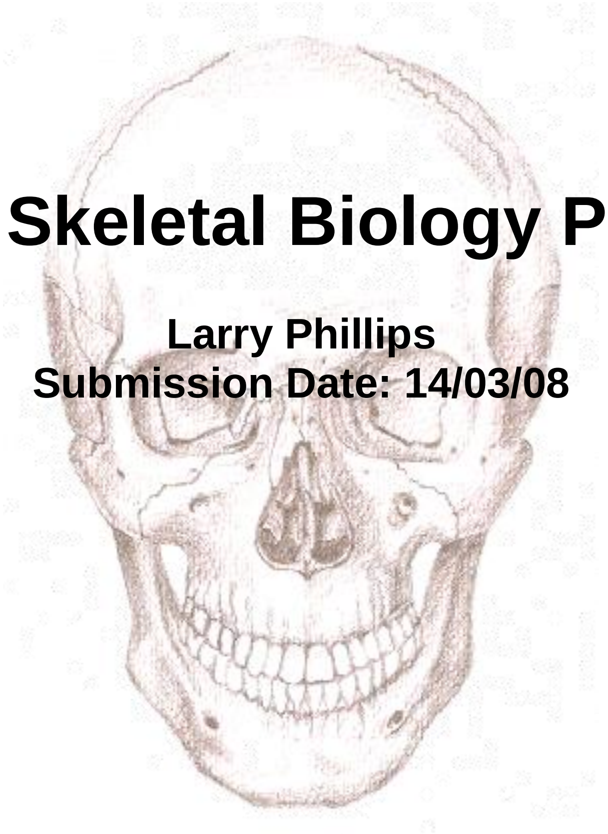
Human Skeletal Biology Practical



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The Skeleton

The human skeleton consists of 206 bones, some of which are ‘flat’ such as the scapula, some ‘tubular’ like the long bones and some ‘cuboid’ such as the carpals (Holst, 2008a, 3). There are also numerous directional terms for the placement of the bones within the skeleton which are; Proximal (closer to the skull) and Distal (away from the skull), Anterior (front) and Posterior (back), Superior (upper) and Inferior (lower), Medial (towards body midline) and Lateral (away from body midline) and for teeth only Buccal (on cheek side) and Lingual (on tongue side) (ibid, 4). Using these directional terms, the correct anatomical positions of the bones in the skeleton can be described.

Starting from the skeletal superior, there are seven cervical vertebrae that are cranial and medial in positioning, being superior to the thoracic vertebrae (White & Folkens, 2005, 163), with the seventh cervical vertebra being the transitional vertebra from cervical to thoracic (ibid, 169). The skeleton has two scapulas, both of which are posterior and lateral in positioning. The scapula is a flat bone that articulates with the clavicle and the humerus (ibid, 195).

There are two clavicles within the skeleton, both of which are cranial, anterior and lateral in positioning. They are tubular bones, the medial end articulates with the manubrium of the sternum while the lateral end articulates with the scapula (White & Folkens, 2005, 193). The sternum is located medially and anteriorly, and connects to the first seven ribs via cartilage. Starting as six separate pieces, it fully fuses together going into adulthood (ibid, 181).

The arms consist of a number of long tubular bones, the first being the humerus. The humerus is lateral; it articulates proximally with the scapula and distally with the ulna and radius. The radius has a round head on the proximal end in which it articulates with the humerus, while the distal end articulates with the carpal bones making up the wrist (White & Folkens, 2005, 214). The radius also articulates laterally (proximally and distally) with the ulna (ibid). The ulna articulates proximally with the humerus at the trochlea (the articulating surface of the humerus) and the radius (Currey, 2002, 248-250). The ulna also distally articulates with the ulna notch of the radius (ibid).

The carpals and metacarpals are located within the wrist and hand and are separated into their individual bones that are (radial-ulnar, where radial is medial and ulnar is lateral); the scaphoid, the lunate, the triquetral and the pisiform (White & Folkens, 2005, 228). The metacarpals are all tubular bones and are usually numbers MC1 – MC5, the first metacarpal being that of the thumb (ibid, 229). Each metacarpal articulates proximally with the carpals distal ends. Located distally to the metacarpals are the phalanges, each one of the fingers has a proximal, intermediate and distal phalanx while the thumb lacks the intermediate phalanx (ibid, 233).

Moving to skeletal inferior, the pelvis is made up of the left and right os coxae, the sacrum and coccyx (White & Folkens, 2005, 246). The ossa coxa are made up from three different parts, the ilium, ischium and pubis that fuse together during adolescence (ibid). Located at the base of the vertebral column; the sacrum *"…articulates bilaterally with the two ossa coxa and inferiorly with the small coccyx"* (ibid, 241). The femur articulates proximally with the acetabular fossa of the os coxae, and distally articulates with the proximal tibia and the patella (ibid, 255). The tibia articulates proximally with the distal femur, distally with the talus and laterally (proximally and distally) with the fibula; that lies lateral to the tibia and not only articulates with it, but also articulates with the talus (ibid, 279-280).

The tarsals and metatarsals and located within the ankle and foot. There are seven tarsals; the talus, the calcaneus, the cuboid, three cuneiforms and the navicular (White & Folkens, 2005, 246), along with five metatarsals that are usually numbered MT1 (the hallux) – MT5 (ibid, 300). The talus articulates superiorly with the distal tibia and fibula, while the calcaneus forms the heel and articulates with the cuboid anteriorly, and the metatarsals proximally articulate with the cuneiforms and the cuboid (ibid). The foot shares the same basic design as the hand with the phalanges, each having a proximal phalanx, intermediate phalanx (the hallux does not have an intermediate phalanx) and distal phalanx (ibid, 306).

The Adult Dentition, Ageing and Sexing

Skeleton Number: Box5, ST 3179/03, H-012

Preservation: Good

Completeness: 75%

Dentition: (TARBAT 16 was used for dentition).

There are many different ways that the age of a skeleton can be approximated; however, these all rely on the development and degeneration of bones and/or teeth (Holst, 2008b, 3). The development of the bones is fairly predictable up to the age of around 25, while the degeneration of bones depends heavily on age, sex and occupation (ibid).

The skeleton that was sexed and aged (Box5, ST 3179/03, H-012) had most bones damaged and no teeth were present to record the dentition, from what remained though, certain aspects of the skeletal characteristics could be studied to provide the sex and age.

