Poulton *Research Project*

Analysis of Human Skeletal Material from the Poulton Research Project: 1995–2002

by

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1. Introduction

Between the start of the Poulton Research Project in 1995 and the end of 2002, 99 human skeletons[1] have been excavated, together with considerable quantities of disarticulated bone. A breakdown by year of excavation is shown in Table 1.

Year	Number of Skeletons Excavated
1995	2
1996	3
1997	22
1998	14
1999	3
2000	11
2001	16
2002	23
Unknown	5

Table 1 – Breakdown of skeletons excavated by year

This represents only a small proportion (perhaps as little as 10%) of the total number of burials at the Poulton Chapel site. They may not be a representative sample, since the selection of which skeletons to excavate has largely been driven by the requirements of the overall research programme: nevertheless, they provide a lot of evidence for the medieval population of Poulton and how they lived and died.

Detailed analyses have already been performed on some of the skeletal material, as listed below:

- Skeleton 1 from 1995: [Quinney, 1996].
- All the material from the 1996 and 1997 excavation seasons, including 25 skeletons: [Owens, 1998].
- Skeleton 53 from 1998: [Roberts, 1998].

Relevant data from these reports has been incorporated into the analysis presented in this paper and is acknowledged at the appropriate points in the text.

Some of the remaining skeletal material has unfortunately been sent for re-burial without being subject to any recording or analysis and is no longer accessible. This left 48 skeletons (and a large quantity of disarticulated bone) available for analysis by the authors. Given the large amount of material, there has been no attempt to perform a detailed analysis of every individual skeleton. Efforts have been concentrated on measuring the basic parameters of sex, age at death and stature (see Section 3), together with general observations on trauma and pathology.

Nevertheless, it has still been possible to address two of the major research areas for the Poulton skeletal material that were proposed by [Quinney, 1996], namely:

- A spatial analysis of the remains.
- The construction of Minimum Number of Individual counts and demographic profiles of the remains.

After analysis, all human skeletal material will be reburied at the Cistercian monastery of Mount St. Bernard, near Loughborough in Leicestershire.

2. Cemetery Analysis

2.1 Location of Burials

Figure 1 shows the locations of all the excavated burials (a total of 66) whose position had been recorded, relative to the chapel itself (shown in outline) and to the site grid. As already noted above, the concentrations of graves are not necessarily significant and the apparently empty spaces on the plan generally indicate areas which have not been excavated.

Type of Burial	Buried Inside Chapel		Buried Outside Chapel	
	Number	Proportion	Number	Proportion
Female Adult	9	33%	6	15%
Male Adult	4	15%	11	28%
Subadult	3	11%	16	41%
Unknown	11	41%	6	15%

Table 2 - Analysis of burial location by type

Table 2 gives a breakdown of the articulated burials by type[2], according to whether they were located inside[3] or outside the chapel.

1 We have defined a 'skeleton' as either (a) a recognisable articulated inhumation, or (b) a skull together with other associated bones (if any).

2 'Unknown' includes skeletons with insufficient material to classify them as female/male/subadult, those where the evidence is ambiguous, and those for which the material was not available.

