Recent Discoveries at All Saints Cathedral, Wakefield, West Yorkshire

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The archaeological investigations conducted in advance of reordering the nave for Wakefield Cathedral Chapter's 'Project 2013' provide the first scientific dating evidence to support the suspected Anglo-Saxon origins of the church, although no corresponding building remains were identified. Additionally, the south side of a probable Norman church was recorded beneath the columns of the south arcade but much of the north side had probably been removed during late 19th-century renovations. It is suggested that the Norman church was both smaller and of a simpler form than previously thought. Masons' marks on the stonework of the 14th-century arcades indicate the work of 22 individuals and suggest that the aisles were either constructed at slightly different times or by teams of stonemasons. The majority of the burials beneath the nave were Georgian and Victorian in date and were consistent with high-status intramural burials of the period.

The cathedral church of All Saints is a beautiful and imposing structure situated in a pedestrian area in Wakefield city centre; its remaining precinct is flanked by Northgate to the west, Westmoreland Street to the north and Teall Street to the east. The building is Grade I listed and is the focus of the Wakefield Cathedral Conservation Area.

The recent archaeological investigations were prompted by proposals for reordering the nave as part of Wakefield Cathedral's 'Project 2013' (WS1). In 2010 a series of trenches was dug within the nave, aisles and tower to evaluate the below-ground remains and inform the design of the renovations (Archaeological Services WYAS 2010) followed, in 2013, by an extensive but shallow programme of excavation and an examination of the internal fabric of the nave (Wessex Archaeology 2014). The following is a summary of the results of the excavations and building recording (Fig 1).

The building and structural investigations

For almost a century the assumed development of the cathedral church was based on Micklethwaite's work (1888) which mainly used architectural evidence (Fig 2). However four opportunities for archaeological recording, during repairs and building works between 1974 and 1995, contributed to understanding the earliest development of the structure, despite the small size of some of the trenches. Excavations in 1974 in the north and south arcades found undated stone foundations beneath the aisle columns indicating that the line of the current nave reflects the position of a Norman precursor (Marshall 1975; Speak and Forrester 1976; Ryder 1993; Swann and Roberts 2006).These investigations also suggested that the west wall was probably located near the centre of the current nave and the chancel arch was in the same position as now.

The church was probably enlarged in the mid-12th and 13th centuries with further reconstruction in the early 14th century, possibly prompted by the collapse

Fig 1
All Saints Cathedral nave during remodelling (Photo: Wessex Archaeology)

of the central tower (Ryder 1993, 177). Excavations in 1995 found no evidence for the 14th-century south aisle proposed by Micklethwaite (Fig 2), suggesting it had either been removed by later burials or the aisle had been somewhat narrower than had previously been supposed (Butler 2006, 87). The nave and aisles were altered in the mid- to late 15th century when clerestories were added above each of the arcades. There was little significant change to the footprint of the church until the north and south fronts were rebuilt in the 18th century and major restoration work was carried out by Sir George Gilbert Scott between 1858 and 1874. When the Diocese of Wakefield was established in 1888 the parish church was elevated to cathedral status and the building was further extended.

New Observations on the Norman Church

The required 500mm reduction in floor level within the nave revealed numerous grave cuts and exposed the footings of the arcade columns (Fig 3). The south wall of the probable Norman church was visible beneath the columns in the southern arcade, with the notable exception of the westernmost column which, like the columns of the north arcade, had brick foundations (Fig 4). It appears that during Sir George Gilbert Scott's renovations in the late 19th century, it was only necessary to underpin column bases that were not built on earlier stone walls.

Thus, the positions of stone and brick column bases may reflect the extent of the earlier walls, placing the westernmost column base in the south arcade beyond the footprint of the early church. However, all the foundations of the north arcade are brick, but on this side a section of stonework recorded between two north arcade columns in 1974 was thought to represent the northern wall of the Norman church (Swann and Roberts 2006, fig 6). The conjectured outline of the Norman church is shown on Fig 3; its nave was probably 8m shorter than proposed by Micklethwaite (1888).

