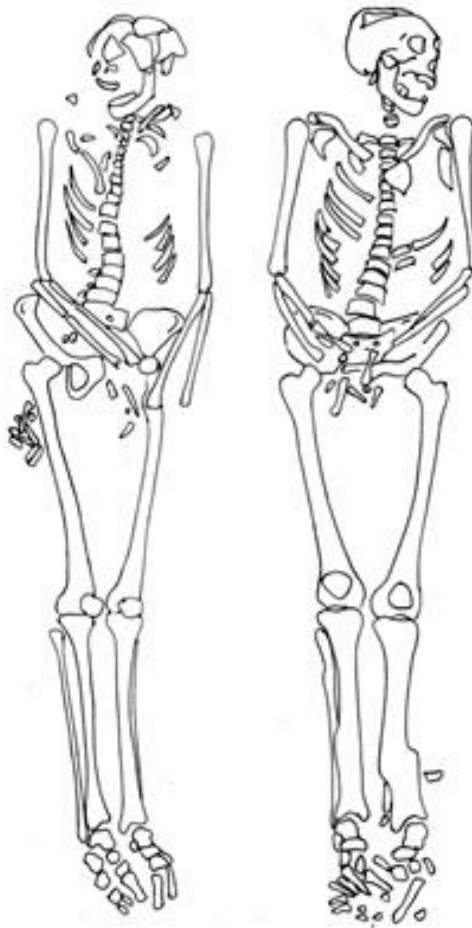




Norton Priory Museum & Gardens

Post-Excavation Analysis of the Human Skeletal Remains Recovered from Halton Castle: July 2015



By

Carla L. Burrell and Eleanor R. Dove

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Introduction

The human skeletal remains of two individuals (HCSK001 and HCSK002) were excavated at Halton Castle during the summer of 2015 by the Salford CfAA. The ruins of Halton castle, situated in Runcorn on a hill facing the river Mersey estuary, date back to the 12th century. The site was in use over a time period spanning from the Norman period to the 20th century, but it was not expected that human remains would be uncovered during the castle excavations. The remains of both individuals were uncovered in Trench 2 and were consequently brought to Norton Priory Museum and Gardens where they were subjected to full osteological analysis.

Both individuals were dry cleaned; reviewed for mould, re-bagged and re-boxed. They are now stored in appropriate conditions, ensuring an optimum environment needed to preserve these remains for future purposes. Each bag is clearly labelled with: the skeleton number, the site of excavation and the skeletal elements present in the bag. The bones have been separated by side, e.g. left hand, left arm, left ribs, etc. Each individual is now stored in good quality, strong cardboard boxes with lids (27 x 47 x 19 cm). The skeletons have been packaged into two boxes each (4 in total) to protect the more delicate elements and the pathology present. The boxes have been packaged to provide the maximum protection: long bones placed at the bottom of the box; the os coxae, cranium, and vertebrae placed on top; and the smaller elements such as the hand and feet bones are packed last and are placed on top. The box in which the skeleton is stored is also clearly labelled with these details. The individuals are now in the care of Lynn Smith, Senior Keeper at Norton Priory Museum and Gardens. Lynn already curates and cares for 130 articulated skeletal remains as part of the Norton Trust. The integrity of these two individuals will be maintained to a very high standard.

A subsequent report will be released in the New Year presenting the findings from the radiographic and, under supervision of Professor Silvia Gonzalez, radiocarbon and isotope analyses. Here, presented for the first time are preliminary results and summary reports of HCSK001 and HCSK002.

Summary Report of HCSK001

HCSK001 is a reasonably complete (>75%) skeleton. Some elements of the hands and feet are missing but overall the individual is in a good state of preservation. Some post-mortem damage has been sustained to the crania, right scapula, proximal humerus, distal radius, and right pelvis, but all fragments are present. The ribs and fibula from both sides have also sustained some post-mortem damage.

The remains of HCSK001 are that of an adult male, with an estimated age of 45 to 49 years, standing at a height of 172.3cm +/- 3.2cm (5ft 7.7in). The cranium was reconstructed and ancestry was assessed to be 19th Century White European using the Howell's crania database, part of the Fordisc program.

This individual does display interesting pathological examples, as well as various nonmetric traits. Most strikingly, this individual has evidence of a healed fracture to both tibia and fibula which has led to secondary osteoarthritis affecting the ankle joints. The left tibia has developed osteomyelitis, an infection likely sustained during the traumatic event. There is also evidence of pronounced periostitis to the femurs, tibia and fibula, with slight enlargement to the posterior distal portion of the left femur. Additionally, there is evidence of various dental pathologies such as dental caries, periodontal disease, and ante-mortem tooth loss. Osteoarthritis is evident throughout the skeleton, particularly affecting the vertebral column and pectoral girdles.

Full details of the analysis are reported on pages 8 to 22.

Summary Report of HCSK002

Like HCSK001, HCSK002 is a reasonably complete (>75%) skeleton with only some elements of the hands and feet missing. The preservation of this individual is not of as high a standard as that of HCSK001. Post-mortem damage has been sustained to almost all elements except for: the clavicles, tibiae, the right femur and fibula, and the left humerus. Where post-mortem damage has occurred, the elements are reasonably complete but fragile.

The remains of HCSK002 are that of an adult female, with an estimated age of 30 to 34 years, standing at a height of 171.6cm +/- 3.5cm (5ft 7.5in). The cranium was reconstructed and ancestry has been preliminary assessed to be 19th Century White Norse using the Howell's crania database, part of the Fordisc program. Unfortunately, due to the fragmentary nature of the cranium, even after reconstruction, these results are inconclusive and require further analysis.

This individual does display some pathological examples as well as various nonmetric traits. There is evidence of various dental pathologies such as dental caries, dental calculus, and ante-mortem tooth loss. There is evidence of periostitis to both tibiae, and healed fractures to the left ribs. The long bones are unusually slender and elongated also, the bodies of the thoracic and lumbar vertebrae are an unusual shape, this could potentially be evidence of Marfan's syndrome.

Full details of the analysis are reported on pages 23 to 36.

Osteological Analysis of HCSK001



Figure 1: HCSK001 in situ at Halton Castle (Image courtesy of Ben Goodburn).