3 Includes Skeleton 114 that lies under the wall of the chapel.

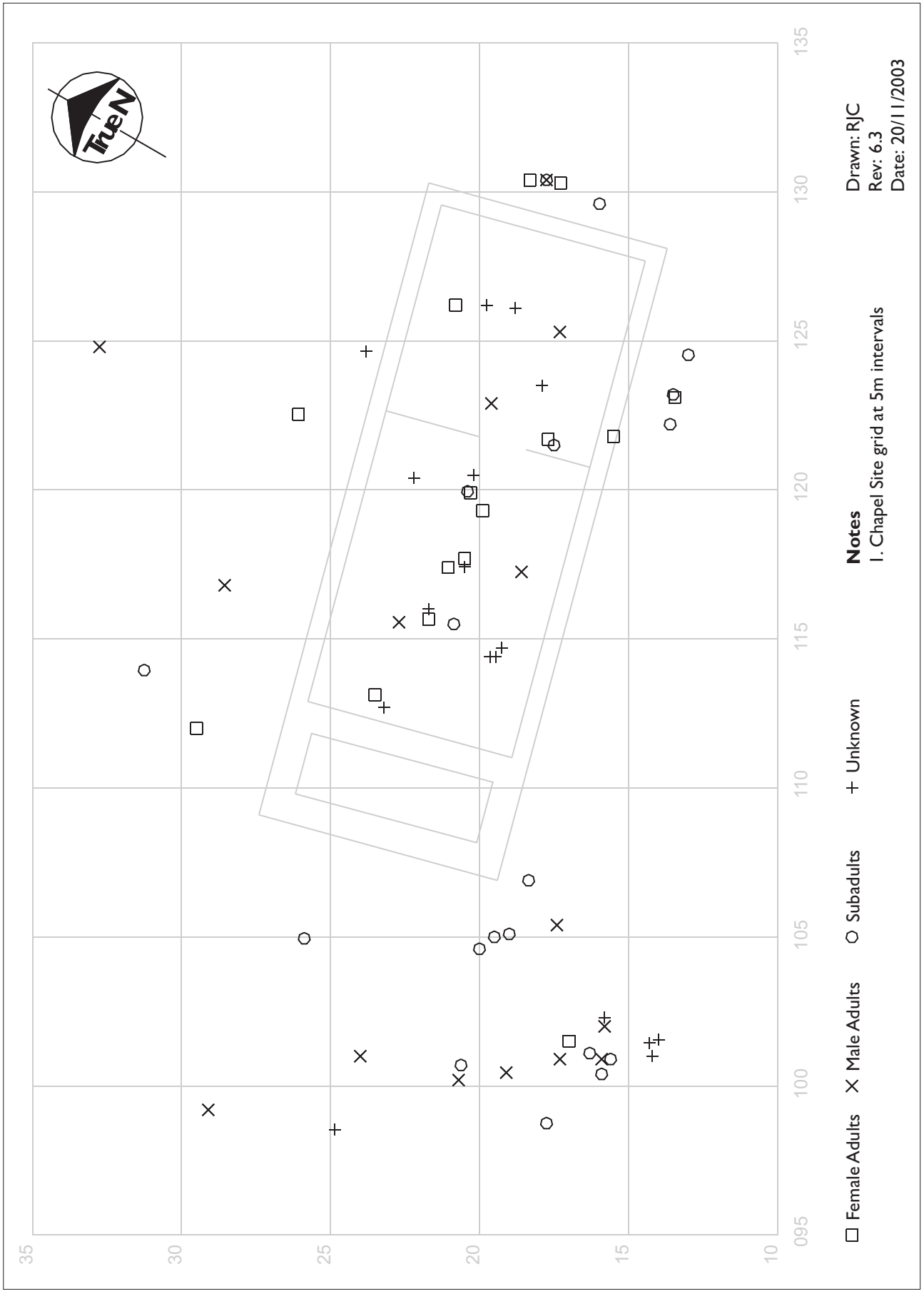


Figure 1 – Location of burials

Caution is needed when trying to distinguish any trends in this data, for a number of reasons:

- The number of burials of each type is small.
- There is a large proportion of burials of unknown type, especially inside the chapel.
- The size and shape of the chapel has changed during its period of use and burials once outside may now appear to be inside (as evidenced by the burial under the south wall).

Based on this sample, we can say that females outnumber males inside the chapel by a ratio of approximately 2:1, while the situation is reversed outside the chapel. However, using the recommended chi-squared test [English Heritage, 2002], this difference between the sexes is not significant at the 5% level. There certainly seems to be no evidence of discrimination against females when it came to being buried in the most favoured locations inside or close to the chapel.

Subadults appear to be significantly under-represented inside the chapel, being nearly 4 times more common outside. Such a large discrepancy possibly reflects their lower status in medieval society, but may be simply a consequence of the sampling, preservation or excavation processes.

2.2 Orientation of Burials

The burials have generally been closely aligned to the main axis of the chapel, i.e. in an approximately East–West direction with the head to the West. This is of course what would be expected for lay persons in a Christian burial ground and confirms that the excavated burials date from the Christian era. The only significant exception was one of the infant burials (Skeleton 105), where the upper part of the body pointed West South West: this could be a consequence of a small body being placed carelessly in a larger grave (perhaps intended for an adolescent or adult?).

It is interesting to note that the chapel itself is misaligned by approximately 15°: the 'West – East' axis of the chapel lies at a true bearing of approximately 75° rather than the expected 90°. This does not appear to be exceptional: [Hoare and Sweet, 2000] studied 183 early medieval churches and found that their orientation ranged from 42° to 128°, with 38% deviating by more than 10°.

2.3 Attitude of Burials

All the undisturbed bodies were in the extended supine position. Arms were usually folded, either across the pelvis or across the chest.

2.4 Preservation of Bone

Where burials have remained undisturbed, the preservation of the bones is generally good, even for the bones of children, which are often very fragile. However, this only applies to a small proportion of the Poulton burials.

Unfortunately, a considerable number of the burials have been disturbed to a greater or lesser extent, for the following reasons:

- Many of the burials are very close to the modern ground surface (as little as 40cm) and have suffered from ploughing and erosion.
- During the period that the graveyard was in use, new graves were dug that intersected previous burials.
- Further damage was caused to the site in the late 19th and early 20th centuries by amateur excavations that were more akin to treasure hunting than to archaeology.

As a consequence, many of the bones are fragmentary and poorly preserved.

2.5 Burial Practices and Finds

2.5.1 Multiple Burials

The burials at Poulton can be very difficult to interpret, because of the disturbances already noted and of the sheer density of burials that overlap and intercut each other. This can be clearly seen in Figure 2, a composite of two separate photographs. At the time the photographs were taken, it was assumed the skull labelled Skeleton 100 be-

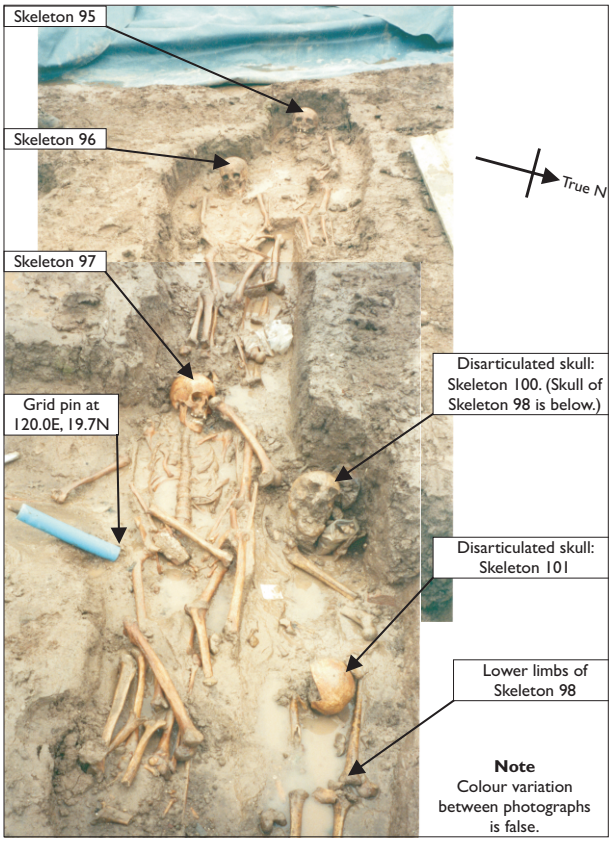


Figure 2 – Skeletons 95–101 (excavated 2002)

longed to Skeleton 98. Only after further excavation was it realised that Skeleton 100 was disarticulated and that the 'real' skull for Skeleton 98 lay underneath. Furthermore, once Skeleton 96 was lifted, another, undisturbed, articulated burial (Skeleton 99) was found immediately underneath.