The eastern end of the early church may well have been removed by the particularly destructive 19th-century renovations, but it is also possible that the 12th-century building was actually smaller and simpler than the cruciform structure envisaged by Micklethwaite. He assumed that it would be a '*simple-cross without aisles, and with the tower in the middle…*' on the basis that this was '*The usual form of a parish church of the larger sort in the twelfth*

Fig 2
Proposed development of the Church (SE James)

century…' (Micklethwaite 1888, 37). However, Butler (2006, 95) observes there are other possible explanations for the evidence used by Micklethwaite to indicate a central tower.

Based solely on the excavated evidence, the Norman church measured at least 18m long by 9m wide (Figs 2 and 3); not inconsistent with the 22m by 8m 12th-century chapel at Tong (Swann 1993, 122) or the 19m by 10m mid- to late 11th-century church at Barton-upon-Humber (Rodwell 1981, 28–9; Rodwell and Atkins 2011, 357–8, fig 391). Wand and Wand (2010, 55) found a high degree of correlation between the nave area in Norman churches without aisles and the Domesday population in Wiltshire, and concluded that these parish churches were built to accommodate the parishioners rather than liturgical functions. With this in mind, a smaller church than that suggested by Micklethwaite appears far more suited to a congregation drawn from the taxable households of 9 villagers, 22 smallholders and 11 freemen recorded by Domesday in Wakefield, especially as there were two churches and three priests (WS2).

Fig 3
Location of archaeological features within the nave. Plan of the cathedral by William Anelay Ltd (reproduced with permission, drawn by SE James)

Fig 4
Arcade column founded on earlier stone structure (left) and brick underpinning (right) (Photos: Wessex Archaeology)

New Observations on the later medieval Church

Stonemasons' marks were identified on the 14th-century ashlar sandstone arches of the north and south arcades. By the 17th century masons did not mark their work on exposed faces of the stone, possibly because they were receiving regular wages, in which case there was no need to identify their output, or they only marked faces of the stone which would not be visible in the final structure (Alexander 2012, 17). In total, 22 different marks were present (Fig 5); all were composed of lines arranged in patterns and most recurred several times, with a particular mark dominating the south arcade and two marks prevalent within the north arcade. Very few marks were observed within the south wall and none within the north wall or the clerestories. The distinct differences between masons' marks on the north and south arcades suggests either the aisles were constructed at different times or possibly by two different teams of masons. Later repairs and replaced stonework were indicated by the carvings *'JM'*, *'JI'*, *'AM'* and *'JK'* at the west end of the south clerestory and *'Thos. Penney 1768'* on the archway between the west tower and the nave.

The majority of the finds from the excavations were funerary items but some structural items were also recovered, all from grave fills or re-deposited grave fills. This was mainly fragmentary window glass; no complete quarries were recovered although several fragments preserve edges or corners. Dating is problematic but the medieval fragments are likely to be the most poorly preserved, degraded to an opaque colour; one of these fragments has a grozed (clipped) edge. Later medieval or early post-medieval windows are represented by glass with a greenish tinge; one of these fragments also has a grozed edge and is painted with a thin red stripe. Colourless or almost colourless glass dates to the later post-medieval period; one of these fragments preserves a right-angled corner from a rectangular quarry.

Fig 5
Masons' marks (mark 'a' dominated in the south arcade and marks 'b' in the north) (SE James)

The burials

The final reduced floor level coincided with that of the structural underpinning and other renovations carried out in the 19th century, which meant that large areas of earlier burials and other *in situ* deposits had already been removed. Despite this, a total of 112 graves

was recorded ranging from barely discernible earth-cut graves to brick-lined shaft graves and stone cists. Burials lying below the final reduced floor level were left undisturbed and exposed skeletal remains were protected with geotextile and a layer of sand. Thirty-six graves were excavated; some were empty whilst others contained skeletal remains and/or remnants of wooden coffins and coffin fittings. Twenty-two skeletons were retained for analysis and one was assessed *in situ* (Appendix 1). Five bone samples were submitted for radiocarbon dating to try to resolve the date of the earliest burials and the chronology of the site (Appendices 1 and 2; see Barclay and Grant 2014 for full details). Three broad periods of burial were identified: Anglo-Saxon, medieval and post-medieval.