The skull's characteristics that were examined and given numbers based on (Fig11) were;

Skull	**Stage**
Mastoid Process	2
Nuchal Crest	3
Supra-Orbital Ridge	4

(Table1: The results from these observations give no clear clue as to the sex of the individual, and so from these the sex is classed as undetermined)

While the areas of the pelvis used for sexing were;

Pelvis	
Sciatic Notch	Wide
Ventral Arc	Yes
Ischiopubic Ramus	Narrow

(Table2: The results from the pelvic observations prove that the individual is infact female)

While the skull gives no clear indication of sex, the pelvis gives very clear indicators that the individual is female. For ageing, the bones were unable to be measured as they were mostly damaged and incomplete, and there were also no teeth for the skeleton that could be used for ageing. The only sections of the skeleton that were usable for ageing were; the pubic symphysis and auricular surface, the results of which are;

Fusion/Development	**Stage**	**Age**
Pubic Symphysis	5	25 – 83
Auricular Surface	4 – 5	34 – 45

(Table3: Results of ageing, the auricular surface age falls between the pubic symphysis age and as such is the more likely age that should be taken)

With the degeneration of the pubic symphysis, the surface becomes less rugged and can be reliable when ageing and sexing a skeleton, the auricular surface also becomes less rugged and more pitted (Holst, 2008b, 4).

For the dentition TARBAT 16 was used, the mandible was missing and so only the teeth left in the maxilla were usable for ageing. The teeth present were;

R	pm	p	p	p	p	pm	pm	pm	pm	Pm	p	p	p	p	p	pm	L
	~~8~~	7	6	5	4	~~3~~	~~2~~	~~1~~	~~1~~	~~2~~	3	4	5	6	7	~~8~~	
	~~8~~	~~7~~	~~6~~	~~5~~	~~4~~	~~3~~	~~2~~	~~1~~	~~1~~	~~2~~	~~3~~	~~4~~	~~5~~	~~6~~	~~7~~	~~8~~	
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
pm – post-mortem tooth loss																p – tooth present	

(Table4: Tooth numbers are indicated by list below. With no mandible, only the maxilla could provide an estimated age based on the remaining teeth present. With the maxilla, there was no ante-mortem tooth lose)

1. First incisor
2. Second incisor
3. Canine
4. First premolar
5. Second premolar
6. First molar
7. Second molar
8. Third molar

There are four incisors in both the maxilla and mandible, with two sitting either side of the midline (Beek, 1983, 45). All of which were missing with TARBAT 16. The canines, the last of the anterior group sit in the corners of the dental arch and are the third teeth on either side of the midline (ibid). Only one was present in the left side of the maxilla. There are then four premolars in the maxilla, two either side of the dental arch called ‘first’ and ‘second’ from the midline respectively, these are unique to permanent dentition (ibid, 46), and all four were present. There are then six permanent molars in the maxilla, three permanent molars posteriorly on either side and are named ‘first’, ‘second’ and ‘third’ from the midline position respectively (ibid), they are unique to the permanent dentition and as such do not replace any deciduous teeth (ibid). By the age of eighteen, the permanent teeth have usually all erupted, however, the two third molars, also known as wisdom teeth are the last to erupt and could do so much later than eighteen (Holst, 2008b, 3). The first and second molars were present with TARBAT 16 while the third molars however, were lost post-mortem. From the dental wear on the first and second molars, it was determined that the individual (TARBAT 16) was around the age of 25-35 at death.

There are a number of limitations when deciphering the age and sex of a skeleton; the first being the completeness of the skeleton in question. Age determination relies on the development and degeneration of bones and teeth (Holst, 2008b, 3), but if these bones are in a poor condition or missing altogether, then ageing the skeleton becomes much harder. The skeleton that was analysed had very little to work from, but as both the pubic symphysis and auricular surface had survived and were present; a general age estimation was able to be given.

The Immature Skeleton

Skeleton Number: 1280

Preservation: Good

Completeness: 70%

Age: Neonate

(Fig1: The assembled bones of skeleton 1280, Author, 2008)

Skeleton 1280 was fairly complete although damaged, there were a few teeth and three complete bones that readings were able to be taken from, these were; the right humerus and femur and the left radius.

Length		Right	Left
	Humerus	75.5	
	Radius		61.4
	Femur	84.8	

(Table5: Results of the bone measurements (mm))

Comparing the measurements taken to the measurements held within the tables provided by Holst (2008c, 5), for a New Born (NB) – 0.5 months old child, the range of variation (mm) for the length of the humerus is 63.5 – 89.0 (ibid), placing skeleton 1280 into this category. This is further backed up with the measurement taken for the radius, as the range of variation for a NB – 0.5 is 49.0 – 73.5 (ibid). The femur measurements also conclude that skeleton 1280 belong in the NB – 0.5 age range with the variation being 62.5 – 106.0 (ibid).

Teeth were also present, and it was possible to get an approximate age from the deciduous molars. As the development tends to follow a known path, there are several systems that can be used to determine the age from a non-adult dentition (Holst, 2008c, 1). The table for ageing, from Moorrees *et al* (1963) as shown in Holst (2008c, 2) was used to compare the deciduous second molar (Table6), it was found to be at stage 4 with ½ the crown complete. When compared with the ‘mean age of attainment of development of the deciduous teeth’ table, the original estimate of NB – 0.5 years is cooperated by an estimate of 0.3 years.

Development Stage	dc	dm1	dm2
Cr½	0.3	0.0	0.3

(Table6: Row taken from Moorrees *et al* (1963) mean age of attainment of development of the deciduous teeth table, showing that the estimated date can now be lowered from 0.5 years)

It is therefore possible to base the age of the skeleton from these results to an average age of NB – 0.4 months.

Immature skeletal changes

The immature skeleton goes though dramatic changes from the foetus until fully formed, the bones to begin with are unfused and start to slowly fuse together during childhood (Holst, 2008c, 3). Scheuer and Black (2000, 4) write that there are two components to overall growth that are; an increase in size and an increase in maturity. The rate at which these develop varies considerably with every individual and also between the sexes (ibid). To asses the skeletal age of an individual Scheuer and Black (2000, 6) write that in order to age an individual from a bone, it has to be identified in one of its three stages which are; *“…the time the ossification centre appears …the morphological appearance and …the time of fusion of the centre with another separate centre of ossification”*.

These processes will not apply to all bone elements and are not all needed to estimate age, they should be considered in relation to the material provided for analysis (Scheuer and Black, 2000, 6). These processes, however, can be useful in determining different factors about the individual, such as the appearance of ossification centres that are useful in determining the developmental status of an individual and an estimated age may then be assigned (ibid, 9). Morphological appearance of the ossification centres, are also useful to assess maturity and can be used to give an age estimation in archaeological assemblages (ibid, 12). The fusion of ossification centres can show growth disturbances and an estimated age can be given, although with a wide variant if the sex is unknown (ibid). Dentition undergoes many changes throughout childhood and this too can be measured to produce estimated ages, as teeth survive relatively well and have less variability than the skeleton (ibid).

Morbidity and Mortality

Neonates

Fanaroff (2003, 56) notes that the highest risk of infant death is within the first 24 hours of birth, although morbidity and mortality remain high until the 28^{th} day of life. Labour, delivery and the neonatal period are the most vulnerable times as neonatal infections like bacterial sepsis causing pneumonia, meningitis and viral infections are easily caught and can cause diseases such as rubella, measles and varicella (Wilson and Cooley, 2000, 103-110).

