Plate 61), a young child aged between 1-3 years at death. The bone deposit was located mainly along the groove for the transverse and superior sagittal sinuses and internal occipital protuberance. This is characteristic of inflammation of the meningeal vessels likely resulting from infection. Similar cases were present in the Kempsey assemblage (Western 2015), though these were all in adults.

Plate 61: Endocranial Lesions, sk(941)

Of the 68 elements exhibiting inflammatory lesions in the Late population, 16 belonged to sub-adults (23.5%) with the remaining 52 being adult (76.5%). In total, inflammatory lesions were observed in 20.3% of all sub-adults (n=13, N=64) compared to 15.9% of all adults (n=31, N=195). The overall CPR of inflammatory disease was 17.0%. Of the 27 adult individuals with inflammatory lesions for whom sex was observable, 7 were female/possible female (25.9%) and 20 were male/possible male (74.1%). Overall, 11.5% of all the females/possible females (N=61) present in the Late population exhibited inflammatory lesions compared to 22.2% of males/possible males (N=90). Of the 20 individuals for whom both sex and age could be assessed, three were young adult females (18.9%, N=16), two were middle adult females (15.4%, N=13) and one was an old adult female (10.0%, N=10). Amongst the males, two were young adults (14.3%, N=14), six were middle aged adults (28.6%, N=21) and six were of old age (37.5%, N=16).

Thirty two of the 52 adult elements exhibiting inflammatory lesions consisted of periostitis, which affected 22 individuals in total, 12 of which exhibited multiple lesions (Table 25). Twelve elements exhibited woven bone lesions that represent active inflammation at the time of death (Plate 62). One further lesion consisted of a mix of woven and lamellar bone, suggesting an ongoing, intermittent case of inflammation. The remaining 20 elements exhibiting periostitis consisted of remodelled lamellar bone, suggesting that the lesion had undergone healing.

Plate 62: *Woven Bone Periostitis (sk(556)) and Lamellar Bone Periostitis (sk(1028))*

Pathology	*No. of Cases*	*No. of Observable Elements*	*TPR*	*CPR (N=195)*
Endocranial bone formation	2	65	3.1%	1.0%
Rib Lesions	8	*84	9.5%	4.1%
Distal Clavicular Erosion	1 (L)	134	0.7%	0.5%
Maxillary Sinusitis	4	91	4.4%	2.1%
Mastoiditis	1	119	0.8%	0.5%
Periostitis Scapula	1 (L)	113	0.9%	0.5%
Periostitis Radius	1 (R)	133	0.8%	0.5%
Periostitis L. Femur	6	90	6.7%	3.1%
Periostitis R. Femur	2	89	2.2%	1.0%
Periostitis L. Tibia	8	86	9.3%	4.1%
Periostitis R. Tibia	7	90	7.8%	3.6%
Periostitis L. Fibula	1	77	1.3%	0.5%
Periostitis R. Fibula	4	80	5.0%	2.1%
Periostitis R. Calcaneus	1	59	1.7%	0.5%
Periostitis L. Calcaneus	1	63	1.6%	0.5%

Table 25: Summary of Inflammatory Pathology in Adults in the Late Population (=number of individuals with elements).*

Eight cases of rib lesions were recorded in the Holy Trinity assemblage, five cases in males/possible males (sk(398), sk(125), sk(409), sk(1238) and sk(1200)) and three in

females/possible females (sk(523), sk(975) and sk(1212)). The crude prevalence rate for the whole Late population is 3.1% and for the adult Late population is 4.1% (N=195), though the true prevalence rate is 9.5% (N=84), in contrast to the complete absence of rib lesions in the Early population at Stratford. Age was unobservable for two individuals but of the remaining five cases, two were young adults, one was a middle aged adult and two were old aged adults. Lesions on the visceral surfaces of the rib are caused by chronic inflammation of the lungs.

Six of the cases of rib lesions consisted of woven bone, indicating that the inflammation was active at the time of death. Two cases were observed to consist of lamellar bone, indicating that the lesion had healed and was not active. In six individuals, the rib lesions were located on the left side, in one individual the lesions were on the right ribs and in one further individual the lesions were present on both the left and right side ribs. Rib lesions are non-specific; however, they are most frequently associated with tuberculosis and tuberculosis co-occurring with other pulmonary conditions; Roberts and Buikstra (2003, 106), from a study of known individuals, demonstrated that rib lesions were present in 62% of those that had died from tuberculosis and in 70% of those that had died with tuberculosis and a co-occurring pulmonary condition, in comparison to only 22% who had died of a pulmonary disease other than tuberculosis and 15% of those who had died of a condition not related to pulmonary diseases. Nonetheless, the presence of rib lesions is not pathgnomic of tuberculosis and differential diagnoses including other respiratory conditions should be considered.

The CPR of rib lesions at Stratford-upon-Avon of 4.1% is much lower than other local assemblages: The crude prevalence rate of 12.5% in Upton population (Western 2014) is higher than Stratford but lower than the contemporary urban assemblage from St Andrew's, Worcester (CPR = 26.3%, n=5) (Western 2006). This may reflect better housing and working conditions in Stratford than Upton, and most likely less crowding compared to the overcrowded, run down slums in St Andrew's. Interestingly, only one individual from the middle class vaults at Tallow Hill exhibited visceral surface rib lesions (CPR = 10%). The rate reported for rib lesions from St Martin's-in-the-Bull Ring, Birmingham (CPR = 8.5 %, n=43) is relatively low, probably to some extent due to the much larger sample size, although the rate is still higher than Stratford-upon-Avon (Brickley, Berry and Western 2006).

Four cases of maxillary sinusitis were recorded in the Holy Trinity assemblage, one in an adult of indeterminate sex (sk(421)), two in males (old adult sk(906) and middle adult sk(103)) and one in a possible female middle aged adult (sk(370)). Also reflecting lifestyle in some cases, maxillary sinusitis, is linked to smoke, environmental pollution, upper respiratory tract infections, smoking, dust, moulds and dust mites amongst other causes (Roberts and Manchester, 1997, 131, http://www.drmanik.com/Sinusitis.html). Changes observed to the maxillary sinuses consisted of new lamellar bone formation, sometimes appearing nodular or more frequently including bony spicules. These cases of the condition appear, therefore, to have been chronic. It is difficult to make fair comparisons of rates of maxillary sinusitis since if the sinuses are well preserved and complete, their inner surfaces are unobservable without endoscopic analysis. The crude prevalence rate for the whole Late population at Holy Trinity is 1.5%, compared to the crude prevalence rate of 8.3% at Upton-on-Severn, 10.5% from St Andrew's (n=2) (Western 2006) and 2.8% at St Martin's-In-The-Bull Ring (Brickley, Berry and Western 2006). The national average CPR reported by Roberts and Cox (2003) is 6.88%. Since the prevalence reports rated are only approximations, it is difficult to draw any firm conclusions; however, it may be noteworthy that as with the rib lesions, the lowest rates of maxillary sinusitis again appear to be in Stratford.

In addition, one case of mastoiditis was observed in the left temporal bone of sk(906), an old adult male, who had also suffered from sinusitis in the right maxilla and right zygomatic bones (Plate 63). Clear indications of an active infection prior to death was manifest by the presence of new woven bone formation around the petrous portions of both the left and right temporal bones, mainly on the endocranial surface of the squame, with bony spicules present in the mastoid air cells of the left. A small amount of porotic woven bone formation was also present on the ectocranial surface of the right temporal bone. Unfortunately, both bones had undergone post-mortem damage and it was

difficult to determine the presence of any ante-mortem sinus. Mastoiditis is a bacterial infection usually occurring as a result of an inflammation or infection of the middle ear, often associated with an allergy or upper respiratory tract infection that causes irritation of the nasal mucosa, nasopharynx and eustachian tube (Ramakrishnan *et al* 2007). The aetiology of the condition is multifactorial including infectious, immunological and environmental factors such as exposure to cigarette smoke. Interestingly, this individual exhibited a pipe-smoking groove in the dentition indicating that he was a smoker. Mastoiditis can cause serious health problems if not resolved as the infection may spread and can cause meningitis or a brain abscess (Ramakrishnan *et al* 2007). Malignant otitis externa, for example, can lead to skull base osteomyelitis and is associated with high fatality rates, most often occurring in elderly diabetic patients with compromised immunity (Juliano *et al* 2013).

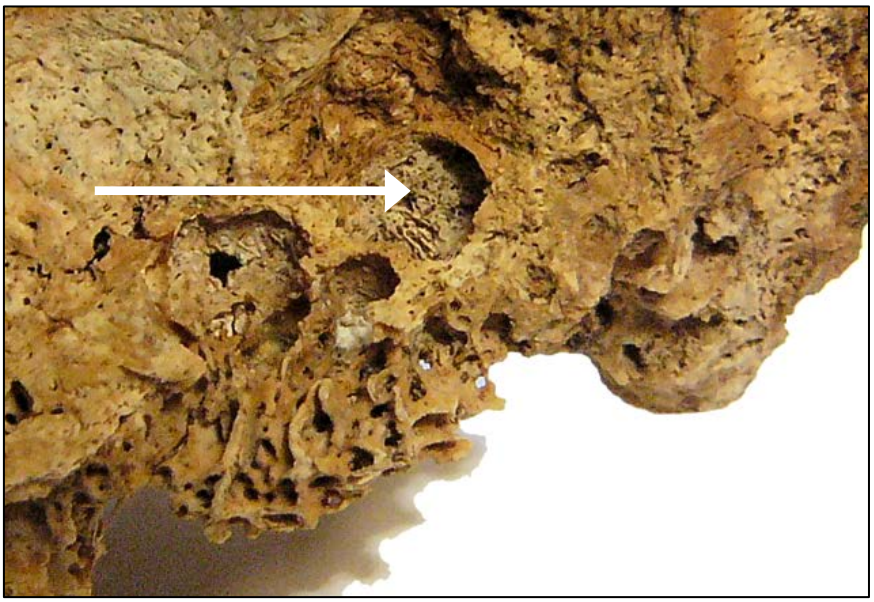

Plate 63: Mastoiditis, sk(906)

Other lesions that may be inflammatory in origin include a localised lytic lesion on the inferior surface of L1, located on the posterior aspect of the body, with perforation of the posterior body wall into the spinal canal (sk(550), a young adult female). The lesion, measuring 17.4mm A-P x 15.3mm M-L, was well defined but no sclerosis was present and the floor of the lesion consisted of sharp, trabecular bone. It was unclear if the lesion was caused by infection in the spine, possibly representing a granulomatous spondylitis such as tuberculosis, for example, or was perhaps caused by a neoplastic lesion, such as a metastasis, which are the most common type of vertebral tumour (Rodallec *et al* 2008).

Sk(837), an old adult male, exhibited a well-defined subcircular lesion in the centre of the frontal bone on the ectocranial surface. The lesion was lytic with blastic bony spicules in the base and measured 27.8mm x 26.8mm. It consisted of rounded, raised edges surrounded by a wider ring of seemingly thickened, pitted bone. All the bone was lamellar. It may have been related to a cystic lesion or was possibly a healing syphilitic lesion, though it did not have the typical stellar appearance. Overall, it had an appearance of a bony reaction to a chronic soft tissue sore of the scalp.

In addition, inflammatory changes were observed on the left side of the thoracic vertebral bodies of T4 and T5 in sk(1136), a middle aged adult male. Changes consisted of a small but easily observable amount of porotic and smooth woven bone periostitis deposited on the left side of the vertebral bodies, in the area of the aorta, possibly representing inflammation. The areas of bone deposit measured c. 11.05mm S-I x 12.71mm A-P and 6.04mm A-P x 6.04mm S-I respectively. This individual had undergone a post-mortem examination and the case is discussed in more detail below. One rare case of distal clavicular erosion was present in sk(1020), a middle adult male (Plate 64). The left clavicle was significantly remodelled in the distal third with a porotic, undulating

surface terminating in a bony spur replacing the normal acromial end. No apparent change on the scapula was observed but the acromion was partly absent through post-mortem damage. This location for infection is associated with syphilis but the changes are not typical of those associated with a treponemal infection and no other bone changes observed in the skeleton. The osteolysis may well have resulted from a direct contact infection or possibly from trauma. Clinically, unilateral erosions of the clavicle are associated with post-traumatic osteolysis, myeloma, metastases from cancers or osteomyelitis (http://radiopaedia.org/articles/distal-clavicular-erosion-differential). It can be related to acute shoulder trauma as may occur from falls, motor vehicle accidents or contact sports, but is believed to occur most frequently following repeated microtrauma to the subchondral bone of the clavicle from overuse of the shoulder joint, such as may be found in weightlifters or air-hammer operators (http://emedicine.medscape.com/article/1262297-overview, Schwartzkopf *et al* 2008). The stress causes inflammation and pain at the joint as the bone starts to erode. Clavicular erosion can also be observed in cases of rheumatoid arthritis though no further skeletal evidence for the condition was present in this individual.

Plate 64: Distal Clavicular Erosion sk(1020), Inferior View, with Normal (Top) for Comparison

Inflammatory Lesions in Sub-adults

Sixteen elements in the Late population exhibited inflammatory lesions (Table 26), affecting a total of 13 individuals, with three of these exhibiting multiple lesions. Six of these lesions consisted of periostitis, all of which consisted of woven bone.

In one particular case, sk(454), an older child of 6-7 years of age at death, the periostitis was associated with a lytic lesion/depression that may suggest a diagnosis of congenital syphilis (Plate 65). Diffuse woven bone periostitis was present on the anterior distal surface, medial and lateral sides of the right humerus. A thicker deposit was located on the posterior side where a lytic depression/lesion is also present. The area affected extended along the diaphysis to the proximal end, tapering and becoming finer in nature. The new bone formation was porotic and striated in the distal end becoming less so and quite smooth towards the proximal end. The lytic lesion and density of bone formation on the distal humerus may be indicative of congenital syphilis. One mandibular molar was present but had no enamel hypoplastic defects. No other long bones were available for observation. However, woven bone deposits were also present on the endocranial surface of the cranium, suggesting that sk(454) was suffering from a systemic infection and endocranial lesions have been linked to congenital syphilis, though the co-occurrence is rare (Lewis 2004).

Plate 65: Porotic Woven Bone Periostitis with Lytic Lesion (arrowed), sk(454)

Pathology	***No. of Cases***	***No. of Observabale Elements***	***TPR***	***CPR (N=64)***
Endocranial bone formation	5	27	18.5%	7.8%
Rib Lesions	4	*42	9.5%	6.3%
Periostsis Humerus	1 (R)	54	1.8%	1.6%
Periostitis Femur	1 (R)	71	1.4%	1.6%
Periostitis L. Tibia	2	26	7.7%	3.1%
Periostitis R. Tibia	1	31	3.2%	1.6%

Table 26: Inflammatory Conditions in the Late Sub-Adults

Four cases of rib lesions were recorded among the sub-adults in sk(337) (11-12 years), sk(888) (6 months-1 year), sk(1135) (11-15 years) and sk(947) (12-20 years), equalling the true prevalence rate in adults (TPR=9.5%, CPR=6.3%). The two former cases consisted of remodelling lesions whereas the latter two individuals had active lesions at the time of death. Five sub-adult individuals were recorded as having endocranial lesions, four of which (sk(454) (6-7 years), sk(491) (9-10 years), sk(891)(2-4 years) and sk(735) (4-6 years)) consisted of bone deposits on the inner surface of the cranium, all involving the occipital and the grooves for the transverse or superior sagittal sinuses. These changes are consistent with inflammation of the meninges, most often associated with infection but also with other conditions such as trauma, scurvy, anaemia, rickets, bone tumours and venous drainage disorders (Ortner 2003; Lewis 2004).

Trauma

Trauma to the skeleton was one of the most frequently observed pathologies in the Holy Trinity assemblage (see Table 24). In total, 46 cases of trauma were recorded, including two fractures present in adults that had occurred during childhood. No fractures were recorded in the sub-adults.

In the Early population, five trauma lesions were recorded, occurring in four individuals, two male (CPR=11.8, N=17) and two female (CPR=15.4%, N=13), in total affecting 8.9% of the population. sk(903), a young adult male, had a suspected old healed fracture of the right clavicle, possibly a greenstick fracture from childhood. The mid diaphysis was irregular and not as sinuous as a normal clavicle, though there was no observable evidence of displacement of the shaft. In addition, a well healed Colles fracture of the right radius was present. Again, there was little evidence of displacement but there was a transverse line of raised bone *c* 1cm superior to the articular surface, which was not present on the left side. Thus, the distal anterior surface of was smooth but irregular in outline.

sk(753), a possible female old aged adult, also exhibited bony remodelling indicative of a fracture to the lower arm. A large smooth lamellar bone callus was present on the left distal ulna, approximately 5cm superior to the distal articular surface. The distal radius had an irregular surface and a notch on the medial side to accommodate the large callus on the ulna. Secondary osteoarthritis was present on the distal joint surface, indicating that this was an old fracture that had placed biomechanical stresses on the wrist joint, causing it to degenerate. Another possible female of middle age, sk(864), was found to have a small lamellar bone enthesophyte protruding from the lateral side of the right 1st metacarpal in the mid diaphysis. This was likely to have resulted from a soft tissue trauma to the thumb.

One further middle aged individual, sk(768), a male, exhibited a large lamellar bone callus in the mid shaft of the left humerus, indicating a healed fracture that was likely to have been oblique (Plate 66). There was no right humerus present to compare to the left but it appeared that some medial displacement of the proximal third of about 30 degrees and possibly a minor amount of anterior displacement had occurred. No secondary DJD humeral head or elbow observable but not these were not well preserved; however, there were no changes to the contiguous glenoid fossa. Fractures of the shaft of the humerus are sustained more commonly by adults than children and frequently as a result of a direct blow resulting in a transverse and comminuted break (Salter 1999: 584). The fracture can also occur indirectly, however, by a fall onto the hand, though this tends to result in a spiral break.

Fourteen cases of fractures were recorded in the Chapter House assemblage from Worcester Cathedral, eleven of which occurred in males, two in females and one in a neonate, in total affecting 7.6% of the population (Waldron 2011). The majority of these fractures affected the upper body (n=10), including the skull, ribs, clavicle, radius, metacarpals and scaphoid. Rib fractures were also observed at Kempsey (n=2, TPR=4.1%, CPR = 2.2%) but here the bone was poorly preserved an observations regarding skeletal trauma was very limited (Western 2015).

Plate 66: Fracture of the Humeral Diaphysis, sk(768)

In the Late population at Holy Trinity, 40 incidences of adult trauma were observed, occurring in 25 individuals, affecting 12.8% of the adult population (Table 27). Two further sub-adult cases of trauma were present, so that the CPR of trauma for the total Late population was 10.0% (N=259). This was lower than the rate at Upton-on-Severn (37.5%, N=24) (Western 2014) and St Andrew's (16.7%, N=24) (Western 2006), Tallow Hill (22.3%, N=9) (Ogden n.d.) and St Martin's, Birmingham (21.4%, N=505) (Brickley, Berry and Western 2006).

Of the 22 individuals that could be ascribed a sex, two were old adult possible females and two were middle aged adult female (n=4, 18.2%); eighteen were male/possible male (81.8%). Age could also be determined for 15 of these males; eight were middle aged and seven were old adult. Multiple trauma lesions were identified in sk(505), sk(639), sk(870), sk(906), sk(1017), sk(1028), sk(1130) and sk(1136), all of whom were male. Remarkably, six cases of healed fractures and trauma were observed in sk(906), including the fracture of five ribs, a compression fracture of one upper/mid thoracic vertebra, fracture of the right clavicle, fracture of the right ulna and radius in the region of the wrist, fracture of the left distal fibula in the area of the ankle and an enthesophyte representing soft tissue trauma at the attachment site of adductor magnus and adductor longus on the right femur. It is highly likely that at least some of these fractures occurred at the same time

and represent a major trauma incident at some velocity, such as a fall from a height or involving a speeding carriage, for example.

Plate 67: Healed Fracture of the Radius with Residual Angulation and Bony Excrescence, sk(931)

Clinically, males are most commonly involved in trauma incidents (Salter 1999). The CPR of trauma amongst the males present in the Holy Trinity assemblage was 20.0% (N=90) compared to 4.9% in females (N=61). At St Martin's, Birmingham, fractures were present in 17.9% of females compared to 41.4% of males (Brickley, Berry and Western 2006), reflecting a similar pattern to that at Upton on Severn (Western 2014). Overall, at Upton, males experienced more trauma than females, with a CPR of 72.8% (N=11) for trauma in males compared to a CPR Of 25.0% (N=4) in females. Six of the nine adult individuals affected by trauma at Upton exhibited multiple fractures or traumata and as at Stratford-upon-Avon, all these individuals were male. Overall, similar patterns of fracture distribution was observed in the Holy Trinity assemblage to other contemporary local sites but the rate of trauma was lower for both males and females. Fracture prevalence has been noted to generally increase over time with the introduction of mechanisation and increase in traffic, leading to more severe fractures, including those of the more robust bones such as the femur as well as multiple injuries (Roberts and Manchester 1997). Injury recidivism, where several injuries occur in the same individual over a period of time, affects young adults most frequently, especially males of lower socio-economic status, and is often associated with interpersonal violence (Judd 2002).

Pathology	*No. of Cases*	*No. of Observable Elements*	*TPR*	*CPR (N=195)*
Clay Shoveller's Fracture	2	123	1.6%	1.0%
Fracture Clavicle (1L +1R)	2	134	1.5%	1.0%
Fracture of the Greater Tuberosity of the Humerus (1R)	1	126	0.8%	0.5%
Greenstick Fracture Ulna (R) (childhood)	1	134	0.7%	0.5%
Fracture Distal Radius and Ulna Diaphyses (R)	1	112	0.9%	0.5%
Fracture Distal Radius (Diaphysis) (R)	1	128	0.8%	0.5%
Fracture Distal Radius (Colles) (L)	1	128	0.8%	0.5%
Fracture Distal Ulna (L)	1	134	0.7%	0.5%
Fracture 1st Metacarpal Diaphysis (R)	1	108	0.9%	0.5%
Fracture 1st Metacarpal, Bennet's (L)	3	108	2.8%	1.5%
Fracture 1st Metacarpal Distal Joint (L)	1	108	0.9%	0.5%
Fracture 2nd Metacarpal	1	110	0.9%	0.5%
Unreduced Dislocation 3rd Metacarpal Head (L)	1	103	1.0%	0.5%
Fracture 5th Metacarpal Intra-articular (L)	1	105	1.0%	0.5%
Fracture 5th Metacarpal Neck (L)	1	105	1.0%	0.5%
Intra-articular Fracture 5th Hand Phalanx	1	782	0.1%	0.5%
Compression Fracture Vertebra (Thoracic)	3	82*	3.7%	1.5%
Fracture Vertebral Transverse Process (Thoracic)	1	82*	1.2%	0.5%
Fracture Distal Fibula (L)	1	153	0.7%	0.5%
Fracture 2nd Metatarsal (L)	1	83	1.2%	0.5%
Avulsion 5th Metatarsal (R) (childhood)	1	84	1.2%	0.5%
Toe Subluxation (R)	1	227	0.4%	0.5%
Fracture of the Ribs	7	84*	8.3%	3.6%

Enthesophyte Iliac Crest	2	157	1.3%	1.0%
Enthesophyte Distal Tibia (L)	1	166	0.6%	0.5%
Enthesophyte 1st Metacarpal (R)	1	108	0.9%	0.5%
Enthesophyte Femur (R)	2	176	1.1%	1.0%
Enthesophyte Fibula (R)	1	153	0.7%	0.5%

*Table 27: Summary of Trauma Prevalence in the Late Population (TPR calculated for total adult elements or *number of adult individuals with elements present)*

The most commonly affected area of the body at Stratford-upon-Avon was the hands, with 10 counts of trauma to the metacarpals and phalanges, followed by arms, with 5 counts of trauma resulting in 6 fractured bones of the lower arm (Plate 67). Hands were also the most common location for trauma in the population at Upton-on-Severn (Western 2006). Clinically, fractures to the metacarpals and hand phalanges are the most common type in the upper extremity (Berger and Weiss 2004). Fractures of the metacarpals represent 30-40% of all hand fractures; of those, 25% are fractures to the 1st metacarpal while the next most common involve the 5th metacarpal (Askenaze and Ruby 1992). Today, thumb fractures occur most commonly in children and the elderly (over 65 years old) (Askenaze and Ruby 1992). Three of the hand fractures recorded in the Stratford assemblage are known as Bennett's fractures (Plate 68), which generally occur as a result of impaction of the thumb while flexed, such as when hitting a hard object, but can also occur as the result of a fall, particularly when an individual has an accident while holding a hard object (i.e. in modern populations, holding bike handles or steering wheels) (CE4RT.com 2015). Evidence of this is manifest by intra-articular fractures across the joint surfaces.

Plate 68: Bennett's Fracture with Secondary Osteoarthritis, sk(1136)

Two further fractures involving the 1st metacarpal were also recorded, one an intra-articular fracture at the distal end of the bone, also resulting from an impact injury, and another across the diaphysis. The remaining four counts of trauma involving the hand involved the 2nd, 3rd and 5th metacarpals. Fractures of metacarpals 2-5 are also most commonly the result of direct impaction;

although crushing cannot be ruled out, severe crush injuries to the hand often involve multiple metacarpals (Salter 1999). Fractures to these metacarpals are often associated with longitudinal forces along the axis of the bone, occurring as the result of falling onto a clenched fist as well as interpersonal violence. Dislocation co-occurring with these types of fractures is common. Although the bones observed here were healed, the incongruity of the healed joint surface evidence can lead to degenerative joint disease and osteoarthritis due to the stresses placed on the uneven joint surface. This was noted in sk(1136), where secondary degenerative joint disease had occurred in the thumb following a Bennett's fracture. In sk (870), large osteophytes, macroporosity and eburnation present on the left 3rd metacarpal head, though no fracture lines/callus present and the other metacarpals were normal. The metacarpal head was well aligned but the superior part on the lateral side was absent, with just an angulated, porotic surface being present. The origin of this lesion was likely to be trauma related, possibly relating to a crush type injury and/or dislocation.

Seven cases of rib fractures were noted in the assemblage (CPR=2.7%) (Plate 69). This is lower than reported average reported rates of 4.2% from this period (Roberts and Cox 2003, the rate at St Andrew's, Worcester and at Upton-on-Severn (both 12.5%) (Western 2006; Western 2014) but slightly higher than that of St Martin's, Birmingham, where the CPR was 2.3% (Brickley, Berry and Western 2006). Ribs fractures occur when they strike or are struck by a hard object (Salter 1999). The fractures were well healed in all cases denoted by the presence of smooth lamellar bone callus. In two cases, the ribs affected were located on the left hand side, in two cases ribs on the right and left side were fractured and in three cases the fractured ribs were located on the right side only. Five of the individuals were male/possible male, one was female and another was unobservable for sex. Three of the male individuals with rib fractures also suffered trauma to other elements of the skeleton; sk(906) had undergone multiple trauma, as described above, while sk(1136) had also sustained a Bennett's fracture and sk(505) had a well healed Colles' fracture. Colles' fractures are often seen today in the elderly and are associated commonly with osteoporosis (Salter 1999). They frequently result from a fall onto an outstretched hand where the hand is pronated, or facing downwards. The example observed here in the Late population was present in a middle aged adult male.

Plate 69: Multiple Rib Fractures, sk(906)

Three compression fractures of a vertebra were present in the Late population. These can occur as the result of a fall landing on the feet or bottom, where the forces generated travel up the body and result in compression of the vertebra (Salter 1999). They are also commonly associated with both

osteoporosis and tumours in the vertebra, both of which weaken the underlying structure of the bone (Brickley and Ives 2008). It was thought that one of the cases of compression fracture in the vertebrae was likely to have been associated with osteoporosis or osteopenia, where the 10th thoracic vertebra was compressed and reduced in height, and had subsequently become ankylosed to the 11th in sk(421). Unfortunately, the skeleton was not very well preserved, so it was not possible to estimate the age and sex of the individual. Another compression fracture of a vertebra was present in sk(906), the male who had sustained several trauma-related injuries including fractured ribs and a fractured ankle. It may, therefore, be a possibility that this fracture was sustained as a result of trauma, though this individual was an old aged adult, and it could also be the case that the vertebra became compressed later on in life. The affected vertebral body was observed to be concave on both sides and wedge-shaped. A similar possible fracture that may have been related to osteoporosis or osteopenia was observed in sk(1130), where the bodies of the 6th, 7th and 8th thoracic vertebrae were all reduced in height and large osteophytes were present were present on the right hand side. This male individual was middle aged, rather than old aged, however, and so trauma cannot be ruled out as the underlying cause.

A rare fracture worth noting that was observed in the Stratford assemblage was an un-united fracture of the right transverse process of the 9th thoracic vertebra in sk(1017), a middle adult male (Plate 70). The separated process was present. Clinically, these fractures usually result from a sudden extreme twisting or side bending movement. Occasionally it may be due to a direct impact to the process itself, although the processes are well covered by muscle, making a direct blow an unusual mechanism of fracture in these cases (http://www.sportsinjuryclinic.net/sport-injuries/low-back-pain/transverse-process-fracture). Other unusual fractures included two 'clay-shovellers' fractures of the tips of the spinous processes in the 7th cervical vertebra and 1st thoracic vertebra (sk1017, a male, who also had the transverse process fracture described above and sk(934), a possible female). Clinically, these fractures are usually found incidentally, though they are painful, and in modern populations are found after a sudden muscle contraction, direct blows to the spine or occurring as the result motor vehicle accidents (http://radiopaedia.org/articles/clay-shoveler-fracture-2). It is a common facture in labourers, who are lifting heavy weights with the arms extended i.e. when shovelling heavy soils up and over the head, using pickaxes, scythes and pulling out roots from the ground (http://www.medicinenet.com/script/main/art.asp?articlekey=7987). Overall, these three fractures in the processes of the spine indicate that some of the individuals in Stratford were likely to have been regularly involved in heavy, manual work.

Plate 70: Fracture of the Transverse Process, sk(1017)

Plate 71: Displaced Fracture of the Greater Tuberosity of the Humerus, sk(704)

Another relatively rare fracture was present in sk(704), also a middle aged female (Plate 26). Although only partially preserved, the humeral head could be seen to be abnormal in shape with posterior displacement of the neck/head area. The intertrochanteric groove, therefore, rather than running superior-inferiorly along the longitudinal axis of the diaphysis, ran posteriorly at a tangent. There was no defined greater tuberosity and a flattened lesser tuberosity. The joint surface was only partially preserved but appeared flattened and was irregular. This deformity of the bone was may have been subsequent to a displaced avulsion fracture of the greater tuberosity, most often occurring following a fall onto an outstretched hand or a direct fall onto the shoulder (George 2007). Isolated fractures to the greater tuberosity are most frequently seen in healthy middle aged adults (George 2007), though this example in a middle aged female was well healed and remodelled, possibly representing an old fracture at the time of death.

Trauma in the lower limb was comparatively rare, with only one fracture of the distal fibula in sk(906), who exhibited multiple trauma-related lesions, and two fractures of the metatarsals, one of which had occurred during childhood or adolescence. A well healed fracture of the second metatarsal was present in sk(1028), an old adult male. Fractures of this type are commonly related to excess stresses from high levels of running or walking-based activities, frequently seen today in sports such as football or rugby, and hence are also known as a ‘march’ fracture (Salter 1999, http://www.physioroom.com/injuries/ankle_and_foot/metatarsal_fracture_full.php). Enthesophytes, however, were seen more commonly in lower limb elements. These are common bony growth consisting of smooth and dense lamellar bone, often irregular in shape, and generally are thought to represent ossified soft tissue trauma lesions where damage or stress has occurred to the tendons or ligaments at the site of attachment onto the bone (Plate 72). Enthesophytes can range in size and represent relatively minor stresses to more substantial trauma. Six counts of enthesophytes were recorded in the lower limb compared to only one in the upper limb, suggesting that the lower limbs were more prone to less serious soft tissue trauma, while the upper limbs were more likely to be fractured and involved in serious trauma. This corresponds well to patterns of trauma seen in modern populations, with 50% of all fractures in adults occurring in the arm bones,

the most common area within the arm being the wrist (http://visual.ly/5-most-commonly-broken-bones).

Plate 72: Enthesophyte, sk(639)

Trauma in Childhood and Epiphyseal Disorders

Two additional healed fractures were observed in adults that were likely to have occurred during childhood. One, in sk(626), an adult male, was manifest through anterior bowing of the distal third of the right ulna. There was no evidence of a callus and no similar deformity in the radius, suggesting that an isolated greenstick fracture of the distal ulna had occurred rather than representing Madelung's deformity, which results in development sequellae of both the ulna and radius, or healed rickets, which would similarly affect the radius and would be very rare in the arms of an adult. An avulsion fracture through the base of the 5th right metatarsal was also present in sk(639), an old adult male, usually occurring as the result of forced plantar flexion prior to complete fusion of the apophysis in adulthood (Salter 1999).