Archaeothanatology

The burial of HCSK001 (Figure 1) is in a typical position for a Christian burial with an east to west orientation (Daniell, 1998). It is surmised that the body was wrapped in shroud that was loose but not so loose to allow that much movement of the remains during decomposition (Harris and Tayles, 2012). The clavicles are slightly rotated upwards and this is indicative of a shroud burial, further evidence can also be seen in the lack of movement of the os coxae and patella. During decomposition, the bones move slightly in the soil as the space around the remains increases. Movement of the mandible, the hands, cervical and lumbar vertebrae and the sternal body are typical of this occurrence.

The excavation records of HCSK001 (see Appendix 1) suggest that the hands and neck originally looked bound. This is a normal part of the decomposition process. Burials wrapped in a shroud have their hands clasped together. As the skin, ligaments, muscles, and fat surrounding the hands and pelvis decomposes the hand bones will move into the newly vacated area and this can lead to an appearance of binding. However, no ligature or rope was found in the burial. Similarly, the bones in the neck can move with the weight of the decomposing skull and this can lead to the disorganisation seen in Figure 1. This is not indicative of hanging or trauma. The hyoid bone and the second cervical vertebra were found intact and neither have signs of ante-mortem trauma. There is evidence of roots in the grave cut however, the roots have not moved or passed through the burial and have not caused any damage to the remains. There is no taphonomic evidence that suggests the remains were disturbed by human or animal activity before the excavation. The only damage that has occurred to the remains took place during their unexpected discovery during the excavation.

Condition & Preservation

Skeletal preservation depends on a number of factors, including age, sex, and robusticity of an individual. The burial environment, disturbance of burials, and the post-excavation treatment can also have an impact of the condition of the bones (Brickley, 2004). The preservation of the remains is assessed subjectively and based upon the

severity of bone surface erosion and post-mortem breaks, as well as completeness. Preservation is important as it can impact the quantity and quality of the information that could be obtained from the human skeletal remains.

HCSK001 is completely skeletonised: the bones are dry, lightweight, and smooth in texture. The skeleton is in a fairly good state of preservation: whilst there is some post-mortem damage and erosion from excavation, the individual is reasonably complete with only some of the hand and foot elements missing (see Appendix 2 and 3 for further details). Nonmetric traits, pathological conditions, and trauma are noted later in the report.

Minimum Number of Individuals

To determine the minimum numbers of individuals (MNI) present in this assemblage of skeletal remains it is necessary to account for each bone, separating them according to type and side. The remains can then be counted and corresponded with the opposite side to determine the number of individuals present. Any duplicates, or bones of different age or sex, suggest that more than one individual is present amongst the assemblage of remains (Adams and Konigsberg, 2004 and White and Folkens, 2005). HCSK001 showed no duplications of any bones, therefore MNI for HCSK001 indicates one individual.

Inventory

HCSK001 was assembled in anatomical position (Figure 2). Each bone, whether complete or fragmented was recorded from the cranium to the feet (see Appendix 2 and 3). The entire skeleton was examined macroscopically and any unusual features were photographed and recorded thoroughly for further examination.

HCSK001 is a reasonably complete skeleton with some fragmented elements. The crania showed evidence of post-mortem damage caused by a mattock. Unfortunately, during the excavations at Halton Castle, human skeletal remains were not anticipated; this led to the damage seen in the cranium. On the other hand, all fragments were fortunately

successfully collected so it would be possible for a full reconstruction of the skull to take place.



Figure 2: HCSK001 in anatomical position at Liverpool John Moores University.

The left ramus of the mandible has a post mortem break but the two pieces fit together and the mandible is complete. The splanchnocranium is reasonably complete; the right nasal however has sustained some damage and is incomplete. Both clavicles and left scapula are complete and well preserved. The right scapula has sustained quite extensive damage but is reasonably complete. The right proximal humerus and left proximal ulna have both sustained a single break across the neck, but are otherwise complete. The distal portion of the right radius is quite fragmented and incomplete. The other paired elements are complete. There are no carpals present for the right hand, only the 1st and 2nd metacarpal remain; with 3 proximal phalanx and only 1 intermediate phalanx remaining. The left hand is a little more complete: only the hamate, capitate, 1st, 4th and 5th metacarpal are missing. Additionally two proximal phalanx and 1 distal phalanx are missing. There are no hand sesamoids present.

All 7 cervical, 12 thoracic and 5 lumbar vertebrae are present and complete only the 8th thoracic arch has sustained post-mortem damage. The sacrum is complete although the coccyx is missing. Most ribs have sustained a single break; this is typical for most archaeological specimens as the rib is one of the most delicate elements. The manubrium and sternal body are present and complete.

The pelvis (both left and right os coxae) is complete; however a post-mortem break has occurred across the acetabulum of the right os coxae. The right femur is complete and undamaged; but whilst the left femur is complete, there is a post-mortem break across

the greater trochanter and it is consequently quite fragile. Both tibiae are complete and there is evidence of healed ante-mortem trauma for both elements. The proximal portion of the right fibula has a post-mortem break but it is complete. However, the left fibula is quite fragmentary. There is damage to both the distal and proximal portions of the bone; one is along an ante-mortem fracture. Both patella's are present and complete. The right foot is almost complete: only 2 intermediate phalanxes and the entire distal phalanx are missing. The left is missing the 3rd, 4th and 5th metatarsal and all the phalanx elements. All foot sesamoids are present.

Analysis was hindered by the fragmentary condition of HCSK001. To further understand this individual, the cranium was reconstructed using B72 Paraloid 60% mixed with acetone to join the fragments together, essentially reconstructing the skull (see Figure 3). This was completed by Satu Valoriani, an experienced PhD student from Liverpool John Moores University.



Figure 3: HCSK001 reconstruction: A, Satu Valorini working on the reconstruction. B, HCSK001 after reconstruction.

Age at Death Estimation

Age related changes in the skeleton reflect three different phases of lifespan: growth and development, equilibrium and senescence. The first phase is represented by children and young adults who undergo changes that proceed at a uniform and predictable rate in a well-documented pattern. However once growth has ceased the changes in the adult skeleton vary greatly and this is due to individual factors such as genetics, lifestyle, and occupation.

HCSK001 is an adult skeleton. For adults as many standards and methods as possible should be used when determining age at death because of the degenerative changes that occur across the skeleton. Brothwell (1981) reviewed dental attrition of the three permanent molars in British skeletons from the Neolithic to the medieval and produced a table which shows the dental wear patterns with corresponding specific age categories. Analysis of the degeneration of the pubic symphysis surface is considered to be one of the most reliable methods of estimating adult age at death when present (Buikstra et al., 1994). The Suchey-Brooks scoring system (Brooks et al., 1990) is used to identify the degenerate changes that alter the pubic symphysis surface. This method is broken down into 6 phases with an age range of 19 to 87 years of age. The auricular surface on the iliac crest is another area of degeneration used for ageing. Lovejoy et al., (1985) derived a chart dividing the assessment into 8 phases which describe the changes to the auricular surface that corresponds with an age range of 20 to 60+ years.