There are a number of multiple burials, especially at the south-western corner of the site. These are most likely to have been family burials, rather than 'plague pits'.

2.5.2 Coffins and Grave Goods

Evidence for coffins is very scanty: the Poulton soil does not favour the preservation of wood, but some graves contained heavily corroded iron objects that may be nails or other coffin fitments. However, numerous pins have been found in and around some of the skeletons, indicating shroud burials that would probably have been more common in a poor rural community.

There has been very little evidence of personal items being buried with the bodies, as one would expect for Christian burials. A belt buckle was found with one skeleton and a copper alloy 'petal mount'(probably part of some clothing decoration) with another [Emery, 2000: 56].

2.5.3 Grave Fills

A few of the grave fills contained dateable material such as potsherds. Many of the grave fills contained significant quantities of building stone, plaster, charcoal and slate. For burials within the chapel, some of this material could come from the floor through which the graves were dug, but it is much more difficult to explain for burials which are some distance outside the walls.

A number of the burials contained assemblies of stones, predominately around the skull. Three examples show the type of assemblies found.

Figure 3 shows Skeleton 99 immediately after the skull had been lifted. There is large 'L' shaped stone that was supporting the right side of the skull and a smaller, rectangular stone at the back of the head. This burial was undisturbed and there is no doubt that the stones were placed there as part of the inhumation process. What purpose these stones served is not clear.



Figure 3 – Skeleton 99

Figure 4 shows a cluster of small stones around the skull of Skeleton 103. Given the closeness of the burial to the modern surface, plough damage or disturbance is a possibility and might explain the small size of the stones compared to the other examples. However, it does not explain the presence of the stones in the first place.



Figure 4 – Skull of Skeleton 103

This is also another example of the intersecting burials at Poulton. The piece of skull to the right of the picture (below the identification tag) belongs to Skeleton 107. Note also the anomalous formation of the first molar (both left and right) in the mandible; we refer to this below in Section 3.4.

Figure 5 shows Skeleton 104 with a number of pieces of local sandstone around the top of the skull. One explanation is that the stones are at the bottom of a modern hole for a fence post. That would certainly explain the stones and the damage to upper skull. However, no evidence was found for such a post-hole during the excavation.



Figure 5 – Skull of Skeleton 104

2.6 Disarticulated Remains and Minimum Number of Individuals (MNI)

Because of the disturbances described above, there is a

considerable amount of disarticulated human bone, some of which can be related to specific contexts and some of which is completely unstratified.

[Owens, 1998] performed a sophisticated MNI analysis using the material excavated from 1995 to 1997. This determined that, in addition to the 27 individual skeletons already identified (Table 1), another 19 adults and 39 subadults were represented in this material, giving a total of 85 individuals.

An MNI analysis was also performed on the disarticulated bone excavated from 1998 onwards and the detailed results are shown in Appendix 2. This material included 14 adults and 5 subadults. No attempt was made to differentiate between male and female remains.

Table 3 provides a summary of the currently available MNI data:

Data Set	Adult		Subadult		Unknown	Total
	Articulated	Disarticulated	Articulated	Disarticulated	Articulated	
All material from 1995–1997 [Owens, 1998]	16	19	10	39	1	85
Skeletons from 1998–2002 and date unknown	35	0	14	0	23	72
Disarticulated bone from 1998–2002	0	14	0	5	0	19

Table 3 – Minimum number of individuals

Any attempt to determine an overall Minimum Number of Individuals by simply adding together the 3 totals in Table 3 would be invalid. This is because there may well be overlaps between the data sets, e.g. some of the disarticulated bone from 1998–2002 may in fact belong to the skeletons from the same period. More analysis is required before a reliable MNI can be calculated (see Section 4).

3. Demographic and Metrical Analysis

3.1 Sex

The sex of adult skeletons was determined using the attributes listed in Table 4.

As many of these attributes as possible were assessed for each skeleton, depending on the available bones and their state of preservation. For each attribute, a score of 1 (most female) to 5 (most male) was assigned using the diagrams and charts in the appropriate reference. An overall assessment was then made, taking into account the greater reliability of some attributes [Brothwell, 1981: 62] and not simply averaging the scores. This resulted in an overall assessment of female, probable female, ambiguous, probable male or male.

In some cases, there was insufficient material to make any sex determination (shown as indeterminate in Table 5).

Normally, no attempt was made to determine the sex of subadults, since there are no generally accepted standards that do not involve destructive techniques such as DNA testing. However, in one case, Skeleton 115, the skeletal material was clearly sufficiently mature and was assessed as female. The age was subsequently determined to be 16–18, that is, post puberty, and thus old enough to justify such an assessment. Uniquely, Skeleton 115 was classified as a female subadult. In the analyses that follow, information relating to Skeleton 115 is included when females or subadults are being discussed but excluded when adults are being discussed.

Pelvis	Greater Sciatic Notch	[Buikstra and Ubelaker, 1994: 18]
	Sub-Pubic Angle	[Mays, 1998: 34]
	Preauricular Sulcus	[Brothwell, 1981: 60]
	Ventral Arc	[Sutherland and Suchey, 1991: 502]
	Subpubic Concavity	[Buikstra and Ubelaker, 1994: 17]
	Ischiopubic Ramus Ridge	[Buikstra and Ubelaker, 1994: 17]
Skull	Nuchal Crest	[Buikstra and Ubelaker, 1994: 20]
	Mastoid Process	[Buikstra and Ubelaker, 1994: 20]
	Supra-Orbital Margin	[Buikstra and Ubelaker, 1994: 20]
	Glabella	[Buikstra and Ubelaker, 1994: 20]
	Mental Eminence	[Buikstra and Ubelaker, 1994: 20]

Table 4 – Techniques for assessing sex

Estimated Sex	Number of Skeletons
Female	12
Probable Female	8
Ambiguous	1
Indeterminate	4
Probable Male	15
Male	12

Table 5 – Results of sex estimation for adult burials

The summarised results of the sex estimation for each of the skeletons are given in Table 5, incorporating the results of earlier analyses (see Section 1).