Also likely to have resulted from trauma during childhood was a case of an epiphyseal dysplasia in the left proximal humerus of sk(470), a middle adult female (Plate 73). The humeral head was not developed and instead, a splayed, cup-like concave articular surface was present, consisting of lamellar bone. The anterior surface is eburnated while the posterior half is irregular with lamellar bony nodules. The contiguous glenoid cavity was also malformed and consisted of a convex dense lamellar bone surface, which was eburnated anteriorly and exhibits macroporosity along with osteophyte formation. The shoulder in essence consisted of a pseudoarticular joint. The diaphysis itself was well developed, however, the humerus having a prominent deltoid muscle attachment and no indications of atrophy, so presumably was used in life. These bony lesions appear to be the

result of a long standing 'developmental' issue, possibly arising from trauma to the joint at a young age. It is also possible that an idiopathic dysplasia has occurred, such as an osteochondrosis, though these usually involve pressure epiphyses.

Clinically, fractures to the proximal humerus are rare, totalling only *c* 0.5% to 3.5% of all fractures reported (Lefèvre *et al* 2014). Such epiphyseal injuries, however, are the most common type of injuries to the shoulder and upper arm amongst adolescents (Binder *et al* 2011). Clinically, the most common age for the occurrence of proximal humerus fractures is between 10 and 14 years of age (Lefèvre *et al* 2014). In these cases, the mechanism of the fracture is often a fall backwards onto the extended arm. While buckle fractures involving the metaphysis are more common in younger children, adolescents are more likely to experience Salter-Harris fractures, which directly involve the physis (growth plate) itself (http://www.rch.org.au/clinicalguide/guideline_index/fractures/Proximal_humeral_fractures_Emergency_Department/).

Plate 73: Epiphyseal Dysplasia, Left Shoulder Joint, sk(470)

Transphyseal separation of the humeral head may also occur as a result of neonatal injury the birthing process. In neonates, a third of all humerus fractures occur at the proximal end but overall these are very rare, occurring in only 0.03 per 1000 births (Lefèvre *et al* 2014). In the youngest age groups, fractures of the humerus can be the result of abuse and in fact, two thirds of all humeral fractures in individuals aged younger than 18 months have been found to be related to physical violence, although traction on the upper limb of the neonate during childbirth is also a mechanism of this fracture (Lefèvre *et al* 2014). While simple fractures generally heal well without orthopaedic intervention, severe fractures with more than 50% displacement of the humeral head relative to the diaphysis, severe angulation, pathological fractures (i.e. underlying bone cyst) and fractures with associated vascular or nerve damage would require intervention to ensure adequate healing. Without surgery, it is possible that that necrosis of the humeral head would occur, which appears to have been the case in sk(470).

In addition, two individuals were observed with osteochondritis dissecans, which in one case (sk(879)) was bilateral. This is a condition consisting of a localised subcircular defect in the joint surface of a pressure epiphysis, most commonly seen in distal condyle of the femur, which forms part of the knee joint. It appears to be an idiopathic condition, involving an asceptic necrosis and recalcification of part of the joint, but is thought to be linked to microtrauma of the joint surface and is most commonly seen in males between 10 and 20 years old who have a history of trauma to the joint (Salter 1999, http://emedicine.medscape.com/article/89718-overview).

Joint Disease

Primary osteoarthritis and degenerative joint disease (DJD) are an inevitable consequence of old age when the body's tissues begin to break down and are unable to repair themselves adequately (Salter 1999). Clinically, this condition is most common in adult women, though it occurs in 80% of women and men over the age of 75 years (Salter 1999). Joint disease can be extra-spinal (i.e. affecting long bones and joints) or spinal. The latter is diagnosed through the appearance or osteophytes round the periphery of the vertebral body, increased porosity of articulating surfaces and additionally subchondral cysts due to the breakdown of the subchondral bone surface. In the most severe cases, eburnation of the articulating surfaces created as the bones' surfaces abrade each other is present and this is feature is pathgnomic of osteoarthritis.

Primary extra spinal joint disease occurs without associated trauma or underlying pathological conditions and is associated mainly with abnormal stress on the joint or age. When associated with trauma or pathological conditions, the joint disease is said to be 'secondary'. Degenerative joint disease is characterised by the presence of macro- or microporosity to the joint and osteophyte formation around the joint surface. Osteoarthritis has only been diagnosed if eburnation was present. This is the result of the complete destruction of the cartilage lining the joint, allowing the bone surfaces to abrade against each other (Plate 74). It is difficult to assess which conditions would have had the greatest impact on the individual, as in some clinical cases patients present with joint pains where little bony change has occurred, yet others exhibit quite advanced skeletal changes and experience little discomfort (Rogers and Waldron 1995). Joint diseases such as osteoarthritis, however, can be a debilitating disorder.

Plate 74: Osteoarthritis of the knee, sk(542)

Observations of spinal joint disease, including osteoarthritis, for the Early and Late population per element are recorded below in Tables 14 and 15. Pathological changes in the spine are recorded separately for the anterior body and for the posterior arch at the zygapophyseal joints. The distribution of elements affected by spinal joint disease in the spine was similar in both the Early and Late periods (Figs 34 and 35). Overall, the highest levels of degenerative joint disease (DJD) and osteoarthritis in the posterior (zygapophyseal) joints occurred in the upper and mid thoracic vertebrae, with moderate levels of osteoarthritis being seen in the cervical vertebrae of the neck. In the vertebral bodies, the cervical vertebrae were the most frequently affected by degenerative changes with a moderate increase in prevalence in the lower spine (lower thoracic and lumbar vertebrae). Clinically, degeneration of the cervical joints is quite common in the elderly (Salter 1999).

In the Early population, 10 of the 23 individuals who had at least one vertebra observable for degenerative changes exhibited DJD and/or OA (TPR = 43.5%, CPR = 31.3%). Six of the individuals were female/possible female and four were male/possible male. Of the nine individuals that could be assigned an age, only one was a young male adult, while two male and two female adults were middle aged. The remaining three female and one male adults were old age. Although the sample size was small, the data suggests that age was a primary factor in the onset of degenerative changes in the spine in this population, as is seen clinically in modern populations. At the Chapter House, Worcester Cathedral, ten males and 5 females are reported to have exhibited osteoarthritis in the zygapophyseal joints of the spine (Total CPR = 8.1%; Waldron 2011) and at St Mary's, Kempsey, the overall CPR for spinal joint disease was 13.0%, though the skeletal remains here were not well preserved. The rates of spinal joint disease appear, therefore, to be considerably higher amongst the Stratford population.

	Zyg. joints Affected	Body Affected	Fusion	Zyg. Joints Present	Body Present	TPR Zyg. Joints %	TPR Bodies %	CPR (N=32) Zyg. Joints %	CPR (N=32) Bodies %
C1-C2	1	0	0	12	12	8.3	0.0	3.1	0.0
C2-C3	2	0	0	9	9	22.2	0.0	6.3	0.0
C3-C4	2	3	0	12	11	16.7	27.3	6.3	9.4
C4-C5	2	2	0	13	13	15.4	25.0	6.3	6.3
C5-C6	2	3	0	13	12	15.4	16.7	6.3	9.4
C6-C7	0	4	0	12	12	0.0	33.3	0.0	12.5
C7-T1	1	1	0	13	12	7.7	8.3	3.1	3.1
T1-T2	2	0	0	16	14	12.5	0.0	6.3	0.0
T2-T3	2	1	0	15	14	13.3	7.1	6.3	3.1
T3-T4	5	1	0	15	12	33.3	8.3	15.6	3.1
T4-T5	2	1	0	15	14	13.3	7.1	6.3	3.1
T5-T6	4	1	0	15	13	26.7	7.7	12.5	3.1
T6-T7	2	1	0	16	13	12.5	7.7	6.3	3.1
T7-T8	2	2	0	15	12	13.3	16.7	6.3	6.3
T8-T9	2	2	0	16	12	12.5	16.7	6.3	6.3
T9-T10	2	1	0	16	13	12.5	7.7	6.3	3.1
T10-T11	2	1	0	15	11	13.3	7.1	6.3	3.1
T11-T12	0	1	0	16	13	0.0	7.7	0.0	3.1
T12-L1	0	3	0	16	15	0.0	20.0	0.0	9.4
L1-L2	1	1	0	17	16	5.9	6.3	3.1	3.1
L2-L3	0	1	0	17	17	0.0	5.9	0.0	3.1
L3-L4	0	0	0	17	16	0.0	0.0	0.0	0.0
L4-L5	0	1	0	15	15	0.0	6.7	0.0	3.1
L5-S1	0	1	0	16	15	0.0	6.7	0.0	3.1

Table 28: Summary of Spinal Joint Disease in the Early Population

	Zyg. Joints Affected	Body Affected	Fusion	Zyg. Joints Present	Body Present	TPR Zyg. Joints %	TPR Bodies %	CPR (N=195) Zyg. Joints %	CPR (N=195) Bodies %
C1-C2	1	2	0	48	48	2.1	4.2	0.5	1.0
C2-C3	3	4	0	48	48	6.3	8.3	1.5	2.1
C3-C4	5	8	0	49	49	10.2	16.3	2.6	4.1
C4-C5	5	9	0	50	48	10.0	18.8	2.6	7.2
C5-C6	1	10	0	54	50	1.9	20.0	0.5	5.1
C6-C7	4	7	0	58	57	6.9	12.2	2.1	3.6
C7-T1	2	3	0	59	57	3.4	5.3	1.0	1.5
T1-T2	2	2	0	66	60	3.0	3.3	1.0	1.0
T2-T3	2	0	0	67	63	3.0	0.0	1.0	0.0
T3-T4	5	0	0	68	64	7.4	0.0	2.6	0.0
T4-T5	9	1	0	67	63	13.4	1.6	7.2	0.5
T5-T6	4	1	0	69	65	5.8	1.5	2.1	0.5
T6-T7	4	2	2	73	62	5.5	3.2	2.1	1.0
T7-T8	2	2	2	70	67	2.9	3.0	2.1	2.1
T8-T9	1	3	4	70	70	1.4	4.3	0.5	1.5
T9-T10	2	3	3	74	76	2.7	3.9	1.0	1.5
T10-T11	2	2	2	78	79	2.6	2.5	1.0	1.0
T11-T12	2	7	1	77	74	2.6	9.5	1.0	3.6
T12-L1	1	6	0	79	77	1.3	7.8	0.5	3.1
L1-L2	2	1	0	81	75	2.5	1.3	1.0	0.5
L2-L3	2	2	0	81	71	2.5	2.8	1.0	1.0
L3-L4	2	2	0	81	72	2.5	2.8	1.0	1.0
L4-L5	2	4	0	88	76	2.3	5.3	1.0	2.1
L5-S1	3	1	0	82	74	3.7	1.4	1.5	0.5
L5-L6	1	1	0	6	5	16.7	20.0	0.5	0.5
L6-S1	0	1	0	6	5	0.0	20.0	0.0	0.5
S1-S2	0	0	0	2	1	0.0	0.0	0.0	0.0

Table 29: Vertebral Pathology in the Late Population

In the Late population, of the 124 adult individuals who had at least one observable vertebra, 39 displayed degenerative joint changes (CPR = 20.0%, TPR adults = 31.5%), a lower rate than observed in the Early population at Stratford. In comparison, 13 of the 17 adult individuals present in the post-medieval population at Upton-on-Severn exhibited some degenerative change to their spine (CPR = 76.5%, TPR adults = 92.9%), reflecting to some degree the absence of young adults in this assemblage; the rate of spinal joint disease at Stratford is more comparable to that reported for St Andrew's, Worcester (CPR Adults = 26.3%), though higher than that at St Martin's, Birmingham (TPR adults = 19.59%). Male and females were both affected; however, males/possible males exhibited higher rates of DJD/OA in all areas of the spine. In the cervical vertebrae, 33.3% males/possible males DJD/OA (n=12, N=36) were affected by joint disease compared to only 7.4% of females/possible females. Males were also more frequently affected by DJD and OA in the spine than females/possible females in both the thoracic vertebrae (TPR 33.3%, n=16, N = 48 compared to TPR 16.1%, n=5, N=31) and the lumbar vertebrae (TPR 17.8%, n=8, N=45 compared to TPR 10.5%, n=4, N=38).

Examining the differences in the rates of DJD/OA by age, it is clear that while age was an important factor in the presence of DJD/OA, with more old adults of both male and female sex

exhibiting degenerative changes, the onset of DJD/OA in the spine is earlier in males than females (See Figures 36 and 37). For example, 27.3% of young males adults (TPR, n=3, N=11) exhibited DJD/OA in the thoracic spine where none of the young female adults (N=12) were affected. Similarly, DJD/OA was observed in 33.3% (n=5, N=15) of middle aged males compared to only 10% of middle aged females (n=1, N=10). Overall, these degenerative changes in the young and middle adult males are most often seen in the thoracic and cervical vertebrae compared to females. Since they do not appear to be specifically related to the aging process alone, the increased frequency of these degenerative changes in the younger and middle aged males compared to females is indicative of differences between the sexes in physical activity and micro-trauma involving the spine, quite likely relating to occupation and lifestyle. This is unlike the Early sample from Stratford where the distribution of spinal joint disease between males and females was more equal, though this sample was much smaller overall.

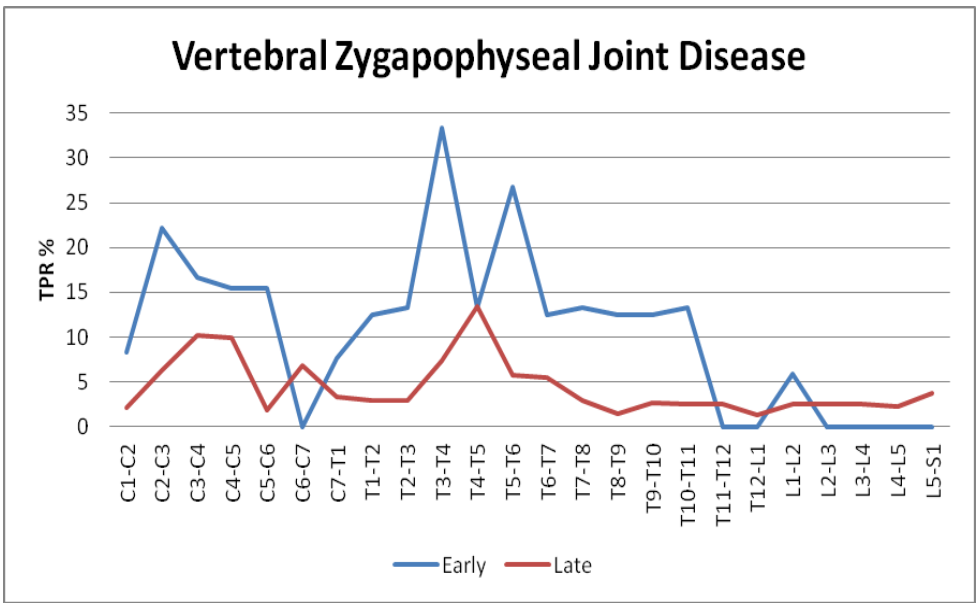

Figure 34: Comparison of the Distribution of Joint Disease in the Posterior Spinal Joints

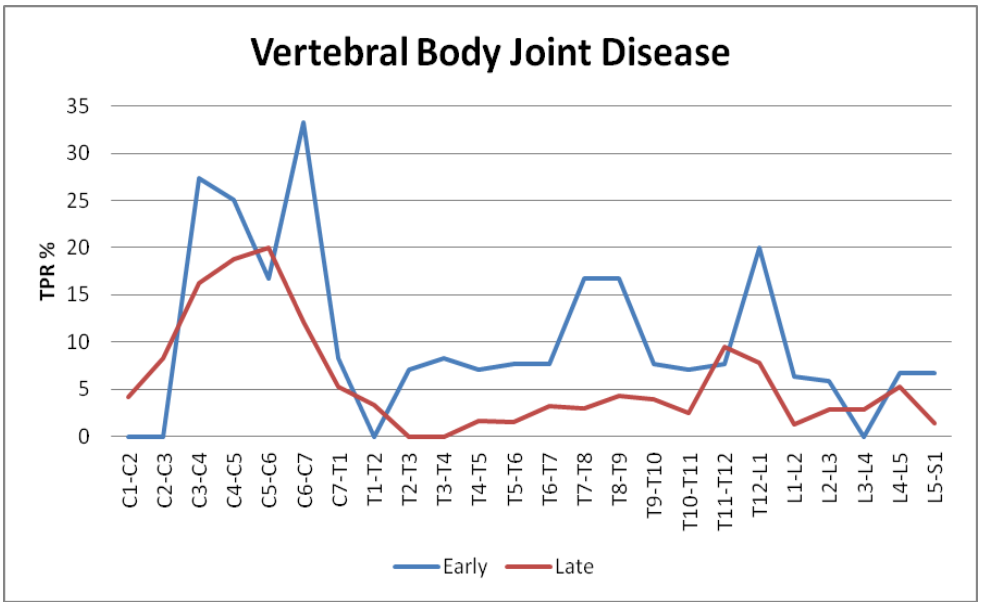

Figure 35: Comparison of the Distribution of Joint Disease in the Vertebral Bodies

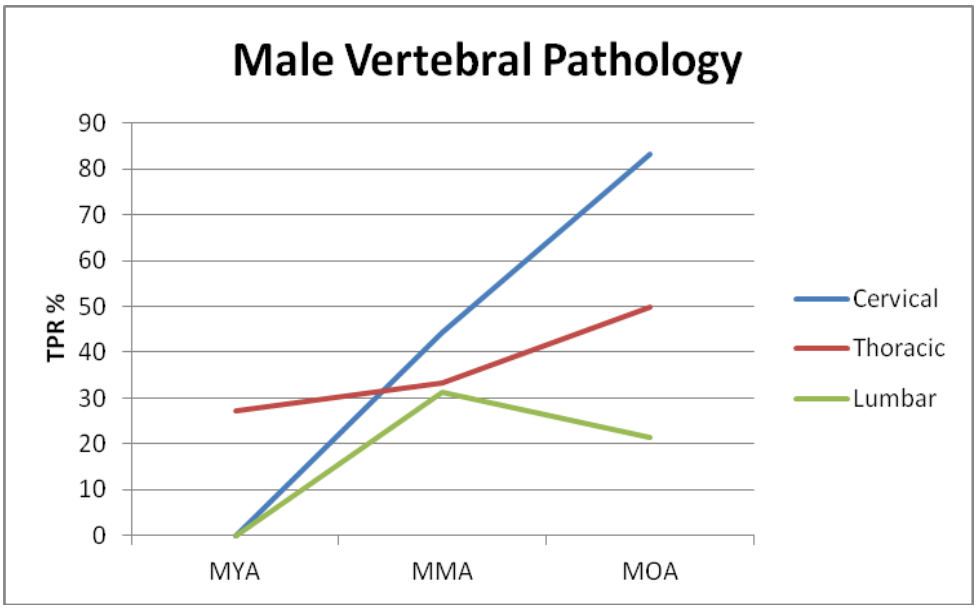

Figure 36: Vertebral Pathology in Males according to Age

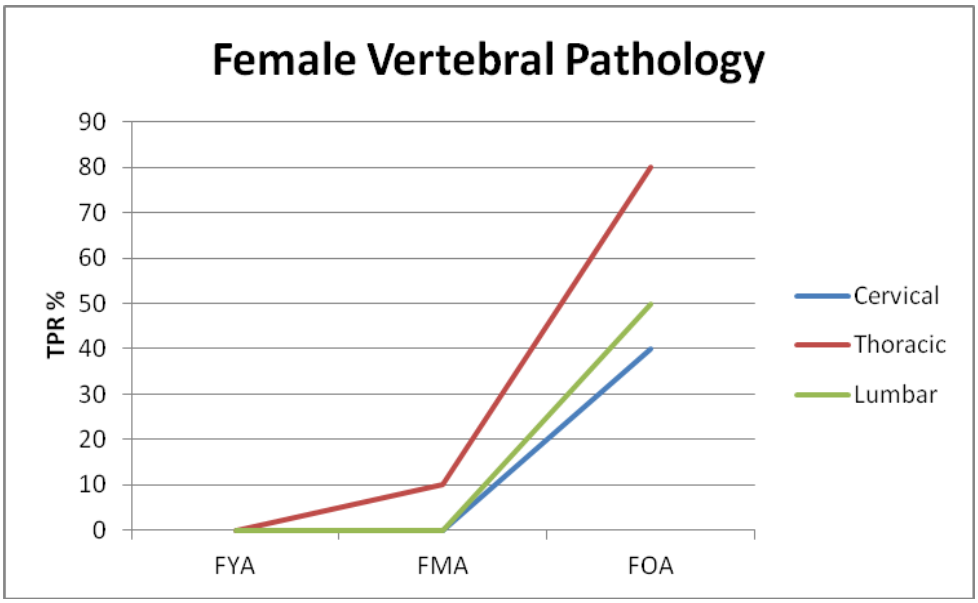

Figure 37: Vertebral Pathology in Females according to Age

Also manifest as vertebral joint disease amongst the population at Holy Trinity were Schmorl's nodes. These are rounded lesions occurring in the surfaces of vertebral bodies and occur as a result degenerative changes to the intervertebral disc and soft tissues. With age, the annulus fibrosis of the intervertebral disc loses its elasticity and the thin cartilage lining the end plate (body surface) deteriorates. This allows the nucleus pulposis of the intervertebral disc to protrude through the cartilage forming a depression in the surface of the body (Salter, 1999, 274). Schmorl's nodes are frequently seen radiographically in modern populations but they are of little clinical significance. They are, however, a clear indication of degeneration of the spine in archaeological populations.

	Early assemblage			*Late assemblage*		
	SN	*N. Obs*	*TPR %*	*SN*	*N. Obs*	*TPR%*
C2-C3	0	11	0.0	0	48	0.0
C3-C4	0	12	0.0	0	49	0.0
C4-C5	0	12	0.0	0	48	0.0
C5-C6	0	11	0.0	0	50	0.0
C6-C7	0	13	0.0	0	57	0.0
C7-T1	0	13	0.0	0	57	0.0
T1-T2	0	14	0.0	0	60	0.0
T2-T3	0	14	0.0	2	63	3.1
T3-T4	0	12	0.0	2	64	3.1
T4-T5	1	14	7.1	6	63	9.5
T5-T6	2	13	15.4	10	65	15.4
T6-T7	5	13	38.5	19	62	30.6
T7-T8	6	12	50.0	27	67	40.3
T8-T9	5	12	41.7	26	70	37.1
T9-T10	6	13	46.2	32	76	42.1
T10-T11	2	11	18.1	35	79	44.3
T11-T12	7	13	53.8	30	74	40.5
T12-L1	7	15	46.7	30	77	39.0
L1-L2	7	16	43.8	20	75	26.7
L2-L3	6	17	35.3	21	71	29.6
L3-L4	5	16	31.3	16	72	22.2
L4-L5	2	15	13.3	5	76	6.6
L5-S1	1	15	6.7	3	74	4.1

Table 30: Presence of Schmorl's Nodes

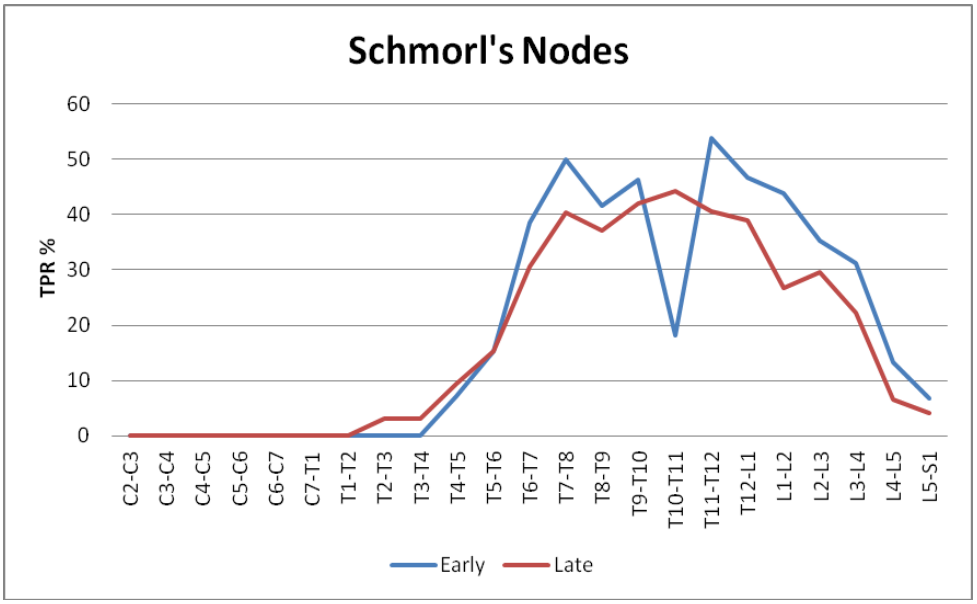

Figure 38: Comparison of the Presence of Schmorl's Nodes in the Early and Late Populations

As can be seen from Table 30, Schmorl's nodes were present throughout the lower thoracic and lumbar vertebrae, as would be expected with a condition that is in part related to weight bearing in

its aetiology, with a greater prevalence in the mid and lower thoracic areas as well as upper lumbars. The prevalence and distribution of Schmorl's nodes is very similar in both the Early and Late populations at Stratford-upon-Avon (Figure 38).

In total, 14 of the 22 Early adult individuals with at least one element observable for Schmorl's nodes in the thoracic and lumbar spine exhibited one or more nodes (TPR = 63.6%, CPR adults = 43.8%), six being female/possible female and eight being male/possible male. As with the degenerative disease, it appears that males and females were affected in approximately equal numbers. All age groups were affected, though interestingly more young adults exhibited Schmorl's nodes (n=4) than DJD/OA. Six adults affected were middle aged while three were old adults.

In the Late sample, 65 individuals exhibited Schmorl's nodes out of a possible 105 adults who had a least one vertebra observable for the condition in the thoracic and lumbar spine (TPR = 61.9%, CPR adults = 33.3%). Overall, the true prevalence rates are, therefore, very similar for Schmorl's nodes in the Early and Late populations. Of the 55 individuals to whom sex could be ascribed, 17 were female/possible female (30.9%) and 38 were male/possible male (69.1%). Analysis of the age and sex of those individuals with Schmorl's Nodes indicated that males were more likely to develop Schmorl's nodes than females and at a younger age. Female young adults had the lowest prevalence rates of Schmorl's Nodes while male middle aged and old age adults were the highest (Table 31), reflecting to a degree the patterns of spinal joint disease as discussed above.

	Female YA	***Female MA***	***Female OA***	***Male YA***	***Male MA***	***Male OA***
n	3	7	3	7	13	10
N	14	11	6	11	14	13
%	21.4	63.6	50.0	63.6	92.9	76.9

Table 31: Distribution of Schmorl's Nodes According to Age and Sex (YA = Young Adult, MA = Middle Aged Adult, OA = Old Adult)

One specific joint disease recorded at Holy Trinity that is worthy of note was diffuse idopathic joint disease (DISH). Typically, DISH is represented by large flowing osteophytes along the front of the vertebral bodies, usually on the right hand side in the lower thoracic region, formed through ossification of the anterior longitudinal ligament of the spine. In addition, further ossification of ligaments manifest as enthesophytes, is seen typically at the joints and muscle attachment sites such as at the olecranon process of the ulna, the greater trochanter of the femur, the ischium and the patella (Ortner 2003, Resnick *et al* 1975). Pathognomic of the condition is the fusing together of at least 3 of the vertebrae through the ossified ligament. Generally the condition occurs in older adults over the age of 50 (Plate 75). While some studies report that 25% of individuals with DISH are with obese and suffering from adult-onset diabetes (Roberts and Manchester 1997:120, Rogers and Waldron 1995: 48), other studies report no correlation between the condition and diabetes (Diedericks 2011). Very often, it is interpreted that individuals with DISH may have had a diet rich in meat or other proteins. Interestingly, a recent study of stable isotopes of a cemetery containing a lay and monastic population from medieval York found that nitrogen and carbon isotopes of individuals with DISH differed from the remainder of the sample (Müldner and Richards 2007: 169). Although it wasn't clear if the nitrogen results were affected by physiological changes in these individuals through the condition itself, the evidence suggested that those individuals with DISH may have had a dietary intake high in animal protein.

Five cases, three definite and two probable, were observed in the Late period only, in sk(381) (young adult male), sk(642) (middle adult male), sk(620) (unobservable age and sex), sk(488) (unobservable age and sex) and sk(331) (old adult male). The CPR of DISH amongst the adults at Holy Trinity is 2.6% (N=195), though the rate of DISH in adults with a least one vertebra observable in the thoracic and lumbar spine is 4.8% (N=105). One further possible case was noted in sk(846), an old adult possible female, who exhibited prominent enthesophytes bilaterally on the ischial tuberosities and femoral trochanters as well as a small enthesophyte on the superior aspect

of the left patella (Plate 76). Extensive osteophytes were also present on the lumbar vertebrae but no thoracic vertebrae were observable and therefore, it was not possible to diagnose DISH without the pathognomic fusion of the vertebrae (Ortner 2003). It is possible that the enthesopathies were age-related and caused by one of the spondyloarthritides (McGonagle and Benjamin 2009).

Plate 75: DISH, sk(620)

Plate 76: Enthesophytes on the Ischial Tuberosities, sk(846)

The CPR of DISH at Holy Trinity at 2.6% is higher than at Upton-on-Severn, Tallow Hill and at St Andrew's, Worcester, where no cases were observed in any of the adult individuals, though this may in part be due to the small number of individuals in these assemblages. The rate is also higher, however than St Martin's-in-the-Bullring, Birmingham, where in total eight individuals were noted to have DISH (CPR=1.6%, TPR=2.4%). Further possible cases of DISH at Holy Trinity were also noted in the disarticulated assemblage (see below). This presence of DISH suggests a diet richer in animal proteins may have been accessible to a greater number of people, and possibly also a wider segment of the population, in Stratford than seen elsewhere.

Extra-Spinal Joint Disease

Joint disease was the most frequently observed pathology. Overall, 87 cases of osteoarthritis (OA) and degenerative joint disease (DJD) were present. Ten cases of joint disease were present in eight of the Early individuals (CPR=22.2%, CPR adults = 31.3%) (Table 32), whereas 76 cases were present in 38 Late individuals (CPR=14.7%, CPR Adults = 19.5%) (see Table 33). The crude prevalence national average for extra-spinal joint disease in the medieval period is 14.1% (Roberts and Cox 2003). In comparison, the national CPR for osteoarthritis post-medieval populations is 24.53% and for DJD, 11.02% (Roberts and Cox 2003).

In the Early period, all eight individuals exhibiting extra-spinal joint disease could be assessed for age and/or sex. Four of these individuals were female/possible female and four were male/possible male. One of the females was a young adult, one a middle aged adult and two were old adults. Sex could only be determined in three of the males; one was young aged, one was middle aged and one was old aged.

Pathology	No. of Cases	No. of Observable Elements	TPR(%)	CPR Total Population (%) (N=45)	CPR Adults (%) (N=32)
Primary DJD TMJ	2	21	9.5	4.4	6.3
Primary DJD Shoulder (1R +1L)	2	28	7.1	4.4	6.3
Primary DJD Wrist (1R)	1 (2 Elements)	69	2.9	2.2	3.1
Primary OA Hand (1R)	1 (2 elements)	230	0.9	2.2	3.1
Primary DJD Sacro-Iliac Joint (2R)	2	14	14.3	4.4	6.3
Primary DJD Knee (1R)	1	28	3.6	2.2	3.1
Secondary OA Wrist (1L)	1	69	1.4	2.2	3.1

Table 32: Extra-Spinal Joint Disease in the Early Assemblage

In the Late period, 28 individuals exhibited joint disease for whom sex was observable, 21 of which were males (75.0%) and 7 were female (25.0%). Of the adults who exhibited joint disease and whose age and sex could be determined, two were middle aged and four were old age females/possible females compared to seven middle adult and nine were old adult males/possible males. Age, therefore, was the main factor in the aetiology of joint disease. Comparative prevalence rates of joint disease in old age males and females were 56.3% (N=16) and 40.0% (N=10) respectively, and 38.1% (N=21) and 7.7% (N=13) in the middle aged adults. Thus, men appear to have been more likely to have developed joint disease than females and at a younger age, reflecting the patterns of vertebral joint disease in the Late population observed above. This is in contrast to the pattern observed in the Early population regarding both spinal and extra-spinal joint disease, where males and females exhibited joint disease in more equal numbers, though this sample number was small.