The dentition of HCSK001 has completed eruption and attrition to the mandibular molars has occurred, unfortunately the maxillary molars have been lost ante-mortem. Dental attrition was scored as 45+ years of age based on Brothwell's (1981) method. The os coxae of HCSK001 are complete so both auricular surfaces and pubic symphysis were also used to estimate age at death.

Table 1: Results of age at death estimations

Os Coxae	Left Side	Age Estimation	Right Side	Age Estimation
Auricular Surface	Phase 6	45-49 years	Phase 6	45-49 years
Pubic Symphysis	Phase 5	45.6 years	Phase 5	45.6 years

Table 1 shows the results for estimation of age for HCSK001. The auricular surfaces were assessed as a phase 6, giving an age at death of 45 to 49 years. The pubic symphyseal surfaces were assessed as phase 5, giving a likely age at death of 45.6 years. Combined with the dental attrition, an overall estimation of age for HCSK001 is 45 to 49 years (see Appendix 4).

Sex Estimation

Estimation of sex within a human skeleton is mainly made using the sexual dimorphic traits of the skull and the pelvis. Sex can also be determined by the diameter of the femoral and humeral head, additionally the radial head can also be used when material is available. An accuracy of 98% can be achieved from both the skull and the pelvis (Krogman, 1962). In any population male and female skeletons differ in size and shape, however there are also individuals that do not have defined skeletal characteristics, and therefore do not fall into a definite male or female group. Each attribute is scored on a 1 to 5 basis: 1 being mostly female and 5 being mostly male. Scores made at 3 are classed as ambiguous. The features on the skull and pelvis are quite sexually dimorphic in comparison to other sex estimation methods. The development of these attributes begins in puberty and continues through growth and age.

There are several indicators of sex on the pelvis, but these are only reliable when determining sex as an overall view of the pelvis rather than as individual markers. Idiosyncratic variation is very common amongst human skeletons. Sex estimation indicators include: the greater sciatic notch, the sub-pubic angle, the ventral arc, the sub pubic concavity and the ischiopubic ramus ridge. Table 2 shows the results of sex estimation for HCSK001. Sex determination of the skull is sometimes difficult to interpret due to idiosyncratic variation. Males normally have a larger and more robust skull, whereas females tend to have smoother and more delicate skulls. However this varies within modern human populations. There are five key features that usually survive archaeological and forensic contexts: the nuchal crest, the mastoid process, the mental eminence, the supra-orbital margin, and the supra-orbital ridge. Table 3 shows the results of sex estimation for HCSK001.

Table 2: Results of sex estimation using the os coxae

Os Coxae	Traits	Left Side	Right Side	Sex Estimation
Ilium	Greater Sciatic Notch	5	5	Male
Ilium	Pre-auricular sulcus	5	5	Male
Pubis	Sub-pubic angle	5	5	Male
Pubis	Sub-pubic concavity	5	5	Male
Pubis	Ventral arc	5	5	Male
Pubis	Ischiopubic ramus ridge	5	5	Male

Table 3: Results of sex estimation using the skull

Trait	Left Side	Medial	Right Side	Sex Estimation
Nuchal crest		4		Poss. Male
Mastoid processes	5		5	Male
Mental eminence		5		Male
Supra-orbital margin	5		5	Male
Supra-orbital ridge/Glabella		5		Male

Table 4: Results of sex estimation using humeral and femoral head diameter

Maximum Diameter	Left Side	Right Side	Sex Estimation
Humerus	44mm	n/a	Male
Femur	49mm	48mm	Male

Sex determination using metrics of the femoral and humeral head diameters are not as sexual dimorphic as the pelvis and skull, but are reasonable methods in the determination of sex when the skull and pelvis are not available or to corroborate estimations. Table 4 shows the results produced when examining these traits. Combining the results presented here it is clear that HCSK001 is very likely that of a male (see Appendix 4).

Ancestry

To further assess ancestry with as many methods as possible it was necessary to reconstruct the skulls. This work was undertaken by Satu Valoriani, an experienced PhD student at Liverpool John Moores University (see Figure 3). The cranium of HSK001 is almost complete with only post-mortem damage from the excavation remaining visible. The cranium was reconstructed using B72 Paraloid 60% mixed with acetone to join the fragments together and a pigmented wax (beeswax, pine resin and paraffin) used to fill in the missing fragments. Figure 4 shows before and after process of using wax in the reconstruction.



Figure 4: A, the reconstruction of HCSK001 cranium. B, HCSK001 after the missing areas have been filled with pigmented wax.

A non-metric evaluation was completed using various traits visible on the cranium to estimate ancestry. Table 5 displays a review of the traits observed, results suggest this individual is White European.

Table 5: Results of nonmetric traits in ancestry estimation

Element	Estimation	Element	Estimation
Incisors	n/a	Nasals	White
Zygomatrics	White	Dentition	White
Prognathism	White/Black	Nasal Sill	White
Palate	White	Nasion	White
Cranial Sutures	White	Cranial Vault	White
Nasal Spine	White	Mandible	White
Chin	White	Inion Hook	White
Ascending Ramus	White	Wormian Bones	White
Palatine Suture	White	Sagittal Arch	White
Nasal Profile	White	Incisor Rotation	White

Metric analysis was then undertaken by PhD Samuel Rennie, who has vast experience working with numerous collections of difference ancestral origin and using the Fordisc program. The results (Figure 5) shows that HCSK001 was placed almost central within the 19th Century White males group as indicated by the cross. The recorded metrics were

cross validated across 7 population groups generating a 70.6% accuracy level. Statistically the posterior probability is 0.858, the type chi is 0.254, and the type f is 0.383. This means that HCSK001 is most likely a white male as this is the group it is most similar to within the Howell's database.