Injury; especially injury to the central nervous system can cause lifelong morbidity, low birth weight (any neonate less than 2500g at birth) is also a factor that contributes to mortality rates (Fanaroff, 2003, 56-57). Fanaroff (2003, 57) also notes that race is a factor that contributes to mortality, with mortality rates for 1997 as such; *“Asian and Pacific Islander mothers (5/1000 live births) followed by White (6.0), American Indian (8.7), and black (13.7) mothers”*, it is also noted that this remains unexplained. Maternal factors, such as those of age (usually teenagers or women over 40), drinking, smoking and the use of drugs increase the mortality rates, and in many instances initiate long term morbidity such as cerebral palsy, mental restrictions, physical handicaps, blindness and deafness (ibid, 58).

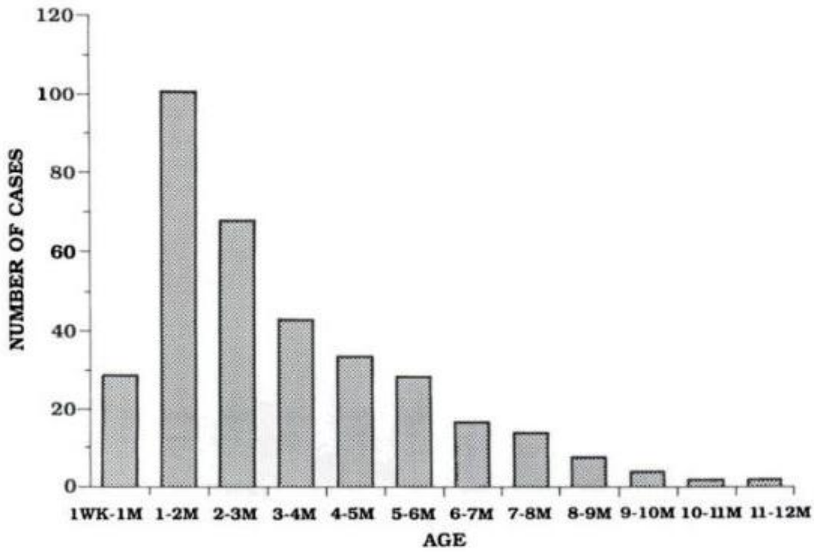
In China, as most of the population is only allowed one child there are policies; between the age of 25 and 27 years is the best time to give birth as the womb is mature, it is considered that the womb is not mature enough under the age of 25 and that problems can arise causing morbidity, while over the age of 30 is considered too dangerous for both mother and child (Wang pers.comm 2008).

Infants

An infant is described as a child; NB – 1 year of age (Holst, 2008c, 1). As with the neonates, preterm birth, intrauterine growth retardation or low birth weight can increase the risk of infant morbidity and/or mortality, and it is also believed that sexually transmitted diseases (STDs) also contribute to infant morbidity and/or mortality rate (Kramer, 1999, 88). Others include congenital Anomalies, such as cleft lip that is visible or the absence of the corpus callosum of the brain that is not visible (Wilson and Cooley, 2000, 8-12).

Metabolic abnormalities such as hyperbilirubinemia can lead to death or hearing loss and/or mental retardation if the infant survives, and hypoglycaemia that can cause seizures and brain injury (ibid, 12-15).

Sudden Infant Death Syndrome (SIDS) is another factor that contributes to infant mortality and has been described as the sudden death of an infant or young child under the age of one that remains unexplained (Byard, 2004, 492). SIDS has been around for thousands of years, even being mentioned in the bible; the judgement of Solomon (ibid), and was once thought to be caused by a mother lying on top of the baby in a shared bed, however, this was shaken up in recent times when infants who did not share beds were found in similar conditions (ibid, 493). Fig2 below shows the characteristic age distribution of SIDS infant deaths in South Australia.



(Fig2: Characteristic age distribution of SIDS infants taken from 351 consecutive SIDS deaths in South Australia, Byard, 2004, 493)

Juveniles

A juvenile is described as being 1 – 12 years of age (Holst, 2008c, 1). According to studies, children from the age of 1 – 3 have the highest frequency of developing ‘Juvenile idiopathic arthritis’ (JIA), one of the most common childhood chronic illnesses that can cause either short or long term disability as well as possible blindness (Woo, 515-520). Byard (2004, 11-148) points out there are many different types of traumas that effect children and for which, he places under the headings ‘unintentional trauma’ and ‘intentional trauma’.

Factors for trauma include; craniocerebral trauma in which studies show that in America during 1986, this accounted for about 7000 deaths of which 55% were falls by children around four years of age (Byard, 2004, 23), and downing in which out of the 26 deaths studied were of children between 2 months and 13 years old, and while the infants were left unobserved the juveniles generally died from either falling into a body of water or were caught in an undertow (ibid). Some other factors include diarrhoeal diseases such as; Escherichia Coli, Shigella and Rotavirus, all of which can cause illness, dehydration and even death, especially in the developing countries (Black, 1984, 142-145).

Adolescents

An adolescent is described as being 13 – 17 years of age (Holst, 2008c, 1). The most common causes of morbidity today are injuries; usually sport, but motor injuries are also frequent, as too is obesity (Elster, 2007). Other factors for morbidity and premature mortality within adolescents can be seen as a mixture of those from neonatal, infant and juvenile.

Factors also change throughout history, for example many men would first go to battle between the ages of 12-15 during the 10^{th} century (Short pers.comm, 2008), no doubt causing an increase in mortality rates amongst juveniles and adolescents. This is also the time when they become sexually active and thus have a chance of catching STDs that can cause morbidity and in some cases eventual death (Kramer, 1999, 88).

Calculating Stature and the Demographic Profile

Calculating and approximating stature can be done in a number of ways, all of which include the measurement of the long bones. Brothwell (1981, 100) notes that height is always varying, and while height increases until adulthood, it subsequently decreases as senility approaches. The average stature for females is also smaller than that for males (ibid).

Brothwell (1981, 101) provides a table (Table7) from Trotter & Gleser (1952, 1958), in which the following measurements can be calculated;

Female femur length: 409mm; Female tibia length: 312 mm
Male femur length: 477mm; Male tibia length: 379mm.