The females (including probables) make up 43% of those skeletons which could be sexed and males (including probables) 57%. Using the recommended chi-squared test [English Heritage, 2002], this difference between the sexes is not significant at the 5% level.

3.2 Age at Death

Table 6 shows the range of techniques used to establish age at death for each of the skeletons, depending on the stage of development of the individual.

Finally, the results from previous analyses (see Section 1) were incorporated to create a data set for all excavated skeletons.

Figure 6 shows the distribution of age at death for both adults and subadults irrespective of sex, while Figure 7 shows the data for adults only, subdivided by sex. Both figures also show the numbers of skeletons which could not be assigned to an age band, because the appropriate skeletal material was unavailable or was too badly damaged (though it was possible in every one of these cases to determine whether the individual was an adult or a subadult).

The proportion of infant (<5 years) deaths is high by modern standards, at 18% of those for which an age could be determined. The true proportion may be even higher, since the remains of younger subadults may be overlooked during excavation and are more prone to taphonomic damage than adult remains [Mays, 1998: 15 & 22].

There is another peak of deaths in the 26–45 years age range, though of course this is the broadest category.

A reasonable number of individuals (largely male) appear to have survived past 45 years: this could be even higher if, as suggested by [Molleson and Cox, 1993], the techniques used underestimate adult age at death by up to 20–30 years. There may also be some sex bias in the techniques applied here: for example, at the medieval site of Wharram Percy [Mays, 1998: 71], 40% of the adults lived to over 50 and the proportion of females living to this age was much closer to the proportion of males (though still smaller).

Children	Development of the deciduous and permanent dentition [Brothwell, 1981: 64–65].
Adolescents	Development of the dentition [as above] Fusion of the epiphyses [Mays, 1998: 48].
Adults	Dental wear [Brothwell, 1981: 72]. While the development of the pubic symphysis is commonly used to determine age, it was not applied to the Poulton skeletons: a) because these bones were often too damaged to be used, and b) because it has been shown to perform poorly on archaeological material, especially when calibrated using a different reference population, e.g. [Mays, 1998: 55] and [Molleson and Cox, 1993: 167–170].

Table 6 – Techniques for assessing age at death

Adults were assigned to the following broad banded age categories [McKinley and Roberts, 1993]:

Young Adult: 18–25 years
Mature Adult: 26–45 years
Older Adult: >45 years

Subadults, who can be aged with greater precision, were assigned to the following categories:

<5 years
5–9 years
10–14 years
15–17 years

3.3 Stature

For adult skeletons, stature was determined by measuring the lengths of the long bones (femur, tibia, fibula, humerus, radius and ulna) with an osteometric board and applying the 'American White' regression formulae of