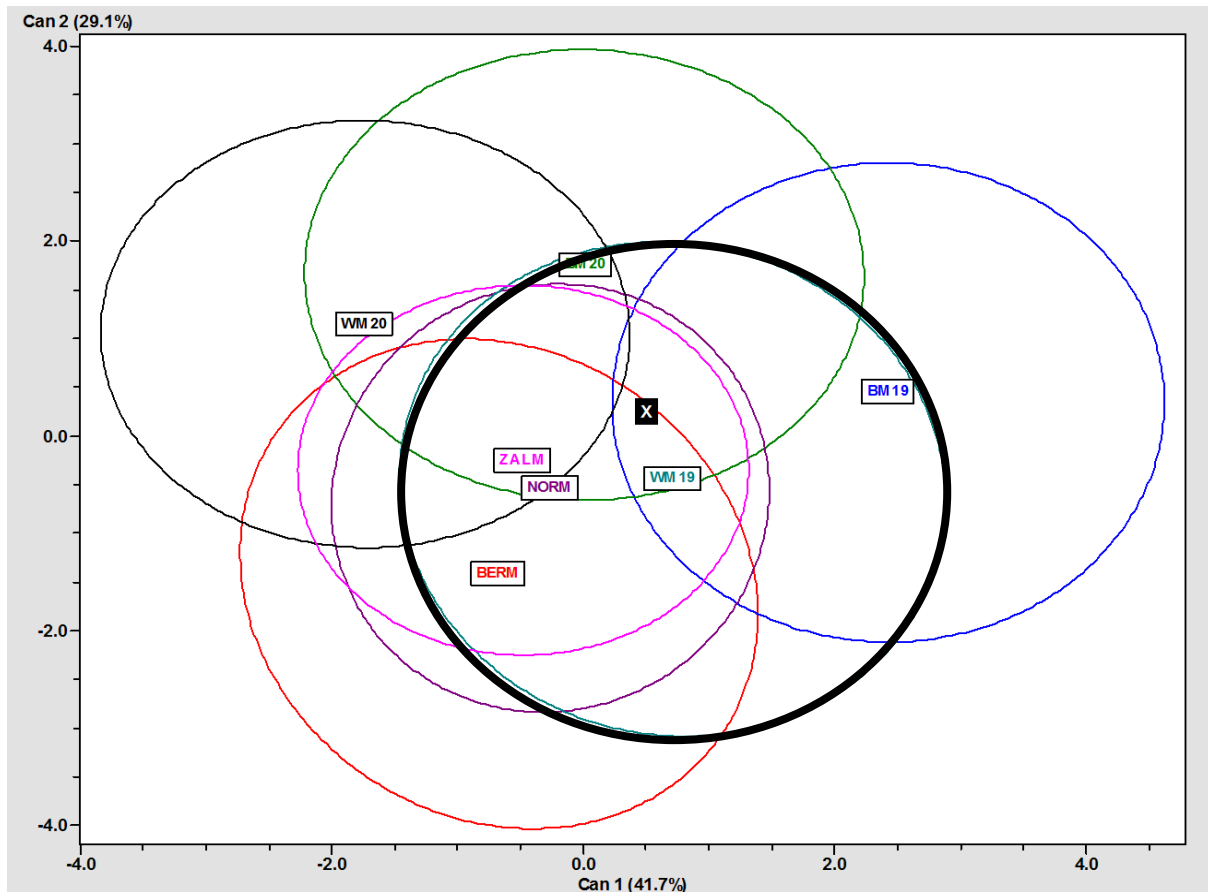


Figure 5: Classification of HCSK001.

Stature Estimation

Before an estimation of stature can be made the sex of the skeleton must be known. Although in most populations females are normally considered smaller than males there are individuals that fall outside these boundaries. To determine an accurate estimation of stature the maximum number of complete long bones possible must be measured. All bones are measured in cm to the nearest mm using an osteometric board. Bones with post-mortem fractures can be re-assembled and measured, provided that the breaks are clean, and only long bones with a maximum of three fractures can be measured. The

measurements of the: humerus, ulna, radius, femur, and fibula, are all rather simple to obtain as the maximum length is needed. The measuring technique of the tibia is slightly more complex as the intercondylar eminence must be excluded.

Many researchers have produced different regression equations to estimate stature from limb bone length using different long bones and for different reference populations. The formula used here was for White males (Trotter, 1952 and 1958) given that HCSK001 cranium observations estimated his ancestral origin to be that of a White European. The results for HCSK001 suggest a height of 172.3cm +/- 3.2cm approximately 5ft 7.7in (see Appendix 4).

Nonmetric Traits

Nonmetric, discontinuous or discrete traits are anomalies found within the range of normal anatomy of the human skeleton. They can include additional sutures, facets, bony processes or foramina that occur in a minority of skeletons. They are not measurable and are simply recorded as present or absent. Most, at least, have a genic basis, so they likely reflect possible relatedness between and within populations (Saunders, 1989). Nonmetric traits can be unilateral, bilateral, paired or single and can also be asymptomatic or pathological (Saunders and Rainey, 2008). It has been noted that some are produced by factors from occupational stress.

Recording the traits presented by Berry and Berry (1967) and Finnegan (1978), HCSK001 displays various cranial and postcranial traits. Cranial traits present include a partial metopic suture, bilateral supra-orbital, zygomatic, maxillary and mastoid foramina, bilateral auditory torus, an extra ossicle at the lambda junction, slight occipital bunning, bilateral single occipital condylar facets, and huschke foramina. Postcranial, traits include accessory sacral facet to the right ilium, bilateral ilium foramina and plaque formation to the femurs, hypotrochanteric fossa on the left femur, the right exhibits a third trochanter, and bilateral double facets to the talus and calcaneus articulates surfaces and peroneal tubercles. Lumbarisation of the first sacral body is evident.

Pathological Conditions

HCSK001 was macroscopically and microscopically examined for any pathology or trauma on each bone and fragment. The most obvious and striking pathology found was the ante mortem fractures sustained to both tibiae and fibulas that were further complicated by infections during healing. The left tibia and fibula exhibit an oblique fracture whereas the right displays a spiral fracture. Unfortunately the left tibia has evidence of osteomyelitis (Figure 6), a bone infection characterised by swelling and cloacae where the build-up of pus and necrotic liquid is able to leave the bone matrix. There is a considerable amount of mal-union in the left tibia and fibula (see Figure 6). Even though both lower limbs have sustained trauma, there is a 10mm difference in length between the two with distinct angulation to the left tibia.

The right tibia, fibula, and femur have been affected by periostitis, which is exhibited on dry bone by slight swelling and uneven surface of the periosteal bone. It is caused by infection and inflammation of the periosteal layer of bone which is an understandable response to the use of the right leg. The tibia is also at high risk of periostitis due to the thin layer of skin and fat that covers the anterior portion of the bone (the shin area).