Males (White, cm)	**Females (White, cm)**
1.26 (Fem + Tib) + 67.09	1.39 (Fem + Tib) + 53.20
2.32 Fem + 65.53	2.90 Tib + 61.53
2.42 Tib + 81.93	2.47 Fem + 54.10

(Table7: Regression equations for males and females, Brothwell, 1981, 101)

Using the regression equations above, the length of both the femur and tibia can be calculated together for both male and female measurements;

Female; 1.39 x 72.1 + 53.20 = 153.41cm = 60.4in = 5ft and 0.4in
Male; 1.26 x 85.6 + 67.09 = 175.94cm = 69.3in = 5ft and 9.3in

Brothwell (1981, 102) concludes that although the height is given as a precise figure, there is a 'standard error' and that the standard error is larger for some bones than others. Although the standard error is not given, the table shows the order of preference from the smallest standard error (ibid). Holst (2008d, 1) shows a list of tables provided by Ubelaker (1989) which for the same bones shows the standard errors used (Table8); the ones that apply in this case are as such;

Males (White, cm)	**Females (White, cm)**
1.30 (Fem + Tib) + 63.29 ± 2.99	1.39 (Fem + Tib) + 53.20 ± 3.55
2.38 Fem + 61.41 ± 3.27	2.90 Tib + 61.53 ± 3.66
2.52 Tib + 78.62 ± 3.37	2.47 Fem + 54.10 ± 3.72

(Table8: Regression equations for males and females also showing the standard error used, Holst, 2008d, 1)

While the calculations stay the same for females with Ubelaker's calculations, the male's calculation is now;

Male; 1.30 x 85.6 + 63.29 = 174.57cm = 68.7in = 5ft and 8.7in

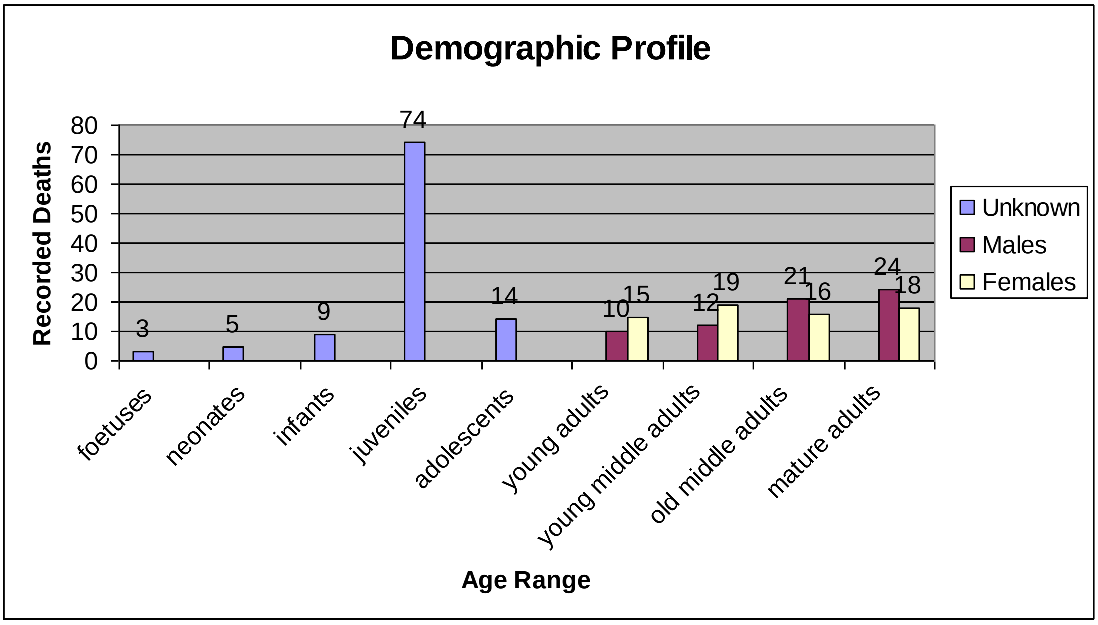
Ubelaker (1989) provides the standard errors; in this case the male calculations have the standard error of ± 2.99, while the female calculations have the standard error of ± 3.55 (Holst, 2008d, 1). While the standard error is not shown in data provided by Trotter & Gleser, it can be assumed, as there is very little difference between the results, that they are very similar, if not the same.

In order to establish certain trends amongst a population, it is useful to calculate the 'minimum number of individuals' (MNI), which is done by counting the ends of all the long bones (Holst, 2008d, 4). The MNI does not always represent the actual number of individuals; it does however, represent the minimum number of individuals on a site (ibid). Once more data is also collected; a profile can be constructed and placed into a spreadsheet (Table9) for analysis. The demographic profile for the given medieval population is as follows;

Age Range	**Male**	**Female**	**Unknown**	**Total**	**%**
Foetuses			3	**3**	**1.25**
Neonates			5	**5**	**2.09**
Infants			9	**9**	**3.75**
Juveniles			74	**74**	**30.84**
Adolescents			14	**14**	**5.84**
Young adults	10	15		**25**	**10.41**
Young middle adults	12	19		**31**	**12.91**
Old middle adults	21	16		**37**	**15.41**
Mature adults	24	18		**42**	**17.5**
Total	**67**	**68**	**105**	**240**	**100%**

(Table9: The given medieval population separated in gender with the percentage for each separate age group)

These results can then be placed into a graph (Fig3) in order to easily compare the data as such;

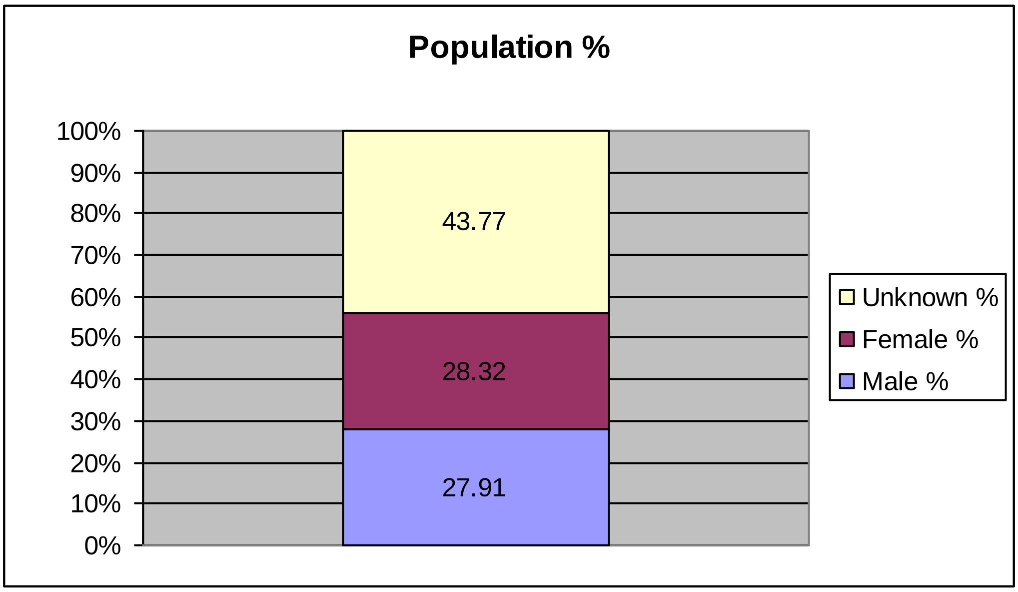


(Fig3: The demographic population, split by gender with recorded deaths also given, Author, 2008)

The percentage for each individual group and sex can also be placed into a table (Table10) and a subsequent graph can be drawn (Fig4) in order to hypothesize and base conclusions on.