Anglo-Saxon

Two stone cists survived south of the south arcade despite standing 400mm above the level of the 19th-century renovations (1014 and 1011; Fig 3). They were constructed from earth-bonded limestone blocks with dressed inner faces. Cist 1014 contained the remains of a *c*20–25 year-old probable male (burial 1126) and had been capped with flat limestone slabs. Part of the lid had been removed for a secondary interment of a 3–4 year-old child (burial 1118), resulting in the disarticulation of the lower limb and pelvic bones of the adult (Fig 6). Cist 1011 contained the co-mingled remains of a 17–20 year-old male and an infant aged 6–9 months. Radiocarbon dating of the remains from the latter returned calibrated dates (at 95% confidence) of AD 970–1150 for the adolescent (burial 1383; Appendices 1 and 2) and AD 1040–1220 for the infant (burial 1384; Appendices 1 and 2). Statistical analysis indicates that it is unlikely that these individuals died at the same time. The interval between these two burials is probably anywhere between a year and up to eight generations, with the infant dying later (see Appendix 2, Fig 9).

A possible cist was also identified *c*3.5m east of cist 1014: a single upright stone visible in the trench edge may have been part of a grave structure or possibly a broken grave marker. In 1974 a stone vault containing three stacked burials was identified *c*5m west of cist 1011 (Swann and Roberts 2006). Although the stratigraphic sequence suggests that it post-dated the foundations of the early church structure, no coffin remains were identified and an Anglo-Saxon date cannot be ruled out. Cists are generally thought to be used for higher status burials (Daniell 1997, 162) and these examples all appear to lie just outside the south wall of the Norman church which is an area typically reserved for higher status individuals.

Fig 6
Anglo-Saxon cist 1014 (burials 1118 and 1126) (SE James)

Skeletal remains in a parallel-sided body position (arms close to the body and ankles together) are thought to result from the constriction of a shroud (Boddington 1987, 36–7) and without grave goods can be characteristic of the late Anglo-Saxon or medieval periods. A number of such burials were found at a depth consistent with an early phase of interment of which four were excavated. Bone samples from a senior adult female and an adult of indeterminate sex both returned calibrated radiocarbon dates of AD 980–1160 at 95% confidence (burials 7 and 8); these burials are likely to be of a similar date to the adolescent in cist 1011 (burial 1383; Appendices 1 and 2).

A Bayesian model (a method for interpreting the chronology of the events represented by radiocarbon dates) indicates that the earliest burial is likely to have been made during *AD 970–1040* (at 95% probability) or *AD 990–1030* (at 68% probability). It can be estimated that the four early burials (7, 8, 1383 and 1384) were made during a period that lasted between *70–180 years* (at 68% probability) or *30–210 years* (at 95% probability). This means it is highly likely that the earliest of the dated burials are of late Anglo-Saxon date, two or more decades before the Conquest.

The dated Anglo-Saxon graves lay beneath the north and south aisles of the modern cathedral which could suggest that the area between the aisles was not used for burial, perhaps because this was the footprint of a contemporary church. However, the 1974

excavation identified pre-Norman burials on each side of both arcades (Swann and Roberts 2006, figs 5 and 6). Assuming that the burials lay outside the building, the Anglo-Saxon church (fig 2) could have been *c*5m wide and comparable with the pre-12th-century remains at St James' church in Tong (West Yorkshire; Swann 1993, 121).

Medieval

Only one burial can dated to the medieval period with any confidence. This is based solely on radiocarbon dating as it could not otherwise be differentiated from the shrouded and uncoffined Anglo-Saxon burials. The remains of an adult of indeterminate sex were dated to cal AD 1430–1620 at 95% confidence (burial 1; Appendices 1 and 2). Located within the medieval nave, this is the earliest interior burial in the excavated sample. Two other graves found at the same depth as burial 1 are also tentatively attributed to this phase in Appendix 1, but it is also possible that other shrouded and undated burials could be medieval.