The compression fractures seen in the T11 and T12 vertebrae are caused by the bone collapsing due to a weakening of the vertebral body. This is a very common fracture seen in skeletal collections affecting the lower thoracic and first lumbar vertebrae most frequently. They can often be caused by lifestyle and occupation as the vertebrae are no longer able to withstand normal bending, lifting, or even sneezing; however genetics and age can have an effect.



Figure 6: A, Spiral fracture to left tibia and fibula. B, Oblique fracture to the left tibia and fibula, mal-union and osteomyelitis is also evident.

Osteoarthritis is the most common pathology recorded in archaeological literature and is still remarkably common in modern populations. HCSK001 has signs of moderate to mild osteoarthritis. There are Schmorls nodes on several of the vertebrae: these depressions are caused when a protrusion of cartilage goes into the vertebral body and are frequently associated with osteoarthritis. There is additional osteophytic growth on the borders of the vertebral bodies that also indicate mild osteoarthritis. The vertebral column, whilst showing evidence of osteoarthritis, is expected in individuals of this age. The left and right acromioclavicular joints display signs of osteoarthritis and is more pronounced to the right hand side. There is also evidence of osteoarthritis to both ankle joints, likely related to the sustained trauma and altered gait

The posterior aspect of the manubrium and sternum has extensive porosity and pitting which reflects in some of the ribs. There is a distinct swell to the distal posterior portion of the left femur (Figure 7), likely osteomyelitis or a cyst related to the trauma sustained to both tibia and fibulas.



Figure 7: Slight swell to the distal portion of the left femur of HCSK001.

In regards to dental pathology, there is evidence of chronic periodontal disease on the mandible and maxilla. This disease is a common occurrence in both medieval and modern populations and is caused by a combination of poor dental hygiene, genetics, and diet. Periodontal disease can lead to ante-mortem tooth loss when the infection moves from gums and into the alveolar bone of the mandible and maxilla. Prolonged infection leads to a loss of the alveolar bone and consequently the tooth becomes loose and prone to fall out.

HCSK001 has lost first and second maxillary molars on both sides ante-mortem (see Appendix 3). As the alveolar bone has completely remodelled in these areas we know this occurred at least 6 months or more before this individual passed away. The high frequency of tooth loss is likely due to a combination of periodontal disease and caries, as the maxillary 4th premolars on the right side and the maxillary left 3rd premolar show evidence of active caries and abscess (Figure 8). The lower (mandible) right 1st molar has evidence of a severe cavity and an abscess on the roots. The 3rd premolar on the right side is also missing its cusp due to a combination of infection and caries.

There is significant attrition to all the teeth present and in particular there is interesting slanted attrition to the central upper incisors. This is most likely due to a combination of diet and altered eating habits due to the infection affecting the molars.



Figure 8: A, Lateral aspect of HCSK001 cranium taking from the right side, abscess is highlighted. B, Close up of the abscess.

Future Ambitions

This preliminary report shows the diverse amount of information that has been accumulated from HCSK001. There are however many more avenues to consider. Firstly we would like to do some radiographic analysis on this individual, particularly to explore the trauma sustained to the lower limbs. The left 2nd mandibular molar has been extracted and replicas have been made. This tooth has been sent for radiocarbon and isotope analysis with results expected before the end of the year. These results will not only provide us an approximate date but also an interpretation about HCSK001's diet and whether this individual is local to the North West area or from elsewhere in the United Kingdom. A consideration into aDNA analysis is also being sought. Alongside this, we are chasing the possibility of a facial reconstruction.

Finally, animal remains were found amongst the assemblage. Further review will be considered to identify what these remains are and their significance in relation to HCSK001.

Post-Excavation Analysis of HCSK002



Figure 9: HCSK002 in situ at Halton Castle (Image courtesy of Tom Fildes).

Archaeothanatology

The burial of HCSK002 (Figure 9) is in a typical position for a Christian burial with an east to west orientation (Daniell, 1998). It is surmised that the body was wrapped in shroud that was looser than HCSK001 (Harris and Tayles, 2012). The skeleton has moved slightly during decomposition evidenced by the slight tilt of the left side of the body, affecting the positioning of the arm, pelvis, and femur. This is likely due to the decline of the natural bedrock situated below the burial. Unfortunately, the hands have been disturbed during the excavation. They have been removed and placed alongside the lateral side of the right femur. This did not occur at the time of burial as the phalanges would still be in articulation, unlike what is seen here were no articulation remains.

Like HCSK001, there is evidence of roots within the grave cut however, the roots have not moved or disturbed the burial and have not caused any damage to the remains. There is no taphonomic evidence that suggests the remains were disturbed by human or animal activity before the excavation. The only damage recorded occurred from soil compression, mostly affecting the cranium and from excavation.

Condition and Preservation

Skeletal preservation depends on a number of factors, including age, sex and robusticity of an individual. The burial environment, disturbance of burials, and the treatment post-excavation can also have an impact of the condition of the bones (Brickley, 2004). The preservation of the remains is assessed subjectively depending on the severity of bone surface erosion and post-mortem breaks, as well as completeness. Preservation is important as it can impact the quantity and quality of the information that could be obtained from the human skeletal remains.

HCSK002 is completely skeletonised: the bones are dry, lightweight, and smooth in texture. The skeleton is in a fairly good state of preservation however, there is a considerable amount of post-mortem damage (see Appendix 6 and 7 for further details). Nonmetric traits, pathological conditions, and trauma are noted later in the report.

Minimum Number of Individuals

To determine the minimum numbers of individuals (MNI) present in this assemblage of skeletal remains, it is necessary to account for each bone, separating them according to type and side. The remains can then be counted and corresponded with the opposite side to determine the number of individuals present. Any duplicates, or bones of different age or sex suggest that more than one individual is present amongst the assemblage of remains. HCSK002 showed no duplications of any bones therefore, MNI for HCSK002 indicates one individual.

Inventory

HCSK002 was assembled in anatomical position (Figure 10). Each bone, whether complete or fragmented was recorded from the cranium to the feet (see Appendix 6 and 7). The entire skeleton was examined macroscopically. Any unusual features were photographed and recorded thoroughly for further examination.



Figure 10: HCSK002 in anatomical position at Liverpool John Moores University.