<table>
<tr><th>Age Range</th><th>Male %</th><th>Female %</th><th>Unknown %</th></tr>
<tr><td>Foetuses</td><td rowspan="5" colspan="2"></td><td rowspan="5">43.77</td></tr>
<tr><td>Neonates</td></tr>
<tr><td>Infants</td></tr>
<tr><td>Juveniles</td></tr>
<tr><td>Adolescents</td></tr>
<tr><td>Young adults</td><td>4.16</td><td>6.25</td><td rowspan="5"></td></tr>
<tr><td>Young middle adults</td><td>5</td><td>7.91</td></tr>
<tr><td>Old middle adults</td><td>8.75</td><td>6.66</td></tr>
<tr><td>Mature adults</td><td>10</td><td>7.5</td></tr>
<tr><td>Total</td><td>27.91</td><td>28.32</td></tr>
</table>

(Table10: This shows the percentage for each gender and age group, sex is unknown before adulthood and so this category carries nearly half the percentage)



(Fig4: This shows the same data as the table, but in graphical form. It can be easier to see that male/female mortality is practically equal overall, Author, 2008)

From the results shown in Table9 and Fig3, the highest mortality rate was that of juveniles while the second highest rate of mortality is the mature adults. The foetuses have the possibility of being still born or aborted while the neonates, infants and juveniles could have been affected by SIDS, possibly the accidental smothering by the mother while sharing the same bed (Byard, 2004, 492).

There are also other possibilities as seen in many other types of populations, and have been explained by the fact that the unsanitary conditions leading to disease is what will take the life of a child (Schofield, 2006, 251). It has even been suggested that due to women taking up work alongside men in the second half of the fourteenth century, and with the possible fact that this encouraged larger families, the breast feeding time for each infact was cut short, which leads to a lack of immunological protection and thus they become vulnerable to disease (ibid).

When male and female mortality rates are compared, Bolton and Stuard (1976, 10) write that women had notably higher mortality rates than men, and this was the price that they paid for maintaining the population growth. This would account to the higher mortality rates shown for women in Table9 and Fig3 for the ‘Young Adults’ and ‘Young Middle Adults’ age range, as this is the best time for a woman to give birth (Wang pers.comm 2008). Schofield (2003, 237) backs this claim about childbirth, but with the added claim that women in the medieval period were probably also suffering from poorer nourishment when compared to men.

With the ‘Old Middle Adults’ and the ‘Mature Adults’ as shown in Tables9 & 10 and Figs3 & 4; it is the men who have a higher mortality rate and this could possibly be explained by the more obvious factors of life including; occupation, disease and war.

Overall, with the given population there is very little difference between male and female mortality, and as such an assumption can be placed that disease played a large part in the mortality rates. Had a battle had taken place, it can be expected that the data would show a higher number of male deaths over female deaths for the ‘Young Adults’ and Young Middle Adults’ range (Colish, 1983, 17).

Disease

Analysis of diseases is vital to gain an in-depth insight into the health and diet, living conditions and occupations within a population (Holst, 2008e, 1). The greatest causes of deaths were infectious diseases, and it was children who succumbed easily to these, as seen within Table9 where the majority of deaths were of juveniles, although most diseases do not leave marks on the bones and so there is often little evidence (ibid).

Treponemal infections

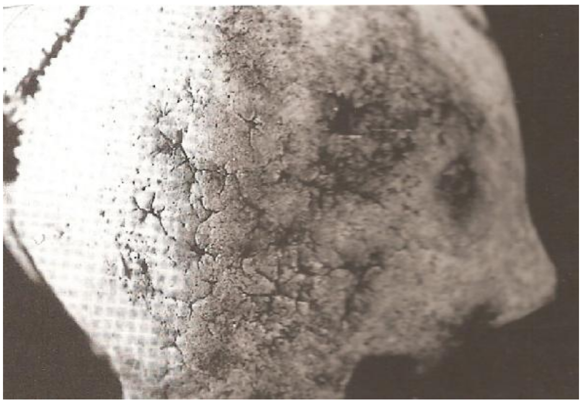
Treponemal infections caused by a spirochaete (microorganisms) can produce yaws, pinta and syphilis, both endemic and venereal (White & Folkens, 2005, 320). The origins are highly debated, and there is much controversy over the fact that it may have been present in the Old World before Columbus returned from the New World (ibid). Mays (1998, 138-139) writes that the documentary evidence describes what could be syphilis ravaging Europe that appears to have coincided with the return of Columbus. Historical sources suggest that syphilis was present in the Americas long before the arrival of the Europeans, with carbon dating of skeletal material showing signs of a treponemal disease going as far back as 4790BC (ibid). Skeletal evidence in York discovered in the 1970s however, shows a strong indicator that the individual had a treponemal disease and dates back to AD 1265 – 1389, more than a hundred years before Columbus (ibid).

Stepping away from Columbus though, new research has been carried out on the 'Heavener Runestone'; a giant rock slab inscribed with Old Norse from two runic alphabets, one that came into effect around 300 CE and the other 800 CE and once translated says 'GLOME DAL' or 'Valley owned by Glome' (Olsen, 2003, 172). If this interpretation is correct, then it could mean that the Vikings landed in North America much earlier than 1000 CE (ibid). As there is skeletal evidence to suggest treponemal diseases before Columbus, it may just be possibly that through a mixture of trade and settlement ranging from North America to Europe by the Vikings, the diseases could have made it here by AD 1265.

Skeletal changes, characteristics and distribution of lesions caused by syphilis

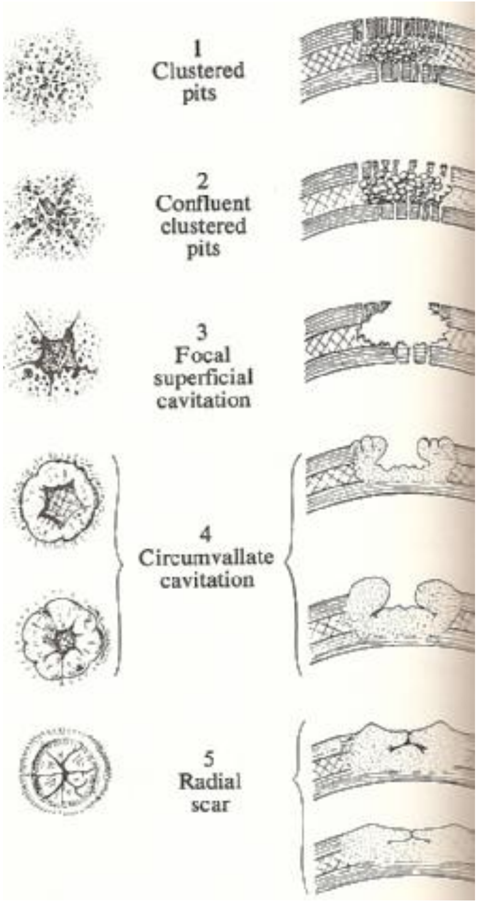
There are generally three different stages associated with syphilis, the primary stage involves the appearance of sores, the secondary stage is the spread of the disease through the body, and the tertiary stage causes damage to different organs and the central nervous system, bone changes are confined to this stage of the disease (Mays, 1998, 135). Coulter (1987, 19) writes that the sores around the infection site begin to appear after about one to three months of incubation, the adjacent lymph glands then also become swollen and rubbery in which the condition is known as ‘regional lymphadenopathy’. After six months of maturing, rashes and other skin symptoms appear as well as the generalisation of regional lymphadenopathy that affects the whole lymphatic system of the body (ibid). The latent stage (in-between the secondary and tertiary stages) in where it remains hidden for a time, and then with the tertiary stage, the brain and nervous system are penetrated (ibid).