Post-medieval

Most of the graves revealed by the excavations were post-medieval and contained skeletal remains at or below the final level of ground reduction. Therefore excavation was only necessary in 12 cases. All of the excavated or observed burials were primary interments of single individuals, laid supine in wooden coffins in earth-cut graves. Typically the coffins were the single-break flat-lidded type, shaped at the shoulders and common from the late 17th century onwards (Litten 1991, 99). Very few coffin nails and no screws were recovered, instead a secure seal for the lid was created with a lip of wood around the inner margin of the coffin. This type of coffin was the work of a skilled artisan and would have been more expensive than simpler coffins. In addition to the earth-cut graves, four brick vaults containing lead-lined coffins were revealed but not opened or removed.

Two coffin breastplates were found. On one, the only decipherable text on the highly abraded copper-alloy plate was the name '*Sara*' and the date '*1718*' (Archaeological Services WYAS 2010, 11). Lead coffins were generally used only in high-status burials until they became compulsory for intramural burials in 1813 (Mytum 1989; Litten 1991; Cox 1998). Sara's burial in a lead coffin almost a century earlier than this became mandatory probably reflects the status of her family. The second breastplate is a well-preserved lozenge-shaped tin plate with the inscription *John Naylor / died / 4th Feb.y 1856, / Aged 63 years* (Fig 7). The shape reflects the popularity of heraldic designs during this period, although in heraldic tradition the lozenge represents young girls and spinsters. Such inconsistencies were common at this time, with aesthetics, rather than heraldic meaning, taking precedence (Litten 1998, 15; Mepham and Every 2008, 44).

The date range provided by the breastplates is consistent with the stylistic dates of the other coffin fittings in the assemblage. Eight identifiable cast-iron grip types were recovered and are comparable with published examples from Christ Church, Spitalfields and the Quaker burial ground in Kingston-upon-Thames (Reeve and Adams 1993; Bashford and Sibun 2007). Of the five grip plates three are variations of plain geometric types from Kingston-upon-Thames which are not shown in any 19th-century funerary trade catalogues and they may be the same as those used for domestic cabinets and sideboards (Bashford and Sibun 2007, 127). The plain grips and grip plates survive in better condition than the punched-pattern versions and consequently the more elaborate, and diagnostic, elements of the coffin furnishings are under-represented in the Wakefield assemblage.

Dark brown and black velvet fabric, sometimes discoloured with the impression of upholstery studs, was recovered from the external surface of three coffins. Most coffins were covered in this way after the mid-18th century (Litten 1991, 103) and typically the

Fig 7
John Naylor's breastplate (Photo: Wessex Archaeology)

fabric was fitted to the coffin wood with a single or double row of equally spaced copper-alloy studs.

The human remains

Osteological analysis was undertaken on 23 skeletons excavated from 36 graves; eight Anglo-Saxon, three medieval and 12 post-medieval (Appendix 1). The undated and disarticulated remains of a minimum of 90 individuals were also recovered, reflecting extensive post-depositional disturbance. Age, and the sex of adult individuals, was assessed following standard methodologies, as were skeletal indices and degree of taphonomic change; full details can be found in the excavation report (Wessex Archaeology 2014).

The majority (56.52%) of the articulated remains are represented by less than 25% of the skeleton, reflecting the extensive post-depositional disturbance by later construction activity. The condition of the bone is highly variable, in contrast to the majority of the disarticulated skeletal elements which are in good to excellent condition; this is probably due to a bias in recovery of the latter during historic construction activity.

The articulated remains comprise those of 17 adults (74%) and six non-adults (26%); including two males (one probable) and three females (two probable) amongst the adults and adolescents (Appendix 2). The disarticulated bone assemblage comprises the remains of 68 adults (74.7%), 10 adolescents/adults, and 12 non-adults (13.9%). The proportion of non-adults in this part of the assemblage is below the 30–50% expected for past populations (Waldron 1994, 23; Chamberlain 2006, 182), whilst amongst the articulated remains the proportion is much closer to 'normal' (with little difference between the phases). The apparent under-representation of non-adults in the disarticulated bone assemblage probably reflects taphonomic and methodological biases rather than socio-cultural ones affecting place of burial of non-adults. The sample populations analysed here indicate the presence of both sexes and individuals across the age range in proportions suggestive of a normal lay population.