HCSK002 is more fragmentary than HCSK001 but is reasonably complete. The cranium is very fragmented and most of the splanchnocranium is missing however, a reconstruction on the remaining fragments was attempted. Both clavicles and scapula are present although significant post-mortem damage has occurred to both scapulae, likely due to the fragile nature of the bone. The left proximal humerus has sustained a post-mortem break across the neck, the left ulna and radius have sustained a clean break to the proximal portion of the shafts, and the distal portion of the right ulna has fragmented. Otherwise, the elements of both arms are complete. Both hands are almost complete but missing the

scaphoid, pisiform, triquetral, and 5th metacarpal. The left hand is missing the trapezoid and the right missing the lunate and hamate. Some proximal phalanges are present but majority or all of the intermediate and distal phalanges are missing. There are no hand sesamoids present.

The manubrium is complete but the sternal body is broken medially and is missing the distal portion. All the vertebrae are present and complete (7 cervical, 12 thoracic and 5 lumbar). Only the 4th thoracic vertebra has sustained some post-mortem damage to the neural arch. The sacrum is complete with coccyx although damage has been sustained to the 2rd, 3rd and 4th segment. Most of the ribs have sustained a single break but are complete; this amount of damage is typical for such fragile elements. There are signs of a possible healed fracture to the left ribs.

The pelvis (both left and right os coxae) is complete however; the left side has suffered post mortem damage to the ischium and pubic bone. The right femur, tibia, and fibula are complete, only the proximal portion of the fibula has sustained some damage, likely from excavation. Both patellae are present and complete. The left femurs, tibia, and fibula are complete although there is a post-mortem break to the medial portion of the femoral shaft and to the distal portion of the fibula. The left foot is almost complete only some of the intermediate and all of the distal phalanges are missing. The right foot is missing the 2nd, 3rd, 4th and 5th metatarsal and all of the phalanges. The foot sesamoids are present.

Like HCSK001, the analysis was hindered by the fragmentary condition of HCSK002's cranium and reconstruction was sought. To further understand this individual, the cranium was reconstructed using B72 Paraloid 60% with acetone to join the fragments together, essentially reconstructing the skull (see Figure 11). This was completed by Satu Valoriani, an experienced PhD student from Liverpool John Moores University.



Figure 11: HCSK002 reconstruction: A, HCSK002 after reconstruction. B, Satu Valorini working on the reconstruction.

Age at Death Estimation

Age related changes in the skeleton reflect three different phases of lifespan; growth and development, equilibrium and senescence. The first phase is represented by children and young adults who undergo changes that proceed at a reasonable and predictable rate in a well-documented pattern. Once growth has ceased, the changes in the adult skeleton vary greatly and are more individual and population specific.

HCSK002 is a skeleton of an adult skeleton. For adults as many standards and methods as possible should be used when determining age at death, due to degenerative changes that occur across the skeleton and dentition. Brothwell (1981) reviewed dental attrition of the three permanent molars in British skeletons from the Neolithic to the medieval and produced a table which shows the dental wear patterns with corresponding specific age categories. Analysis of the degeneration of the pubic symphysis surface is considered to be one of the most reliable methods of estimating adult age at death when present (Buikstra et al., 1994). The Suchey-Brooks scoring system (Brooks et al., 1990) is used to identify the degenerate changes that alter the pubic symphysis surface. This method is

broken down into 6 phases with an age range of 19-87 years of age. The auricular surface on the iliac crest is another area of degeneration used for ageing. Lovejoy et al., (1985) derived a chart dividing the assessment into 8 phases which describe the changes to the auricular surface that corresponds with an age range of 20 to 60+ years.

The dentition of HCSK002 has completed eruption and attrition to the molars has occurred. Dental attrition has been scored as 35-45 years of age based on Brothwell's (1981) method. The os coxae of HCSK002 are complete so both auricular surfaces and pubic symphysis can be used to estimate age at death.

Table 6: Results of age at death estimations

Os Coxae	Left Side	Age Estimation	Right Side	Age Estimation
Auricular Surface	3	30-34	3	30-34
Pubic Symphysis	3	30.7	3	30.7

Table 6 shows the use of Meindl's method (1985), the auricular surfaces were assessed as a phase 3, giving an age at death of 30 to 34 years. The pubic symphyseal surfaces were assessed as phase 3, giving a likely age at death of 30.7 years. Combined with the dental attrition, an overall estimation of age for HCSK002 is 30-34 years (see Appendix 8).

Sex Estimation

Estimation of sex within a human skeleton is mainly made using the sexual dimorphic traits of the skull and the pelvis. An accuracy of 98% can be achieved from both the skull and the pelvis. In any population, male and female skeletons differ in size and shape but, there are individuals who do not have defined characteristics and therefore do not fall into a definite male or female group. Each attribute is scored on a 1 to 5 basis; 1 being mostly female and 5 being mostly male. Scores made at 3 are classed as ambiguous. The features on the skull and pelvis are quite sexually dimorphic in comparison to other sex estimation methods. The development of these attributes begins in puberty and continues through growth and age. Sex can also be determined by the diameter of the femoral and humeral head the radial head can also be used when material is available.

There are several indications of sex on the pelvis but these are only reliable when determining sex as an overall view of the pelvis than as individual markers, as idiosyncratic variation is very common amongst human skeletons. Such sexual markers include the greater sciatic notch, the sub-pubic angle, the ventral arc, the sub pubic concavity and the ischiopubic ramus ridge. Table 7 shows the results of sex estimation for HCSK002. Sex determination of the skull is sometimes difficult to interpret due to idiosyncratic variation. Males normally have a larger and more robust skull in comparison to females who tend to be more smooth and delicate but, this varies with the human population today. There are five key attributes that would survive archaeological and forensic contexts, the nuchal crests, the mastoid process, the mental eminence, the supra-orbital margin and the supra-orbital ridge. Table 8 shows the results of sex estimation for HCSK002.