The formation of a firm swelling known as gummata may occur, this can form inside various tissues including bone; this is known as gummatous lesions and leads to cavities within or on the bones surface as shown in Fig5 (Mays, 1998, 135). Chronic inflammation that is not associated with gumma formation can also happen; this is known as non-gummatous lesions and leads to periostitis and the thickening of marked bone as seen in Fig6 (ibid). Brothwell (1981, 134) draws on the work of Hacket (1976, 134) who, in his diagrams, clearly shows the sequence of syphilis on the skull. In the case of the skull, it begins with small areas of periostitis (clustered pits) and leads to extensive deep ‘cavitation’ as seen in Fig7 (ibid).

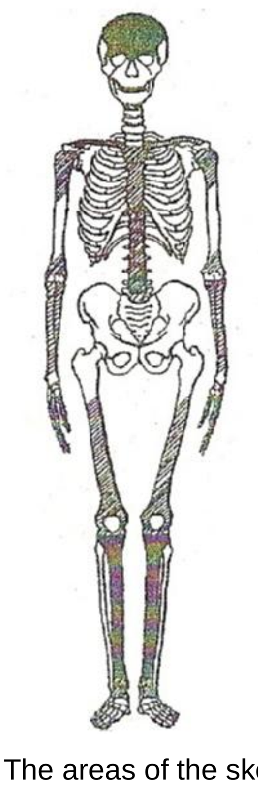


(Fig5: radial scarring, a healed stage of cranial treponemal disease, Mays, 1998, 139)

(Fig6: Thickened tibia (four views) due to non-gummatous periostitis, Hacket 1976, Figure 21)



(Fig7: Syphilis sequence in skull bones, Brothwell, 1981, 134)



The bones that are most commonly affected are; the cranial vault, usually the frontal section, and both the tibia (Mays, 1998, 138) as shown in Fig8 as the dark areas of the skeleton. Other areas that can be affected are usually the other tubular bones, ribs and sternum (ibid) as seen in Fig8 as the hatched areas of the skeleton.

(Fig8: The areas of the skeleton that are likely to be affected, Holst, 2008e, 7)

Life with syphilis

Syphilis is an immunosuppressive disease, it can suspend or inactive the body's immune system causing a collapse of the immune system and the opening of the doors to many other diseases (Coulter, 1987, 33). Symptoms for primary syphilis have already been discussed and include the sores at the infection site, for the secondary stage though common symptoms include; non-itchy skin rashes, tiredness, headaches, and swollen lymph glands while less common symptoms include; fever, weight loss, hair loss and joint pains (NHS, 2008). With the tertiary stage that can begin years or decades after infection, symptoms depend on where the infection has spread within the body, but can include; strokes, loss of coordination, numbness, paralysis, blindness, deafness, and heart disease (ibid). Today syphilis can be treated with a course of antibiotics, however, these symptoms would have plagued the people of the past, possibly being misdiagnosed as leprosy and thus the individuals were outcast away from society (Mays, 1998, 138).

Skeletal Report

Skeleton Number: B19
Preservation: Moderate
Completeness: 70%
Age: Adult

(Fig9: The assembled remains of skeleton B19, Author, 2008)

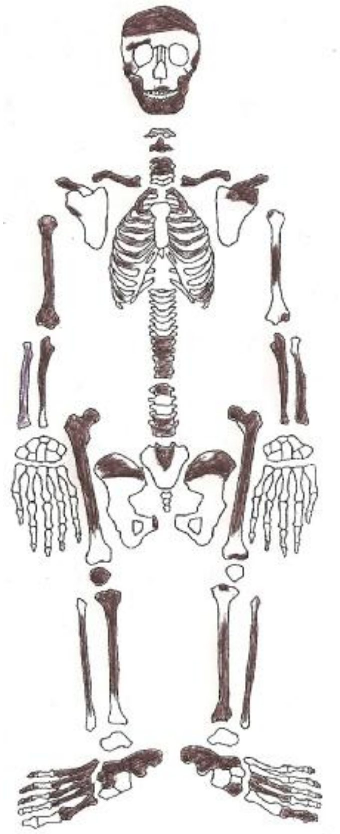
Preservation

The preservation of skeleton B19 overall is moderate; there is little erosion of the bone surfaces, but there are a number of post-mortem breaks like those of the skull, sternum, sacrum and pelvis as seen in Fig9.

Completeness

The completeness skeleton B19 was given at 70%; the hands were not present as too were some of the metatarsals, tarsals and foot phalanges. Fig9 shows the skeleton as far as it could be put together, while Fig10 shows what bones were present and how complete the bones were, with the present bones being highlighted. The left over bags contained small fragmented bits from many different bones, it was not possibly to distinguish which bones they belonged to.

The proximal and distal ends of the left humerus were not present. The proximal ends of both the left and right radius were not present along with the distal end of the right ulna. Both distal ends of the left and right femurs were not present, the left patella was not present, and the proximal and distal ends of the right fibula, the distal end of the left fibula, the distal end of the right tibia and the proximal end of the left tibia were not present. Both the left and right tali were also not present.