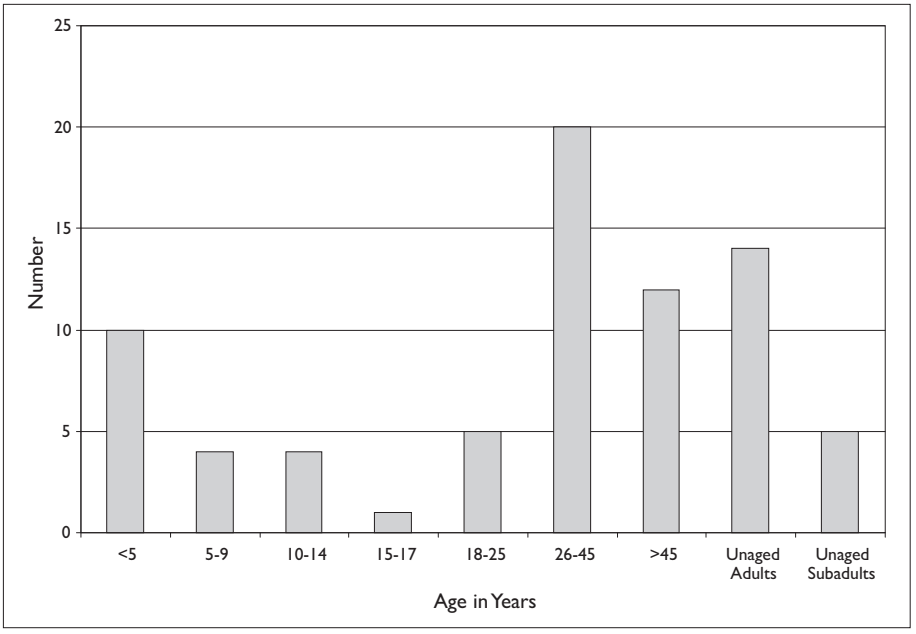


Figure 6 - Age at death for adults and subadults irrespective of sex

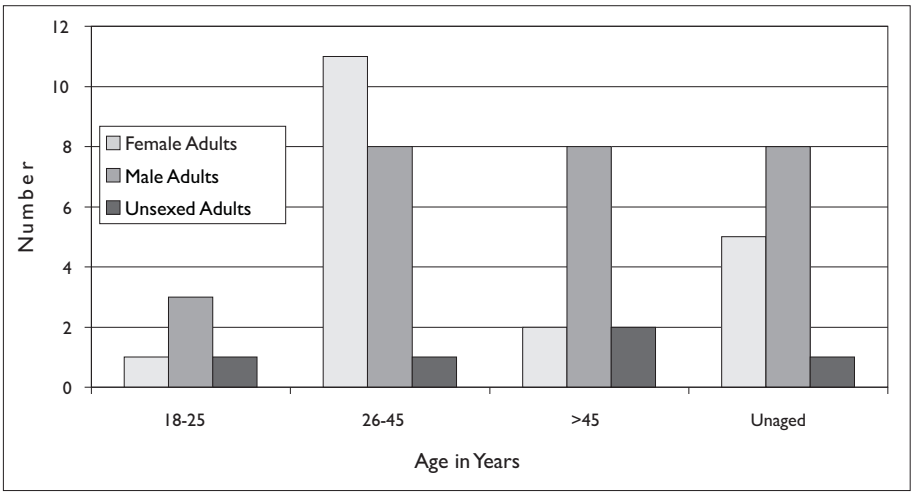


Figure 7 - Age at death for adults by sex

Trotter and Gleser [Brothwell, 1981: 101]. Where bones were broken but all pieces were present and fitted cleanly together, they were temporarily re-assembled and measured.

The set of regression formulae used depends on the sex of the individual. For each skeleton, the stature was calculated using as many as possible of the regression formulae, depending on the available bones. The various estimates were compared to check that there were no gross errors (e.g. a mistake in taking the measurement, or the use of a bone from the wrong skeleton) and an average height was calculated for each side (left and right). Finally, these were averaged to give an overall height.

Where more than one estimate can be calculated, some sources recommend that only the one with the smallest standard error should be used, rather than an average. However, the standard errors of each of the formulae are very similar at around 4cm [Applegate, 2002], so it was judged appropriate to use all the available data.

Although stature calculations had already been performed on some of the earliest material (as described in Section 1), heights were re-calculated for all these skeletons using the same principles as outlined above. This ensured that the stature estimates were directly comparable and also took advantage of all the available long bone measurements. In [Roberts, 1998] the stature of Skeleton 53 was reported as 1.82m (the tallest skeleton yet excavated). However, this was incorrectly converted into imperial units as 6' 4", rather than the true value of 6' 0". Unfortunately, this error has been perpetuated in many other publications.

Stature could only be calculated for 35 of the adult skeletons, for which relatively intact long bones were available and for which the sex could be determined (since the set of regression formulae used depends on the sex of the individual).

No attempt was made to determine the stature of subadults, as childhood diaphysial length reflects development rather than chronological age.

Figure 8 shows the height distribution subdivided by sex and grouped into 5cm bands.

The stature data is summarised in Table 7.

Both male and female average heights are typical for the medieval period [Boylston and Weston, 2001; Roberts

Sex	Mean	Range	Standard Deviation	Number of Individuals
Male	1.72m / 5' 7.7"	1.55 – 1.82m	0.06m	18
Female	1.59m / 5' 2.6"	1.50 – 1.66m	0.05m	17

Table 7 – Summary of adult stature

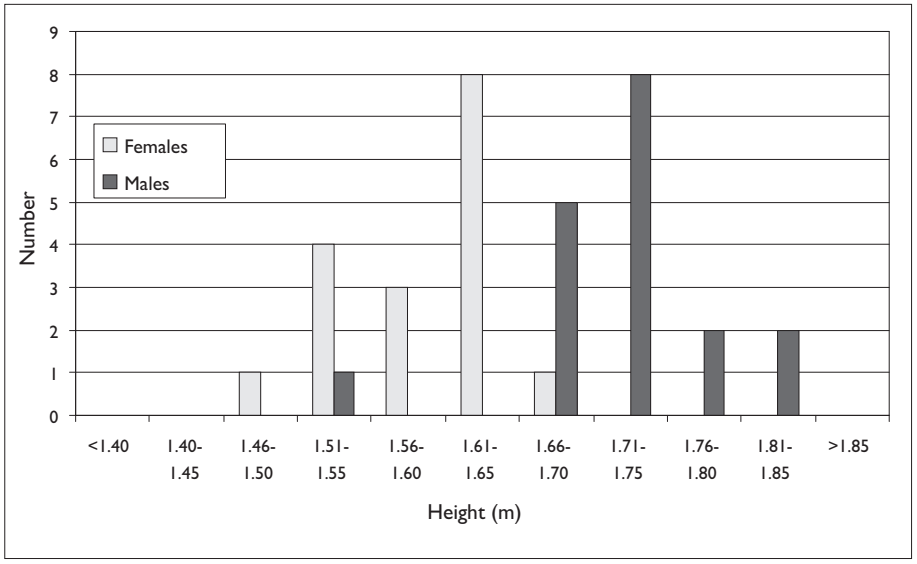


Figure 8 - Adult height

and Manchester, 1995: 27]. It is also noticeable that there is very little overlap between the female and male height ranges.

In 4 cases, sufficient skeletal material was available to perform a height estimation but the sex was ambiguous or indeterminate. These are shown in Table 8.

Skelelton	Height (m) if	
	Male	Female
31	1.63	1.58
54	1.68	1.65
83	1.74	1.70
125	1.80	1.76

Table 8 – Stature of unsexed adults

Using the data from Tables 7 and 8, there is a strong suggestion that Skeletons 83 and 125 are male, based purely on their height.

3.4 Other Observed Traits

Any obvious abnormalities of the skeleton were recorded, for possible further investigation at a later stage. This made no pretence at being a comprehensive analysis.

Although no detailed records of the dentition were made, casual examination revealed that dental disease was common, including ante-mortem tooth loss, caries, calculus and abscesses. Skeletons 83, 103 and 114 all exhibited anomalous molar formation.

Skeletons 50 and 112 showed sacralization of the fifth lumbar vertebra. [Brothwell, 1981: 109] suggests that this may be evidence of a close relationship between the individuals concerned.