Table 7: Results of sex estimation using the os coxae

Os Coxae	Traits	Left Side	Right Side	Sex Estimation
Ilium	Greater Sciatic Notch	1	1	Female
Ilium	Pre-auricular sulcus	2	2	Female
Pubis	Sub-pubic angle	1	1	Female
Pubis	Sub-pubic concavity	1	1	Female
Pubis	Ventral arc	1	1	Female
Pubis	Ischiopubic ramus ridge	1	1	Female

Table 8: Results of sex estimation using the skull

Trait	Left Side	Medial	Right Side	Sex Estimation
Nuchal crest		1		Female
Mastoid processes	1		1	Female
Mental eminence		1		Female
Supra-orbital margin	1		1	Female
Supra-orbital ridge/Glabella		1		Female

Table 9: Results of sex estimation using humeral and femoral head diameter

Maximum Diameter	Left Side	Right Side	Sex Estimation
Humerus	41	n/a	Female
Femur	44	44	Indeterminate

Sex determination using metrics of the femoral and humeral head diameters are not as sexual dimorphic as the pelvis and skull but, are reasonable methods in the determination

of sex when little material is available. Table 9 shows the results produced when examining these traits. Combining the results presented here, it is clear that HCSK002 is likely that of a female (see Appendix 8).

Parturition

Further work was undertaken by Sarah Canty, a PhD student from Liverpool John Moores University whose research focuses solely on the parturition scaring seen on the os coxae. It has been long suggested that pregnancy and the act of giving birth leaves a lasting mark on the skeleton that can be observed after death (Ubelaker and De La Paz, 2012). However, this has not been proven and no clear method has been established. Currently, it is not possible to state whether an individual has even been pregnant or given birth from their skeletal remains. Research is being conducted into this area, one of which is the study of a trait on the pelvic bones called the preauricular sulcus. A grading system (Canty, 2014) has been created to assess this trait and is in the process of being tested and proven. HCSK002 has a Grade 2 and a Grade 3 sulcus. Grade 3 sulcus is thought to be linked to pregnancy and parturition however, until this method has been developed and established, it cannot be stated for certain.

Ancestry

To further assess ancestry with as many methods as possible it was necessary to reconstruct the skulls. This work was undertaken by Satu Valoriani, an experienced PhD student at Liverpool John Moores University. The cranium of HSK002 is almost complete with only some of the splanchnocranium is missing. The cranium was reconstructed using B72 Paraloid 60% with acetone to join the fragments together and a pigmented wax (beeswax, pine resin and paraffin) used to fill in the missing fragments. Figure 12 shows before and after process of using wax in the reconstruction.



Figure 12: A, the reconstruction of HCSK002 cranium. B, HCSK002 after the missing areas have been filled with pigmented wax.

A non-metric evaluation was completed using various traits visible on the cranium to estimate ancestry. Table 10 displays a review of the traits observed, results suggest this individual is White European.

Table 10: Results of nonmetric traits in ancestry estimation

Element	Estimation	Element	Estimation
Incisors	White	Nasals	White/Asian
Zygomatics	White	Dentition	White
Prognathism	White	Nasal Sill	White
Palate	White	Nasion	n/a
Cranial Sutures	White	High	Asian
Nasal Spine	White	Mandible	White
Chin	White	Inion Hook	White
Ascending Ramus	White	Wormian Bones	White
Palatine Suture	White	Sagittal Arch	White
Nasal Profile	White	Incisor Rotation	White

Metric analysis was then undertaken by PhD student Samuel Rennie, who has vast experience working with numerous collections of difference ancestral origin and using the Fordisc program. The results (Figure 13) show that HCSK002, as indicated by the cross, does not fit into any population group within the database. The group that was

closest was Norse females, with a posterior probability of 0.785, a type chi of 0.001, and a type r of 0.018. However, this does not mean that HCSK002 is a Norse female. Further analysis is required as some of the metrics were not possible to take.

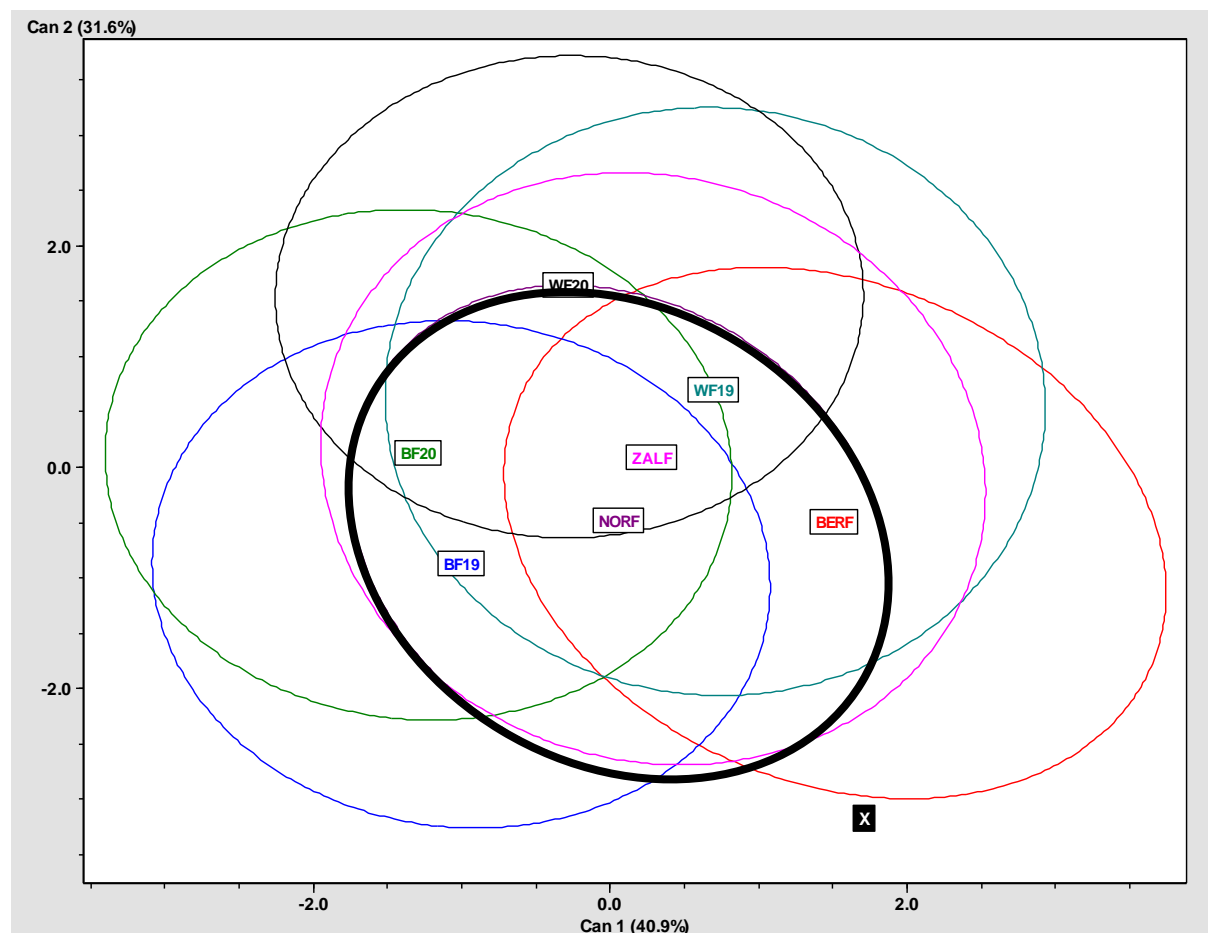


Figure 13: Classification of HCSK002.