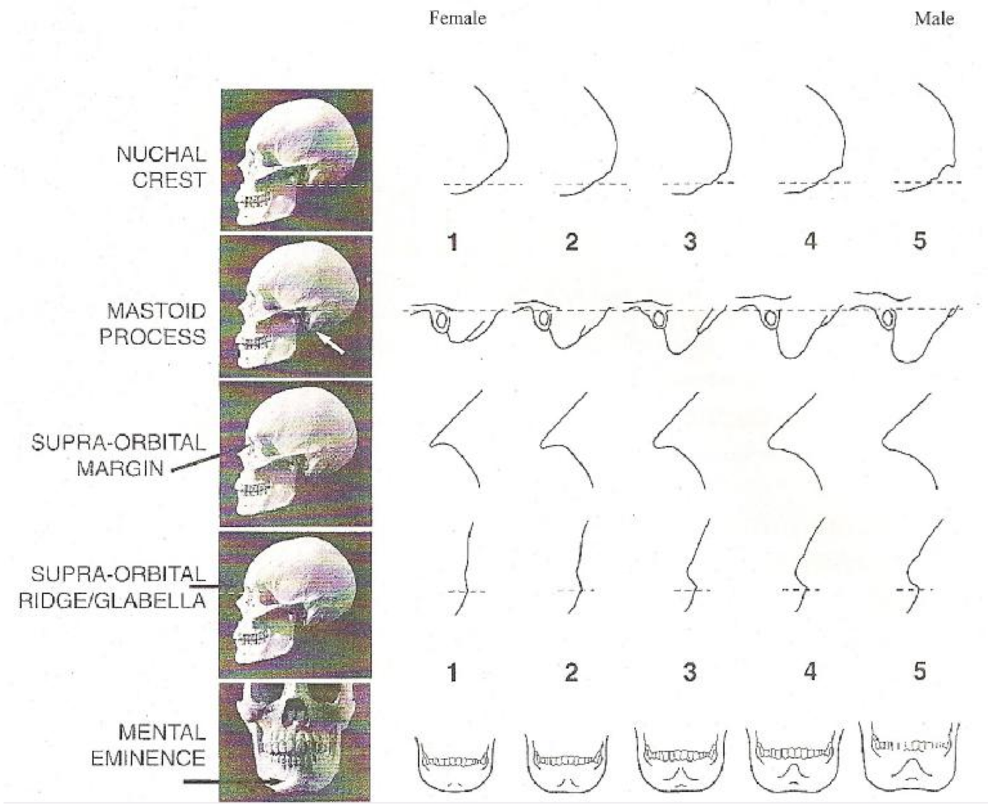


(Fig10: The coloured in drawing showing which bones were present for skeleton B19, Author, 2008)

Sex

There are a few different ways that sex can be determined, the main ones being the skull and pelvis. The pelvis is much more reliable though, as there are distinct features that separate men from woman. The skull also carries distinct features that separate men from woman, but these are flawed as young male skulls may take the appearance of a female skull and older female skulls may take the appearance of a male skull (White & Folkens, 2005, 386).

Fig11 shows the appearance for the different areas of the skull that should distinguish between male and female, with '1' being definitely female and '5' being definitely male. Table11 shows the observational results, pointing mostly to this individual being a male, as the nuchal crest was the only female indicator. The pelvis however, showed that the individual was actually female, as only females have a ventral arc and the sciatic notch is much wider than the male counterpart.



(Fig11: Features of the skull that can determine sex, not all skulls relate to this though and so the sexing of an individual based only on the skull could be flawed, Holst, 2008b, 6)

B19's Skeletal Characteristics

Skull/Other		**Pelvis**	
Anterior Mandible	3	Sciatic Notch	Wide
Mastoid Process	4	Ischiopubic Ramus	Narrow
Nuchal Crest	2	Ventral Arc	Yes
Supra-Orbital Ridge	4		

(Table 11: The observational sexing results for skeleton B19 with the skull suggesting male, but the pelvis clearly showing that the individual is female)

B19's Measurements

Bone	R	L
Clavicle Length (F 138mm, M 150mm)	134.64mm	134.95mm
Femoral Head Width (F 43mm, M 48mm)	41.91mm	41.65mm

(Table12: The only bones that could be measured for sexing, but with each measurement being smaller than the given measurement, these also indicate that the sex is female)

Most of the bones were damaged, however, it was possibly to measure both clavicles and both femoral heads for sexing, the measurements of which were a little smaller than the measurements given as shown in Table12, and as such suggest that the individual was female. Female measurements should be smaller than the given size, while male measurement should be larger, measurement in-between will be classed as undetermined (Holst, 2008b, 8).

Stature

Not all the bones for this individual were able to be measured; only the right humerus and left ulna were sufficient enough to be measured. Table13 shows the results of the measured bones; it must be noted that Trotter & Gleser use the same (female) measurements as Ubelaker for these particular bones, which are;

3.36 x Hum + 57.97
4.27 x Ulna + 57.76

B19's Measurements

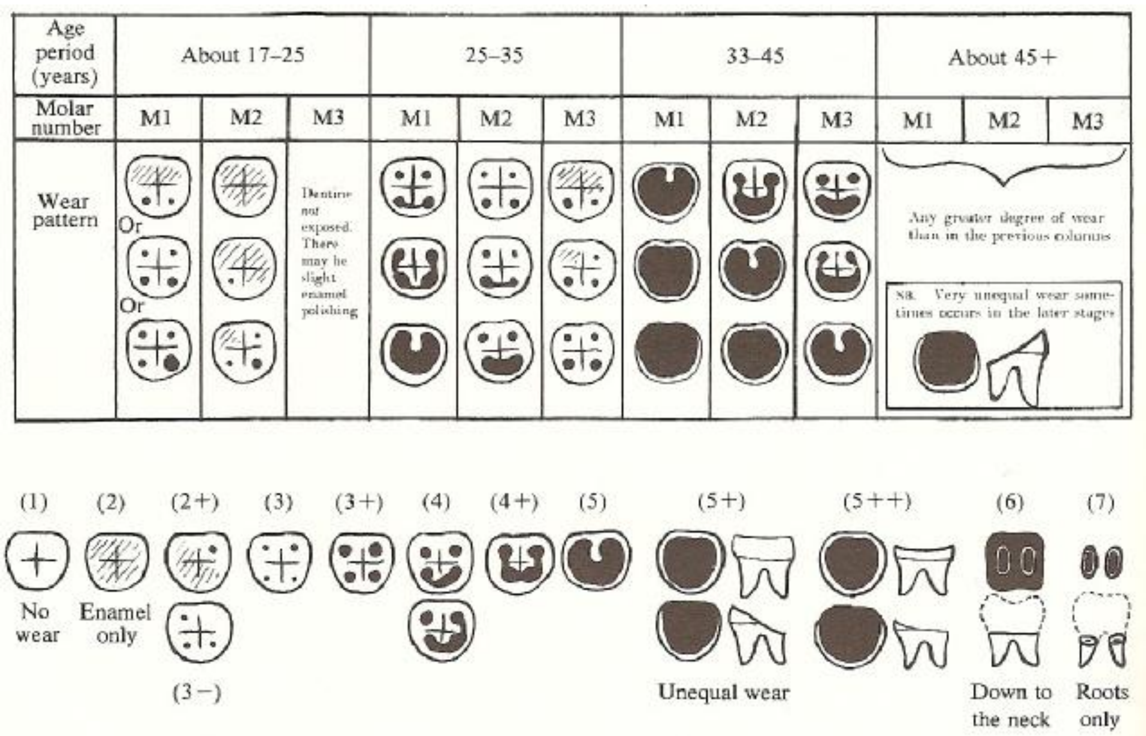
Bone	Length	Trotter & Gleser	Ubelaker	Standard Error
Right Humerus	288mm	154.73cm	154.73cm	±4.45
Left Ulna	240mm	160.24cm	160.24cm	±4.30
Stature:	Between 154.73cm – 160.24cm = 60.9in – 63.1in = 5ft 0.9in – 5ft 3.1in			

(Table13: Trotter & Gleser and Ubelaker used the same measurements for female bones, the standard error comes from Ubelaker's calculations)

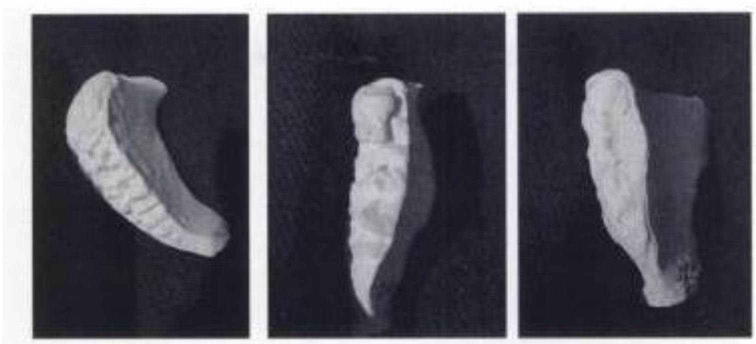
The stature of this individual, with the standard error either side can be placed between; 150.28cm – 164.54cm = 59.2in – 64.8in = 4ft 11.2in – 5ft 4.8in.