A range of pathological lesions was observed in the remains of 15 individuals from the *in situ* deposits (Appendix 1). Lesions were also recorded on bones in the disarticulated assemblage. Whilst the latter can contribute to an understanding of the health of a cemetery population, the remains from Wakefield cathedral cannot be attributed to a specific period and consequently their value is limited. A brief summary of the various conditions observed is presented here, with more detailed discussion of a few of the more noteworthy cases; again full details may be found in the excavation report (Wessex Archaeology 2014).

Dental lesions

These were observed in seven permanent dentitions and one deciduous dentition (Anglo-Saxon and post-medieval; Appendix 1) including: calculus, mineralised dental plaque; dental caries, resulting from destruction of the tooth by acids produced by bacteria present in dental plaque; periodontal disease, a gum infection (gingivitis); *ante mortem* tooth loss, which can result from carious destruction of the tooth and associated infection (including abscess formation), periodontal disease, high levels of age-related dental attrition or trauma; dental enamel hypoplasia, indicating periods of disturbance to the mineralisation of the developing tooth enamel (reflecting malnutrition or prolonged ill health). The various rates of these conditions for both periods fall within the normal range for their time. Overall, the post-medieval skeletal remains have higher rates of dental calculus (93% and 75% respectively), caries (20% and 6%) and dental enamel hypoplasia (12% and 6%) than the Anglo-Saxon remains, suggesting differences in diet and nutritional stress; however, the level of *ante mortem* tooth loss (19%) in the earlier phase compared with a lack of cases in the later, and the small size of the assemblage, caution against over-interpretation of these limited data.

Joint disease

The various forms of joint disease are amongst the most commonly recorded conditions in archaeological skeletal material. Lesions such as osteophytes (new bone growth at surface margins) may form as a consequence of one of several different disease processes, also occurring as lone lesions largely reflective of age-related wear-and-tear. Many of the conditions are known to increase in frequency and severity with age; consequently they are commonly viewed as degenerative in nature.

Slight lesions were observed in the remains of four individuals (two Anglo-Saxon, one medieval and one post-medieval; Appendix 1). Schmorl's nodes, pressure defects resulting from rupture in the intervertebral disc and protrusion of the disc material into the vertebral body surface, were recorded in one Anglo-Saxon young adult male. Both the relatively young age of the

individual and the location of the lesions (the lower spine, ie the most stressed area) correspond with those frequently observed where stress-related trauma is implicated as a major cause of the condition (Roberts and Manchester 1997, 107). An older Anglo-Saxon female has bony fusion in the thoracic spine suggestive of ankylosing spondylitis (a seronegative arthropathy), which would have seriously affected the mobility of this individual.

Trauma

Three individuals (one from each phase) have healed fractures in a limb element (Appendix 1). The metacarpal lesion in the young Anglo-Saxon male, caused by a blow to the hand, may represent a case of inter-personal violence; impact fractures of the foot phalanges were (and still are) common occurrences due to their susceptibility to forceful collisions; the compression fracture in the tibia indicates a forceful blow from the side, which could have been accidental or deliberate. The fused distal and intermediate pedal phalanges on a medieval adult may represent another healed fracture or could be a case of congenital fusion.

A disarticulated right femur has a well-healed but badly misaligned transverse fracture of the midshaft (Fig 8). The bone does not appear atrophied, suggesting limited, if any, loss of use, though the shortening of the limb would have certainly resulted in a disability, and the individual's survival after such a traumatic episode reflects some form of care.

Infections

Periosteal new bone is formed in response to infection of the periosteal membrane covering the bone. Infection may be introduced directly to the bone as a result of trauma, develop in response to an adjacent soft-tissue infection, or spread via the blood stream from *foci* elsewhere in the body (Roberts and Manchester 1997, 127–9; Loe and Robson-Brown 2005, 51). Lesions were present on the femur/tibia shafts of seven adults (three Anglo-Saxon, two medieval and two post-medieval; Appendix 1).

One Anglo-Saxon infant had active periosteal new bone formation throughout the cranial and post-cranial skeleton. This proliferation represents an underlying systemic infection or inflammatory condition the nature of which, given the limited surviving skeleton of this individual, is inconclusive. The infant also has lesions indicative of *cribra orbitalia* (see below) which may have been contributory to, or a consequence of, an underlying condition. The skeletal changes observed in this case are consistent with the descriptions of scurvy in immature individuals provided by Ortner et al (1999; 2001).