Pathology	No. of Cases	No. of Observable Joint surfaces/ Elements	TPR (%)	CPR Total Population (%) (N=259)	CPR Adults (%) (N=195)
Primary DJD TMJ	4	119	3.4	1.5	2.1
Primary OA Acromio-Clavicular Joint (1R)	1	69	1.4	0.4	0.5
Primary DJD Acromio-Clavicular Joint (2L +1R)	3	69	4.3	1.2	1.5
Primary DJD Sterno-Clavicular Joint (4R + 3L)	7	136	5.1	2.7	3.6
Primary DJD Shoulder (3R)	3	146	2.1	1.2	1.5
Primary OA Elbow (1L + 2R)	3	122	2.5	1.2	1.5
Primary DJD Elbow (3R +1L)	4	122	3.3	1.5	2.1
Primary DJD Hand (3R +1L)	4 (8 Elements)	1322	0.6	1.5	2.1
Primary OA Hand (1R +1L)	2 (4 Elements)	1322	0.3	0.8	1.0
Primary OA Wrist (1R)	1 (2 Elements)	363	0.6	0.4	0.5
Primary DJD Wrist (2R + 1L)	3 (6 Elements)	363	1.7	1.2	1.5
Primary DJD Sacro-Iliac Joint (1R)	1	128	0.8	0.4	0.5
Primary OA Hip (5R +3L)	8	137	5.9	3.1	4.1
Primary DJD Hip (4R +3L)	7	137	5.1	2.7	3.6
Primary OA Knee (4R +1L)	5	168	3.0	1.9	2.6
Primary DJD Knee (3R +4L)	7	168	4.2	2.7	3.6
Primary OA Foot (2R + 1L)	3 (6 Elements)	1215	0.5	1.2	1.5
Secondary DJD Shoulder (1R)	1	146	0.7	0.4	0.5
Secondary OA Wrist (1L)	1 (2 Elements)	363	0.6	0.4	0.5
Secondary OA Hand (2L)	2 (4 Elements)	1322	0.3	0.8	1.0
Secondary DJD Hand (1R +1L)	2 (4 Elements)	1322	0.3	0.8	1.0
Secondary OA Knee (1R + 1L)	2	168	1.2	0.8	1.0
Secondary OA Foot (1R + 1L)	2 (4 Elements)	1215	0.3	0.8	1.0

Table 33: Extra-Spinal Joint Disease in the Late Assemblage

In total, 66 cases of joint disease were classed as primary whereas ten were secondary. In primary joint disease, the most commonly affected joint was the hip, with 11.0% (n=15) of all observable hip joints in adults exhibiting either DJD or OA, followed by the knee joint (7.2%, n=12) and the elbow (5.8%, n = 7). Interestingly, today osteoarthritis is seen most commonly in the weight-bearing joints such as the hip (Plate 77 and Plate 78) and knee and also in the small joints of the hand but rarely in the elbow (Filbin *et al* 2004). This difference in distribution of joint disease may relate to the shift from more manual, physically intensive work to sedentary office based

employment. In modern populations it has been estimated that more than 80% of men and women are affected by primary degeneration of the joints after the age of 75 (Salter 1999). Multiple cases of joint disease were observed in 19 individuals, 18 of which could be assessed for sex. If these, four (22.2%) were female while the remaining 14 (77.8%) were male. Of the 14 that could be assigned an age at death, seven were old adult males/possible males (50.0%), four were middle adult males (28.6%) and three were old adult females (21.4%). Thus, the majority of those individuals with multiple cases of joint disease were male and 71.4% were old adults.

Plate 77: Gross Remodelling caused by Osteoarthritis of the Hips, sk(1028)

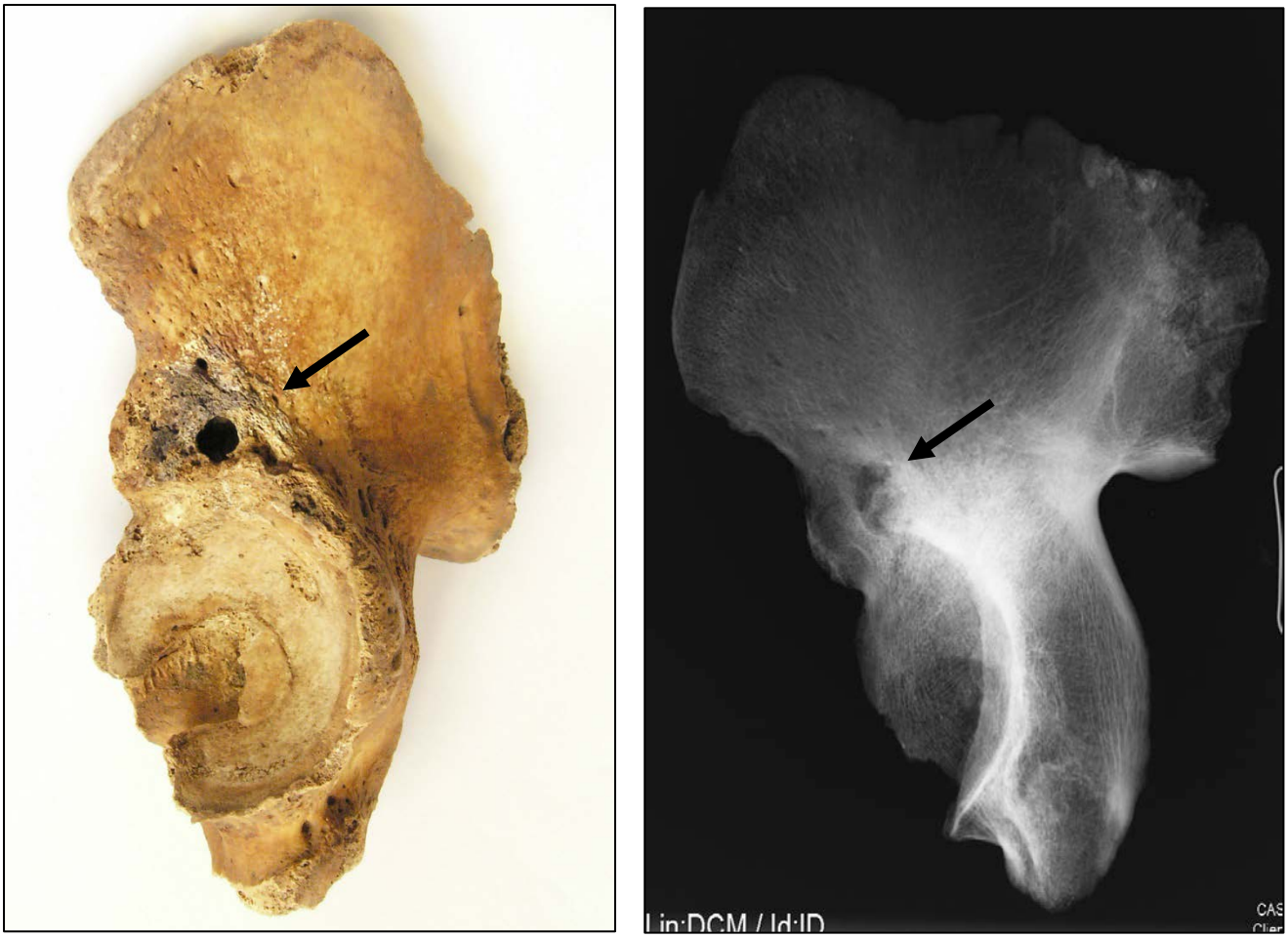

Plate 78: Geode Associated with Osteoarthritis, sk (573)

Secondary changes following trauma and fractures are more common in males and is not age related (Salter 1999). A similar pattern was seen at Stratford, secondary disease was present in four males, three middle adult and one old adult, compared to two middle aged female/possible females. Some cases of secondary DJD or OA were associated with long-standing pathological conditions, such as in the case of secondary DJD of the shoulder in sk(470), where a long standing deformity associated with an epiphyseal dysplasia of the proximal humerus was present.

One example of gouty arthritis was observed in sk(626), a possible male adult. A cystic lesion in the medial side of the 1st right metatarso-phalangeal joint was noted that was approximately 5mm in length, smooth, subcircular and had a sclerotic margin. Unfortunately, the left side had been eroded post-mortem and was unobservable, so it was not possible to tell if the condition was bilateral.

On further case of joint disease was present in sk(688), an old adult female, which may represent the early stages of a case of one of the sero-negative spondyloarthitides, such as psoriatic arthritis (Plate 79). All of the proximal and middle hand phalanges exhibited fine porotic woven bone remodelling around the diaphysis on the palmar sides, with deep grooves for muscle attachments in addition to the terminals of the distal phalanges that appeared porotic and 'fluffy'. Large grooves on the palmar sides of the distal phalanges present indicated chronic flexion of the first digits. The joint surfaces themselves are all normal and unaffected. No pencil and cup deformity was observed. The changed were bilateral, although only a few elements were observable from the right hand. Differential diagnoses include reactive arthritis and thyroid acropachy (http://radiopaedia.org/articles/psoriatic-arthritis).

Plate 79: Fine Porotic Woven Bone on the Metacarpals and 'Fluffy' Distal Phalanges, sk(688)

Neoplastic Disease and Fibrous Lesions

Neoplastic disease and fibrous lesions are rarely observed in the archaeological record, mainly due to the fact that few neoplastic and fibrous lesions diseases result in pathgnomic changes in the skeleton that are easily diagnosed macroscopically (Roberts and Manchester 1997). Thirteen potential neoplastic conditions or fibrous lesions were observed in the Holy Trinity assemblage, however (See Table 34).

Pathology	*No. of Cases*	*No. of Observable Elements*	*TPR*	*CPR (N=259/*64)*
Ewing's Sarcoma	1	57	1.7%	*1.6%
Dentigerous Cyst	1	91	1.1%	0.4%
Osteoma (Ivory)	4	355	1.1%	1.5%
Solitary Osteochondroma	1	108	0.9%	0.4%

Table 34: Summary of Neoplastic and Fibrous Disease

Five cases were observed in the Early population, most of which consisted of localised dense blastic lesions that were thought to be osteomas and were benign. One such lesion was found on the cranium of sk(1156), a middle aged male. The growth consisted of a localised but ill-defined subcircular blastic lesion on the cranium, situation on the saggital suture on the right parietal approximately 7cm superior to the lambda. It consisted of smooth, lamellar bone with some post-mortem damage to the surface and measured 32.1mm A-P x 30.6mm M-L. No endocranial changes were observed. Similar dense blastic lesions were observed on the lateral aspect of the distal third of the right tibia in sk(762), on the visceral surface of a left mid shaft rib fragment in

sk(1074), on the posterior aspect of the tibia in sk(818) and on the frontal bone of sk(762), which was very dense and subcircular, thus being diagnosed as an ivory button osteoma. Radiographic analysis confirmed that these growths consisted of solid periostitis and no nidus associated with osteoid osteoma was observed in any of the lesions.

Similar lesions were also seen in the Late population, with four individuals (sk(798), sk(720), sk(852) and sk(1234) exhibiting dense bony outgrowths on long bones, two tibiae and two femora respectively. The radiographs confirmed that these lesions were consisted of solid periostitis and were, therefore, likely to represent benign conditions such as osteoma. The lesion on the tibia of sk(798) was typical of an ivory button osteoma. One further individual, sk(674), exhibited a large outgrowth of bone from the medial aspect of the mid diaphysis of the 1st right metacarpal (Plate 80). The outgrowth measured 21.7mm S-I x 10.4mm M-L. The surface of the lesion appeared porotic but overall appeared to be a localised, benign growth. Radiographic analysis confirmed no intramedullary involvement of the growth, such as would be expected in enchondroma, and that the diagnosis was likely to be a sessile osteochondroma. These are common growths accounting for approximately 35% of all benign bone tumours (http://radiopaedia.org/articles/osteochondroma), although occurrence in the hand is rare (Lamichlane and Mahara 2013).

Plate 80: Sessile Osteochondroma on the 1st Right Metacarpal of sk(674)

A similar small bony outgrowth or exostosis was present on the medial side of the distal third of the left humerus of sk(639). The growth was unilateral and triangular in shape, measuring only 4mm S-I x 3mm M-L. This could represent a small pedunculated osteochondroma or a supracondylar process, often recorded as a non-metric trait. Unfortunately, the growth did not point in either a superior or inferior direction and it was therefore not possible to differentiate between the two diagnoses. Both are benign growths and of little clinical significance.

In sk(1287), an adolescent aged between 14 and 17 years at death, a large ovoid lytic lesion was present on the distal third of the right fibula (Plate 81). Although being sub-adult and not fully developed, the skeletal elements present were large and metric analysis of the femoral head suggested that the sex was likely to be male. The lesion measured 53.6mm S-I x 13mm and was located on the antero-medial aspect. It was intramedullary and had penetrated the cortex on this side of the diaphysis. There was little sclerosis to the margins, with the trabecular bone projecting from the anterior edge of the lesions. The medial edge was a little more rounded and sclerosed.

The edge of the lesion was uneven and irregular, indicating an aggressive condition. Overall, the bone had an enlarged appearance in the distal end where the bone has expanded around the intramedullary neoplasm before it has perforated through the cortex. There was no blastic periosteal reaction present. The outer cortex on the medial and posterior side appears porotic and osteopenic. Some striated and porotic lamellar bone periostitis was present on the right tibia on the medial aspect in the mid third. It was diffuse and covers an area 114.9mm S-I x 22.8mm A-P. Additionally, porotic and smooth woven bone was present on the proximal third of the left tibia inferior to the metaphysis on the medial aspect. The area affected measures 54.4mm x 38.4mm. Femoral cribra was also present on the left femoral neck and appears quite marked, with projecting sharp edged trabecular bone (Plate 82). This has been associated with anaemia in the palaeopathological literature (Smith-Guzman 2015). The area affected measured 20.2mm at the widest point M-L x 27.0mm A-P.

The lack of sclerosis of the margins of the lesion suggests that it represents an aggressive neoplastic disease. Osteosarcoma and Ewing's sarcoma in its rarer form can both affect the distal fibula and are both malignant, aggressive conditions. Primary osteosarcoma most commonly affects teenagers going through the adolescent growth spurt and it is generally found in higher rates in males (http://radiopaedia.org/articles/osteosarcoma). Both osteosarcoma and Ewing's sarcoma most commonly affect the long bones, usually the femur and tibia, though 6% of Ewing's sarcoma lesions are found in the fibula, half of these occurring in the distal end (Norman-Taylor 1994). Eighty percent of osteosarcomas are intramedullary and due to their aggressive nature exhibit a wide zone of transition radiographically (Plate 83). Ewing's sarcoma generally exhibits an 'onion-peel' laminated periostitis but in a rarer form, it can mimic or even arise from a unicameral cyst (Steinberg 1985, http://www.bonetumor.org/tumors-foot-and-ankle/ewing-sarcoma-foot-and-ankle). Both conditions are grave with a poor prognosis in advanced cases, and this is particularly true in individuals who have cancer and are anaemic (Szkandera *et al* 2014)

Plate 81: Osteosarcoma/Ewing's sarcoma, sk(1287)(M-L, A-P)

Plate 82: Femoral Cribra, sk(1287).

Plate 83: Radiographs of Osteosarcoma/Ewing's Sarcoma, sk(1287 (M-L, A-P)

One final neoplastic lesion was noted in assemblage. A dentigerous cyst was observed in the right maxilla of sk(631), a young male adult. A smooth walled large cavity in the alveolar bone was present in the area of the 3rd molar, which measured 25.5mm S-I x 23.7mm A-P. There was a large void in the sinus wall with perforation into the sinus; however the edges are ragged and not clear if

this is purely post-mortem damage or whether there was post-mortem damage superficial to an ante-mortem perforation. Dentigerous cysts form via an accumulation of fluid at the neck of the cement-enamel junction, commonly affecting the maxillary third molar and always occurring in association with the permanent dentition (http://radiopaedia.org/articles/dentigerous-cyst). They can be differentiated from periapical cysts, which are smaller and measure a maximum of approximately 1cm in diameter. They are similar in form, however to ameloblastomas, although these tend to take on a soap-bubble appearance radiographically, which was not the case here.

5.4.9 Dental Disease

Dental diseases include conditions that not only directly affect the teeth but also the soft tissue surrounding them, sometimes observable in changes to the underlying alveolar bone. Each condition can give an indication of different aspects of lifestyle and health of the individual. For example, caries is associated with diets high in sucrose content. The presence of calculus can inform us about dental hygiene whilst enamel hypoplastic defects testify to developmental stresses that an individual has undergone in childhood. The analysis of dental disease, therefore, not only informs us of specific oral conditions but provides complimentary data regarding overall health status and cultural practices.

Prevalence rates of dental diseases are presented here as a percentage of the number of observable teeth present or number of observable sockets. The number of observable teeth and sockets are presented in Table 35 below along with the true prevalence rates of the dental diseases recorded in the Early and Late populations as a whole.

	Early (n)	***Obs. Elements (N)***	***TPR %***	***No. of Affected Individuals***	***Late (n)***	***Obs. Elements (N)***	***TPR %***	***No. of Affected Individuals***
Caries	17	291	5.8	6	113	1559	7.3	45
Calculus	164	291	56.4	10	821	1559	52.7	65
Ante-Mortem Loss	21	405	5.2	7	274	2765	9.9	47
Abscess	10	405	2.5	6	29	2765	1.0	13
Enamel Hypoplasia	26	291	8.9	5	295	1559	18.9	35
Periodontal Disease	84	405	20.7	8	622	2765	22.5	47

Table 35: Dental Disease in the Early and Late Populations

Caries (Plate 84), linked to diets high in sucrose and poor oral hygiene, had a lower prevalence in the Early period in the Stratford-upon-Avon population than in the Late period, recorded as 5.8%, which is slightly higher than the national average of 5.5% (Roberts and Cox, 2003) but much lower than the rate recorded at Kempsey, Worcestershire (13.6%) (Western 2015). The 7.3% TPR for caries in the Late Stratford population, is well below the national average TPR of 11.2% for contemporary sites (Roberts and Cox, 2003). The overall TPR is also lower than that recorded at St Andrew's Worcester (16.7%); Tallow Hill, Worcester (22.9%); Upton-on-Severn, Worcs. (22.8%) and at St Martin's, Birmingham (9.88%) (Brickley, Berry and Western 2006). The TPR is the same as that recorded for (Ogden n.d.). It is also interesting to note the presence of caries (TPR = 8.8%) in one sub-adult individual, sk(401) , who had two carious teeth and was aged between 7 and 9 years old. Seemingly, although a diet sufficient in sugar to cause caries (cariogenic) was also accessible to some children at Stratford, the overall TPR of 0.5% for caries among Late sub-adults was much lower than Upton-on-Severn (8.9%) and the 2.81% recorded for sub-adults at St Martin's, Birmingham (Brickley, Berry and Western 2006). None of the Early sub-adults were affected by caries at Stratford.

Roberts and Cox (2003) report an increase in caries from the medieval period to the post-medieval when considering true prevalence rates; crucially, during the 19th and 20th centuries, the development of beet sugar and high fructose corn syrup, concomitant with the mechanisation of cane sugar processing and the lifting of import duties on refined sugars (Hillson 1996), allowed a wide-spread adoption of sugar into the mainstream diet. During the medieval period, honey is likely to have been the only source of sweetening foodstuffs (Roberts and Manchester, 1997). The low TPR rate at Stratford-upon-Avon suggests that the local diet was not as rich in sugary foodstuffs as other contemporary sites and may be an indicator of more limited access to sugar. Better dental hygiene routines may also reduce rates of caries since interproximal caries develop from food particles lodged between neighbouring teeth.

Plate 84: Caries and Periodontal Disease, sk(218)

Evidence of whether dental care was employed regularly can be inferred from the relative presence of calculus or mineralised plaque in an archaeological population (Plate 40). Overall, the TPR of calculus decreased only slightly from 56.4% in the Early population to 52.7% in the Late period, suggesting that dental hygiene was not all that thorough in either period. The much higher rates of caries at Upton-on-Severn reflects the much higher rates of calculus in this population, where 88.9% of observable teeth present exhibited calculus deposits. The rate at Stratford is also lower that the rate reported from St Martin's, Birmingham (TPR = 63.0%) (Brickley, Berry and Western 2006) and from St Andrew's, Worcester (TPR = 92.5%) (Western 2006). A higher amount of plaque and mineralised calculus, like caries, is found in those individuals with greater sucrose in their diets (Roberts and Manchester 1997) and is also associated with a diet high in protein (Roberts and Cox 2003); however, it is generally assumed that high levels of calculus relate to poor oral hygiene. The national average TPR for calculus during the medieval period is 53.9% compared to a post-medieval average of 21.43% (Roberts and Cox 2003, 194).

As calculus builds up as a deposit on the teeth along the lines of the gums it eventually causes irritation to the neighbouring gums. This irritation is known as gingivitis, or gum disease, which can lead to changes observed in the underlying alveolar bone, known as periodontal disease. Of all the observable teeth with tooth sockets from the Early assemblage, 20.7% exhibited some of the changes associated with alveolar inflammation and resorption. This increased slightly to 22.5% in the Late population. These rates are much lower than that reported at St Andrew's, Worcester (TPR = 73.1%) and the 50.14% TPR reported for St Martin's, Birmingham (Brickley, Berry and Western 2006).

Plate 85: Thick Calculus Deposits on the Anterior Dentition of sk(384). (Note the ante-mortem loss of the posterior dentition, also arrowed).

Eventually, as periodontal disease progresses, the gum and the underlying bone may recede causing teeth to become loose. In this assemblage, it was noted however, that ante-mortem loss was comparatively low in both the Early and Late periods, with the Early TPR of 5.2% rising to 9.9% in the Late period. Ante-mortem loss amongst the Upton population was much higher at 31.6% and also at St Martin's, Birmingham (TPR = 26.65%) (Brickley, Berry and Western 2006) as well as at St Andrew's, Worcester (TPR=22.2%) (Western 2006). Once the tooth is lost the alveolar bone is resorbed and remodelled, leaving little evidence of any periodontal disease present during life. The low proportion of individuals with ante-mortem tooth loss within the assemblage is likely to reflect the lower levels of caries, calculus and periodontal disease to some extent. It should also be noted that some teeth recorded as being lost ante-mortem may have been extracted; when full removal of the tooth has been successfully achieved, there are no means of differentiating between natural or artificial tooth loss.

Ante-mortem tooth loss can also be associated with abscesses, where the infective process leads to a loss of alveolar bone around the tooth root. Severe caries and attrition are both linked to abscess formation, where bacteria from the tooth infection spread through the pulp to the jaw (Plate 86). The TPR of dental abscess at Stratford appear to have decreased over time, from 2.5% in the Early period to 1.0% in the Late period. Again, this is lower than the national average of 2.8%, reported by Roberts and Cox (2003, p.192) and of the rates recorded at local contemporary sites; the TPR for abscesses at Upton 2.6% approximates the rates of 2.63% and 2.3% reported for St Martin's, Birmingham (Brickley, Berry and Western 2006) and St Andrew's (Western 2006) respectively. The national average of abscess in the medieval period is 3.1% and 2.2% for the post-medieval period (Roberts and Cox 2003).

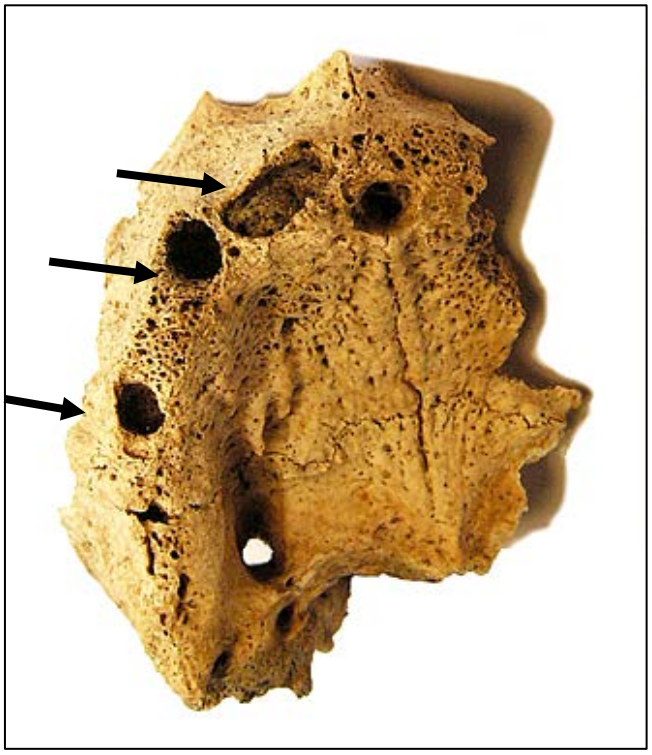

Plate 86: Multiple Dental Abscesses in the Maxilla, sk(834)

Caries and abscesses would have caused individuals great discomfort. Great improvements in dental treatment had been made during this period but overall treatment was fairly crude; fillings and extractions could be undertaken but the lack of antibiotics meant that chronic infections could still be a serious issue. The first professional dental training in Britain began in 1856 (Roberts and Cox 2003) and access was probably restricted to those who could afford it. Fillings could be made from a variety of substances including gold, silver and mercury pastes as well as some cheaper materials lead, pitch and a variety of amalgams (Roberts and Cox 2003). The two examples of fillings at St Martin's, Birmingham were found in individuals of higher socio-economic status interred in vaults (Brickley, Berry and Western 2006); no examples of fillings were found at Holy Trinity, Upton-on-Severn (Western 2014), St Andrew's, Worcester (Western 2006) nor at Tallow Hill (Ogden, n.d.). Crude prosthetics (dentures) were also in use during this period but no evidence of these was found at Holy Trinity. The toothbrush was in mass production from about 1840, although its widespread uptake may have been later. Prior to this innovation, people commonly employed a variety of abrasive substances such as soot, salt, brick dust, cuttlefish and later bicarbonate of soda, applied with rags or just with the fingers to clean their teeth (Roberts and Cox 2003, http://www.bbc.co.uk/dna/place-london/A2818686) in addition to using chewing sticks and picks. Toothpaste was only first mass-produced in 1873 (http://www.bbc.co.uk/dna/place-london/A2818686).

The data from the skeletal assemblages suggests a consistency in rates of dental diseases present in these populations, indicating that these diseases are interdependent. Fortunately for the Stratford population, the rates of all dental diseases here were notably lower than other local populations in the post-medieval period, though a general increase from rates seen in the Early assemblage was recorded within the population.

	Adult (n)	Adult Obs. Elements (N)	Adult TPR	Subadult (n)	Subadult Obs. Elements (N)	Subadult TPR
Caries	15	187	8.0%	2	104	1.9%
Calculus	142	187	75.9%	22	104	21.2%
Ante-Mortem Loss	21	230	9.1%	0	175	0.0%
Abscess	10	230	4.3%	0	175	0.0%
Enamel Hypoplasia	20	187	10.7%	6	104	5.8%
Periodontal Disease	84	230	36.5%	0	175	0.0%

Table 36: Prevalence Rates of Early Dental Disease According to Age

	Adult (n)	Adult Obs. Elements (N)	Adult TPR	Subadult (n)	Subadult Obs. Elements (N)	Subadult TPR
Caries	111	1145	9.7%	2	414	0.5%
Calculus	715	1145	62.4%	106	414	25.6%
Ante-Mortem Loss	272	1511	18.0%	2	1254	0.16%
Abscess	29	1511	1.9%	0	1254	0.00%
Enamel Hypoplasia	226	1145	19.7%	69	414	16.7%
Periodontal Disease	622	1511	41.2%	0	1254	0.0%

Table 37: Prevalence Rates of Late Dental Disease According to Age

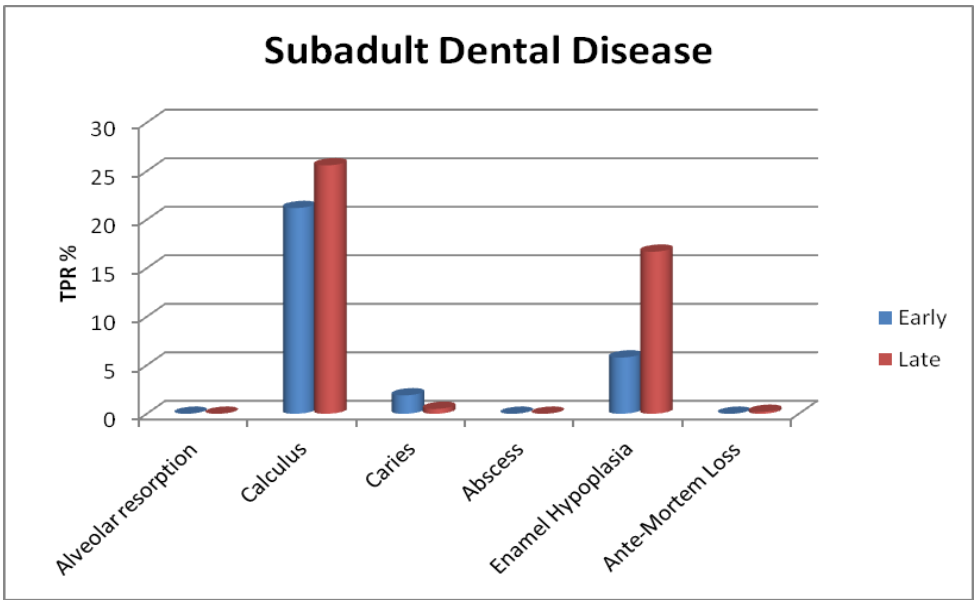

Figure 39: Comparative Rates of Dental Disease in Subadults

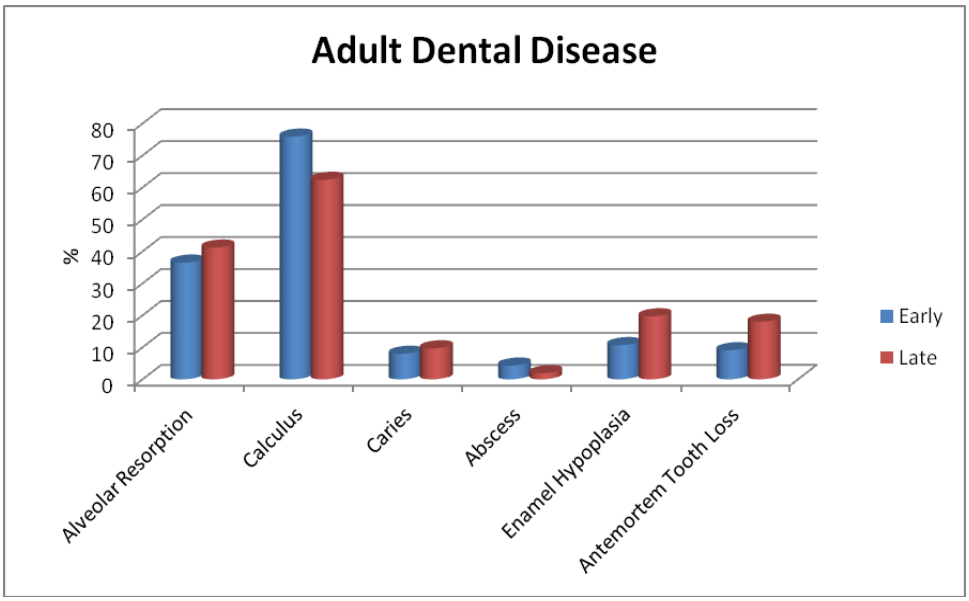

Figure 40: Comparative Rates of Dental Disease in Adults

When comparing adult dental diseases to those of sub-adults, as expected, rates of all diseases in both the Early and Late periods are lower among sub-adults than adults, since these sub-adult teeth have been exposed to the environment (i.e. cariogenic diets) for much less time (Tables 36 and 37; Fig 39 and 40). The rates of sub-adult dental diseases are generally very low or even absent, with the exception of calculus and enamel hypoplasia, both of which increased in the Late assemblage.

With the exception of calculus and abscess, dental diseases in adults were more prevalent in the Late assemblage. The reduction in calculus may indicate that oral hygiene regimes were improved latterly, although the increase in caries, ante-mortem tooth loss and periodontal disease associated with alveolar resorption may suggest otherwise. This more likely reflects a more cariogenic diet. Dental diseases are generally age-related, since the longer a tooth is exposed, the increased the risk of disease, decay and loss. Higher rates of ante-mortem loss, for example, are frequently found among old adults (Western 2006).