Age

There was little to use for the ageing of the skeleton, there were few teeth and only one pubic symphysis. Using Brothwell's (1981, 72) classification chart (Fig12) the wear on the molars were assigned to the appropriate categories, while the pubic symphysis undergoes age related change up to 20-40 years, shows different morphological changes and can be used for age estimation using component phase analysis (Scheuer & Black, 2006, 211). Fig13 shows the possibly morphological changes, while Table14 shows the age ranges for particular phases reached.



(Fig12: A tentative classification of age in Neolithic to medieval British skulls, based on molar wear, Brothwell, 1981, 72)



(Fig13: Morphological changes to the pubic symphyseal, youngest shown on left and oldest shown on the right, Scheuer & Black, 2006, 211).

Phase	Age (years) Females
I	15-24
II	19-40
III	21-53
IV	26-70
V	25-83
VI	42-87

(Table14: Data from Brooks and Suchey (1990:Table 1), showing the age ranges in which 95% of the individuals studied by Suchey and co. fell, Mays, 1998, 53)

The observational results for both the dental wear and pubic symphysis for skeleton B19 are as such;

Fusion/Development	Stage	Age
Dental Wear	5+	45+
Pubic Symphysis	VI	42-87

(Table15: The observational ageing results using both Brothwell's dental chart and the Brooks-Suchey method to age)

With these results, we can conclude that this individual is between the ages of 45 and 87 years old. Had more of the skeleton remained intact enough to analyse, then a more precise date may have been achieved.

Non-metric traits

Non-metric traits are nonpathological minor anomalies that appear on the bones and suggest diversity and familial affiliation (Holst, 2008d, 5).

With skeleton B19's skull, only the upper cranium remained fairly intact, although still damaged as shown in Fig14. For the cranium, Lambdoid ossicles were present while the left temporal as shown in Fig15 shows that the auditory torus is present.

(Fig14: The cranium of skeleton B19, Author, 2008)

(Fig15: Left temporal of skeleton B19, showing the auditory torus, Author, 2008)

Dentition

Skeleton B19 had lost all of her upper teeth ante-mortem, both her lower right premolars and her lower right first molar, as well as her lower left second premolar and first molar were also lost ante-mortem. All four lower incisors, the lower right canine and lower left first premolar were lost post-mortem. The difference between ante-mortem and post-mortem tooth lose can be seen with the bone of either the mandible or maxilla remodelling to fill the empty sockets, this processes does not happen after death (Mays, 1998, 149). Table16 shows the dentition results for skeleton B19;

		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	R	~~8~~	~~7~~	~~6~~	~~5~~	~~4~~	~~3~~	~~2~~	~~1~~	~~1~~	~~2~~	~~3~~	~~4~~	~~5~~	~~6~~	~~7~~	~~8~~	L
		8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	
		P	p	am	am	am	pm	pm	pm	pm	pm	P	pm	am	am	p	p	
Wear		6	4									6				5	7	
Caries		o,s															o,m	
Calculus		b,m	b,s									b,s					b,m	

pm – post-mortem tooth loss p – tooth present

am – ante-mortem tooth loss

position: b – buccal, o – occlusal

severity: s – small, m – medium

(Table16: The observational dentition results for skeleton B19, there were no teeth present for the maxilla as all were lost ante-mortem, tooth numbers are listed on Page 27)

1. First incisor
2. Second incisor
3. Canine
4. First premolar
5. Second premolar
6. First molar
7. Second molar
8. Third molar

Both lower third molars had occlusal caries, cavities in the crown, (Holst, 2008e, 3), and both lower third molars, the lower right second molar and lower left canine had buccal calculus, plaque concretions, (ibid), for which both lower third molars had a slightly higher concentration than that of the lower right second molar and lower left canine. As most of the teeth were lost ante-mortem, it can be concluded that the individual had little choice in using her third molars more often; this is also an indicator that the hygienic standards and general dental care were not very high.

Pathology

Starting from skeletal superior and moving down to skeletal inferior, the cervical vertebrae shows signs of sever degenerative joint disease (DJD, osteoarthritis), the right clavicle, the scapulas, the lumbar vertebrae and the left os coxae also show signs of sever DJD expressed in the form of porosity. The right distal humerus, the distal left ulna, the proximal right ulna, the thoracic vertebrae and the distal right femur also show signs of osteoarthritis. Often associated with osteoarthritis is eburnation, the bone takes a polished look due to the cartilage being destroyed (White & Folkens, 2005, 327). The proximal right tibia shows evidence for this process taking place. The vertebrae also show schmorl's nodes, these occur when the axial discs rupture due to pressure, usually when bearing a heavy load without lifting properly (Berkoff, 2004, 188).

There is evidence of healing amongst the fragmented ribs, and there is also healing on the left distal radius, the result of a broken wrist (collies fracture), while the right radius shows woven bone. Infections, either of the soft tissue or bone, results in inflammation and this in turn results in increased blood circulation that favours bone production which is initially laid down as woven bone (Mays, 1998, 123). Woven bone indicates that the lesion was active at the time of death, and thus indicates that the individual died shortly after contracting the condition (ibid).

Malmesbury Collection

The individual is part of the Malmesbuiry collection, the site was excavated in 2002 by Cotswold Archaeology (Holst, 2008f). The remains of 90 individuals were found in which 69 were lifted and is believed that the site, a graveyard, was probably in use from the 11th century (ibid). Disease and trauma was widespread in this discovered population (ibid).

Conclusion

The individual, Female, 45-87 years old, from the pathology suffered from sever DJD, this as White & Folkens (2005, 325) writes, *"…is an inherent part of the ageing process"*. She would have suffered in her later years from a lot of pain as most of her body was affected by this. This possibly indicates that she was very active; indeed the schmorl's nodes are yet another indicator that she could have been doing heavy manual labour of some kind (Berkoff, 2004, 188). Her dentition was also not great; loosing most of her teeth ante-mortem would have caused a lot of discomfort throughout her life.

The woven bone suggests not only infection, but infection at time of death. The infection itself can not be identified and so remains a 'non-specific infection', however, clues may lie with other victims from the same site as disease was widespread during this time.

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