Fig 8
Healed misaligned fracture (Photo: Wessex Archaeology)

Metabolic disease

C*ribra orbitalia* may be caused by iron deficiency due to a lack of iron in the diet or disease, particularly gastro-intestinal infections or parasite infestations (Stuart-Macadam 1992; Mays 1998, 142). The condition has also been linked with rickets, scurvy, eye infections and leprosy (Brickley and Ives 2006; Mays 2007). Lesions were recorded in three Anglo-Saxon individuals (Appendix 1; see above).

Although vitamin D is obtainable from some foodstuffs, the majority forms through the exposure of the skin to ultraviolet light. A deficiency inhibits the body's ability to absorb calcium which can reduce bone strength and consequently the bones can become malformed when subjected to weight bearing or muscular tension causing rickets during childhood and osteomalacia in adults (Ortner and Mays 1998, 46). Healed rickets/osteomalacia was observed in one Anglo-Saxon and one post-medieval individual (Appendix 1) and in five bones from the disarticulated assemblage. Both of the *in situ* remains also have dental enamel hypoplasia (see above), and the Anglo-Saxon male may also have suffered from an additional iron deficiency indicated by diplöic expansion of the parietal bones. Vitamin D deficiency is not uncharacteristic for wealthy people and indeed prior to the Industrial Revolution rickets was strongly associated with affluence (Lewis 2007, 121).

The combined data from the pathological conditions observed suggest those buried within the church, not surprisingly, did not derive from the labouring classes.

Conclusions

It has long been suspected that the cathedral church of All Saints stands on the site of one of the two churches in Wakefield that were recorded by the Domesday survey. Until the recent investigations the evidence for pre-Conquest origins comprised reports of Anglo-Saxon fabric encountered during the construction of an extension between 1898 and 1905 (Walker 1934), a 10th-century cross found nearby and thought to have stood in the churchyard (Collingwood 1908, 185–7; Coatsworth 2008), a decorated 10th-century type finger-ring in an inhumation burial (Swann and Roberts 2006, 100, 104) and an established correlation in the county between pre-Conquest churches and dedications to All Saints or All Hallows (Ryder 1993, 24).

Bayesian analysis of the radiocarbon dates confirms that this site has been used for burial since at least the early 11th century, making it only the third excavated late Anglo-Saxon cemetery in West Yorkshire (Swann and Roberts 2006, 105) and probably the second in a non-monastic context (Roberts 2002, 401). Although no Anglo-Saxon structures have yet been recorded, the burial evidence supports the theory that this was the site of one of the churches recorded in Domesday.

It was common for Anglo-Saxon timber churches to be rebuilt in stone, either as the result of the development of parishes between the 10th and 12th centuries and/or as the result of new ownership after the Conquest (Wand and Wand 2010, 43). The stone foundations beneath the columns of the south aisle clearly post-dated some of the burials recorded in 1974 (Swann and Roberts 2006); no evidence was found to contradict the assumed 12th-century date of the first stone church.

The majority of the burials identified within the nave occurred between the late 18th century and the early 19th century. The archaeological evidence from these graves, including coffin fittings and health indicators, were consistent with middle- or upper-class burials recorded at contemporary cemeteries (Reeve and Adams 1993; Bashford and Sibun 2007; Swales 2007), and therefore is as expected for intramural burials in a parish church.

The human remains were returned to the cathedral and reburied on July 17th 2012.