Skeleton 112 shows evidence of possible congenital dislocation of the hip joints.

Apart from the cases originally recorded by [Owens, 1998] and [Roberts, 1998], no additional instances of trauma were detected.

3.5 Skeleton Database

The results of these analyses have been stored in a computerised database. This is not intended to replace the existing paper-based recording system, but to assist in the rapid analysis of the considerable quantity of data that has been collected and generated. For example, the database has been used to automatically create plans showing the locations of the burials (as in Section 2.1) and graphs of age distribution (as in Section 3.2).

Details of the skeleton database are given in Appendix 3.

4. Conclusions and Suggestions for Further Research

Ninety-nine human skeletons have been excavated at the Poulton chapel site between 1995 and the end of 2002, together with large quantities of disarticulated bone. They are all believed to date from the medieval period, though no precise dates have yet been determined.

Many of the burials have been considerably disturbed, often by other burials, making analysis and interpretation more complex. All of the undisturbed burials are aligned approximately East–West, with the head to the West and in an extended supine position.

There is some evidence for shroud burials and many of the grave fills contained significant quantities of building material. It is not easy to explain all of this building material for graves inside the chapel and quite difficult for those outside.

Females predominate over males inside the chapel, while the reverse is true outside. Subadults are significantly under-represented inside the chapel. However, all these findings should be treated with caution due to the relatively small number of burials whose position had been recorded and that could be definitively classified as male, female or subadult.

Osteological data was already available ([Owens, 1998], [Quinney, 1996] and [Roberts, 1998]), or was generated by the present authors, for 75 skeletons. The basic parameters of sex, age at death and stature were assessed

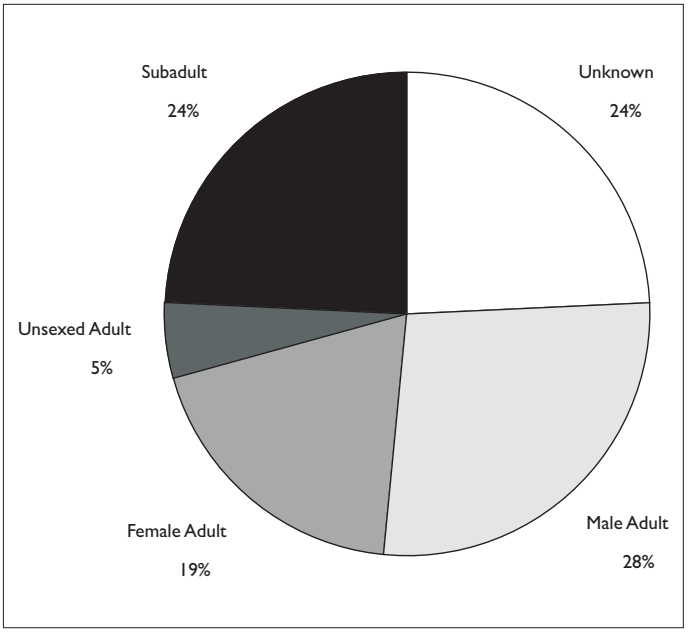


Figure 9 – Summary of excavated skeletons

for all those skeletons for which the necessary material was available. A summary of the skeleton population is shown in Figure 9.

All results should be treated with some caution because of potential sampling errors. However, key points include:

- There is an overall predominance of males but this is not statistically significant.
- The proportion of infant (<5 years) deaths is 18%.
- 21% (mainly males) lived more than 45 years.
- Average stature was 1.72m for males and 1.59m for females, with very little overlap between the height ranges of the two sexes.
- Based on the available evidence, the Poulton burials appear to represent a typical rural medieval population with no abnormalities in demographic, metrical or pathological terms.

The large amount of material available at Poulton offers considerable opportunities for further research, if the necessary resources can be made available:

- The Minimum Number of Individuals analysis could be completed by counting all the key bone portions for the articulated skeletons excavated in 1998–2002 and combining these with all the other data sets.
- Analysis should be carried out to determine sexual metrics for the Poulton population (e.g. using femoral head diameter and sacral index) and hence to attempt the sex determination of otherwise unsexed skeletons.
- A detailed catalogue of all the available skeletons should be compiled, including dental records.
- All the available remains should be examined by an expert to assess the extent of dental disease, skeletal pathology, trauma, infection and metabolic diseases.
- A population biology study of genetic indicators should examine regional affinities and family relationships.
- A carefully selected sample of skeletons should be ^{14}Carbon dated in order to relate the burial sequences to the historical record.