Enamel hypoplasia is interpreted in many archaeological analyses to indicate physiological stress during development. Hypoplastic defects in the teeth, usually more common in the anterior dentition, are caused by bouts of childhood illness or severe malnutrition and are often used as an indicator of stress to health in childhood (Goodman and Armelagos 1985). These defects appear to occur most often around the age of three years (Dobney and Goodman, 1991) and it is believed that only one person in 14,000 is affected by a hereditary hypoplastic condition (Hillson, 1986). Many ethnographic studies have found correlations between low socio-economic status and a higher rate of hypoplastic defects (e.g. Dobney and Goodman, 1991) and diachronic increases in observations of such defects have also been observed in archaeological populations thought to be related to lifestyle changes and increased stress following colonisation (Hutchinson and Larsen, 1988). It should be borne in mind, however, that many of the people who are subjects in ethnographic studies live in conditions of the extreme poverty where there is little scope for social mobility and that we should expect to see more variance and less of a clear-cut picture in populations where the nutritional standard is over the critical nutritional threshold and where social mobility is more likely.

Enamel hypoplasia was present in both adult and sub-adult sets of dentition. Overall, the TPR in the Early Stratford population was 8.9%, which increased substantially to 18.9% in the Late population. This increase was observed in both adults and sub-adults. However, rates of enamel hypoplasia were still lower than many local sites. Using prevalence rates based on observations of the permanent anterior dentition only, often considered more accurate due to hypoplastic defects occurring most commonly in these teeth, the rate of enamel hypoplasia in the Stratford Late

population was 23.6%. In comparison, At Upton-on-Severn, defects were found in 26.7% of the anterior dentition, slightly lower than of the 30.1% TPR observed at St Andrew's (Western 2006) and 31.0% TPR recorded at St Martin's, Birmingham. The defects were typically manifest as horizontal linear grooves in the anterior teeth. In all cases the lesions were minor. Hypoplastic defects occurred in 16.7% of the sub-adult Late dentition at Stratford-upon-Avon compared to 40.0% of sub-adults from St Martin's, Birmingham. This appears to indicate that the younger sub-adults from a more rural location enjoyed a comparatively healthy childhood compared to the suburban population at St Martin's, Birmingham, perhaps suffering from less febrile diseases and enjoying a better diet. The prevalence rate amongst adults is also lower at Stratford (20.1%) than St Martin's (29.7%) suggesting that this seemingly healthier environment continued to offer benefits to older sub-adults as well.

Severe enamel defects on the 1st maxillary permanent incisors and 1st maxillary permanent were present in sk(392), an adolescent aged between 13 and 16 years of age at death. The lesions on the molars and incisors resemble 'mulberry molars' and 'Hutchinson's incisors', associated clinically with congenital syphilis (CPR=1.6%, N=64) (Plates 87 and 88). No skeletal lesions were observed but the skeleton was incomplete and not very well preserved. It should be noted, however, that these severe enamel defects are non-specific and, therefore, may have been caused by another infectious or febrile illness. For example, a similar molar was also noted in sk(1136) in the 1st right maxillary permanent molar but the left side was unobservable and no skeletal lesions were observed. Given that this individual was a middle adult male it is unlikely that this severe enamel defect was caused by congenital syphilis, since there is high fatality rate amongst sub-adults without treatment, although a mild infection may take several years to manifest itself (Ortner 2003). Both individuals were from the Late population.

Plate 87: Hutchinson's Incisors, sk(392). (Also note the defective lesions on the canines)

Plate 88: Mulberry Molars, sk(392)

One further interesting feature was noted in the dentition from Stratford-upon-Avon. Eight individuals (CPR Adults = 4.1%), all males from the Late period, had pipe-smoking grooves, a round circular defect worn into the dentition from habitual use of the teeth to bite down on to a clay pipe stem (Table 38). Usually the anterior dentition is affected, involving canines and premolars most frequently. The prevalence rates among males with observable anterior dentition was 21.1% (N=38), suggesting that pipe-smoking was a reasonably popular activity with males in Stratford (Table 39). Similar grooves were observed in the population from Upton-upon-Severn, in 6 males and 1 possible female. This population consisted of a high percentage of middle aged and old aged adults and hence the high CPR of 41.2% among adults and TPR of 77.8% may be artificially high in comparison to the rates at Holy Trinity. At Holy Trinity, more young adults were present, who would be less likely to exhibit pipe-smoking grooves even if they were pipe smokers due to the groove being worn into the teeth over time. Comparative data from a study undertaken in a contemporary population from St Mary and St Michael, London suggests that pipe-smoking was much more common amongst males than females and that it was a habit predominantly associated with the poorer classes in the City (Walker and Henderson 2010). Here, 39.6% of males with dentition exhibited pipe grooves compared to only 2.9% of females. Pipe grooves were often noted occurring in tandem with lingual stains from tobacco tar (55.2%) (Walker and Henderson 2010). This was observed in sk(906) at Holy Trinity (Plate 89) and in two individuals from Upton-on-Severn.

Skeleton No.	Sex	Age	Age Category	Ribs Present	Rib Lesions
103	Male	35-50	MA	Yes	No
331	Male	50+	OA	Yes	No
381	Male	25-35	YA	Yes	No
578	Possible Male	40-44	MA	Yes	No
631	Male	25-29	YA	Yes	No
906	Male	50+	OA	Yes	No
931	Male	30-40	MA	Yes	No
1136	Male	35-49	MA	Yes	No

Table 38: Individuals with Pipe-Smoking Grooves

Total Males with Pipe-Smoking Groove	Total Males with Observable Anterior Dentition	Prevalence
8	38	21.1%

Table 39: Prevalence Rates of Pipe-Smoking Grooves

Plate 89: Pipe-Smoking Groove and Tar Stained Teeth, sk(906)

At St Mary and St Michael, a higher rate of visceral surface rib lesions (indicating inflammation of the lungs) was noted amongst pipe-smokers compared to non-smokers (Walker and Henderson 2010). No such pattern was found at Holy Trinity or Upton-upon-Severn, however, with none of the pipe-smokers from Holy Trinity exhibiting such rib lesions (despite the presence of observable ribs in all the smokers) and only one of the seven individuals with pipe-smoking grooves from Upton also having evidence of rib lesions (TPR = 14.3%). It appears that pulmonary inflammation was not directly linked to smoking at Stratford-upon-Avon and Upton-on-Severn, perhaps due to the rural location with its cleaner air and likely reduced rates of infectious diseases such as tuberculosis that affect the lungs. Smokers were also noted at St Martin's-In-The-Bull Ring, Birmingham but the prevalence rate there was much lower, with only 11 individuals (3.6% of those individuals with dentitions) displaying grooves. All of these individuals were interred in earth-cut graves and were assumed to be of lower socio-economic status. Two individuals, both male/possible male, from St Andrew's, Worcester (CPR = 8.3%, CPR Adults = 10%) and one male from Tallow Hill, Worcester (CPR = 10%, CPR Adults = 12.5%) were also recorded as displaying pipe-smoking grooves. It is interesting to note that pipe smoking grooves are present in both the lower and higher socio-economic populations in Worcestershire. Given the duration of time taken to wear a pipe-smoking

groove into the teeth and the fact that smoking was probably a chronic habit in these individuals, it is possible that the presence of evidence for pipe-smoking in individuals of higher economic means reflects a certain amount of opportunity for social mobility in the smaller cities or that social stratification was less rigidly defined or more cross-cutting than that in the metropolitan centres.

5.4.10 Post-Mortem Treatment of the Body

Post-mortem modifications were observed in one skeleton, sk(1136), a middle adult male from the Late assemblage (CPR = 0.5%). Surgical cuts through the mid third of the left clavicle and left ribs 1-8 were noted. The line of cuts through the clavicle and ribs ran at an oblique angle across the chest, from the point immediately lateral to the impression for the costoclavicular ligament on the clavicle to 11cm lateral from the sternal end of the 8th rib (roughly where the arm would lie at the side of the chest). False start kerfs are present on three of the cut left ribs, *c* 3-4 mm lateral to the cut on the main part of the rib. An additional, similar false start kerf is present on a 4th sternal portion of transected rib. The cuts are oblique, *c* 45° degree lateral angles to the rib diaphysis.

On the right side of the torso, a cut had been made across the manubrium just inferior to the right clavicular notch (Plate 90). A transection had also been made through the right clavicle at the sterna end. A false start kerf was located on the superior-anterior area parallel with the transaction along with a small breakaway spur located on the inferior-posterior aspect, indicating that the angulated cut had been made from front to back. Some striae parallel with the kerf floor are observable though subtle, which had been left by the use of a saw. No cuts were present, however in any of the right ribs, which were more or less complete. The cut had, therefore, been made inferior to the ligaments and subsequently inferiorly through the parasternal cartilages. No cuts were present in left ribs 9-12 either, so at this juncture it is likely that an incision was made across the body (RHS to LHS of the individual's torso) across the chest through the cartilages and soft tissue, passing just inferior to the xiphoid (no evidence of cuts to the sternum or xiphoid) to meet the cut made through the 8th left rib. This unilateral trapzeoid shape cut around the left side of the chest would allow examination of the periocaridium and heart with minimal invasion (Plate 91).

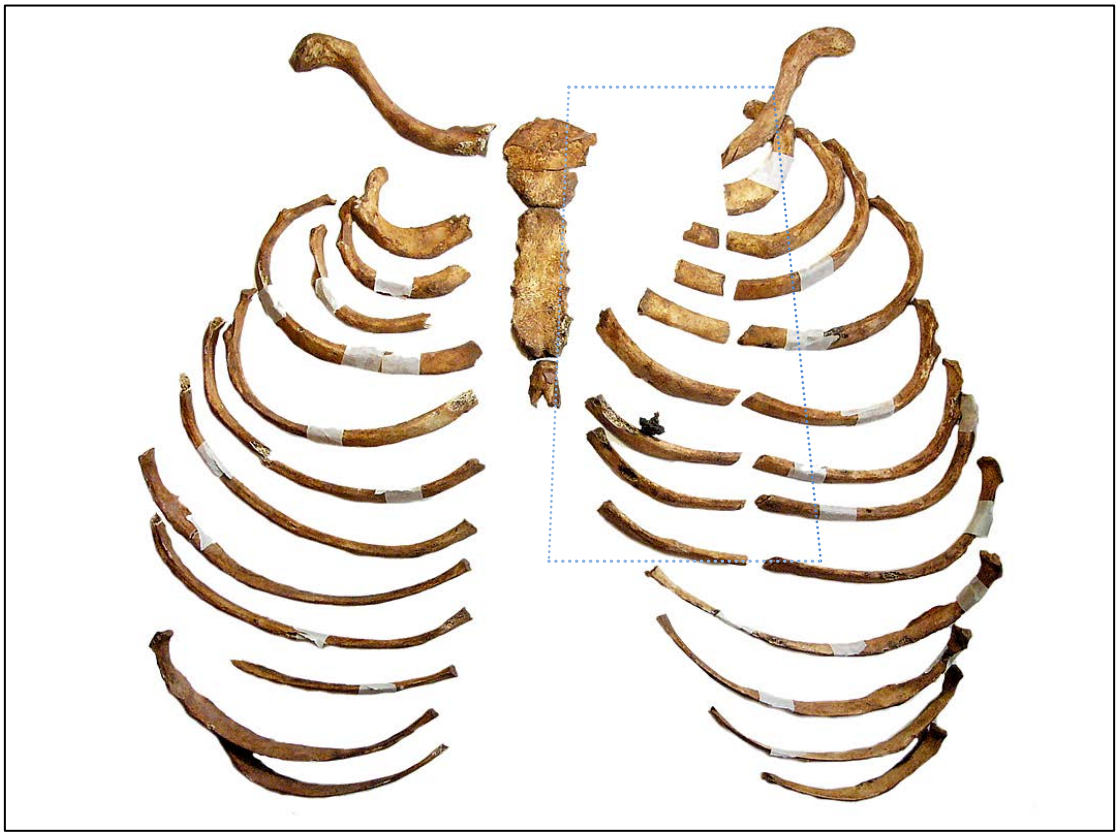

Plate 90: Thoracotamy with lines of cuts illustrated, sk(1136)

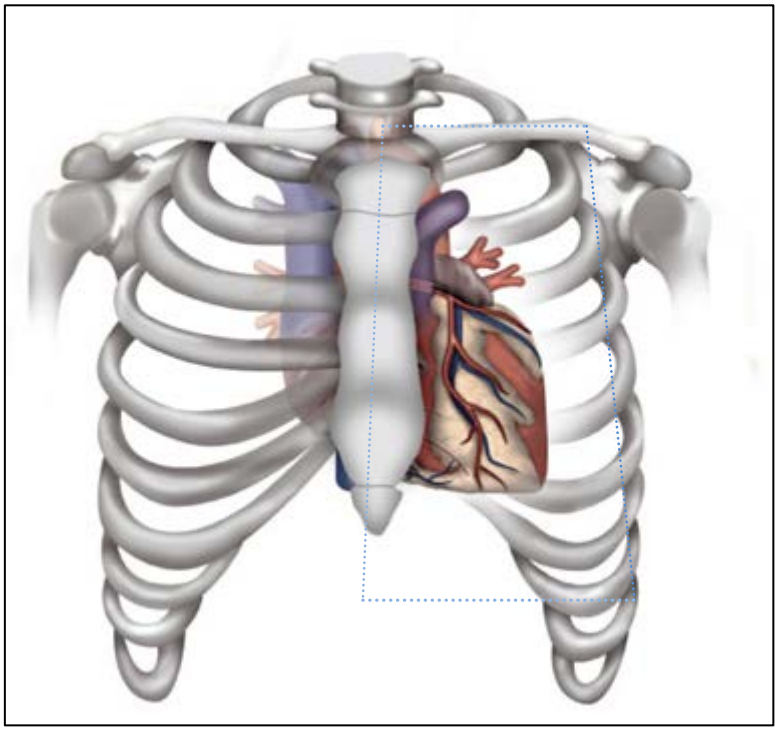

Figure 41: Illustration of the Anatomical Location of the Peri-cardium and Heart in the Chest

In terms of pathological changes, minor inflammatory lesions were present on the left side of the thoracic vertebral bodies of T4 and T5 in the form of woven bone periostitis, which indicate inflammation (Plate 92). Additionally, what may be an inferior rib notch (Roesler sign) was present in one the left ribs, most likely the 5th (Plate 93). Three well healed fractures present, two on the right side and one on the left of sk(1136) as well as a Bennett's fracture to the left 1st metacarpal. In the thoracic spine, the 8th, 9th and 10th vertebrae were fused via a smooth osteophyte on the right hand side, though no other similar osteophytes were present elsewhere and the osteophyte was not flowing like a DISH osteophyte, perhaps indicating that the lesion was trauma related. The tenth thoracic vertebra also exhibited a well-defined, smooth rimmed lytic lesion in the posterior body, perforating the posterior body wall and the inferior end plate. sk(1136) also exhibited pipe-smoking grooves in the dentition.

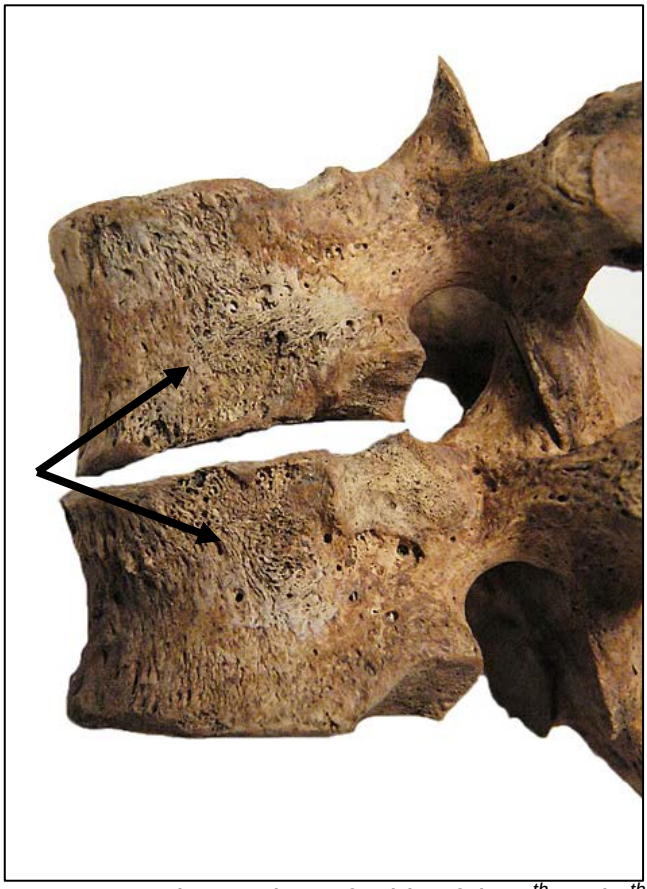

Plate 92: Active Woven Bone Formation on the Left Side of the 4th and 5th Vertebral Bodies, sk(1136)

Plate 93: Rib Notch on the Left 5th Rib

Rib notches are associated with malformation of the collateral vessels or coarctation of the aortic arch (narrowing of the aortic lumen), a congenital defect that is often associated with other congenital heart defects and syndromes, including bicuspid aortic valve, cyanotic congenital

conditions and mitral valve defects (http://radiopaedia.org/articles/coarctation-of-the-aorta). Rib notches forms when the intercoastal collateral vessels expand to bypass the coartion and supply the descending aorta. They are most commonly found in the 4th to 8th ribs, and can present unilaterally or bilaterally. Unilateral left rib notches, as seen here, are associated with an aberrant right subclavian artery arising after the coarction, the origin of which is distal to the left subclavian artery, thereby collaterals form on the left (http://radiopaedia.org/articles/coarctation-of-the-aorta). The ascending aorta becomes the descending thoracic aorta at the level of the inferior border of the 4th thoracic vertebra, at which point it lies directly against the vertebral bodies on the left hand side. Generally, the fewer the number of ribs involved, the less serious the condition. Isolated rib notches can also be caused by schwannoma, neurofibromatosis or trauma, which should also be taken into consideration given the evidence for rib fractures and likely trauma-related lesions in the spine.

Post-mortem examinations would have been undertaken during the late Georgian and Victorian period to establish the cause of death of sudden and unexplained deaths, where requested by relatives or by the Coroner, or where a morbid pathologist examined the body of a deceased inpatient in an Infirmary to confirm the cause of death. Aortic aneurysms can cause lesions to the thoracic spine, in the same area as the lesions in sk(1136), and do lead to sudden, unexpected deaths. A case of a post-mortem being undertaken to determine the cause of a sudden death, found to be 'atheromatous degeneration of the aorta' is recorded in the Medical Times and Gazette' in 1865 (Duffey 1865), for example. However, cases referred to in the palaeopathological literature consist of erosive lesions in the left side of thoracic vertebral bodies, such as was found at the Worcester Royal Infirmary assemblage (Western 2011), rather than blastic bone forming lesions, though some bone formation may be co-occur with the lytic lesions (Ortner 2003). There is a possibility, then, that the active bone formation on the vertebral walls in sk(1136) are the result of early aortic disease at the time of death.

Thoracic aortic aneurysms most commonly occurring in males of 50-60 years old but are not as frequent as abdominal aortic aneurysms (http://radiopaedia.org/articles/thoracic-aortic-aneurysm). Thoracic aortic aneursyms can also atherosclerotic or part of other conditions such as rheumatoid arthritis, ankylosing spondylitis and syphilis, as well as resulting from trauma. There is also an increased risk of thoracic aortic aneurysm in patients with aortic valve issues, in particular bicuspid aortic valve, and tobacco use is an additional strong risk factor (Vu *et al* 2014).

Other aortic conditions that may lead to rupture are aortic intramural haematomas, commonly occurring in the elderly with hypertension but also can result from blunt chest trauma with aortic wall injury (http://radiopaedia.org/articles/aortic-intramural-haematoma), penetrating atherosclerotic ulcers, typically occurring in older male patients with a history of hypertension, smoking and coronary heart disease (http://radiopaedia.org/articles/penetrating-atherosclerotic-ulcer) and aortic dissection, again occurring most commonly in elderly hypertensive patients, though factors such as aortic coarction and bicuspid aortic valve are also predisposing factors (http://radiopaedia.org/articles/aortic-dissection).

Rib notches can also be associated with mycotic aneurysms, which arise from an infection of the arterial wall and are most commonly the result of the haematogenous spread of a bacterial infection of the heart. The infection causes a weakness in the aortic wall and the formation of a false aneurysm. They are extremely prone to rupture and are associated with a very high mortality risk (http://radiopaedia.org/articles/mycotic-aneurysm).

Overall, the combination of osteological signatures and post-mortem modifications found in sk(1136) suggest that this individual is likely to have suffered an acute aortic syndrome, which may have resulted in a sudden or unexpected death that was deemed necessary for examination by autopsy. Several factors may have contributed to the condition, such as the individual's sex being male, his middle age, tobacco consumption, chest trauma and likely congenital abnormality of the aorta. Unfortunately, it is not possible to identify which particular aortic condition caused his death but it is likely to have involved its sudden rupture.

Autopsies during the post-medieval period were initially very rarely performed but became increasingly more common during the period as medical knowledge expanded and legislation required independent medical witnesses to establish the cause of death. Autopsies undertaken at the Coroner's request to establish a cause of death where death was unexpected or sudden were generally carried out openly in public houses and members of the jury were expected to inspect the bodies in person. Autopsies were not formulaic, standardised practices and investigation of the body could be restricted to a single anatomical area of interest, particularly if requested by relatives. In the archaeological record, craniotomy, or opening of the cranial vault, is most frequently observed whereas thoracotomy, or opening of the chest and/or abdomen, is more uncommon.

One individual from St Andrew's, Worcester had undergone an autopsy following trephination to the cranium; this middle aged male had sustained a peri-mortem crush fracture to the leg and is likely to have succumbed to a major accident. There was no evidence of a post-mortem examination to the thorax. Another male individual, an old aged adult, from Tallow Hill, Worcester had undergone a thoracotomy, with similar cutmarks to the manubrium and clavicles as seen in the individual from Holy Trinity, although no cutmarks to the ribs were present, suggesting the thoractomy had been undertaking by transecting the parasternal cartilages on both sides. Interestingly, this individual was also observed to have evidence of heart disease due to the calcified arterial walls present. Post-mortem examinations had been carried out on seven individuals from St Martin's in the Bullring, all seven of which exhibited evidence of craniotomy but only one had evidence of thoractomy (Brickley, Berry and Western 2006), again with no cuts to the ribs. Here, three of the individuals were female and four were males, all being in the young or middle adult age categories. The cuts to the ribs observed in the thoracotomy undertaken on the individual from Holy Trinity are rare and reflect the individual approaches of practitioners undertaken post-mortem examinations at the time. It is also very unusual to have such cut marks made unilaterally with the intent purpose of examining the heart rather than the thorax as a whole.

5.4.11 Death in Childbirth

One burial contained the remains of two individuals interred in the same coffin. The female adults individual, sk(1143), aged between 27 and 49 years old, was interred with the remains of a neonate, sk(1144), aged between 34 and 38 weeks at death. The neonate had been placed between the knees of the female adult (Plate 94). Given the ages of the individuals, it is likely that this burial represents a case of death resulting from childbirth. Although burials of sub-adults period are known to have occurred within the graves of unrelated individuals during this period, they are generally interred separately and represent an additional interment within a grave, rather than being contained in the same coffin. Childbirth is recorded historically in Stratford though was rare, only documented as the cause of 1.2% of deaths in the population in the 1850's. Of the 195 Late adult burials, this case represents a crude rate of 0.5%.

Plate 94: Adult and Neonate Interment, sk(1143) and (1144) (Close-Up Inset)

5.4.12 The articulated assemblage: Conclusions

Overall, the articulated remains were generally of good preservation, with the chronological age of the remains not affecting the state of preservation. However, there was a high level of intercutting of many graves resulting in the majority of the skeletal remains being incomplete. Nonetheless, the large number of articulated skeletons exhumed from the south side of the churchyard at Holy Trinity allowed the creation of a substantial osteological dataset, particularly with regard to pathological evidence of health and disease among the medieval and post-medieval populations of Stratford, which could not have been achieved through the examination of historical records.

Comparison of the Early (1066-1300AD) and Late (1300-1887AD) populations at Stratford indicated that the ratio of sub-adults to adults was approximately equal in both assemblages, with younger sub-adults, particularly those of neonates, being under-represented in both groups. While females were under-represented in the Early assemblage, they were also significantly under-represented in the Late assemblage. There were comparatively fewer old adults in both groups.

The documentary records suggest that Stratford-upon-Avon remained a relatively small market town throughout the medieval and post-medieval periods, with little change in the population during the latter period. No heavy industries emerged in Stratford-upon-Avon during the Industrial period and therefore the environment appears to have remained relatively healthy and stable, despite the arrival of the railway and canal in the later Victorian period. Stature, often used as an indicator of health status, remained the approximately same in the population from the Early to the Late periods in both males and females and was very similar to the national averages.

However, the skeletal analysis indicated that some diseases were on the rise through time in Stratford (Figure 42). Despite the relative lack of growth in the size of the population, there were substantially more cases of inflammatory diseases, in particular inflammation of the chest, related to chronic chest infections, present in both adults and sub-adults. A substantial increase in enamel hypoplasia over time points to increased health stress during childhood in the Late period. Infections more frequently associated with the post-medieval period such as congenital syphilis may also have been present. Rates of cribra orbitalia were also increased, related to anaemias associated with parasitic infestations during childhood. Dental disease was also generally on the increase, as was Diffuse Idiopathic Skeletal Hyperostosis (DISH), a condition associated with a diet rich in animal proteins. Also present was a rare case of likely neoplastic or cancerous diseases in the Late period, as well as evidence for autopsy in one individual.

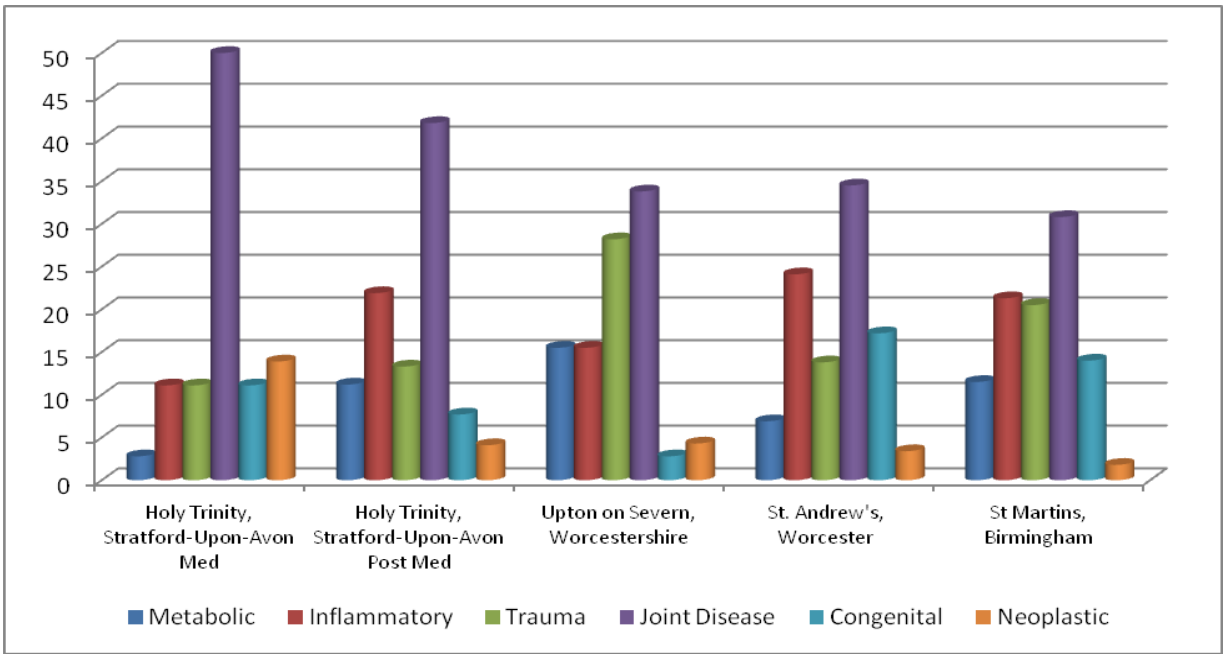

Figure 42: Relative Percentage of Diseases in each Population based on Number of Individuals Affected

Joint diseases and trauma also increased and in particular in males. Males exhibited significantly more trauma, and notably rare cases of stress fractures were present occurring as a result of repetitive physical strains, particularly in the spine. Cases of os acromiale, distal clavicular erosion, joint disease in the upper limb, clay shoveller's fractures and a fracture of the transverse spinous process all point to a lifestyle for many males based on strenuous, physical activity. In addition, cases of multiple trauma in males was also common. Males also exhibited both spinal and extra-spinal joint disease at an earlier age, whereas in the Early period, joint disease was found more equally distributed in males and females. This may indicate a specialisation in the types of physical tasks undertaken by males and females in the Late period compared to the Early period. Interestingly, osteological analysis of Saxon remains from the Centenary Gardens also revealed evidence for hard physical lifestyles from the presence of spinal and extra-spinal joint disease, testament to the craft and agricultural trades present in Stratford-upon-Avon over the centuries (AOC Archaeology 2010). Evidence for trauma from this group, however, was low.

Despite this increase in the prevalence of many diseases from the Early to the Late period in Statford-upon-Avon, the prevalence rates of many conditions are relatively low compared to other local skeletal assemblages in the West Midlands, suggesting that overall, the more rural location of Stratford offered a comparatively healthy place to live in the post-medieval period.

5.4.13 The disarticulated remains

The total number of fragments present according to each context was tabulated. The results of the analysis of the data collated for the whole assemblage is provided in Table 40 below:

	Total Element Count	*MNI*
Adult	26,828	**223**
Sub-Adult	1951	**75**
Neonate	110	**13**
Total	**28,889**	**311**

Table 40: Minimum Number of Individuals in the Disarticulated Assemblage

Overall, the minimum number of individuals represented in the disarticulated assemblage is 311, 223 of which were identified as adult, 75 of which as sub-adults and 13 of which as 'neonates'. The large number of fragments recovered reflects the high level of disturbance to graves within the burial ground, mirroring the incomplete nature of many of the articulated skeletons analysed. It is likely that at least some of the disarticulated elements may have originated from some of the exhumed partially complete articulated skeletons. Combining the highest number of repeated elements from the disarticulated assemblage with the additional count of the same repeated elements from the articulated assemblage, the total number of individuals represented by both the articulated and disarticulated assemblages combined is 454 (Table 41).

	Disarticulated MNI	*Articulated MNI*	*Total MNI*
Adult (Prox. R. Femur)	223	102	**325**
Sub-Adult (Prox. R Femur)	75	37	**112**
Neonate (Prox. R Femur)	13	4	**17**
Total	**311**	**145**	**454**

Table 41: Minimum Number of Individuals represented by the Articulated and Disarticulated Assemblages.

Age Category	*Disarticulated No. Of Elements*	*Disarticulated MNI Individuals*	*Articulated No. Of Individuals*
Foetal (<36 Weeks)	4	4	0
Neonate (0-1 Month)	26	7	3
Young Infant (1-6 Months)	8	2	2
Older Infant (6-12 Months)	10	3	1
Younger Child (1-3 Years)	14	9	11
Older Child (4-7 Years)	11	6	30

Table 42: Representation of Children in the Disarticulated and Articulated Assemblages

It was clear from the excavations and osteological analysis of the articulated human remains that neonates and young children were under-represented in the skeletal assemblage compared to the mortality profile established from the burial records from Evesham Road Cemetery. This is very likely to be due to the high frequency of inter-cutting of graves and subsequent disturbance of earlier burials. The assessment of the disarticulated remains revealed, however, 73 elements, mainly long bones, which were observably very small and likely to originate from neonates or young children. Additionally, most were sufficiently complete to allow metric analysis to be

undertaken. These measurements could then be used to estimate age at death and categorised into sub-adult age groups to compare with the age profile of the younger sub-adults present in the articulated assemblage (Table 42 and Figure 43).