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Appendix 1
Summary of results from the analysis of articulated human skeletal remains

Burial	Grave type	Age and sex	Pathology	Radiocarbon date (calibrated 95% confidence)
Anglo-Saxon				
1118	cist	young child c3–4 yr	calculus; *cribra orbitalia*; periostitis – cranial & post-cranial (scurvy)	
1126	cist	young adult c20–25 yr male?	DEH; calculus; caries; AMTL; diplöic expansion of parietals; Schmorl's nodes – T6–7 & T11; periostitis – left tibia; osteomalacia/healed rickets	
1383	cist	young adult c17–20 yr male	calculus; *cribra orbitalia*; healed trauma – left third metacarpal	cal AD 970–1150 SUERC-43946
1384	cist	infant 6–9 months	*cribra orbitalia*; endocranial lesions	cal AD 1040–1220 SUERC-43947
6	earth cut, shrouded	adult 18+ yr		
7	earth cut, shrouded	senior adult 45+ yr female	AMTL (edentulous); ankylosis – 4 thoracic vertebrae	cal AD 980–1160 SUERC-43944
8	earth cut, shrouded	adult 18+ yr	periostitis – left tibia	cal AD 980–1160 SUERC-43945
9	earth cut, shrouded	senior adult c45–50 yr	calculus; periostitis – left tibia	
Medieval				
1	earth cut, shrouded	adult 18+ yr	healed periostitis – left tibia & fibula; healed trauma – distal phalanx (right foot)	cal AD 1430–1620 SUERC-43943
13	earth cut	adult 18+ yr	trauma – ankylosis distal & intermediate pedal phalanges	
14	earth cut	adult 18+ yr	periostitis – right femur; osteophytes – right femoral head	
Post-medieval				
1072	earth cut, coffined	young child c3–4 yr		
1209	earth cut, coffined	adolescent c16–17 yr female	calculus; DEH; healed rickets; osteopenia	
1213	earth cut, coffined	adult 18+ yr		
1225	earth cut, coffined	adult 18+ yr	periostitis right tibia; exostosis – interosseous crest	
1263	earth cut, coffined	adult 18+ yr		
1270	earth cut, coffined	adult 18+ yr	periostitis – right tibia	
1343	earth cut, coffined	adult 36–45 yr female	osteophytes – shoulders, hips	
2	earth cut, coffined	young child c2–5 yr		
3	earth cut, coffined	adult 18+ yr		
4	earth cut, coffined	adult 18+ yr	trauma – right tibia	
5	earth cut, coffined	adult c25–30 yr	calculus; caries; periodontal disease; abnormal tooth wear (occupational)	
10	earth cut, coffined	young child c2–3 yr	congenital malformation sternal body	

KEY: DEH = dental enamel hypoplasia; AMTL = *ante mortem* tooth loss)

Appendix 2
Radiocarbon dates
Alistair J Barclay and Michael J Grant

Laboratory code	Burial	Material	Radiocarbon age (BP)	δ13C (‰)	δ15N (‰)	Calibrated date range (95.4% confidence) cal AD	*Posterior density estimate (95% probability) cal AD*
SUERC-43943	1	Right metatarsal 5	415±29	-19.8	13.00	1430–1620	
SUERC-43944	7	Distal left clavicle	1001±28	-20.8	10.20	980–1160	*980–1050 (73.6%) 1090–1130 (16.9%) 1140–1160 (4.9%)*
SUERC-43945	8	Right metatarsal 4	999±29	-20.5	9.60	980–1160	*980–1050 (69.4%) 1090–1130 (20.1%) 1140–1160 (5.9%)*
SUERC-43946	1383	Right rib	1014±28	-19.7	12.00	970–1150	*980–1050 (87.6%) 1100–1130 (6.5%) 1140–1150 (1.3%)*
SUERC-43947	1384	Left rib	901±29	-19.8	12.70	1040–1220	

Notes

i) The radiocarbon results are quoted in accordance with Stuiver and Kra (1986; Stuiver and Polach 1977), using the calibration curve of Reimer et al (2009) and the computer program OxCal (v4.1) (Bronk Ramsey 1995; 2009). The calibrated date ranges cited in the text are those for 95% confidence, quoted in the form recommended by Mook (1986), with the end points rounded outwards to 10 years for errors > 25 years and calculated according to the maximum intercept method (Stuiver and Reimer 1986). All other ranges are derived from the probability method (Stuiver and Reimer 1993).

ii) The δ13C and δ15N values for each individual are consistent with a terrestrial diet and therefore potential date offsets are unlikely to be a concern (see Bayliss et al 2004).

iii) The posterior density estimates derive from the model defined in Figure 9.