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Appendices

Appendix 1. Results of Basic Skeletal Analysis

The results for all excavated skeletons are summarised in Table 9

Skeleton No	Skeleton Context	Adult/ Subadult	Sex	Age at Death			Height (m)	Source
				Minimum	Maximum	Units		
1	108	Adult	Female	30	40	Years	1.5	[Quinney, 1996]
4	127	Adult	Male	Indet	Indet		1.55	[Owens, 1998]
5	130	Adult	Male	50	50	Years	Indet	[Owens, 1998]
10	149	Adult	Male	25	25	Years	1.76	[Owens, 1998]
11	150	Adult	Female	49	49	Years	1.62	[Owens, 1998]
13	167	Adult	Male	38	38	Years	1.74	[Owens, 1998]
14	168	Subadult	Indet	2	9	Years	Indet	[Owens, 1998]
15	169	Subadult	Indet	Indet	Indet		Indet	[Owens, 1998]
16	170	Subadult	Indet	7	12	Years	Indet	[Owens, 1998]
17	171	Adult	Male	47	47	Years	1.66	[Owens, 1998]
18	165	Adult	Male	50	50	Years	Indet	[Owens, 1998]
19	166	Adult	Female	54	54	Years	1.55	[Owens, 1998]
20	172	Subadult	Indet	7	17	Years	Indet	[Owens, 1998]
21	173	Subadult	Indet	7	10	Years	Indet	[Owens, 1998]
23	194	Adult	Male	35	35	Years	1.69	[Owens, 1998]
24	400	Adult	Male	48	48	Years	1.73	[Owens, 1998]
25	403	Subadult	Indet	9	15	Years	Indet	[Owens, 1998]
27	405	Subadult	Indet	Indet	Indet		Indet	[Owens, 1998]
29	412	Adult	Male	40	40	Years	1.69	[Owens, 1998]
30	415	Adult	Male	25	25	Years	Indet	[Owens, 1998]
31	416	Adult	Ambig	55	55	Years	Indet	[Owens, 1998]
32	417	Adult	Male	26	26	Years	1.74	[Owens, 1998]
36	439	Subadult	Indet	4	5	Years	Indet	[Owens, 1998]
37	440	Subadult	Indet	8	8	Years	Indet	[Owens, 1998]
38	441	Adult	Male	55	Indet	Years	Indet	[Owens, 1998]
39	442	Subadult	Indet	3	4	Years	Indet	[Owens, 1998]
45	470	Adult	Female	25	Indet	Years	1.64	Carpenter & Crane
46	479	Adult	Male	45	Indet	Years	1.74	Carpenter & Crane

Skeleton No	Skeleton Context	Adult/ Subadult	Sex	Age at Death			Height (m)	Source
				Minimum	Maximum	Units		
47	485	Subadult	Ambig	12	16	Years	Indet	Carpenter & Crane
48	499	Adult	Male	30	40	Years	1.69	Carpenter & Crane
49	504	Subadult	Indet	6	16	Months	Indet	Carpenter & Crane
50	513	Adult	Male	45	Indet	Years	1.75	Carpenter & Crane
53	529	Adult	Male	40	60	Years	1.82	[Roberts, 1998]
54	534	Adult	Ambig	25	35	Years	Indet	Carpenter & Crane
66	647	Subadult	Indet	8	16	Months	Indet	Carpenter & Crane
67	648	Adult	Female	30	40	Years	1.61	Carpenter & Crane
81	706	Adult	Male	20	Indet	Years	1.73	Carpenter & Crane
82	707	Adult	Male	30	40	Years	1.79	Carpenter & Crane
83	708	Adult	Ambig	20	30	Years	Indet	Carpenter & Crane
84	709	Adult	Male	35	45	Years	1.71	Carpenter & Crane
85	718	Adult	Male	16	Indet	Years	1.69	Carpenter & Crane
86	727	Adult	Female	21	Indet	Years	1.66	Carpenter & Crane
87	732	Subadult	Indet	8	16	Months	Indet	Carpenter & Crane
88	745	Subadult	Indet	3	9	Months	Indet	Carpenter & Crane
89	747	Subadult	Indet	2	6	Years	Indet	Carpenter & Crane
90	760	Adult	Female	25	35	Years	1.63	Carpenter & Crane
91	763	Adult	Male	25	25	Years	1.82	Carpenter & Crane
92	764	Adult	Indet	Indet	Indet		Indet	Carpenter & Crane
93	765	Adult	Female	21	Indet	Years	1.56	Carpenter & Crane
94	774	Adult	Male	19	Indet	Years	Indet	Carpenter & Crane
95	805	Adult	Female	30	40	Years	1.53	Carpenter & Crane
96	808	Adult	Female	35	45	Years	1.62	Carpenter & Crane
97	811	Adult	Female	35	45	Years	1.6	Carpenter & Crane
98	814	Subadult	Indet	Indet	16	Years	Indet	Carpenter & Crane
100	818	Adult	Female	Indet	Indet		Indet	Carpenter & Crane
102	822	Adult	Female	15	21	Years	1.62	Carpenter & Crane
103	859	Adult	Female	30	40	Years	1.57	Carpenter & Crane
104	861	Subadult	Indet	Indet	18	Years	Indet	Carpenter & Crane
105	862	Subadult	Indet	6	12	Months	Indet	Carpenter & Crane
106	847	Subadult	Indet	Indet	16	Years	Indet	Carpenter & Crane
107	860	Subadult	Indet	7	10	Years	Indet	Carpenter & Crane

Skeleton No	Skeleton Context	Adult/ Subadult	Sex	Age at Death			Height (m)	Source
				Minimum	Maximum	Units		
108	871	Adult	Female	21	Indet	Years	1.62	Carpenter & Crane
109	872	Adult	Male	35	45	Years	Indet	Carpenter & Crane
110	873	Adult	Female	35	45	Years	1.63	Carpenter & Crane
112	878	Adult	Female	30	40	Years	1.55	Carpenter & Crane
114	901	Adult	Female	35	45	Years	Indet	Carpenter & Crane
115	902	Subadult	Female	16	18	Years	Indet	Carpenter & Crane
116	920	Adult	Female	25	35	Years	1.53	Carpenter & Crane
120	930	Adult	Male	17	Indet	Years	1.72	Carpenter & Crane
121	933	Adult	Male	Indet	Indet		Indet	Carpenter & Crane
122	934	Adult	Male	Indet	Indet		Indet	Carpenter & Crane
123	935	Adult	Male	Indet	Indet		Indet	Carpenter & Crane
124	936	Subadult	Indet	18	60	Months	Indet	Carpenter & Crane
125	939	Adult	Ambig	45	Indet	Years	Indet	Carpenter & Crane
126	942	Subadult	Indet	3	5	Years	Indet	Carpenter & Crane

Table 9 – Results of Basic Skeletal Analysis

Notes:

- 'Indet' means Indeterminate; 'Ambig' means Ambiguous.
- Where the source is shown as 'Carpenter & Crane', this indicates that the analysis was carried out by the authors, and is published here for the first time.
- Where the source is shown as [Owens, 1998], sex and age data was taken from that source, but the height data was re-calculated by the authors as explained in Section 3.3.
- The range of skeleton numbers is greater than the total number of skeletons excavated (Section 1), because some skeletons which have been assigned numbers have not yet been excavated, and also because, in the early days of the project, skeleton numbers were assigned to some concentrations of bones which were later interpreted as 'charnel pits' or groups of elements from disturbed burials [Owens, 1998: 10].