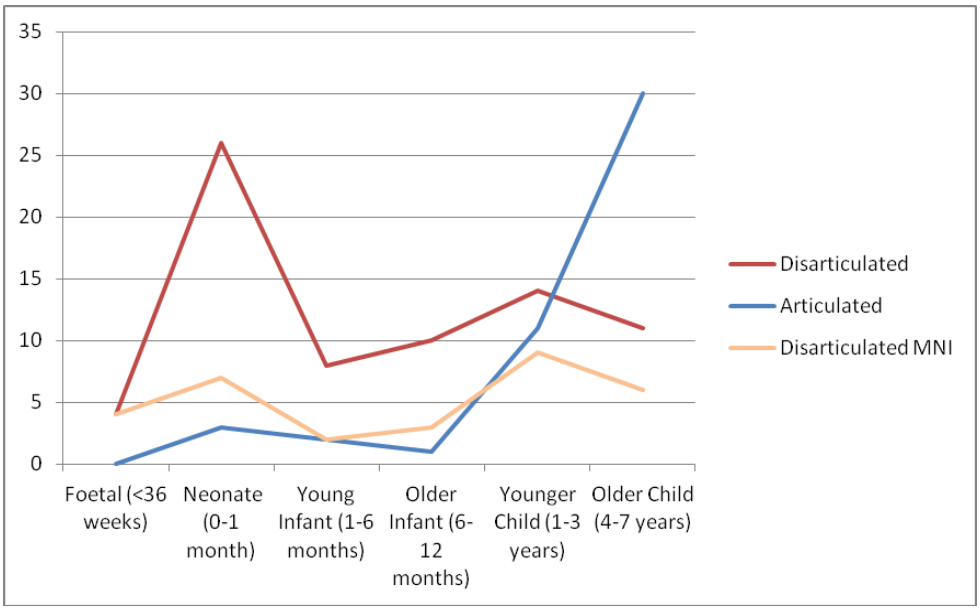

Figure 43: Age Profiles of the Younger Sub-Adults in the Disarticulated and Articulated Assemblages.

The youngest age estimate based on the metric analysis of the disarticulated elements was 22 weeks old. A further three age estimates were also classified as 'Foetal' (<36 weeks old). Due to the disarticulated nature of the elements, it is not possible to tell if these 'foetuses' represent intrauterine deaths (i.e. death of the baby and mother pre-partum), stillbirths or perhaps premature births with death ensuing shortly post-partum.

Comparison of the numbers of disarticulated elements and the minimum numbers of individuals represented in the age categories 'Foetal', 'Neonate', 'Younger Infant' and 'Older Infant' (i.e. those age groups containing individuals less than 1 year old at death) suggests that these groups were most vulnerable to being disturbed by later burials, resulting in their complete disarticulation. Both the numbers of elements and the minimum numbers of individuals represented in each of the young sub-adult age groups in the disarticulated assemblage is equal to or higher than the corresponding number of younger sub-adult individuals represented in the articulated assemblage (Figure 43). Interestingly, the age groups of 'Younger Child' and 'Older Child' (i.e. over 1 year old) were more frequently represented in the articulated assemblage, though the most notable difference is at 4 years of age and older at death where many more 'Older Children' were represented in the articulated than disarticulated assemblage. The difference between the numbers of sub-adult elements and individuals in the articulated and disarticulated assemblages is not explained by a difference in taphonomic preservation, since the disarticulated elements were on the whole well preserved and complete enough for metric analysis. In fact, it is much more probably that articulated neonates and young infants would be recovered by hand excavation than the very small single disarticulated elements from this age group. The data indicates that the under-representation of the younger sub-adults in the articulated assemblage is an artefact of burial activity in the churchyard. Although several of the articulated 'Older Children' were incomplete, it would appear then that children in this age group were much less likely to be disturbed by later interments to the extent that their remains would become completely disarticulated.

It is also interesting to note that the preservation of younger sub-adult burials appears to reflect a similar age profile to that of the commemoration of children on the headstones at Holy Trinity Church. Infants less than 1 year old at death were very much under-represented on inscriptions on monuments and are the most under-represented age group in the articulated skeletal assemblage.

Although the inference from the mortality profile obtained from the burial records of Evesham Road Cemetery is that neonate and young infants were likely to have been given a respectful burial at Holy Trinity Church, their commemoration on monuments was not as commonplace as older sub-adults or adults and neither was the preservation of their physical integrity in the ground. In such a heavily used churchyard, the small size of the skeletal remains of infants undoubtedly played a significant role in the lack of the preservation of their articulated state. Nonetheless, funerary customs and burial practices in the churchyard, at least in part, dictated this pattern of the annihilation of infant interments.

Pathology

Gross pathological changes were recorded in 49 fragments, though the assemblage remained unwashed and therefore this represents the minimum of the pathology present, due to the likelihood that more subtle changes such as periostitis and joint disease were generally obscured by adhering soil. Nonetheless, inflammatory lesions were observed on eight fragments, seven of which consisted of thick periostitis, all consisting of woven bone, indicating active lesions at the time of death (Plate 95). Most of the lesions were extensive, involving large areas of the diaphysis.

Plate 95: Woven bone periostitis (26)

Elements affected included one 2nd rib (18), three tibiae (23), (26) and (45), and two femora (37) and (51). One fibula (4) exhibited extensive lamellar bone periostitis, resulting in a grossly remodelled surface (Plate 96). The entire diaphysis was affected, giving the bone an irregular and expanded appearance.

Plate 96: Extensive periostitis and remodelling of the fibula (4)

Twenty cases of joint disease were observed, 11 of which involved vertebrae of the spine. Most of these represented degenerative joint disease or osteoarthritis, with macroporosity, osteophytic lipping and eburnation present on the joint surfaces. Five cases presented large flowing osteophytes on the right hand side of thoracic vertebrae, thought to be likely to be caused by DISH (Diffuse Idiopathic Skeletal Hyperostosis).

One case of septic arthritis was identified, an inflammatory joint disease, whereby there was ankylosis (fusion) of the proximal and middle hand phalanges, with middle phalanx fixed at right angles to the proximal on the palmar side (47). This may represent a septic arthritis following trauma and dislocation of the finger joint (Plate 97).

Plate 97: Ankylosis of the Proximal Interphalangeal Joint (47)

Five cases of ankylosis, one including kyphosis, of the vertebrae were observed. One case (6) involved the 2nd and 3rd cervical vertebrae that were fused at the zygapophyseal joints. The vertebral bodies were not observable.

A second similar case involved ankylosis if the 2nd, 3rd, 4th and 5th cervical vertebrae at both vertebral bodies and zygapophyseal joints (44). Interestingly, ossification of the intervertebral discs could be observed along with osteophyte formation on the anterior of the bodies (Plate 98). This may represent a Type I Klippel-Feil syndrome case, consisting of congenital block vertebrae, a relatively rare condition with a familial gene locus on the long arm of chromosome 8 (http://www.wheelessonline.com/ortho/klippel_feil_syndrome). Segmentation of the vertebrae into individual elements does not occur (Barnes 1994). Most cases observed osteologically, however, do not present with an open intervertebral disc space as is seen here. This sign may be more indicative of a degenerative spondyloarthropathy, such as rheumatoid spondylitis, ankylosing spondylitis or myostitis ossificans (Dussault and Kaye 1977).

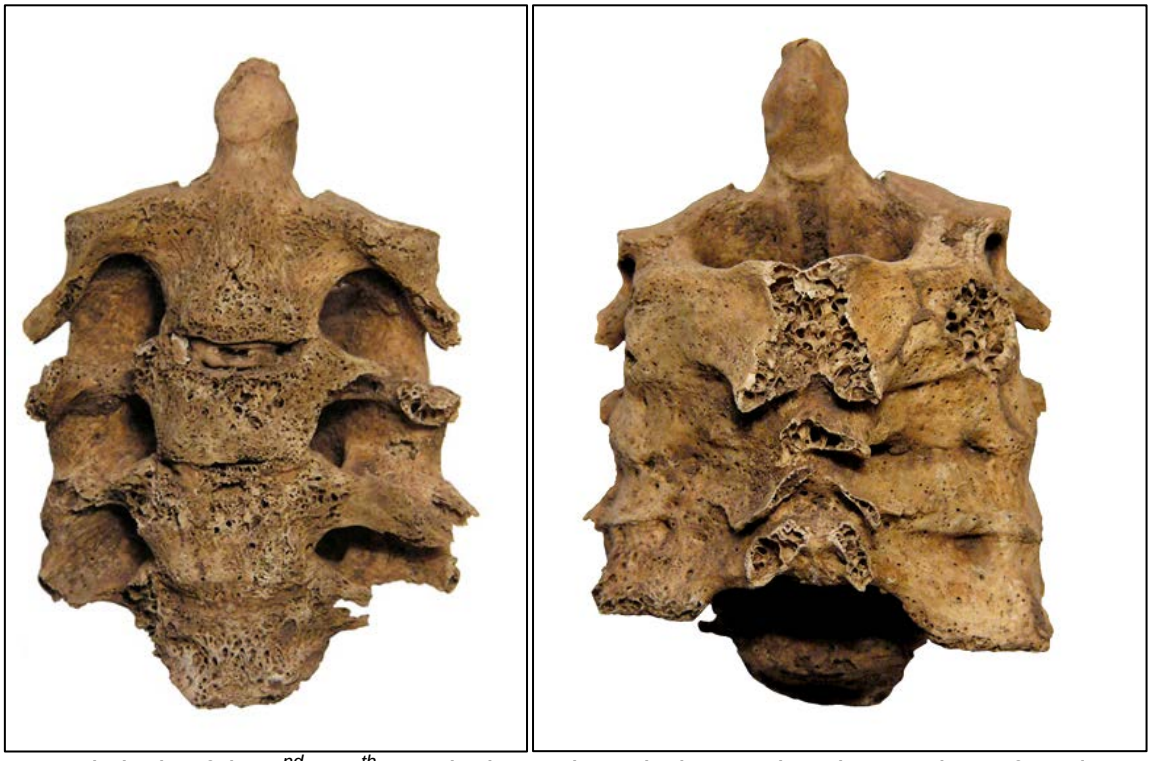

Plate 98: Ankylosis of the 2nd to 5th Cervical Vertebrae (44), Anterior View on the Left and Posterior View on the Right

Two more cases of ankylosis or fusion involving just two vertebral bodies were noted. The first involving two thoracic vertebral bodies, (7), and the second involving two lumbar vertebrae (38), were thought to be the result of degenerative joint disease.

However, a further case of vertebral ankylosis, (9), was more severe in nature, involving the fusion of four upper-mid thoracic vertebrae at the zygapophyseal joints that would have caused the individual a significant kyphosis (anterior curvature) and scoliosis (lateral curvature) of the spine (Plate 99). Unfortunately, the bodies were not well preserved and it was difficult to assess the extent to which they were affected but it was evident that the vertebrae must have been greatly reduced in height or hypoplastic. The smooth nature of the bony fusion between the posterior joints and the location of the kyphosis in the upper thoracics may be more indicative of a developmental origin of the fusion. An infection such as tuberculosis may also have caused such a lesion but through osteolysis of the vertebral bodies. This generally creates a much sharper angulation in the kyphosis than a congenital cause (Walker 2012), which may be seen in the example here in the upper most vertebra. However, tuberculosis more commonly involves the lower thoracic vertebrae, although an example in the upper thoracic vertebrae has been reported by Walker (2012, 71). One possible case of tuberculosis of the hip was noted in the Saxon assemblage at the Centenary Gardens (AOC Archaeology 2010), though a differential diagnosis of geodes associated with osteoarthritis should be considered here.

Plate 99: Vertebral Kyphosis in the Upper-Mid Thoracics (9)

Three further cases of fusion of the vertebrae were also noted, all cases involving ankylosis of the zygapophyseal (posterior) joints of the thoracic vertebrae and involving smooth, bony fusion. Other congenital conditions present included an example of a bilateral spondylosis in a lumbar vertebra (4), a bony tubercle present on the inferior side of a rib head (28), a right clavicle with a flaring acromial end (28), and a possible unfused calcaneonavicular bar with secondary degenerative joint disease on the talar articular surface on a right calcaneus (25). Os acromiale was also observed in a left scapula, thought to be a developmental condition associated with repeated excessive tension on the shoulder joint prior to adulthood (Stirland 2000).

One case of a possible epiphyseal disorder was noted in a right femur (3), which consisted of an osteochondrosis known as Legg-Perthes disease (Plate 100). The disease was manifest by the presence of a significantly reduced and flatted femoral head with no slipping of the femoral capitis evident nor any fracture of the femoral neck. Necrosis of the femoral head with secondary osteoarthritis was exhibited consisting of eburnation, macroporosity and extensive osteophytic

formation. Extensive enthesophytes were also present along the line of the ligament attachment site.

Plate 100: Legg-Perthe's Disease (3), Anterior view on the Left, Posterior View on the Right

Dysplasia was also present in a right humerus (11), which was malformed and exhibited what may have been either a pseudoarthrosis (false joint) or malformed joint surface at the proximal end (Plate 101). The joint surface was extensive eburnated. The diaphysis was bowed anteriorly and was very short if the majority diaphysis was present. The entire fragment measured only 182mm; the distal epiphysis, was however, absent. The osteoarthritis suggests that the arm belonged to an adult individual and that the condition was long standing: the anterior bowing of the diaphysis perhaps suggests an origin in childhood. Given the lack of articulation of the humerus with the remainder of the skeleton, it could represent a severe epiphyseal dysplasia (often caused by trauma) with secondary osteoarthritis or may be an unhealed fracture with a pseudoarthrosis formation in the shaft. Bowing and pseudoarthrosis of long bones is frequently associated with the congenital condition neurofibromatosis (NF) (Vigorita 2008), though it can occur as an idiopathic or isolated congenital condition. The most commonly affected element is the tibia, known as congenital pseudoarthrosis of the tibia, but other elements such as the forearm and humerus can also be involved (Beaty and Kasser 2010). Fractures heal poorly in individuals with neurofibromatosis due to the co-occurring osteopenia, explaining the long-standing non-union of the bone shaft. NF is a genetic condition involving the skin, subcutis, peripheral nerves and the skeleton, and is one of the most common autosomal dominant disorders, occuring in approximately 1:3000 live births (Vigorita 2008).

Plate 101: Dysplastic humerus (11), Postero-lateral view on the Left, Antero-medial view on the Right with Close-up of Pseudoarthrosis inset

Five examples of trauma were also present in the disarticulated assemblage and consisted of well healed old fractures. The fractured elements included one right humerus (14), one right and one unsided fibulae and one right 5th metacarpal. In addition, one case of trauma consisted of an ankylosed distal left tibia and fibula (34) (Plate 102). Enthespophytes were present around the groove for the ligament on the posterior distal tibia on the medial side. It was likely that the fusion of the elements was caused by localised ossified soft tissue trauma, since there no observable evidence of a fracture.

Plate 102: Ankylosis of the Inferior Tibiofibular Join (34).

Four cases of possible healed rickets were observed in one unsided tibia (22), one left (33), one right (43) and one unsided (36) femur. All elements exhibited anterior bowing of the diaphysis, two (36) and (33) with bony buttressing at the linea aspera. Bowing was noted in the proximal third in femur (43).

Osteoarthritis and degenerative disease was also observed involving two hip joints (proximal femora), one shoulder joint (glenoid fossa), two wrists (distal ulnae) and one big toe joint (1st metatarsal). One of the cases of joint disease at the hip was erosive osteoarthritis, with large areas of subchondral bone were exposed. Additionally, one sternoclavicular joint (clavicle) was also affected by osteoarthritis, with macroporosity and eburnation affecting the entire joint surface.

Only two cases of neoplastic disease were observed, both being large sessile type osteocondromata of the proximal right tibia. The grows were extensive in both cases, though one had been damaged post-mortem. Both osteochondromata projected from the lateral side. The first (1) measured 28.4mm from superior to inferior margins and the second (35) measured 20.9mm from the superior to inferior margins and 36.6mm from the medial to lateral side (Plate 103). Such large osteochondromata can cause clinical issues due their size such as nerve impingement and compromising muscle function, though on the whole they are asymptomatic. Osteochondroma is a benign bone tumour and one of the most common, accounting for 35% of all benign bone tumours and 9% of bone tumours in total (Dickey 2015).

Plate 103: Osteochondroma (35), Proximal Right Tibia (M-L View)

5.4.14 Discussion of the disarticulated assemblage

Assessment of the disarticulated assemblage has provided a substantial quantity of supplementary osteological data to aid the interpretation of the articulated skeletal assemblage. The minimum number of individuals (MNI) contained within the disarticulated assemblage was calculated to be 311. Furthermore, based on the total number of elements exhumed including the articulated assemblage, the MNI of the combined assemblages was estimated at 454.

The presence of a considerable number of neonate and young infant bones has confirmed that individuals in the age groups were indeed interred within the churchyard in greater numbers than perhaps might have been assumed from the excavation of the articulated skeletons. It is likely that it was practice to inter neonate and infants in this part of the churchyard but that burial practices had resulted in the disarticulation of neonates and infants to a much greater extent than those older and more substantial individuals. To a certain extent, this reflects acts of commemoration via monumental inscription during the Victorian period.

A wide range of pathology was observed in the assemblage, some of provided examples of different types of diseases not found in the articulated assemblage, such as possible case of spinal tuberculosis, block vertebrae, Perthe's Disease and large osteochondromata. Other conditions recorded, such as DISH, rickets and joint disease, expanded upon the observations initially made in the articulated assemblage, consolidating observations that were often based upon incomplete skeletal remains.

5.5 Environmental analysis, by Elizabeth Pearson

The results are summarised in Tables 45 and 46.

Uncharred remains, consisting of mainly root fragments are assumed to be modern and intrusive as they are unlikely to have survived in the soils on site for long without charring or waterlogging.

A moderate quantity of human bone was recovered from some contexts (Table 46), and in one sample (393) human bone was abundant. This is likely to be disarticulated bone residual in the burial soil, so was not included in the analysis of human bone (Section 5.4). Of significance were

three bladder stones recovered from (683) (Section 5). Occasional small mammal, frog/toad, fish bone and molluscs (snails and oyster shell) were also recorded in several burials which are likely to be residual in the burial soil and not directly associated with the burials. Low levels of artefactual material such as small fragments of window glass are also likely to be residual in the burial soil but fragments of iron and lead objects could be either residual or associated with the coffins.

Little interpretation could be made of these remains.

Context	Sample	Feature type	Skeleton/context	Period	Sample volume (L)	Volume processed (L)	Residue assessed
382	16	Grave	581 pelvis		1	1	Yes
393	2	Grave	392 whole grave		10	10	Yes
410	23	Grave	409 pelvis		2	2	Yes
535	40	Coffin	550 throat		3	3	Yes
550	14	Skeleton	550 throat		0.5	0.5	Yes
550	15	Skeleton	550 stomach		1	1	Yes
551	20	Grave	550 pelvis		1	1	Yes
596	17	Grave	595 pelvis		1	1	Yes
640	18	Grave	639 pelvis		2.5	2.5	Yes
672	19	Grave	671 pelvis		1.5	1.5	Yes
683	22	Grave	682 pelvis		2	2	Yes
715	24	Grave	714 stomach		1.5	1.5	Yes
799	25	Grave	798 pelvis		1.5	1.5	Yes
799	26	Grave	798 pelvis		1.5	1.5	Yes
833	27	Grave	852 pelvis		2.5	2.5	Yes
862	22	Grave	682 pelvis		1	1	Yes
865	29	Grave	864 pelvis		2	2	Yes
882	41	Skeleton	882		2.5	2.5	Yes
903	32	Skeleton	903 pelvis		1	1	Yes
925	31	Coffin	Coffin 926		2	2	Yes
927	30	Grave	926 pelvis		0.5	0.5	Yes
927	30	Grave	926 pelvis		1	1	Yes
932	33	Grave	931 pelvis		2.5	2.5	Yes
945	34	Grave	944 stomach		1	1	Yes
945	35	Grave	944 pelvis		1	1	Yes
993	36	Grave	992 pelvis		1	1	Yes
1018	37	Grave	1017		1	1	Yes
1062	38	Skeleton	1062		4	4	Yes
1083	42	Skeleton	1083		1	1	Yes
1083	43	Skeleton	1083		1	1	Yes

Table 45: List of bulk samples

context	sample	small mammal	human bone	fish	mollusc	charcoal	charred plant	uncharred plant	comment
382	16		occ			occ			
393	2		abt			occ			occ window glass, unidentified object
410	23		mod			mod			occ window glass, plant roots (intrusive)
535	40		mod		occ				mod pitch/tar, coffin nails
550	15					occ		occ*	
550	14		occ		occ			occ*	
551	20		occ			occ		occ*	
551	21		occ			occ			

596	17		mod					occ*	
640	18		mod		occ			occ*	coal ash waste , window glass
672	19		occ						
683	22		mod	occ		occ			occ Fe objects, Pb objects, gall stones X3
715	24		occ					occ*	
799	25	occ	mod		occ	occ			burnt flint
799	26		mod		occ	occ			
853	27		occ		occ				
862	28					occ			
865	29		mod					occ*	
882	41		abt			occ			
903	32		occ						occ pot, window glass.
925	31	occ	mod		occ				mod tar/ pitch, Fe objects
927	30	occ	mod						occ fe object, Pb object
932	33		mod		occ		occ		
945	34		occ						
945	35		mod		occ	occ		occ*	
993	36		occ			occ			
1018	37		occ			occ			
1062	38		abt			occ		occ*	
1083	42		occ						
1083	43		mod			occ			window glass

*Table 46: Summary of environmental remains; occ = occasional, mod = moderate, abt = abundant, * = probably intrusive*

6 Synthesis: Life and death in Stratford-upon-Avon, from the medieval to post-medieval periods

The results of the excavation reveal that burials did not occur in this part of the burial ground until the 12th century and no burials or structural remains were encountered that may relate the proposed Saxon activity at the site. A residual Saxon loomweight, recovered from the churchyard soil does imply that earlier settlement features may be present, close to or beneath the church.

A total of 304 burials were lifted during the excavation, although 309 burials were identified and more burials were left in situ across the main excavation area. The significant quantities of disarticulated remains indicates that there had been a high degree of intercutting and the total number of individuals represented by both the articulated and disarticulated assemblages combined is 454.

During the medieval period burials appear to have been interred across all areas excavated, although by the post-medieval period they appear to have been confined to the south, away from established paths around the church. However during this period brick vaults and shafts were constructed below ground that abutted the church. Only one of these was excavated, as it had already been heavily damaged and emptied by the insertion of modern services and no burials were recovered. As most of these abutted the walls of the church it suggests that although probably wealthy and of some standing in the community, those interred within the vaults could not afford to be buried in the church itself or that the church was no longer accepting intermural burials at that time.

The osteological analysis of the inhumated remains has provided a unique insight into health and disease in the medieval and post-medieval populations of the town as well as an opportunity to understand contemporary practices of burial rites.

The human bone retrieved was the generally well preserved, though the majority of remains were incomplete due to a high level of intercutting. Comparison with the historic burial data for the town suggests that younger sub-adults were under-represented in the articulated assemblage but evidence of their presence within the churchyard was established by the retrieval of disarticulated younger sub-adult elements. The contrasting data from the age profiles of the historic burial records from Evesham Road Cemetery, the monument inscriptions from Holy Trinity Churchyard and the skeletal assemblage suggest that the commemoration and preservation of the articulated remains of neonates and infants in situ were equally unrepresentative of the high level of infant mortality rates documented at the time. Adults were well preserved but old age adults are likely to

have been under-represented in the skeletal assemblage, possibly due to the common problem of the underestimation of adult age using osteological aging techniques. Males were present in higher numbers in both the Early and Late populations, the latter of which observations correlated well with the documentary evidence.

Stratford-upon-Avon is a rural town where industrialisation had a minimal impact on the size and nature of the settlement compared to many other places. No heavy industries developed in the town and local trades were largely involved in rural agriculture, particularly relating to sheep farming. Although some developments occurred, such as the arrival of the railway and canal, in terms of an environment for human occupation, the town remained relatively stable. The documentary evidence indicates that in the post-medieval period, most males were employed in agricultural labour while females were domestic hands or officially unemployed. The health of the local population, as manifest through the skeletal remains analysed here, reflects this to a certain degree. Stature, potentially an indicator of health status, remained constant from the medieval period for both males and females. Although many diseases and conditions increased slightly from the Early to Late period within Stratford-upon-Avon, these remained low in prevalence compared to most other local towns and cities. One of the most frequently observed pathologies was cribra orbitalia, a condition linked indirectly to parasitic infestation during childhood most commonly occurring in water-polluted areas. Given the intermittent flooding at Stratford-upon-Avon, it may be that local clean water supplies were frequently contaminated by dirty flood water.

Enamel hypoplasia associated with febrile diseases and malnutrition during childhood increased substantially from the Early period to the Late period in Stratford-upon-Avon, as did inflammation, both almost doubling in prevalence over this time and possibly reflecting the high rates of infant mortality historically documented latterly. Also on the increase were other childhood conditions such as rickets and epiphyseal injuries. Trauma-related pathology also increased amongst adults, though not to the same degree. The majority of these injuries were seen in males in the Late assemblage, in comparison to a more equal distribution of trauma-related lesions between males and females in the Early population. Several fractures and injuries appear to be related to torsional stresses and the shearing of bones within the spine, such as the transverse process and clay shoveller's fractures, as well as stress on the upper body joints, including distal clavicular erosion and joint disease in the upper limb, as well as accidental fracturing of fingers. These injuries suggest that many individuals were involved in physically strenuous activities, probably relating to occupation, and that there may have been a specialisation in the tasks undertaken by males in the Late period. Analysis of the occurrence of spinal joint disease according to age and sex during this period corroborates a difference in the physical activities undertaken by the sexes, with males suffering from degenerative joint disease and osteoarthritis at a younger age than their female counterparts. Dental disease rates were also lower than other contemporary assemblages. Interestingly, rates of Diffuse Idiopathic Skeletal Hyperostosis (DISH), a condition associated with a diet rich in animal proteins, was relatively high at Stratford-upon-Avon, suggesting that a good diet was available to a number of the residents, possibly thanks to the local sheep trading. Stable isotope analysis of a small sample of individuals also suggested a varied diet containing some marine proteins, with values comparable to some riverine and coastal Saxon settlements (Mays and Beaven 2011). Also observed were pipe-smoking grooves in the dentition of a few male individuals, who evidently enjoyed one of the latest past-times.

The assemblage contained a wide range of skeletal pathologies, some of them rare, including three cases of humeral dysplasia, one an epiphyseal dysplasia, one secondary to fracture and another possibly relating to neurofibromatosis, possible tuberculosis and congenital syphilis, rachitic rosary, mastoiditis, hypertrophic osteoarthropathy, and possible cases of Paget's disease and osteosarcoma, providing tangible evidence of such diseases and conditions in Stratford-upon-Avon for the first time. In addition, skeletal evidence was found for a post-mortem examination, likely to have been undertaken to examine the heart and associated anatomical structures in order to identify the cause of death. The osteological analysis, therefore, has provided a substantial body of archival evidence for past health, disease, lifestyle and burial rituals in Stratford-upon-Avon for

the first time that can be used in future research, in order to discern diachronic and contemporary trends in human health and behaviours.

7 Publication summary

Worcestershire Archaeology has a professional obligation to publish the results of archaeological projects within a reasonable period of time. To this end, Worcestershire Archaeology intends to use this summary as the basis for publication through local or regional journals. The client is requested to consider the content of this section as being acceptable for such publication.

An archaeological excavation and watching brief was undertaken at Holy Trinity Church, Old Town, Stratford-Upon-Avon, Warwickshire (SP 2010 5428). It was undertaken on behalf of Holy Trinity Church Parish Office, who is constructing an extension along the southern side of the church.

The investigations excavated and lifted 304 burials of medieval to post-medieval date, although no structural remains or burials were identified to confirm the putative Saxon origins of the church. Few other features were identified during the archaeological works other than modern services, although four brick vaults and a brick shaft were encountered. Only one of the vaults was excavated as it had already been damaged and emptied by the insertion of a water pipe, as had the brick shaft.

The osteological analysis of the inhumated remains appears to reflect the rural nature of Stratford-upon-Avon where industrialisation had a minimal impact on the size and nature of the settlement compared to many other places in the later post-medieval period. The analysis supports the documentary evidence from the post-medieval period which indicates that most males were employed in agricultural labour while females were domestic hands or officially unemployed. The stature of the assemblage, potentially an indicator of health status, remained constant from the medieval period for both males and females, although many diseases and conditions increased slightly from the medieval to post-medieval. However in comparison to other more industrial towns instances of disease remained low and the cleaner air, agricultural lifestyle and access to a good diet for many of the inhabitants has resulted in relatively healthy population.