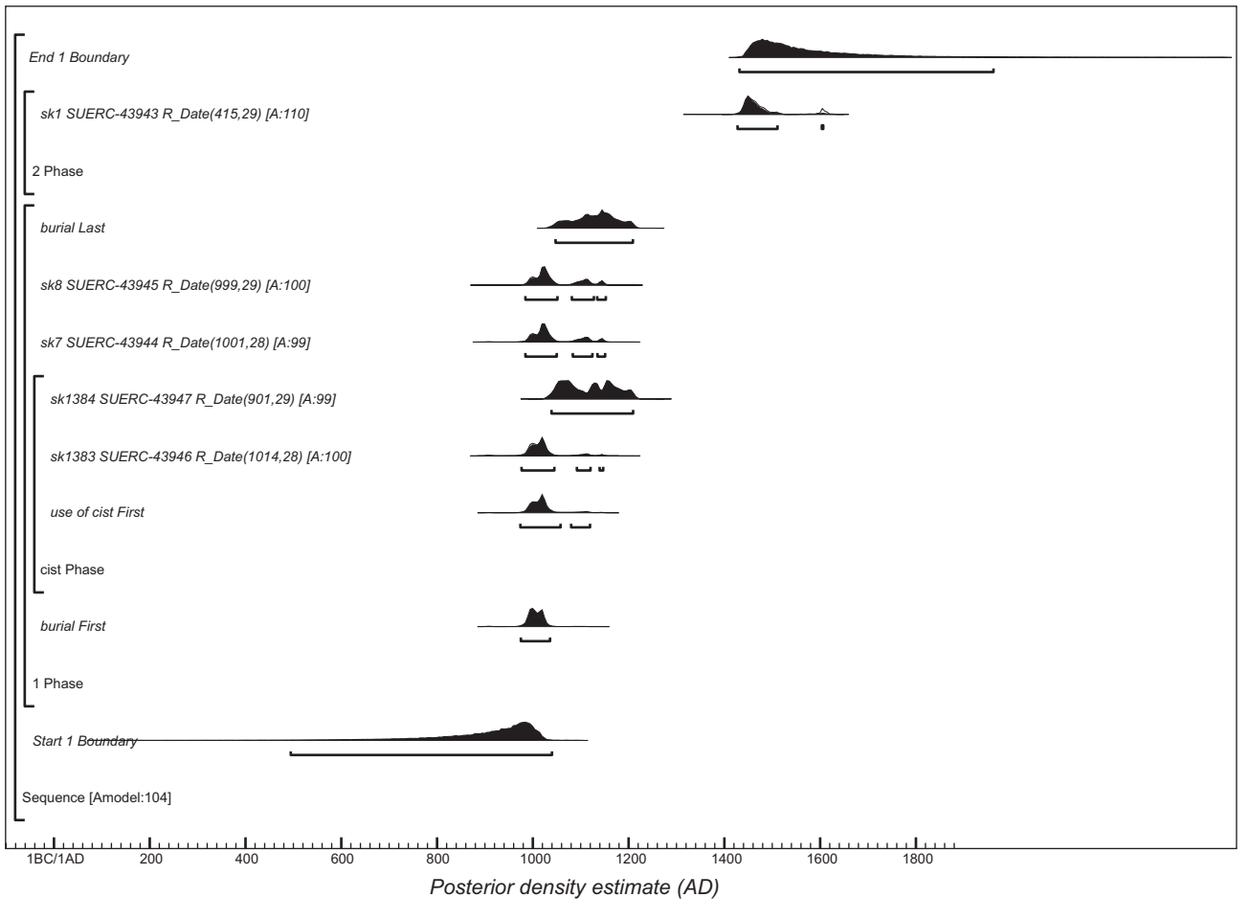

Fig 9
Probability distributions for the dates from Wakefield Cathedral. Each distribution represents the relative probability that an event occurred at a particular time. For each of the dates two distributions have been plotted, one in outline which is the result produced by the independent calibration of the radiocarbon measurement and a solid one which is based on the chronological information provided by the model. For example, the distribution 'First burial' is the estimated date for the first inhumation burial event. The large square brackets down the left-hand side of the diagram, along with the OxCal keywords, define the overall model exactly (Wessex Archaeology)

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