Appendix 2. MNI Analysis of Disarticulated Bones from 1998–2002

All the available disarticulated bones from the 1998–2002 excavations were examined, and the numbers of various key bone portions were counted. These portions were chosen as being those which:

- Were generally well preserved in the material being analysed.
- Were identifiable even for bones in bad condition.
- Were distinctive enough to minimise the risk of double counting.

This analysis was performed separately for adult and subadult bones.

The key bone portions are shown in Table 10 (for adults) and Table 11 (for subadults), together with the numbers of each which could be identified. The Minimum Number of Individuals (MNI) is then calculated as the largest of these numbers, i.e. 14 for adults and 5 for subadults in this data set.

Key Bone Portion	Left		Right	
	Proximal	Distal	Proximal	Distal
Mastoid	11		9	
Nuchal Crest	7			
Upper Orbit	4		4	
Mandible	11		9	
Mental Eminence	14			
Clavicle	6	5	1	1
Humerus	6	8	4	14
Radius	7	7	6	8
Ulna	10	5	12	4
Sacrum	3			
Pubic Symphysis	4		3	
Femur	11	12	9	7
Tibia	11	13	13	13
Fibula	3	8	2	7

Table 10 – Results of MNI analysis for disarticulated bones: Adults

Key Bone Portion	Left		Right	
	Proximal	Distal	Proximal	Distal
Mastoid	0		0	
Nuchal Crest	1			
Upper Orbit	0		0	
Mandible	1		1	
Mental Eminence	0			
Clavicle	1	1	2	2
Humerus	0	2	0	2
Radius	0	1	0	1
Ulna	1	0	2	0
Sacrum	0			
Pubic Symphysis	0		1	
Femur	3	2	5	3
Tibia	3	1	2	1
Fibula	1	1	0	0

Table 11 – Results of MNI analysis for disarticulated bones: Subadults

Appendix 3. IT Systems

As both of the authors earn their living in the IT industry, it is not surprising that IT systems have been developed and used in processing the skeleton data.

Appendix 3.1 Skeleton Database

The heart of the system is a Skeleton Database created using Microsoft© Access 2000. Although surrounded by numerous ancillary tasks and datasets, information about the skeletons is stored in five main tables:

Master Data
Post-Excavation Data
Plans
Associated Contexts
Nominal Values

The *Master Data* table contains most of the information from the skeleton recording sheet such as the skeleton number, skeleton context number, the site grid location, date of lifting, etc, together other useful information such as the current location of each skeleton (e.g. in store or at Mount St. Bernard), in how many boxes it is stored and whether it has been cleaned.

The *Post-Excavation Data* table contains the summary results from the post excavation analysis: sex, age and height estimations. To date, the authors have resisted the temptation to include the full detailed information from the post excavation analysis (e.g. individual long bone measurements); that data remains on paper records. Nevertheless, the post excavation analysis sheet was prepared with that possibility in mind and such an enhancement is likely, given sufficient time.

The *Plans* table contains information about each plan that shows a skeleton. As any individual skeleton may be shown on more than one plan, this information is held separately from the Master Data.

The *Associated Contexts* table contains information about other contexts associated with a skeleton. Normally each skeleton has two associated contexts, the grave cut and the grave fill. However, given the intersecting nature of the burials at Poulton, there may be more than one cut or fill context associated with any particular skeleton. To deal with this situation, the associated context information is held separately from the Master Data.

All the above tables contain 'static' data. That is, the data is entered and maintained by hand. However, to permit further analysis and categorisation, an automatic process with a manual modification capability was provided. That process creates the *Nominal Values* table. The problem primarily lies around the age estimates and their categorisation.

Most post-excavation analyses produce an age range that we have delimited by a minimum and maximum age. However, to process the data further, for example, to categorise a skeleton as an adult or subadult, it is necessary to reduce this age to a single value. If both the minimum and maximum ages can be established, this single age (the Nominal Age) is the mean value of the minimum and maximum ages. Unfortunately, due to the availability of skeletal material or its quality, it is sometimes only possible to establish either a minimum or maximum age (occasionally, neither). In such a case, human judgement is required to assign a nominal age to be able to categorise the skeleton. As a form of audit, any nominal data that is modified manually is logged within the database. The automatic process currently achieves about a 95% success rate on creating a 'correct' nominal age leaving only a small number (less than 10) to be corrected by hand. We are continuing to improve the algorithm but we fully expect the law of diminishing returns to set in very quickly.

Appendix 3.2 Graphs

All the graphs used in this report were created using Microsoft© Excel 2000. The source of the data is the Skeleton database described above. The data is copied electronically into pre-prepared Excel spreadsheets, which provide more convenient data-analysis (e.g. distribution analysis) and graphing facilities. We claim no originality for the techniques and methods used.

Appendix 3.3 Location Plan

The location plan is produced by the combination of two programs: a Computer Aided Drawing (CAD) package, AutoDesk Autosketch Release 8 and a mapping/surveying package, CMT CogoCAD V2.3.

The 'static' data on the plan, such as the site grid and the outline of the chapel, are produced by standard CAD techniques. Overlaying the burial location data is more complex.

The 'raw' location data is obtained from the Skeleton database, filtered by the category required (e.g. male adult, subadult, etc.). Each data set is then processed by the CogoCAD program to produce a CAD compatible output. Finally, Autosketch is re-used to merge the static data with the 'dynamic' burial data to produce the composite picture.