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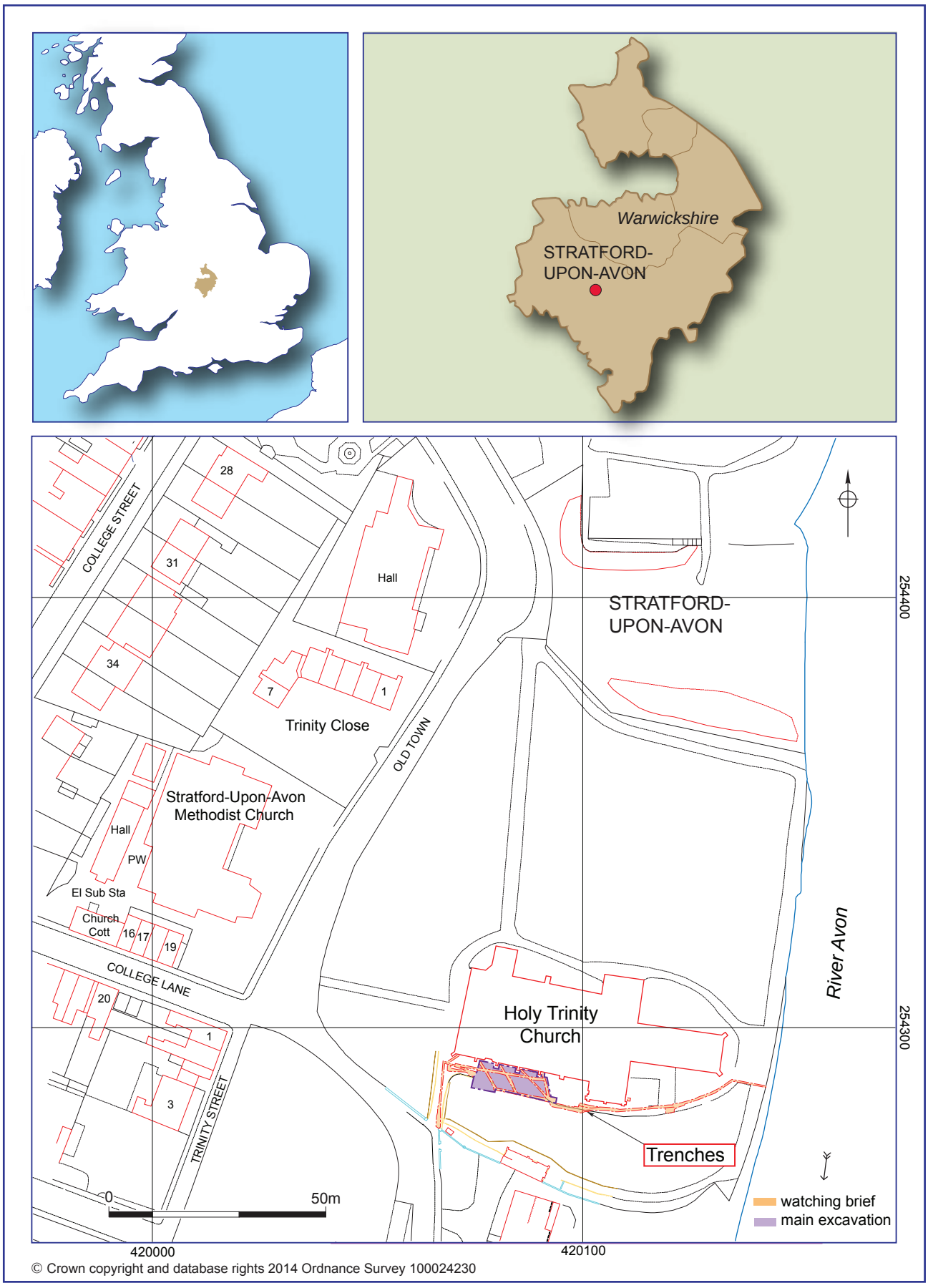
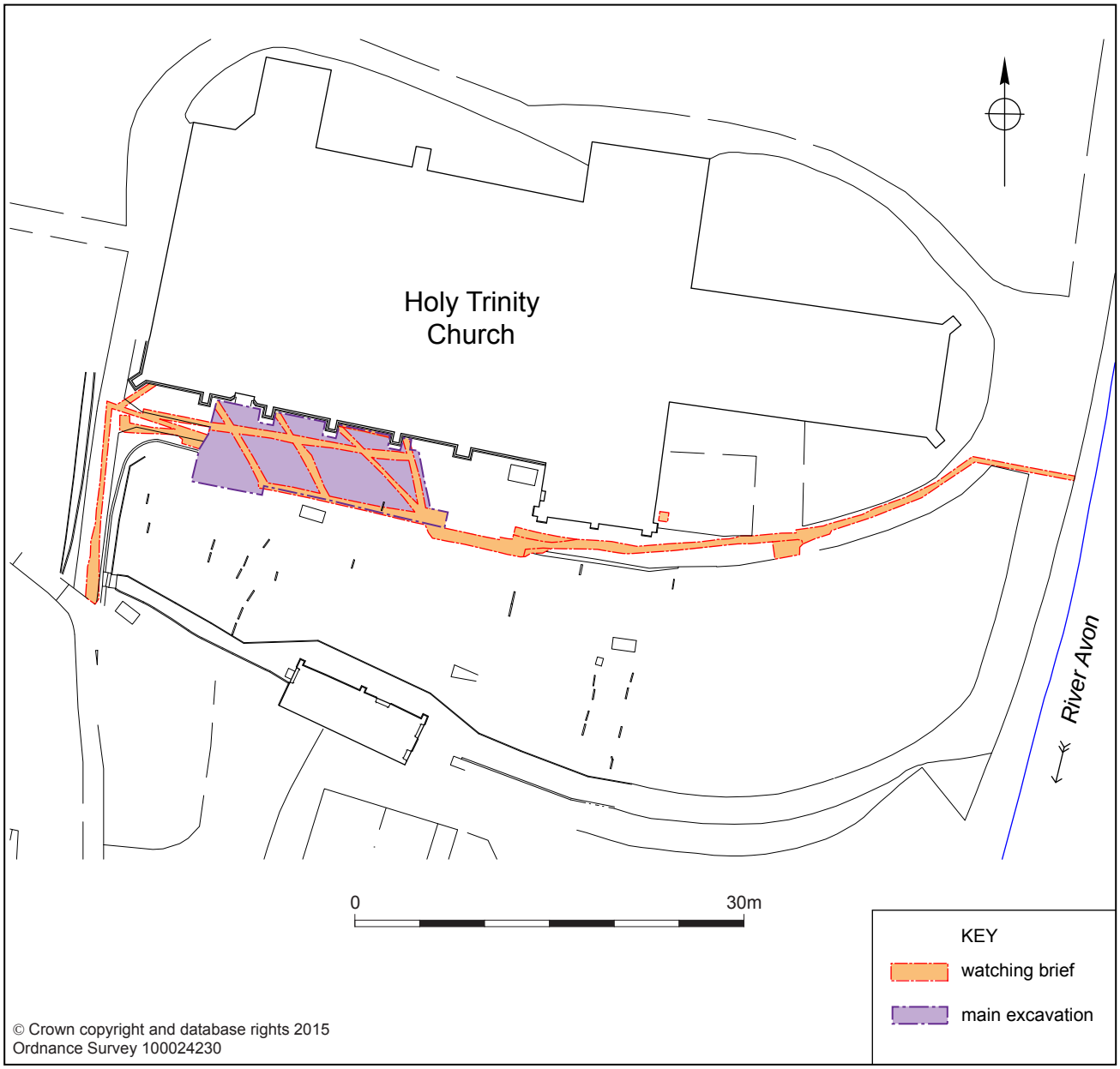
Figures



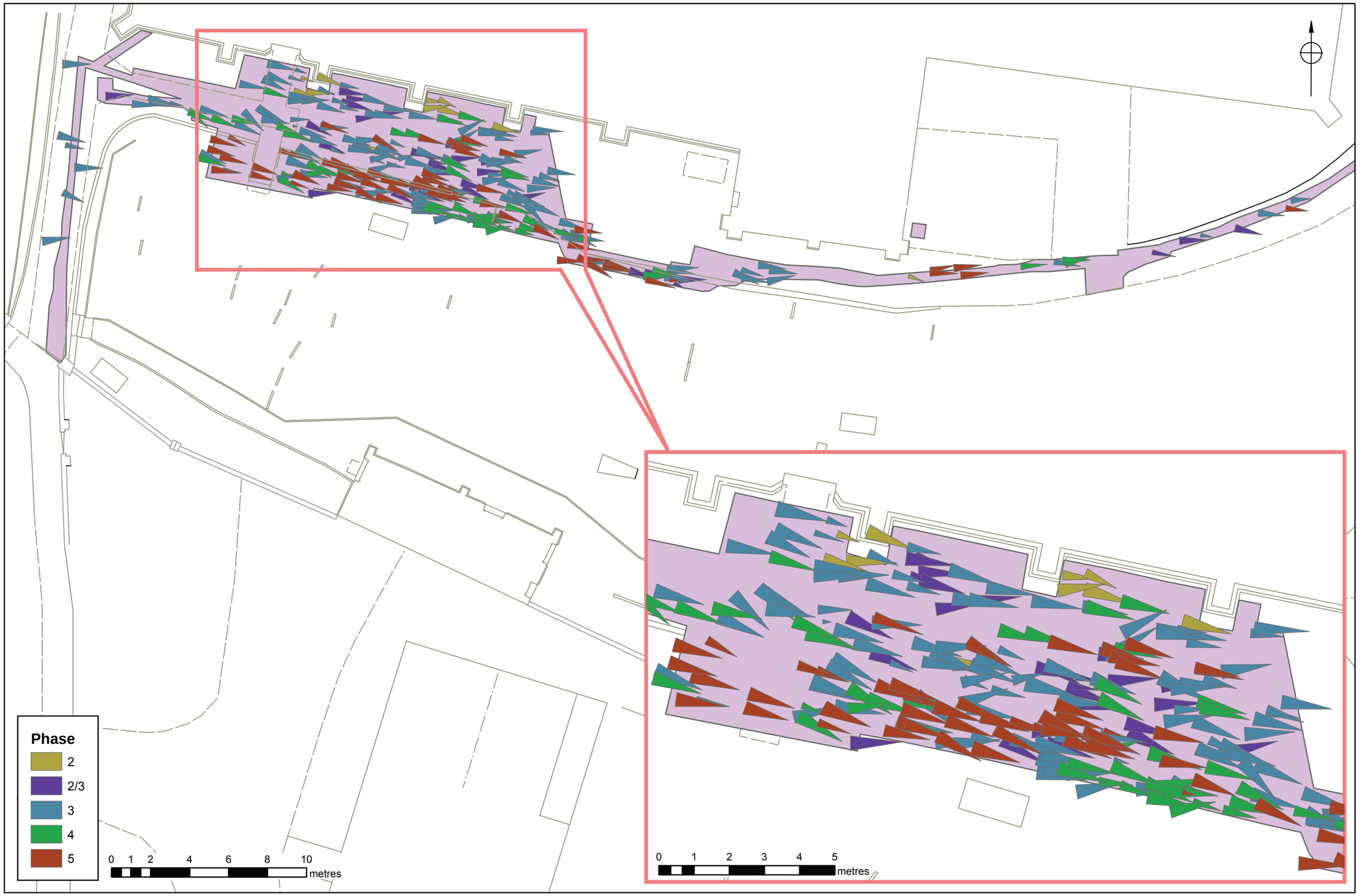
Location of the site

Figure 1

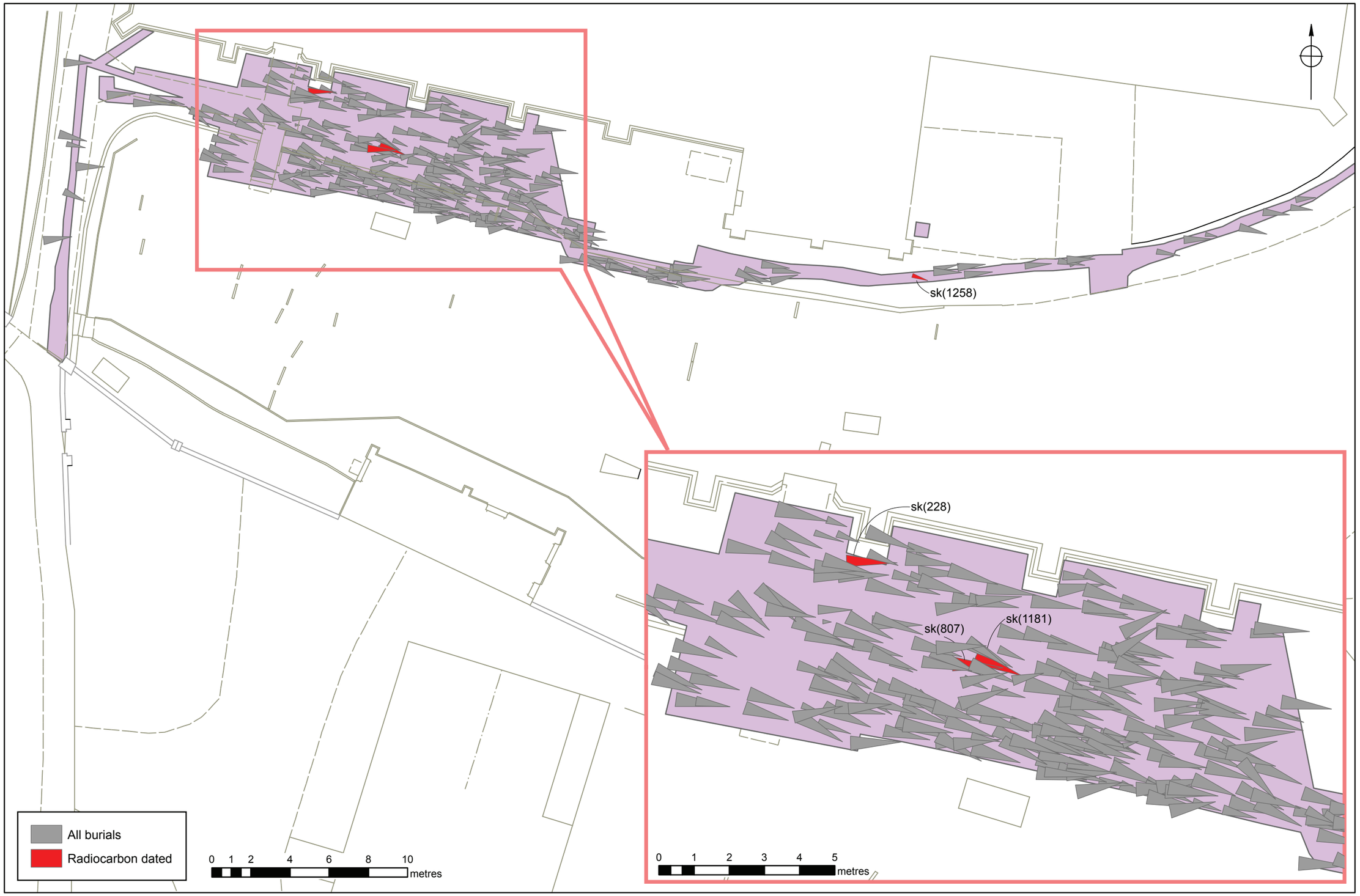


Trench location plan

Figure 2

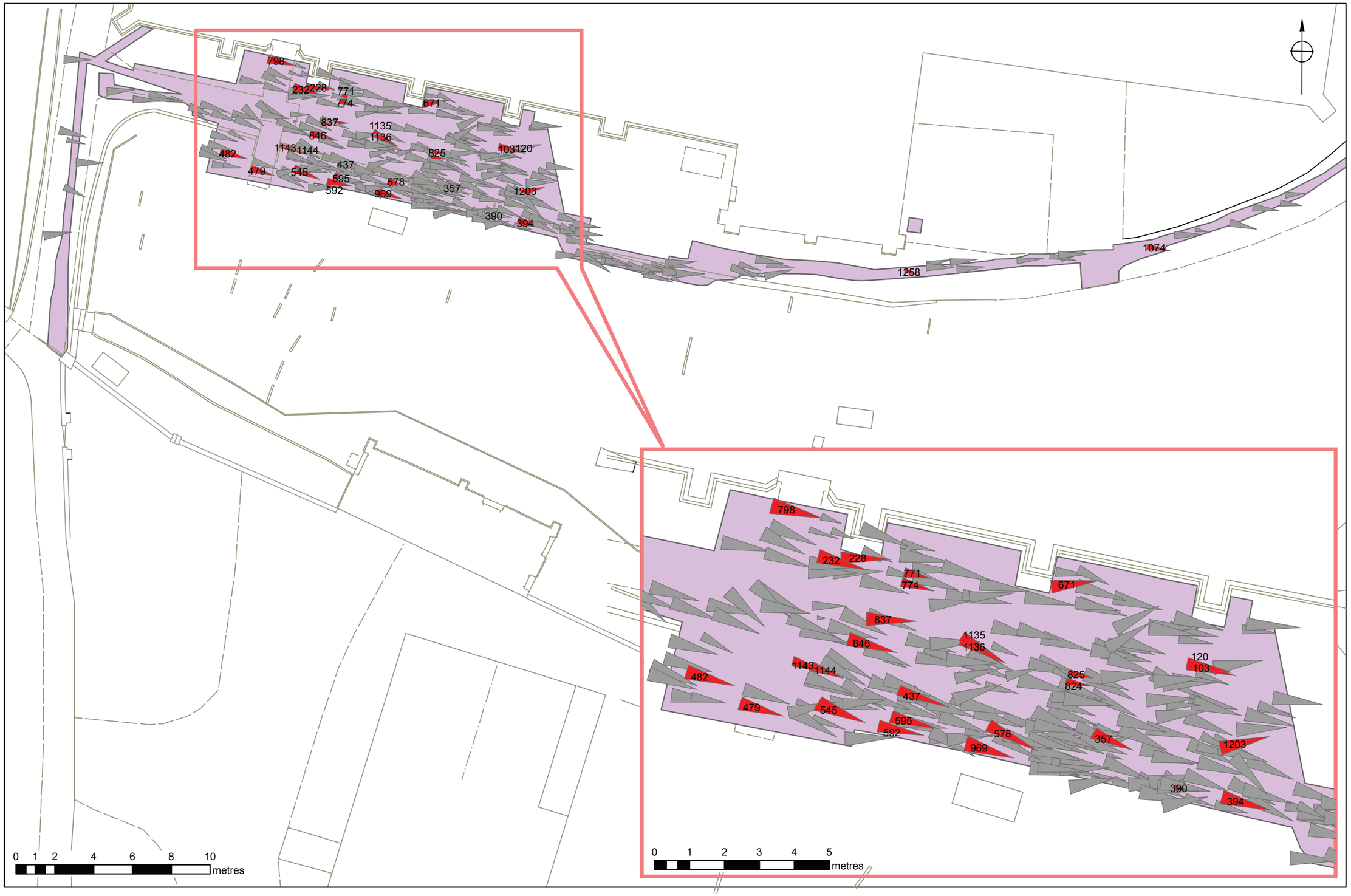


Distribution of burials by phase: *Figure 12*

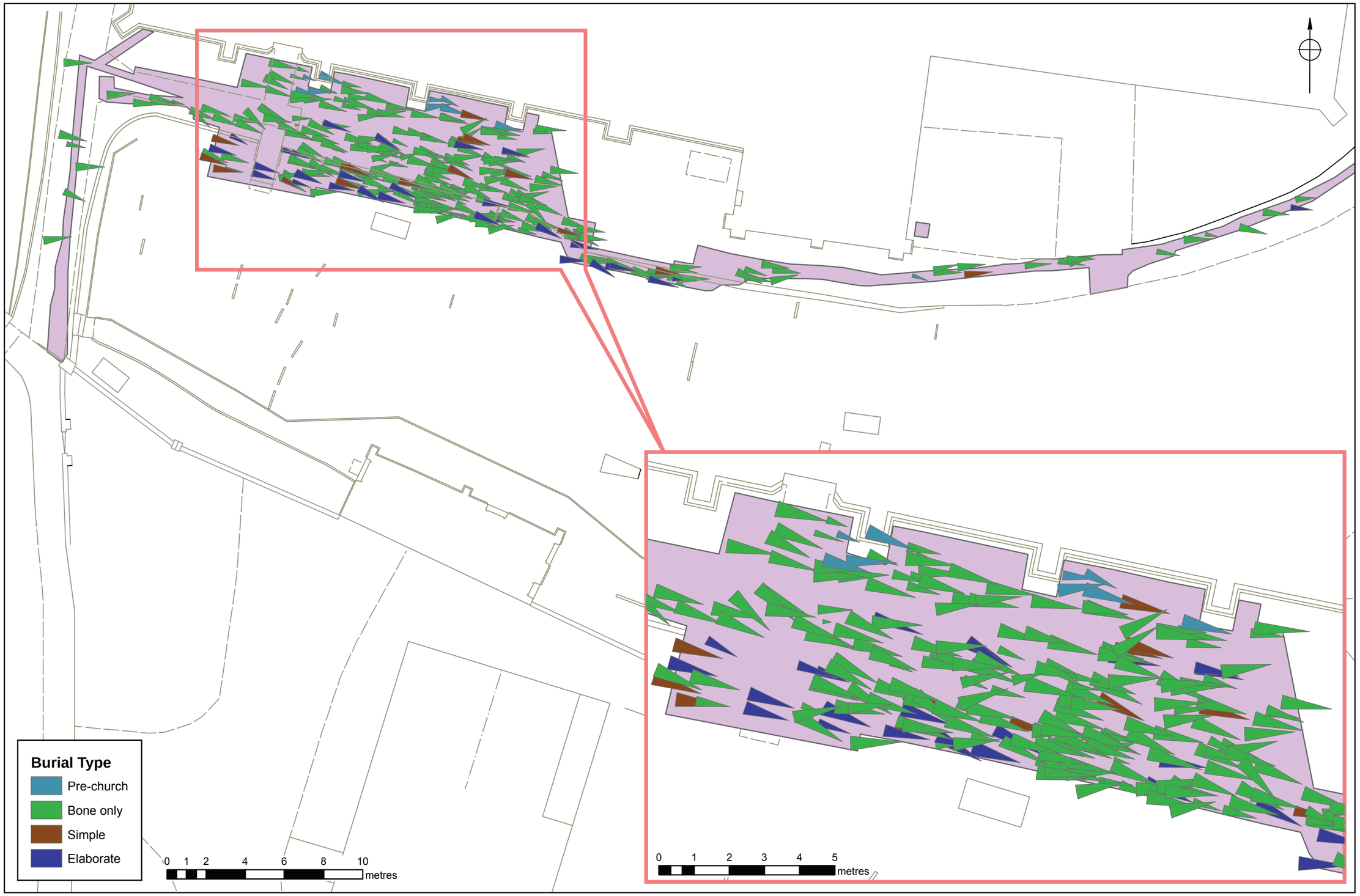


Distribution of radiocarbon dated burials:

Figure 13

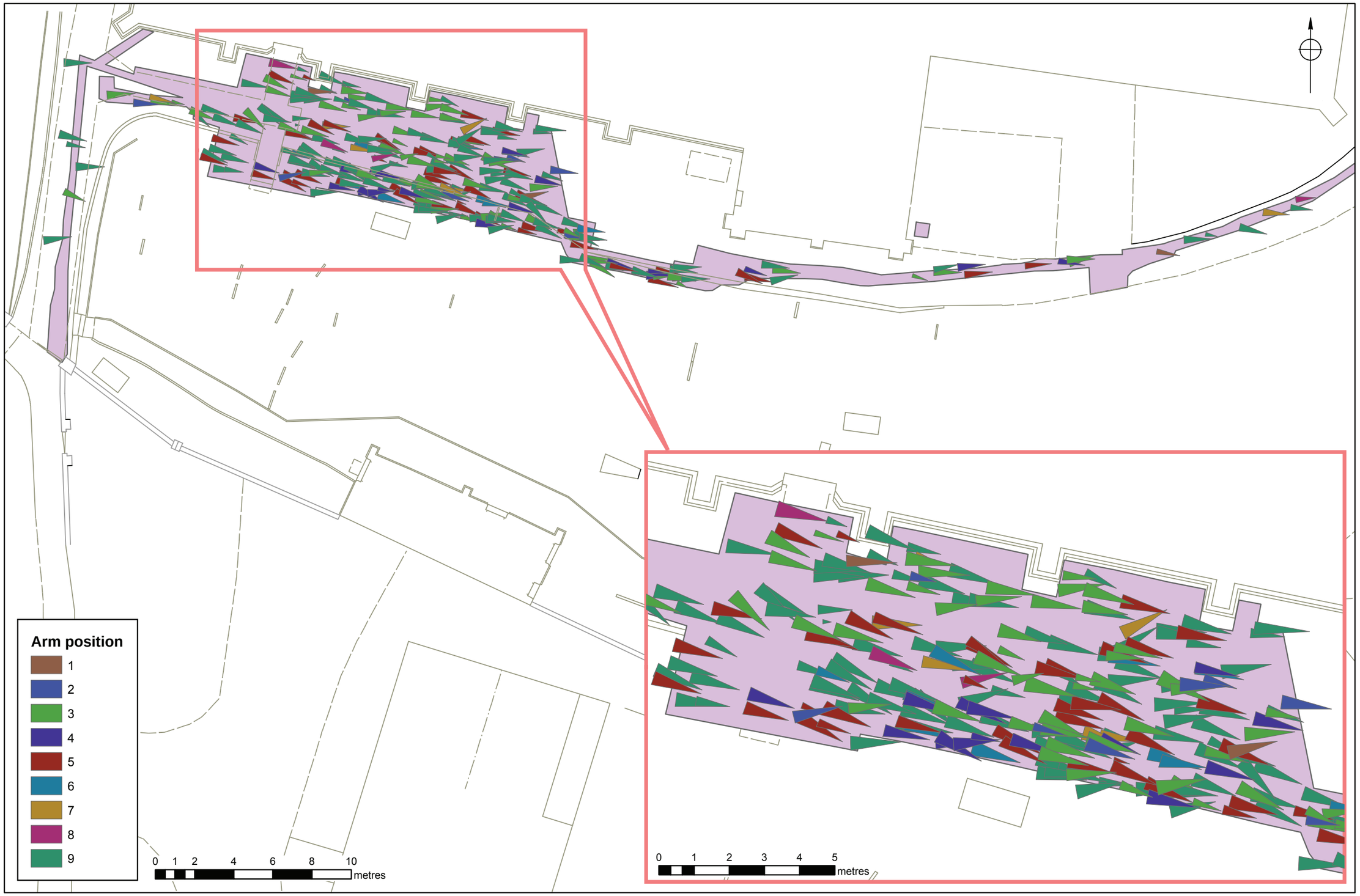


Distribution of burials discussed in text: *Figure 14*



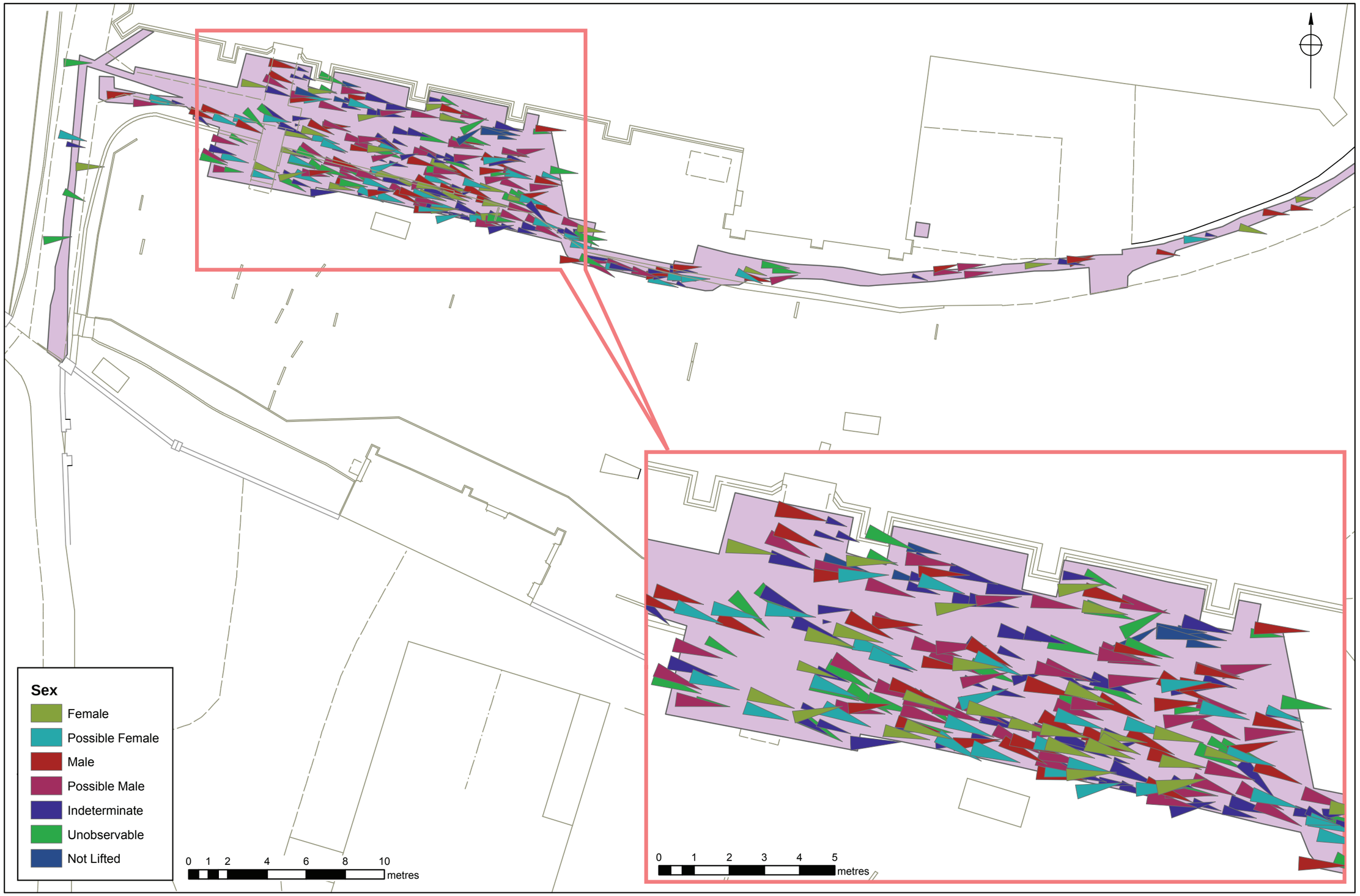
Distribution by burial type:

Figure 15



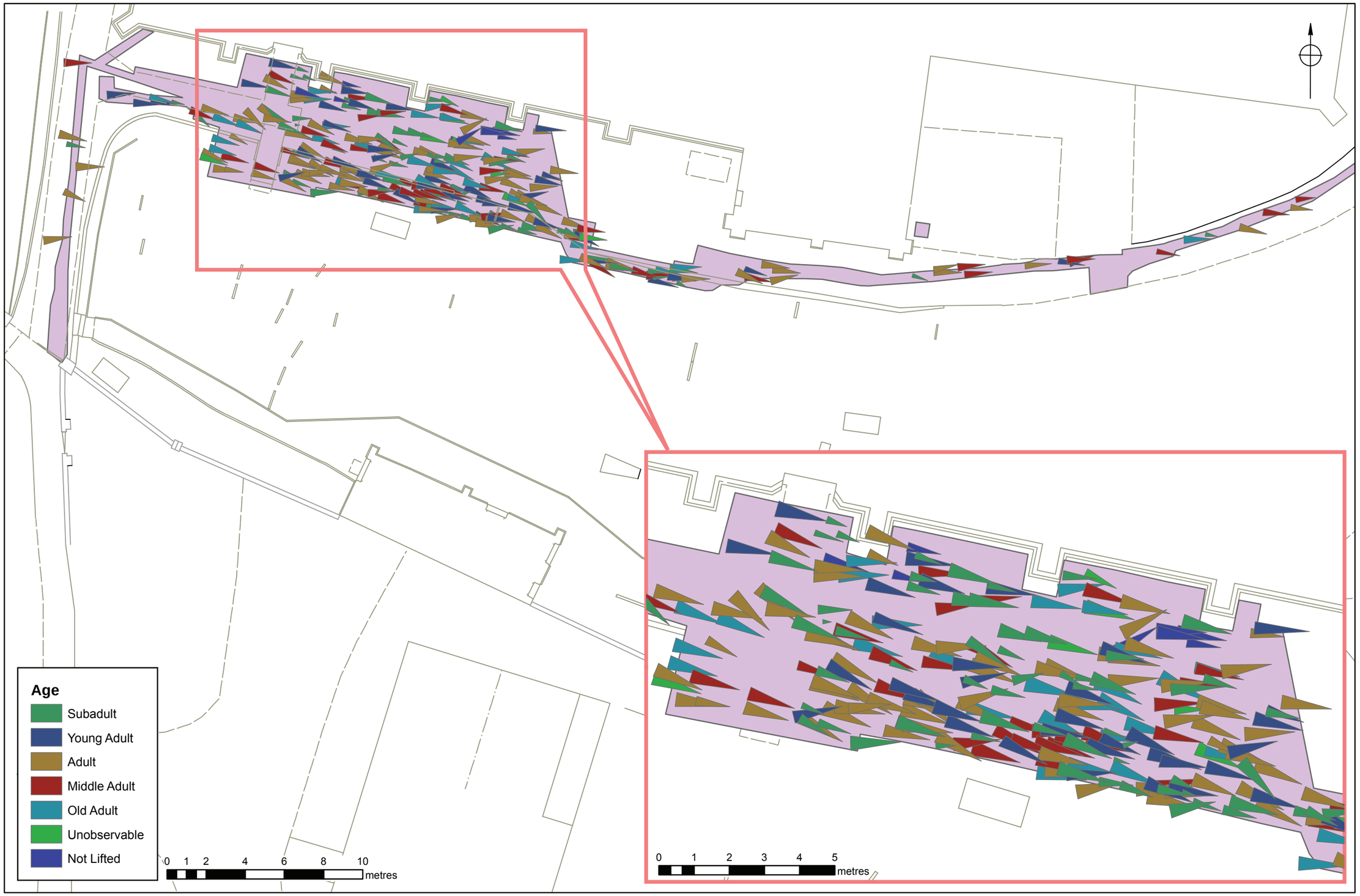
Distribution of burials by arm position:

Figure 16



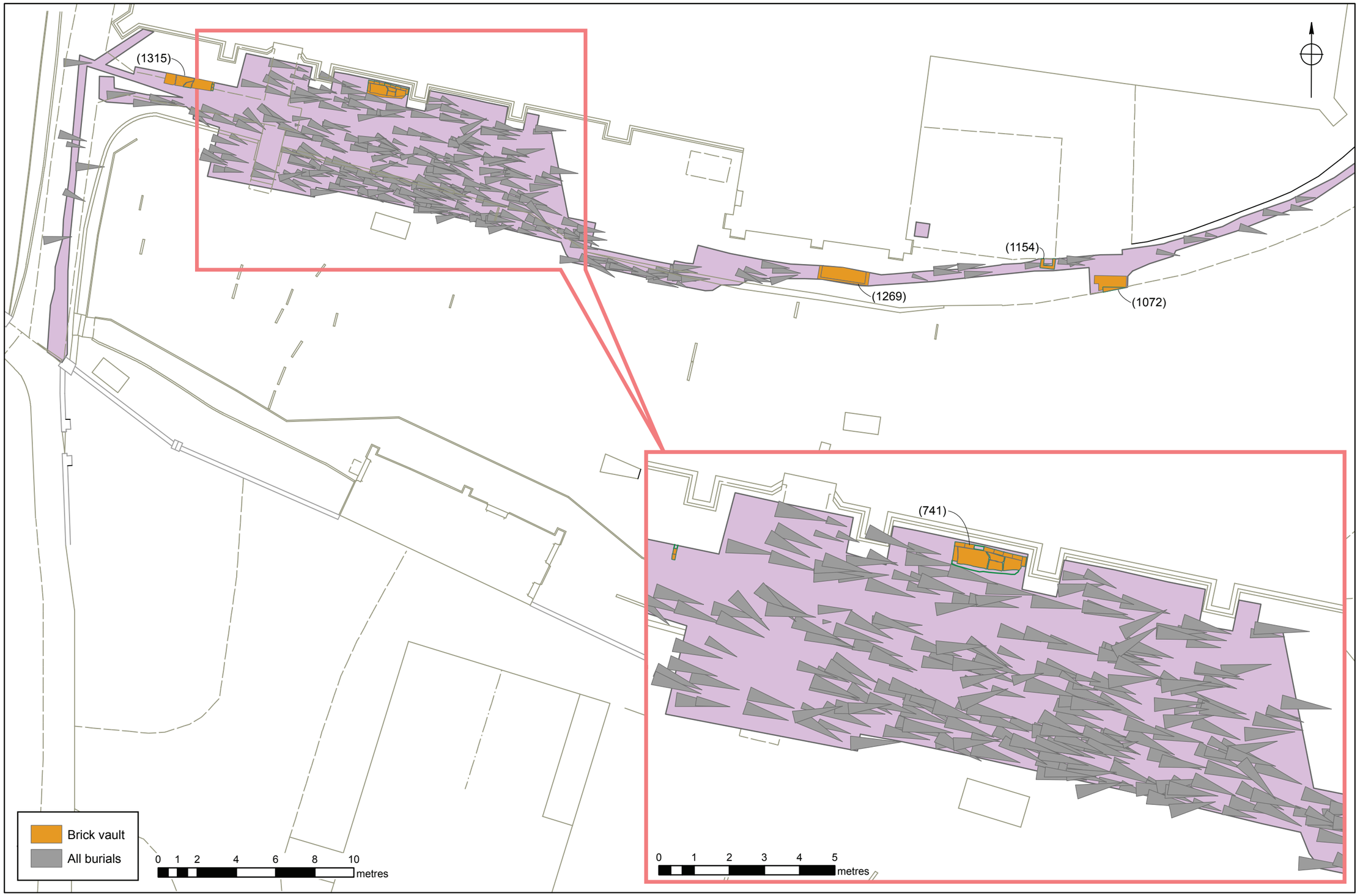
Distribution of burials by sex:

Figure 17

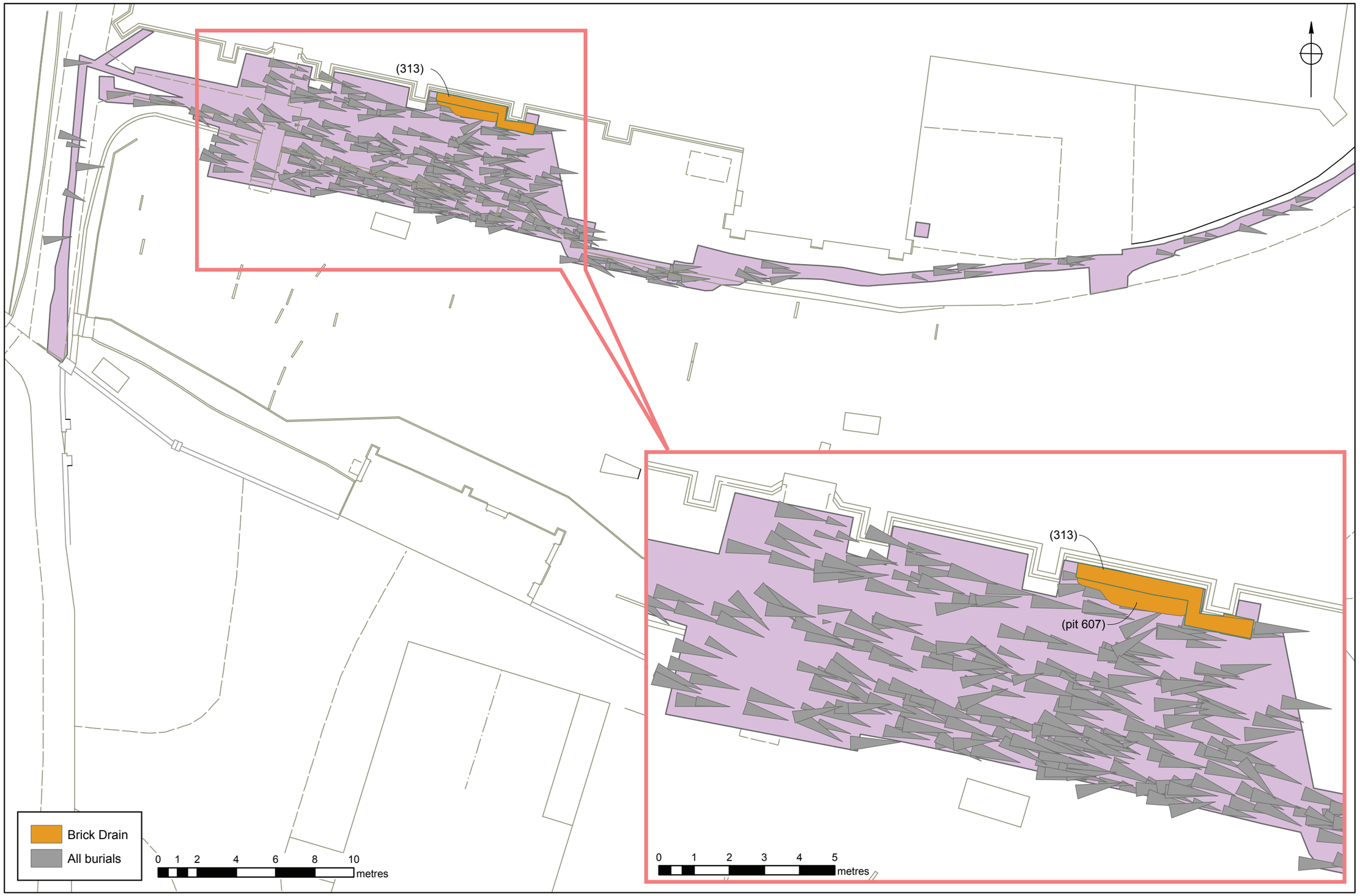


Distribution of burials by age:

Figure 18



Distribution of brick vaults and shafts: *Figure 19*



Brick culverted drain location: *Figure 20*

Location of modern features excluding services: *Figure 21*

Appendix 1 Osteology data

sk	Phase	Completeness	Preservation	Sex	Age Category	Stature (M)	No. of Deciduous Teeth	No. of Permanent Teeth	Alveolar Resorption (No.)	Calculus (No.)	Caries (No.)	Abscess (No.)	Enamel hypoplasia (No.)	Pathology
103	5	50-75%	Good	Male	Middle Adult	1.72	0	27	23	23	1	4	4	Maxillary sinusitis bilateral.
120	5	50-75%	Fair	Possible Male	Old Adult	1.81	0	0	0	0	0	0	0	Congenital: 13 thoracic vertebrae; Severe Primary OA R Hip; Primary OA R Elbow; One healed rib fracture; Minor Scoliosis Lumbar Spine; OA and DJD Spine.
123	3	75%	Good	n/a	Older Child	n/a	15	7	0	5	0	0	7	
125	5	25-50%	Fair	Possible Male	Young Adult	1.70	0	0	0	0	0	0	0	Periostitic L Rib Lesion;
141	2	<25%	Fair	n/a	Older Child	n/a	0	0	0	0	0	0	0	
210	5	75%	Fair	Possible Male	Young Adult	1.73	0	25	12	17	2	3	18	DJD Spine.
212	3	<25%	Good	n/a	Older Child	n/a	0	0	0	0	0	0	0	
213	3	<25%	Good	Unobservable	Adult	0.00	0	6	6	6	1	0	3	
216	3	25-50%	Fair	Possible Female	Old Adult	0.00	0	0	0	0	0	0	0	
217	3	<25%	Good	Possible Male	Young Adult	1.80	0	0	0	0	0	0	0	
223	3	<25%	Good	Male	Adult	1.75	0	0	0	0	0	0	0	
226	3	<25%	Fair	Possible Male	Adult	1.73	0	0	0	0	0	0	0	Primary OA 1st MTP joints; Primary DJD L Knee; Large enthesophyte R Tibia.
228	2	50-75%	Good	Female	Old Adult	1.67	0	31	29	24	0	1	0	TMJ Disease bilateral; Possible Osteoporosis; Cribra Orbitalia; DJD and OA Spine.
237	3	<25%	Fair	Possible Female	Adult	0.00	0	0	0	0	0	0	0	
238	3	<25%	Fair	Unobservable	Adult	0.00	0	0	0	0	0	0	0	
303	4	<25%	Fair	Possible Male	Adult	1.73	0	0	0	0	0	0	0	

328	3	25-50%	Fair	Possible Male	Adult	1.66	0	0	0	0	0	0	0	Primary DJD R SI joint.
331	4	50-75%	Fair	Male	Old Adult	0.00	0	7	2	3	2	0	1	DISH; Primary DJD L Hip; Primary DJD L Elbow; OA and DJD Spine, SNs.
334	4	<25%	Fair	Unobservable	Old Adult	0.00	0	0	0	0	0	0	0	
337	4	50-75%	Good	n/a	Juvenile	n/a	0	13	0	0	0	0	7	Periostitic L + R Rib Lesions.
340	5	<25%	Good	Unobservable	Unobservable	1.68	0	0	0	0	0	0	0	
343	4	<25%	Good	Unobservable	Unobservable	0.00	0	0	0	0	0	0	0	
346	4	<25%	Fair	Possible Male	Adult	0.00	0	0	0	0	0	0	0	
354	5	25-50%	Good	Female	Middle Adult	1.64	0	0	0	0	0	0	0	
357	5	75%	Good	Female	Young Adult	1.54	0	28	0	12	0	0	30	
362	3	<25%	Poor	Unobservable	Adult	0.00	0	0	0	0	0	0	0	SNs.
365	3	<25%	Good	Unobservable	Adult	0.00	0	0	0	0	0	0	0	SNs.
370	3	50-75%	Good	Possible Female	Middle Adult	1.56	0	29	2	24	1	0	0	Maxillary sinusitis; DJD Spine, SNs.
375	4	<25%	Fair	Possible Female	Adult	0.00	0	0	0	0	0	0	0	
378	4	50-75%	Fair	Possible Male	Young Adult	1.74	0	0	0	0	0	0	0	DJD Spine, SNs.
381	4	75%	Good	Male	Young Adult	1.70	0	20	19	0	1	1	8	Congenital: Sacralisation 1st Coccyx; poss early DISH with extra-spinal osteophytes; DJD Spine.
384	3	75%	Good	Male	Old Adult	1.70	0	13	11	12	2	3	0	Primary DJD R Elbow; Primary DJD R Wrist; possible Intra-articular fracture L 5th PIP joint; OA and DJD Spine, SNs.
387	3	25-50%	Good	Unobservable	Young Adult	0.00	0	0	0	0	0	0	0	SNs.
390	5	75%	Good	n/a	Neonate	n/a	0	0	0	0	0	0	0	
392	4	<25%	Fair	n/a	Adolescent	n/a	0	25	0	23	0	0	21	Hutchinson's Incisors and Mulberry Molars.
398	5	25-50%	Poor	Possible Male	Adult	1.67	0	0	0	0	0	0	0	Periostitic L Rib Lesions.

401	3	50-75%	Good	n/a	Juvenile	n/a	9	18	0	10	2	0	4	
406	3	75%	Good	Male	Middle Adult	0.00	0	1	0	1	0	0	0	Congenital: Flaring rib; TMJ Right; Primary DJD R Shoulder; Primary DJD R Elbow; Fracture neck of L 5th MC; Secondary OA R + L Foot to genu valgum + foot deformity, Secondary OA R + L Knee to Healed Rickets; DJD and OA Spine, SNs.
409	4	75%	Good	Male	Old Adult	1.70	0	5	5	2	1	0	0	Large Enthesophyte R 1st MC; Periostitis R Tibia and Fibula; Periostitic R Rib Lesions; DJD Spine, SNs.
415	5	<25%	Fair	Possible Female	Adult	1.50	0	0	0	0	0	0	0	
418	3	25-50%	Fair	Possible Female	Adult	1.55	0	0	0	0	0	0	0	
421	4	50-75%	Good	Indeterminate	Adult	1.61	0	17	16	17	2	1	2	Primary DJD R + L Sterno-Clavicular Joints; Primary OA R + L Wrists; Primary DJD R + L Hands; Compression fracture T10 vertebra - possible osteoporosis; Maxillary Sinusitis; DJD Spine, SNs.
426	3	<25%	Good	Possible Male	Adult	0.00	0	0	0	0	0	0	0	Large Enthesophytes R Tibia & Fibula.
429	4	25-50%	Good	n/a	Older Child	n/a	16	3	0	0	0	0	0	
437	5	50-75%	Fair	Female	Young Adult	1.64	0	25	1	5	0	0	23	
440	5	25-50%	Good	Possible Male	Adult	1.64	0	26	0	0	1	0	9	
447	4	25-50%	Good	Possible Male	Adult	0.00	0	0	0	0	0	0	0	Healed Fracture L 1st Rib; DJD Spine, SNs.
450	5	<25%	Good	Possible Male	Middle Adult	0.00	0	0	0	0	0	0	0	Cribra Orbitalia; OA Spine.
454	4	<25%	Good	n/a	Older Child	n/a	0	1	0	0	0	0	0	Periostitis R Humerus; Endocranial bone formation;

458	4	50-75%	Fair	Male	Young Adult	0.00	0	22	0	0	2	0	0	Congenital: Flaring Rib; Endocranial cyst-like lesion and associated cranial vault protrusion; Possible dermoid cyst; SNs.
461	4	<25%	Good	Unobservable	Young Adult	1.52	0	0	0	0	0	0	0	Congenital: DDH; SNs.
464	4	<25%	Fair	Indeterminate	Old Adult	1.60	0	0	0	0	0	0	0	
466	4	<25%	Good	Possible Male	Adult	1.72	0	14	8	8	3	2	2	Healed Fracture L Clavicle;
470	5	50-75%	Fair	Female	Middle Adult	1.61	0	0	0	0	0	0	0	Secondary OA L Shoulder to Epiphyseal Dysplasia
473	3	25-50%	Good	Male	Adult	0.00	0	26	24	25	0	0	3	Cribra Orbitalia; DJD Spine.
476	4	<25%	Good	Unobservable	Adult	0.00	0	0	0	0	0	0	0	
479	5	25-50%	Fair	Possible Female	Adult	1.62	0	6	2	6	0	0	1	TMJ Disease Bilateral.
482	5	<25%	Good	Possible Female	Middle Adult	1.61	0	0	0	0	0	0	0	
485	5	25-50%	Good	Indeterminate	Old Adult	1.68	0	0	0	0	0	0	0	Primary DJD R Hip; Primary OA R Knee; Paget's Disease;
488	4	<25%	Good	Unobservable	Adult	0.00	0	0	0	0	0	0	0	DISH; OA Spine, SNs.
491	5	75%	Poor	n/a	Juvenile	n/a	2	29	0	2	0	0	0	Extensive periositis most long bones; Endocranial bone formation.
493	5	<25%	Good	Unobservable	Adult	0.00	0	0	0	0	0	0	0	
499	5	<25%	Fair	Possible Female	Young Adult	1.62	0	0	0	0	0	0	0	
502	5	25-50%	Poor	Female	Young Adult	1.59	0	27	0	12	2	0	12	Periostitis R Femur; Endocranial bone formation; Periostitis bilateral calcaneii.
505	5	50-75%	Good	Male	Middle Adult	1.74	0	0	0	0	0	0	0	Developmental: Os Acromiale; Spondylolysis; Healed Fracture Upper Right Rib (2nd?); Healed

														Colles Fracture L Radius; SNs.
508	5	<25%	Fair	n/a	Adolescent	n/a	0	0	0	0	0	0	0	
510	5	<25%	Good	n/a	Adolescent	n/a	0	0	0	0	0	0	0	
512	5	<25%	Fair	Possible Male	Adult	1.70	0	0	0	0	0	0	0	
517	4	25-50%	Good	n/a	Older Child	n/a	5	0	0	4	0	0	0	
520	4	25-50%	Fair	Male	Middle Adult	1.71	0	0	0	0	0	0	0	DJD Spine, SNs.
523	5	25-50%	Fair	Female	Middle Adult	1.64	0	15	12	12	13	0	0	Periostitic L Rib Lesions.
525	3	50-75%	Good	n/a	Older Child	n/a	0	0	0	0	0	0	0	
529	3	<25%	Fair	Unobservable	Adult	0.00	0	0	0	0	0	0	0	
532	3	<25%	Good	Possible Male	Adult	1.75	0	0	0	0	0	0	0	
536	4	<25%	Poor	Unobservable	Unobservable	0.00	0	0	0	0	0	0	0	
539	4	<25%	Good	Unobservable	Adult	1.57	0	0	0	0	0	0	0	
542	3	<25%	Fair	Unobservable	Adult	0.00	0	0	0	0	0	0	0	Primary OA R Knee.
545	5	50-75%	Fair	Possible Female	Adult	1.70	0	8	4	6	2	0	0	Primary DJD R + L Knees.
550	5	75%	Good	Female	Young Adult	1.59	0	0	0	0	0	0	0	Lytic lesion L1 - possible infection; DJD and OA Spine, SNs.
553	4	25-50%	Poor	Possible Female	Adult	1.56	0	0	0	0	0	0	0	
556	3	<25%	Good	Possible Male	Adult	1.72	0	0	0	0	0	0	0	Periostitis R Tibia and Fibula.
559	4	<25%	Good	n/a	Older Child	n/a	0	0	0	0	0	0	0	
562	4	<25%	Fair	Unobservable	Unobservable	0.00	0	0	0	0	0	0	0	
567	4	25-50%	Fair	Possible Male	Adult	1.73	0	0	0	0	0	0	0	Periostitis R Fibula.
570	5	<25%	Fair	Unobservable	Adult	0.00	0	0	0	0	0	0	0	SNs.
573	5	<25%	Fair	Possible Male	Old Adult	1.68	0	0	0	0	0	0	0	Primary DJD L + R Hips.
578	5	75%	Fair	Possible Male	Middle Adult	1.84	0	9	7	8	1	0	0	Primary OA L Hip; Primary DJD R Hip; Primary DJD L Knee; Possible healed

														rickets; DJD and OA Spine, SN's.
581	3	75%	Good	Female	Young Adult	1.59	0	28	0	0	0	0	5	Developmental: Os Acromiale; DJD Spine.
583	3	<25%	Good	Possible Male	Middle Adult	0.00	0	0	0	0	0	0	0	DJD Spine, SNs.
592	5	50-75%	Fair	Female	Adult	1.66	0	23	23	23	4	1	6	
595	4	50-75%	Good	Male	Old Adult	1.61	0	8	4	6	1	0	4	DJD Spine.
605	4	<25%	Poor	Possible Female	Old Adult	0.00	0	0	0	0	0	0	0	
610	5	<25%	Fair	Unobservable	Unobservable	0.00	0	0	0	0	0	0	0	
614	5	25-50%	Fair	Female	Middle Adult	1.66	0	0	0	0	0	0	0	OA Spine, SNs.
617	3	<25%	Fair	Unobservable	Adult	1.51	0	0	0	0	0	0	0	
620	3	25-50%	Fair	Unobservable	Unobservable	0.00	0	0	0	0	0	0	0	DISH; OA and DJD Spine.
623	3	<25%	Good	Unobservable	Adult	0.00	0	0	0	0	0	0	0	
626	5	50-75%	Fair	Possible Male	Adult	1.70	0	30	26	30	0	0	0	Suspected greenstick fracture R Ulna; Gout;
629	5	50-75%	Good	n/a	Older Child	n/a	13	8	0	5	0	0	0	Cribra Orbitalia;
631	5	50-75%	Good	Male	Young Adult	1.66	0	25	22	14	10	1	18	Cribra Orbitalia; Dentigerous Cyst; SNs.
633	3	25-50%	Good	Male	Adult	0.00	0	25	25	24	0	1	0	DJD Spine.
636	3	25-50%	Fair	Female	Old Adult	1.49	0	5	5	0	0	0	0	Cribra Orbitalia; DJD Spine.
639	5	75%	Good	Male	Old Adult	1.64	0	16	14	14	3	0	0	Primary DJD R + L Acromio-Clavicular Joints; Primary DJD R Sterno-Clavicular Joint; Healed Fracture R Ulna; Large enthesophyte R Femur; L enthesophyte (ossified haematoma?) R Fibula; Avulsion Fracture R 5th MT; Supracondylar process; DJD Spine, SNs.

642	5	50-75%	Good	Male	Middle Adult	1.66	0	0	0	0	0	0	0	DISH; Primary OA R Elbow; Primary OA R + L Hands; DJD Spine.
645	5	75%	Good	Female	Young Adult	1.61	0	30	0	0	0	0	0	
648	5	<25%	Good	n/a	Older Child	n/a	0	0	0	0	0	0	0	
651	5	25-50%	Good	n/a	Adolescent	n/a	0	0	0	0	0	0	0	
656	3	75%	Fair	Female	Old Adult	1.59	0	13	12	13	3	0	0	Primary DJD R Knee; Primary DJD R Sterno-Clavicular Joint; Primary DJD R Hand; OA and DJD Spine.
659	2b	50-75%	Good	Female	Middle Adult	1.61	0	0	0	0	0	0	0	Primary OA R Hand; DJD Spine, SNs.
662	2b	<25%	Fair	Possible Male	Middle Adult	0.00	0	0	0	0	0	0	0	OA and DJD Spine.
665	3	<25%	Fair	Possible Female	Middle Adult	0.00	0	0	0	0	0	0	0	Secondary DJD R Hand to possible trauma; DJD Spine.
668	3	<25%	Poor	Indeterminate	Middle Adult	1.64	0	0	0	0	0	0	0	Possible Osteoporosis;
671	2	75%	Good	Female	Old Adult	1.62	0	0	0	0	0	0	0	Periositis bilateral tibiae; DJD Spine, SNs.
674	3	50-75%	Fair	Possible Male	Old Adult	1.70	0	0	0	0	0	0	0	Primary DJD L Sterno-Clavicular Joint; Sessile Osteochondroma 1st R MC; DJD Spine, SNs.
679	2	25-50%	Good	n/a	Juvenile	n/a	0	0	0	0	0	0	0	
682	5	50-75%	Poor	Possible Male	Adult	0.00	0	0	0	0	0	0	0	Developmental: Os Acromiale; Severe OA R Hip; Primary DJD R Shoulder; SNs.
685	5	<25%	Fair	Possible Female	Young Adult	1.56	0	0	0	0	0	0	0	SNs.
688	3	25-50%	Fair	Female	Old Adult	1.52	0	0	0	0	0	0	0	Possible Seronegative OA Hands.
691	5	75%	Good	Possible Male	Young Adult	1.60	0	0	0	0	0	0	0	
698	2b	75%	Good	n/a	Older Child	n/a	9	4	0	6	0	0	0	
701	2b	50-75%	Fair	Possible Male	Young Adult	0.00	0	16	5	8	5	0	4	TMJ Left;

704	5	25-50%	Good	Female	Middle Adult	1.54	0	0	0	0	0	0	0	Epiphyseal dysplasia R Humerus; DJD Spine; SNs.
708	4	<25%	Good	Male	Young Adult	1.71	0	0	0	0	0	0	0	SNs.
711	4	25-50%	Good	n/a	Young Child	n/a	1	0	0	0	0	0	0	
714	3	75%	Fair	Female	Old Adult	1.55	0	0	0	0	0	0	0	Primary OA R Shoulder; Primary DJD R Elbow; Primary OA L Elbow; Primary OA R + L Knee; OA and DJD Spine.
717	3	25-50%	Good	n/a	Older Child	n/a	0	0	0	0	0	0	0	
720	3	<25%	Good	Indeterminate	Young Adult	1.54	0	0	0	0	0	0	0	Osteoma R Tibia;
723	3	<25%	Good	n/a	Juvenile	n/a	0	0	0	0	0	0	0	
726	3	<25%	Good	n/a	Older Child	n/a	0	0	0	0	0	0	0	
732	3	75%	Good	n/a	Older Child	n/a	4	1	0	1	0	0	0	
735	3	25-50%	Good	n/a	Older Child	n/a	0	0	0	0	0	0	0	Endocranial bone formation;
738	3	<25%	Fair	n/a	Adolescent	n/a	0	0	0	0	0	0	0	
743	3	75%	Good	n/a	Juvenile	n/a	5	11	0	8	0	0	2	
747	2	25-50%	Good	n/a	Older Child	n/a	0	0	0	0	0	0	0	
750	3	<25%	Good	Male	Middle Adult	1.65	0	0	0	0	0	0	0	
753	2b	25-50%	Fair	Possible Female	Old Adult	1.54	0	5	4	5	2	2	0	Seondary OA L Wrist to fracture of the ulna; Primary DJD R Knee; Healed Fracture L Ulna; OA and DJD Spine.
756	4	50-75%	Good	n/a	Juvenile	n/a	0	21	0	8	0	0	0	Localised area of porosity, endocranial;
759	4	<25%	Good	n/a	Juvenile	n/a	0	0	0	0	0	0	0	
762	2b	50-75%	Good	Possible Male	Adult	0.00	0	0	0	0	0	0	0	Congenital: Spondylolysis; Ivory osteoma R Tibia; Ivory osteoma frontal bone; DJD Spine.
765	5	<25%	Fair	Possible Male	Adult	1.71	0	0	0	0	0	0	0	

768	2b	75%	Good	Male	Middle Adult	1.64	0	19	0	3	0	0	0	Healed Fracture L Humerus; DJD Spine, SNs.
771	2b	75%	Fair	n/a	Older Child	n/a	20	0	0	5	0	0	0	
774	3	75%	Fair	n/a	Juvenile	n/a	0	8	0	0	0	0	0	
777	3	<25%	Fair	Unobservable	Adult	1.67	0	0	0	0	0	0	0	
780	2b	<25%	Good	Female	Young Adult	1.59	0	0	0	0	0	0	0	
783	3	25-50%	Fair	Possible Male	Old Adult	1.72	0	0	0	0	0	0	0	Periostitis bilateral tibiae;
789	3	<25%	Fair	Unobservable	Adult	1.64	0	0	0	0	0	0	0	
792	3	50-75%	Fair	Male	Old Adult	1.77	0	1	0	0	1	0	0	Possible healed rickets; Diffuse periostitis L tibia and L femur; DJD Spine.
795	3	<25%	Good	n/a	Young Child	n/a	0	0	0	0	0	0	0	
798	3	75%	Good	Male	Young Adult	1.65	0	22	19	20	2	4	3	Ivory Osteoma L Tibia; SNs.
801	3	25-50%	Good	n/a	Adolescent	n/a	0	3	0	0	0	0	0	
804	3	50-75%	Fair	n/a	Young Child	n/a	0	0	0	2	0	0	0	
807	3	25-50%	Good	Possible Female	Adult	1.60	0	0	15	18	1	0	0	
812	3	<25%	Good	Female	Young Adult	0.00	0	0	0	0	0	0	0	
815	3	<25%	Good	Possible Male	Adult	0.00	0	0	0	0	0	0	0	
818	2	<25%	Good	Unobservable	Adult	0.00	0	0	0	0	0	0	0	Osteoma L Tibia.
821	3	50-75%	Fair	n/a	Older Child	n/a	4	11	0	0	0	0	5	
824	2b	75%	Good	n/a	Older Child	n/a	20	0	0	0	0	0	0	
825	2b	25-50%	Good	n/a	Older Child	n/a	15	0	0	3	0	0	0	
828	3	<25%	Fair	n/a	Adolescent	n/a	0	0	0	0	0	0	0	
831	4	25-50%	Fair	Unobservable	Adult	1.64	0	0	0	0	0	0	0	Primary DJD L Hip; DJD and OA Spine.
834	2b	75%	Fair	Possible Male	Old Adult	1.61	0	2	1	0	2	1	0	Congenital: Spondylolysis L4 and L5; Primary DJD R + L Shoulder; Primary DJD R Wrist; DJD and OA Spine, SNs.

837	3	50-75%	Fair	Male	Old Adult	1.70	0	22	22	20	2	4	0	Cribra Orbitalia; Ectocranial lytic lesion (chronic scalp sore?); DJD Spine, SNs.
840	2b	50-75%	Fair	Male	Adult	1.82	0	27	0	19	4	3	4	DJD Spine, SNs.
843	3	50-75%	Good	n/a	Older Child	n/a	10	0	0	0	0	0	0	
846	5	25-50%	Good	Possible Female	Old Adult	1.54	0	0	0	0	0	0	0	Congenital: Asymmetry neural arch T12; Primary OA R Knee; DISH like enthesophytes ischial tuberosities, femoral trochanters and small enthesophyte L patella, prominent ostophyte lumbar verts; DJD Spine, SNs.
849	2b	25-50%	Good	n/a	Older Child	n/a	0	0	0	0	0	0	0	
852	3	75%	Good	Male	Middle Adult	1.71	0	16	0	12	6	0	8	Periostitis L Femur + L Tibia; Osteoma R Femur; DJD Spine and SNs.
855	3	<25%	Good	n/a	Older Child	n/a	0	0	0	0	0	0	0	
858	3	75%	Fair	Possible Male	Young Adult	1.64	0	4	0	3	0	0	0	DJD and OA Spine.
861	3	50-75%	Good	n/a	Older Child	n/a	0	0	0	0	0	0	0	
864	2b	75%	Good	Possible Female	Middle Adult	1.56	0	0	0	0	0	0	0	Small enthesophyte R 1st MC; DJD Spine, SNs.
867	3	25-50%	Good	n/a	Older Child	n/a	0	0	0	0	0	0	0	
870	3	25-50%	Fair	Male	Old Adult	1.76	0	0	0	0	0	0	0	Secondary OA L Hand x 2 to trauma (possible healed Bennett's Fracture); Possible osteoporosis; DJD and OA Spine.
873	3	<25%	Good	Unobservable	Adult	1.58	0	0	0	0	0	0	0	
876	3	25-50%	Fair	Female	Middle Adult	1.60	0	0	0	0	0	0	0	DJD Spine, SNs.
879	4	25-50%	Poor	Female	Adult	1.53	0	0	0	0	0	0	0	Bilateral Osteochondritis dissecans;

882	3	50-75%	Good	n/a	Young Infant	n/a	0	0	0	0	0	0	0	
885	4	<25%	Good	n/a	Adolescent	n/a	0	0	0	0	0	0	0	
888	5	75%	Good	n/a	Older Infant	n/a	6	0	0	0	0	0	0	Rickets (rachitic rosary); Periostitic R Rib Lesions;
891	5	75%	Poor	n/a	Young Child	n/a	8	0	0	0	0	0	0	Possible rickets; Endocranial bone formation;
894	5	<25%	Good	Unobservable	Adult	0.00	0	0	0	0	0	0	0	
897	3	50-75%	Fair	n/a	Young Child	n/a	1	0	0	0	0	0	0	
900	5	25-50%	Good	n/a	Adolescent	n/a	0	0	0	0	0	0	0	
903	2b	50-75%	Good	Male	Young Adult	1.77	0	4	4	4	0	0	0	Congenital: Hypoplasia T8-T12 bodies; Suspected greenstick fracture R clavicle; Healed Colles Fracture R radius; OA and DJD Spine, SNs.
906	4	75%	Good	Male	Old Adult	1.62	0	8	0	0	2	0	0	5 Healed R rib fractures; Compression fracture upper/mid thoracic vertebra (T5?); Healed fracture R Clavicle + Fracture R Ulna + R Radius + L Fibula; Moderate Enthesophyte R Femur; Bilateral Mastoiditis; DJD Spine, SNs.
909	3	50-75%	Good	Possible Female	Young Adult	1.65	0	15	0	14	0	0	1	
912	3	<25%	Good	Possible Male	Young Adult	1.84	0	0	0	0	0	0	0	
915	3	<25%	Fair	Possible Male	Adult	1.75	0	0	0	0	0	0	0	
922	5	25-50%	Poor	Possible Male	Adult	0.00	0	13	13	13	1	0	0	DJD Spine, SNs.
926	5	75%	Good	Possible Female	Young Adult	1.65	0	27	0	14	4	0	0	

931	4	75%	Fair	Male	Middle Adult	1.71	0	24	23	23	1	1	10	Secondary OA L Wrist to Fracture of R Radius; Primary OA R Hip; Primary DJD R + L Sterno-Clavicular Joint; Fracture L Radius; DJD Spine, SNs.
934	3	75%	Fair	Possible Female	Old Adult	1.61	0	0	0	0	0	0	0	Clay shoveller's Fracture C7; DJD Spine.
938	2b	75%	Good	n/a	Older Child	n/a	4	4	0	4	2	0	6	
941	2b	75%	Good	n/a	Young Child	n/a	20	0	0	1	0	0	0	Endocranial bone formation;
944	2b	75%	Fair	n/a	Juvenile	n/a	5	3	0	3	0	0	0	
947	4	<25%	Good	n/a	Adolescent	n/a	0	0	0	0	0	0	0	Periostitic L + R Rib Lesions;
954	4	25-50%	Good	n/a	Older Child	n/a	0	0	0	0	0	0	0	
957	3	<25%	Fair	Male	Old Adult	0.00	0	0	0	0	0	0	0	
960	4	<25%	Poor	n/a	Adolescent	n/a	0	0	0	0	0	0	0	
963	3	75%	Good	n/a	Young Child	n/a	7	0	0	0	0	0	0	
966	5	<25%	Fair	Possible Female	Adult	0.00	0	0	0	0	0	0	0	
969	5	50-75%	Good	Possible Female	Middle Adult	1.61	0	14	14	9	4	0	0	Known Individual: Elizabeth Smith, born 1789 and died 1854.
972	4	25-50%	Good	n/a	Older Child	n/a	17	1	0	0	0	0	0	Cribra Orbitalia;
975	4	50-75%	Good	Possible Female	Old Adult	1.56	0	4	3	0	0	0	0	Subluxation 2nd R Proximal Toe Phalanx; Possible healed rickets; Periostitic R + L Rib Lesions; SNs.
979	3	75%	Good	Female	Middle Adult	1.52	0	22	20	21	1	0	8	3 Healed L rib fractures; DJD Spine.
985	3	50-75%	Good	Possible Male	Adult	1.67	0	23	0	21	0	0	0	SNs.
989	5	<25%	Fair	Male	Adult	0.00	0	26	6	17	3	0	0	Cribra Orbitalia;
992	3	75%	Good	Female	Young Adult	1.58	0	30	0	7	0	0	0	Congenital: Lumbarisation S1 to L6; Cribra Orbitalia; Diffuse Periostitis L + R Femur and L + R

														Tibiae;
996	3	<25%	Good	Possible Female	Adult	1.55	0	0	0	0	0	0	0	
999	3	<25%	Good	Possible Female	Adult	1.57	0	0	0	0	0	0	0	
1002	4	50-75%	Good	Female	Middle Adult	1.56	0	0	0	0	0	0	0	SNs.
1005	4	25-50%	Fair	Possible Male	Adult	0.00	0	23	0	0	0	0	0	
1008	4	<25%	Fair	Possible Male	Adult	0.00	0	0	0	0	0	0	0	Osteochondritis Dissecans R Tibia;
1011	4	<25%	Good	n/a	Adolescent	n/a	0	0	0	0	0	0	0	Diffuse Periostitis R + L Tibiae;
1014	3	25-50%	Fair	Possible Female	Adult	1.58	0	0	0	0	0	0	0	
1017	3	75%	Fair	Male	Middle Adult	1.77	0	23	19	19	3	2	0	Primary DJD R Hip with Shaprly defined large lytic lesions; Clay shoveller's fracture; Fracture R transverse process T9 vertebra; Suspected healed fracture R MC 2; DJD Spine, SNs.
1020	3	50-75%	Fair	Male	Middle Adult	1.74	0	20	20	19	1	0	12	Distal clavicular erosion; DJD Spine.
1021	3	25-50%	Good	n/a	Older Child	n/a	14	1	0	0	0	0	0	Cribra Orbitalia;
1024	4	25-50%	Good	n/a	Juvenile	n/a	2	21	0	21	0	0	13	Cribra Orbitalia;
1028	5	25-50%	Good	Male	Old Adult	1.76	0	0	0	0	0	0	0	Primary Severe OA R + L Hips; Primary DJD R + L Knees; Primary OA R Foot; Healed fracture L 2nd MC; Large enthesophytes left ilium - possible ossified haematoma/myostitis ossificans; Extensive periostitis L Femur, L Tibia + L Fibula; DJD Spine.
1031	5	<25%	Poor	Possible Male	Adult	1.67	0	0	0	0	0	0	0	Primary OA R Hip;
1034	2b	<25%	Good	Male	Young Adult	1.69	0	0	0	0	0	0	0	
1037	3	<25%	Poor	Unobservable	Adult	0.00	0	0	0	0	0	0	0	

1040	2b	<25%	Good	n/a	Adolescent	n/a	0	0	0	0	0	0	0	
1044	5	<25%	Poor	Possible Male	Adult	1.69	0	0	0	0	0	0	0	
1049	2b	<25%	Good	Female	Adult	1.57	0	23	23	22	0	2	0	OA and DJD Spine.
1052	3	<25%	Fair	Unobservable	Unobservable	0.00	0	0	0	0	0	0	0	
1055	5	50-75%	Fair	Possible Female	Old Adult	1.67	0	5	5	5	3	0	0	DJD Spine, SNs.
1062	3	50-75%	Good	n/a	Young Infant	n/a	0	0	0	0	0	0	0	
1065	2b	<25%	Good	Possible Female	Old Adult	1.60	0	0	0	0	0	0	0	
1068	5	<25%	Fair	Possible Male	Middle Adult	1.79	0	0	0	0	0	0	0	Primary OA L Hip; Healed fracture L Ulna; DJD Spine, SNs.
1074	2	50-75%	Fair	Male	Middle Adult	1.65	0	14	6	14	0	0	0	Congenital: Lumbarisation of S1 and Sacralisation of Coccyx 1; Blastic Rib Lesion; SNs.
1077	2b	<25%	Fair	Possible Male	Adult	1.71	0	0	0	0	0	0	0	
1083	2b	75%	Good	Possible Female	Young Adult	1.60	0	24	12	24	2	1	10	Primary DJD L SI Joint;
1089	3	50-75%	Fair	Possible Male	Young Adult	1.79	0	0	0	0	0	0	0	DJD Spine, SNs.
1094	5	25-50%	Fair	n/a	Adolescent	n/a	0	0	0	0	0	0	0	
1100	5	25-50%	Good	Possible Female	Adult	1.65	0	0	0	0	0	0	0	
1104	4	50-75%	Good	n/a	Adolescent	n/a	1	27	0	14	0	0	2	
1107	3	50-75%	Good	Possible Male	Adult	1.74	0	25	25	25	1	1	0	Primary DJD L Acromio-Clavicular Joint; Primary OA R Acromio-Clavicular Joint; DJD Spine, SNs.
1110	4	25-50%	Good	Male	Middle Adult	1.71	0	0	0	0	0	0	0	Congenital: Spondylolysis; Healed L Bennett's fracture; Periostitis L Tibia.
1114	3	<25%	Good	Possible Female	Adult	0.00	0	0	0	0	0	0	0	
1117	3	<25%	Fair	Unobservable	Adult	0.00	0	0	0	0	0	0	0	
1120	4	50-75%	Fair	Male	Adult	0.00	0	25	22	23	5	0	0	Congenital: Cervical Left Rib; DJD Spine.

1123	3	<25%	Good	Unobservable	Young Adult	0.00	0	7	0	4	0	0	0	Endocranial bone formation.
1126	3	<25%	Good	Possible Male	Adult	0.00	0	26	0	7	1	0	0	
1131	4	75%	Fair	Male	Middle Adult	1.66	0	23	23	0	3	0	16	Possible osteoporosis with reduced height of T6, T7 and T8 vertebral bodies; Healed fracture R 1st MC; DJD and OA Spine.
1135	3	75%	Good	n/a	Adolescent	n/a	0	28	0	0	0	0	8	Periostitic L Rib Lesion; Periostitis L Tibia.
1136	5	75%	Good	Male	Middle Adult	1.66	0	22	21	22	2	0	13	Congenital: 6 lumbar vertebrae and sacralisation of L6; Secondary DJD to Bennett's fracture; 3 Healed rib fractures (2L & 1R); Bone formation LHS T4 and T5 vertebral bodies; Rib notch L 5th rib; DJD Spine, SNs. Post-mortem Examination (Thoracotomy ipsilateral to the heart);
1139	2b	25-50%	Fair	Possible Female	Young Adult	1.58	0	0	0	0	0	0	0	Small lytic lesion L4 vertebral body.
1143	5	50-75%	Good	Female	Middle Adult	1.48	0	14	12	0	4	0	0	
1144	5	75%	Good	n/a	Neonate	n/a	0	0	0	0	0	0	0	
1147	2b	25-50%	Good	Possible Male	Middle Adult	0.00	0	0	0	0	0	0	0	Primary DJD with fusion of R SI joint to Ilium; DJD Spine.
1150	3	50-75%	Good	Indeterminate	Young Adult	1.71	1	13	6	10	0	0	0	SNs Spine.
1156	2	50-75%	Fair	Male	Middle Adult	1.80	0	22	0	19	0	0	2	Congenital: Angulated mandibular condyle
1159	2	<25%	Fair	Unobservable	Unobservable	0.00	0	0	0	0	0	0	0	DJD Spine.
1162	3	75%	Good	Male	Middle Adult	1.63	0	0	0	0	0	0	0	Possible calcified disc in Schmorl's node; OA Spine, SNs.
1166	3	<25%	Good	Possible Female	Adult	1.55	0	0	0	0	0	0	0	

1169	2b	<25%	Good	Possible Male	Adult	1.80	0	0	0	0	0	0	0	Periostitis L Tibia + Fibula;
1172	2b	<25%	Good	Possible Male	Adult	1.74	0	0	0	0	0	0	0	
1175	2b	50-75%	Fair	Female	Middle Adult	1.59	0	0	0	0	0	0	0	SNs Spine.
1178	3	<25%	Fair	Possible Male	Adult	1.80	0	0	0	0	0	0	0	
1181	3	25-50%	Good	Female	Young Adult	1.60	0	0	0	0	0	0	0	
1185	3	<25%	Good	Possible Male	Adult	0.00	0	0	0	0	0	0	0	Periostitis L Tibia + Bilateral Fibulae;
1188	3	25-50%	Fair	n/a	Adolescent	n/a	0	0	0	0	0	0	0	Cribra Femora; Periostitis unsided tibial fragment.
1191	3	<25%	Fair	Possible Female	Young Adult	1.58	0	0	0	0	0	0	0	
1194	3	<25%	Good	Unobservable	Unobservable	0.00	0	0	0	0	0	0	0	
1197	3	25-50%	Good	n/a	Adolescent	n/a	0	0	0	0	0	0	0	
1200	3	25-50%	Fair	Male	Young Adult	0.00	0	20	10	0	0	0	0	Periostitic L Rib Lesions; DJD Spine.
1203	2	<25%	Good	Male	Young Adult	0.00	0	0	0	0	0	0	0	
1206	3	<25%	Poor	Possible Female	Adult	0.00	0	0	0	0	0	0	0	
1209	3	<25%	Good	n/a	Young Child	n/a	0	0	0	0	0	0	0	
1212	4	50-75%	Good	Female	Adult	1.62	0	17	17	8	1	0	0	Congenital: Bilateral lumbar ribs; Periostitic L Rib Lesion; DJD Spine.
1216	2b	<25%	Good	Male	Middle Adult	1.72	0	0	0	0	0	0	0	
1219	2b	<25%	Fair	Possible Female	Adult	0.00	0	0	0	0	0	0	0	
1222	3	75%	Fair	n/a	Adolescent	n/a	0	28	0	0	0	0	0	
1225	3	25-50%	Good	Unobservable	Adult	1.73	0	0	0	0	0	0	0	DJD Spine, SNs.
1231	3	<25%	Good	Possible Male	Adult	1.74	0	0	0	0	0	0	0	
1234	3	<25%	Fair	Possible Male	Adult	1.75	0	0	0	0	0	0	0	Osteoma R Tibia.
1238	5	50-75%	Good	Possible Male	Middle Adult	1.75	0	0	0	0	0	0	0	Congenital: Partial lumbarisation of S1 bilateral; Periostitic Rib Lesions; Periostitis R + L Tibiae

1243	3	25-50%	Fair	Unobservable	Adult	0.00	0	0	0	0	0	0	0	Primary OA R Wrist; 4 Healed fractures (2R & 2L); Periostitis R Radius and L Scapula; DJD Spine.
1246	3	25-50%	Good	Possible Female	Young Adult	0.00	0	0	0	0	0	0	0	
1249	3	25-50%	Good	Male	Young Adult	1.73	0	0	0	0	0	0	0	
1252	3	<25%	Fair	Possible Male	Adult	1.69	0	0	0	0	0	0	0	Periostitis L Femur + L Tibia.
1255	5	25-50%	Good	Possible Male	Middle Adult	0.00	0	4	4	3	0	0	0	Cribra Orbitalia.
1258	2	75%	Good	n/a	Older Child	n/a	0	0	0	0	0	0	0	
1261	5	<25%	Good	Male	Adult	1.70	0	32	9	21	0	0	0	
1266	5	25-50%	Poor	Possible Male	Adult	0.00	0	0	0	0	0	0	0	
1284	3	75%	Good	Female	Young Adult	1.58	0	0	0	0	0	0	0	SNs.
1287	3	<25%	Good	n/a	Adolescent	n/a	0	0	0	0	0	0	0	Periostitis and Criba Femora R Femur; Osteosarcoma/?Ewing 's Sarcoma R Fibula.
1293	2b	<25%	Good	Possible Female	Adult	1.56	0	0	0	0	0	0	0	
1296	3	<25%	Fair	Male	Old Adult	1.78	0	0	0	0	0	0	0	Primary OA R Foot; DJD and OA Spine.
1299	3	25-50%	Fair	Unobservable	Adult	0.00	0	0	0	0	0	0	0	OA and DJD Spine.
1302	3	<25%	Good	Male	Middle Adult	1.69	0	0	0	0	0	0	0	
1305	3	<25%	Good	Possible Male	Adult	1.75	0	0	0	0	0	0	0	
1308	3	<25%	Good	Possible Female	Adult	1.59	0	0	0	0	0	0	0	
1311	3	<25%	Good	Unobservable	Adult	0.00	0	0	0	0	0	0	0	
1318	3	<25%	Good	Unobservable	Middle Adult	0.00	0	0	0	0	0	0	0	
1321	3	50-75%	Good	n/a	Young Child	n/a	8	0	0	3	0	0	0	
1324	3	<25%	Good	Female	Adult	0.00	0	15	9	14	1	0	6	Cribra Orbitalia.
1327	3	<25%	Good	Possible Female	Adult	1.54	0	0	0	0	0	0	0	
1330	3	<25%	Good	Unobservable	Adult	0.00	0	0	0	0	0	0	0	
4971	4	25-50%	Good	n/a	Young Child	n/a	1	0	0	0	0	0	0	

8461	3	<25%	Good	n/a	Neonate	n/a	0	0	0	0	0	0	0	

Appendix 2: Radiocarbon dating certificates

Scottish Universities Environmental Research Centre

Rankine Avenue, Scottish Enterprise Technology Park, East Kilbride, Glasgow G75 0QF, Scotland, UK
Director: Professor R M Ellam Tel: +44 (0)1355 223332 Fax: +44 (0)1355 229898 www.glasgow.ac.uk/suerc

RADIOCARBON DATING CERTIFICATE

26 February 2016

Laboratory Code	SUERC-65829 (GU40066)
Submitter	Tom Vaughan Worcestershire Archaeology The Hive Sawmill Walk The Butts Worcester WR1 3PD
Site Reference	Holy Trinity, Stratford
Context Reference	sk 228
Sample Reference	P4326/228
Material	bone : human
δ^{13}C relative to VPDB	-19.9 ‰
δ^{15}N relative to air	11.7 ‰
C/N ratio (Molar)	3.3
Radiocarbon Age BP	911 ± 30

N.B. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

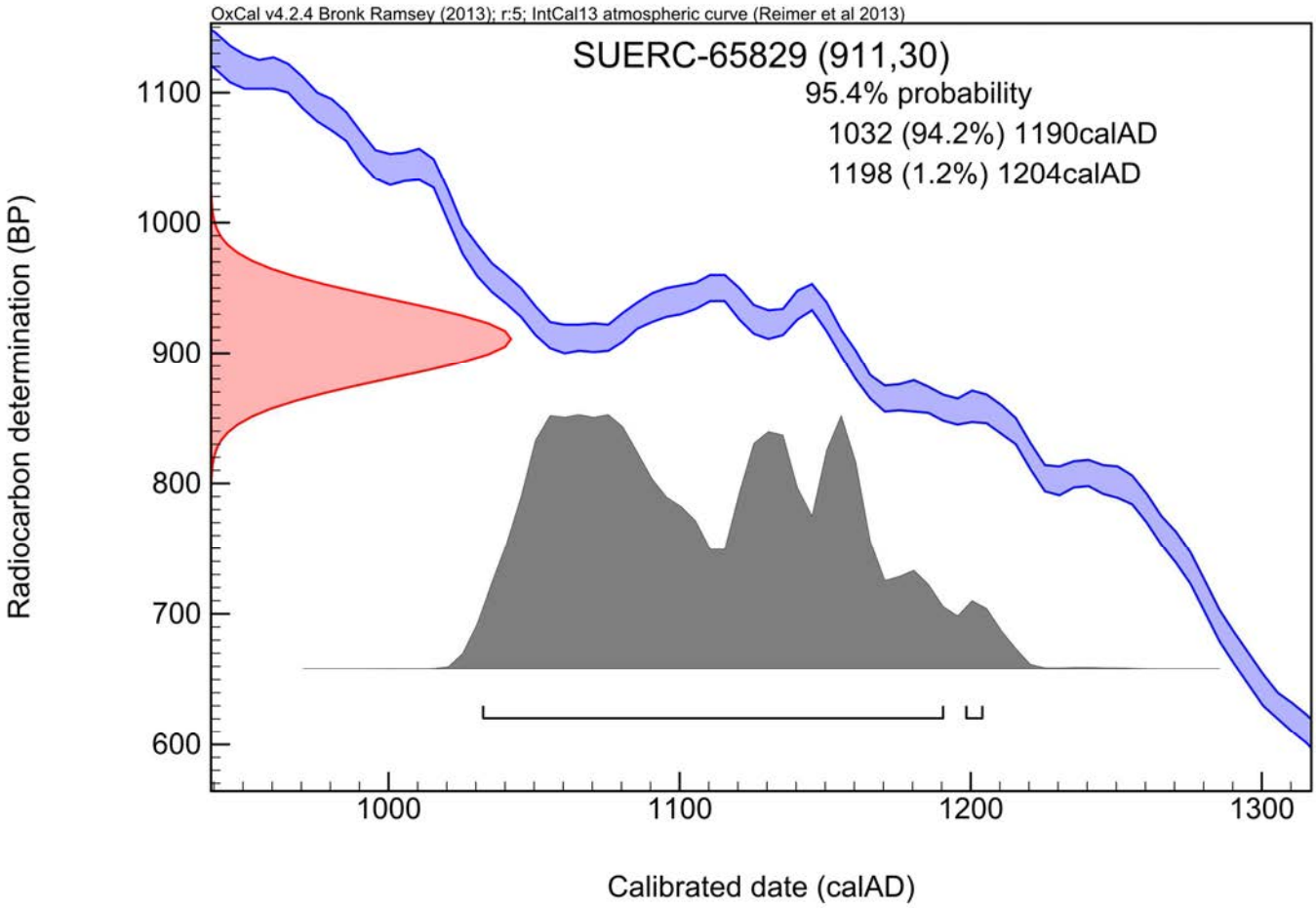
The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email Gordon.Cook@glasgow.ac.uk or telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- E. Dunbar Date :- 26/02/2016

Checked and signed off by :- P. Naysmith Date :- 26/02/2016

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

26 February 2016

Laboratory Code	SUERC-65830 (GU40067)
Submitter	Tom Vaughan Worcestershire Archaeology The Hive Sawmill Walk The Butts Worcester WR1 3PD
Site Reference	Holy Trinity, Stratford
Context Reference	sk 1258
Sample Reference	P4442/1258
Material	bone : human
δ^{13}C relative to VPDB	-19.7 ‰
δ^{15}N relative to air	10.3 ‰
C/N ratio (Molar)	3.2
Radiocarbon Age BP	894 ± 32

N.B. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

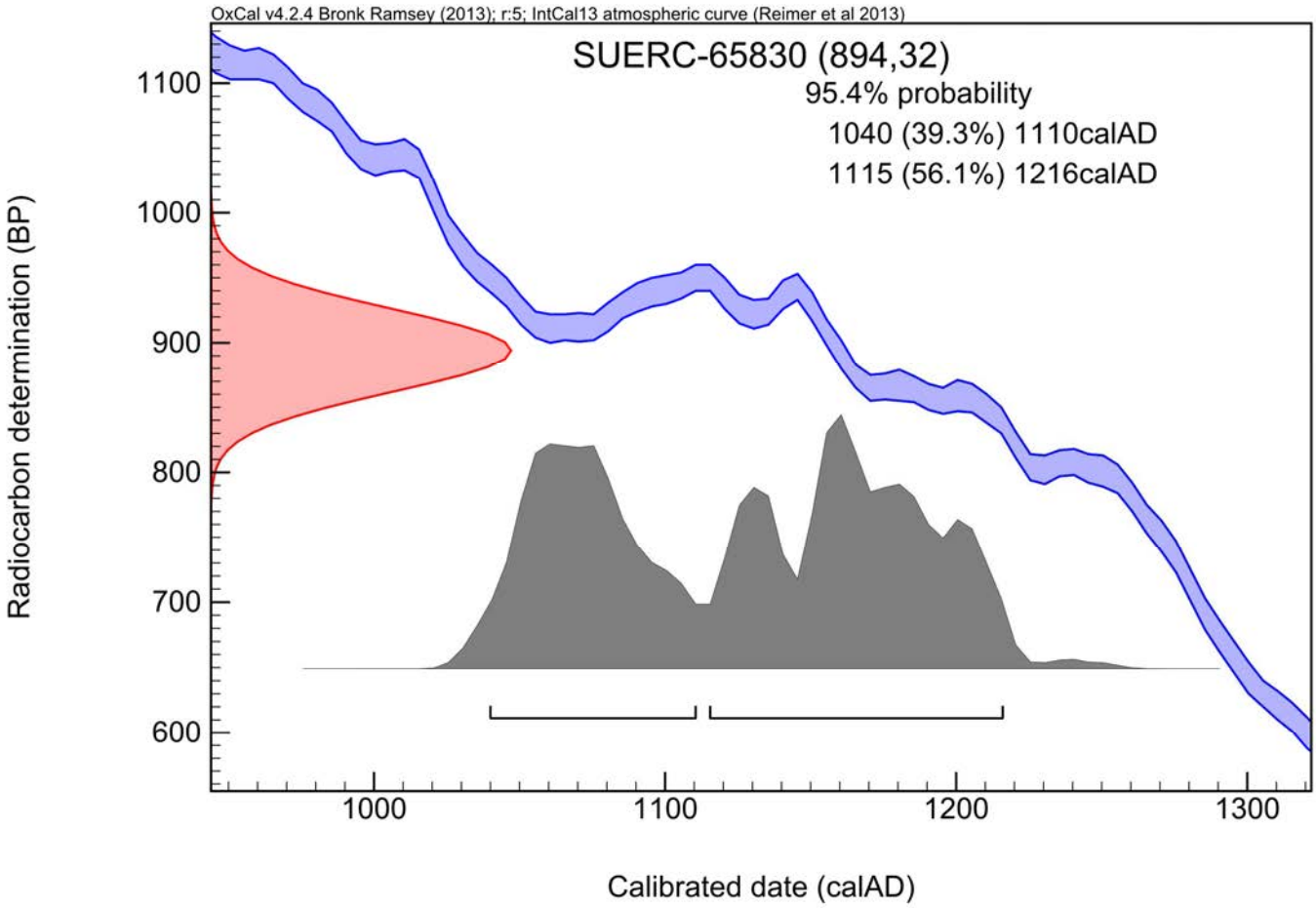
The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email Gordon.Cook@glasgow.ac.uk or telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- E. Dunbar Date :- 26/02/2016

Checked and signed off by :- P. Naysmith Date :- 26/02/2016

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

26 February 2016

Laboratory Code	SUERC-65831 (GU40068)
Submitter	Tom Vaughan Worcestershire Archaeology The Hive Sawmill Walk The Butts Worcester WR1 3PD
Site Reference	Holy Trinity, Stratford
Context Reference	sk 807
Sample Reference	P4442/807
Material	bone : human
δ^{13}C relative to VPDB	-19.7 ‰
δ^{15}N relative to air	10.4 ‰
C/N ratio (Molar)	3.2
Radiocarbon Age BP	593 ± 31

N.B. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

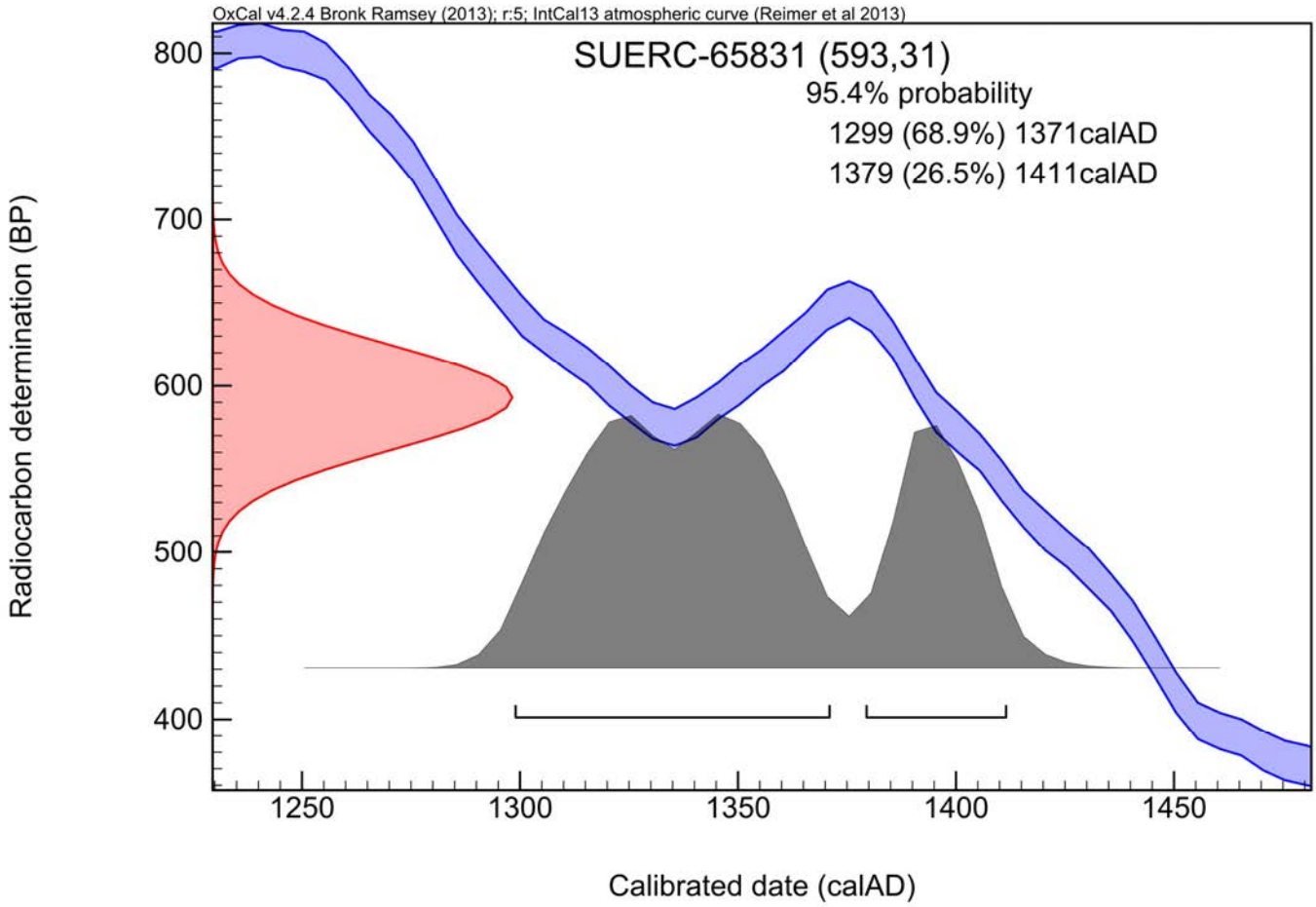
The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email Gordon.Cook@glasgow.ac.uk or telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- E. Dunbar Date :- 26/02/2016

Checked and signed off by :- P. Naysmith Date :- 26/02/2016

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

26 February 2016

Laboratory Code	SUERC-65832 (GU40069)
Submitter	Tom Vaughan Worcestershire Archaeology The Hive Sawmill Walk The Butts Worcester WR1 3PD
Site Reference	Holy Trinity, Stratford
Context Reference	sk 1181
Sample Reference	P4442/1181
Material	bone : human
δ^{13}C relative to VPDB	-19.8 ‰
δ^{15}N relative to air	11.3 ‰
C/N ratio (Molar)	3.3
Radiocarbon Age BP	868 ± 29

N.B. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

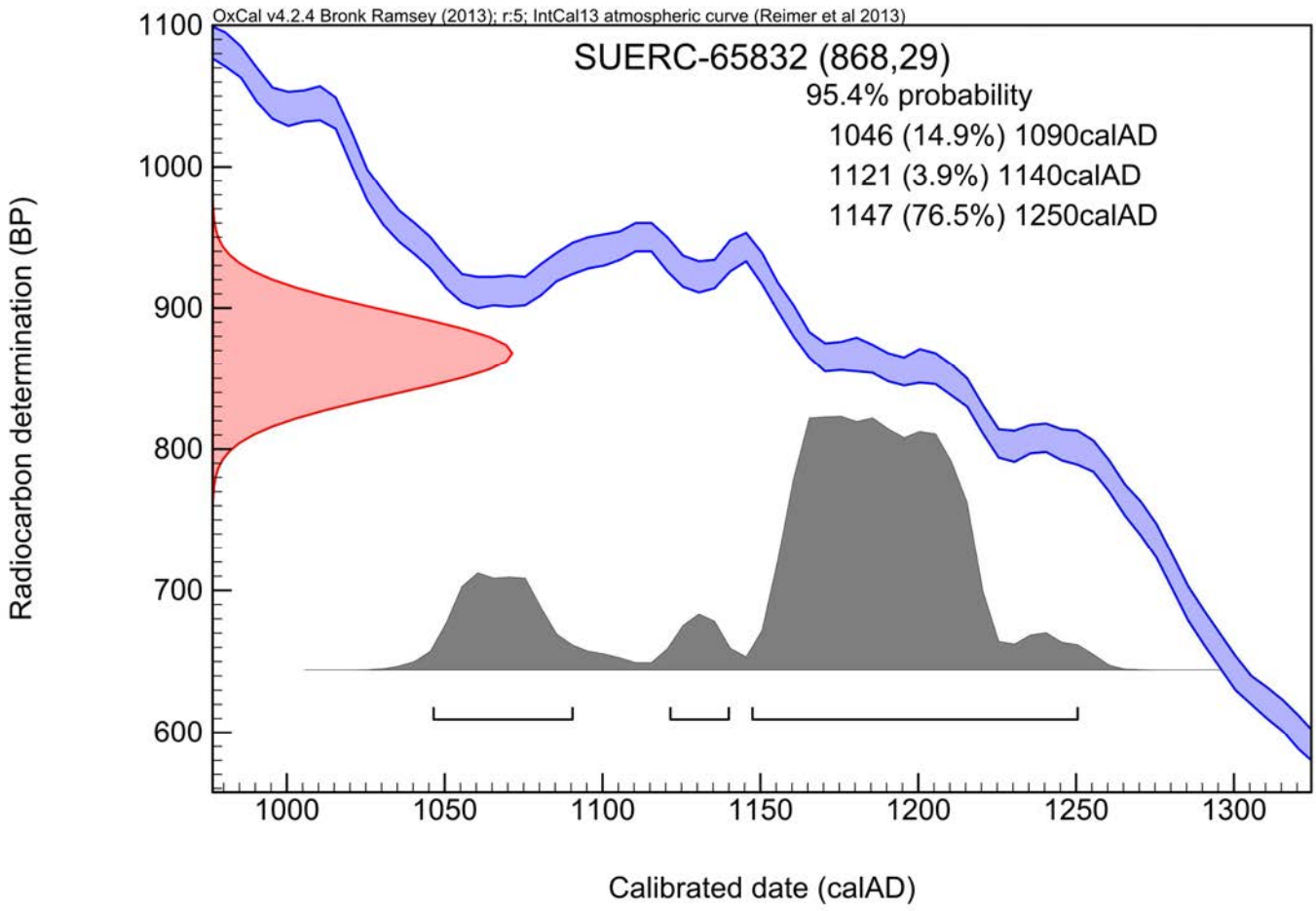
The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email Gordon.Cook@glasgow.ac.uk or telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- E. Dunbar Date :- 26/02/2016

Checked and signed off by :- P. Naysmith Date :- 26/02/2016

Calibration Plot



Appendix 3: Technical information

The archive (WA project number P4442)

The archive consists of:

The archive consists of:

541	Context records AS1
19	Field progress reports AS2
19	Photographic records AS3
10	Black and white photographic films
1071	Digital photographs
1	Drawing number catalogues AS4
9	Scale drawings
13	Context number catalogues AS5
299	Skeleton records AS6
1	Recorded finds records AS13
31	Sample records AS17
1	Sample number catalogues AS18
5	Box of finds
1	CD-Rom/DVDs
1	Copy of this report (bound hard copy)

The project archive is intended to be placed at:

Warwickshire Museum
The Butts
Warwick
Warwickshire, CV34 4SS

Tel. Warwick (01926) 412500