Stature Estimation

Before an estimation of stature can be made, the sex of the skeleton must be known. In most populations females are normally considered smaller than males but, there are individuals that fall outside these boundaries. To determine an accurate estimation of stature as many of the long bones as possible must be measured. All bones are measured in cm to the nearest mm using an osteometric board. Bones with post-mortem fractures can be re-assembled and measured, provided that the breaks are clean, only long bones with a maximum of three fractures can be measured. The measurements

of the humerus, ulna, radius, femur and fibula are all rather simple the maximum length of these bones should be obtained. The measuring technique of the tibia is slightly more complex. The tibia is measured at its full length excluding the intercondylar eminence.

Many researchers have produced different regression equations to estimate stature from limb bone length using different long bones and for different reference populations. The formula used here was for White females (Trotter, 1952 and 1958) given that the HCSK002 cranium observations estimate her ancestral origin to be that of a White European. The results for HCSK002 suggest a height of 171.6cm +/- 3.5cm approximately 5ft 7.5in (see Appendix 8).

Nonmetric Traits

As mentioned earlier, nonmetric traits are anomalies found within the range of normal anatomy of the human skeleton. They can include additional sutures, facets, bony processes or foramina that occur in a minority of skeletons. They are not measurable and are simply recorded as present or absent. Most, at least, have a genetic basis, so they likely reflect possible relatedness between and within populations (Saunders, 1989). Nonmetric traits can be unilateral, bilateral, paired or single and can also be asymptomatic or pathological (Saunders and Rainey, 2008). It has been noted that some are produced by factors from occupational stress.

Recording the traits presented by Berry and Berry (1967) and Finnegan (1978), HCSK002 displays various cranial and postcranial traits. Cranial traits present include bilateral supra-orbital notches, bilateral zygomatic and maxillary foramina, bilateral auditory torus and single occipital condylar facets. Postcranial, traits include bilateral accessory clavicular and sacral facets, bilateral septal apertures, bilateral ilium foramina and hypotrochanteric fossa's, and bilateral single facets to the talus and calcaneus articulates surfaces and peroneal tubercles. There is congenital absence of all 3rd molars.

Pathological Conditions

HCSK002 was macroscopically and microscopically examined for any pathology or trauma on each bone and fragment. There is evidence of periostitis on both tibiae, a probable rib fracture, and some very mild linear enamel hypoplasia is visible on the lower central mandible incisors. There is also chronic periodontal disease present which is seen in most archaeological collections.

Linear enamel hypoplasia (LEH) is an indicator of 'systemic stress' during early childhood whilst the enamel is still forming on dentition. The stress can be nutritional, illness, environmental, or psychological. The hypoplasia occurs when the body is under so much 'stress' that it cannot continue producing enamel and this leaves thin bands of missing or thinned enamel on the teeth. The LEH on HCSK002 is very mild and the enamel is only slightly affected on the central mandibular incisors, canines and third premolars. Using the method compiled by Reid and Dean (2006) it was calculated that the 'stress' happened when HCSK002 was 3 years of age.



Figure 14: Unusual 'wedge' shape to the vertebrae from HCSK002.

There is a possibility that HCSK002 may have a genic condition called Marfan syndrome. To confirm this diagnosis genetic testing would be needed. The reasons for this tentative diagnosis is due partly because of how unusually elongated the long bones are but also

because of the unusual wedging of the lumbar vertebrae, in addition to the angling and compression of some of the thoracic vertebrae (Figure 14). It is unlikely that the wedge shape and compressed appearance of T11 and T12 is because of fracturing or osteoarthritis as none of the other evidence of these pathologies is present. The spinal column shaping is very similar to the shape of vertebra CT scans taken of Marfan syndrome sufferers in modern populations (Kaissi et al, 2013). It must be stressed however, that this is a speculative diagnosis and so therefore cannot be confirmed without DNA testing.

HSK002 also has chronic periodontal disease (Figure 15) and root exposure from the alveolar bone receding. There are also caries present on the right lower 4th premolar and 1st molar and the left 1st molar has evidence of a substantial cavity. There is also calculus present on the lingual side of the central lower incisors. Calculus is a build-up of hardened plaque which is caused by a combination of poor dental hygiene and genetic factors.



Figure 15: Dentition of HCSK002 displaying excessive periodontal disease.

Future Ambitions

This preliminary report shows the diverse amount of information that has been accumulated from HCSK002. There are however many more avenues to consider. Firstly we would like to do some radiographic analysis on this individual, particularly to explore the possible trauma sustained to the ribs. Further reconstruction of the crania is under arrangement for a reanalysis of the Howell's ancestry results. The left 2nd maxillary molar has been extracted and replicas have been made. This tooth has been sent for radiocarbon and isotope analysis with results expected before the end of the year. These results will not only provide us an approximate date but also an interpretation about HCSK002's diet and whether this individual is local to the North West area or from elsewhere in the United Kingdom. A consideration into aDNA analysis is also being sought. Alongside this, we are chasing the possibility of a facial reconstruction.

Finally, animal remains were found amongst the assemblage. Further review will be considered to identify what these remains are and their significance in relation to HCSK002.

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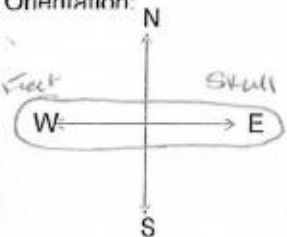
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Appendix List

- 1 – Context sheet of HCSK001
- 2 - Visual inventory of HCSK001
- 3 – Detailed inventory of HCSK001
- 4 – Post-X of HCSK001
- 5 – Context sheet of HCSK002
- 6 – Visual inventory of HCSK002
- 7 – Detailed inventory of HCSK002
- 8 – Post-X of HCSK002

Appendix 1: Context sheet of HCSK001

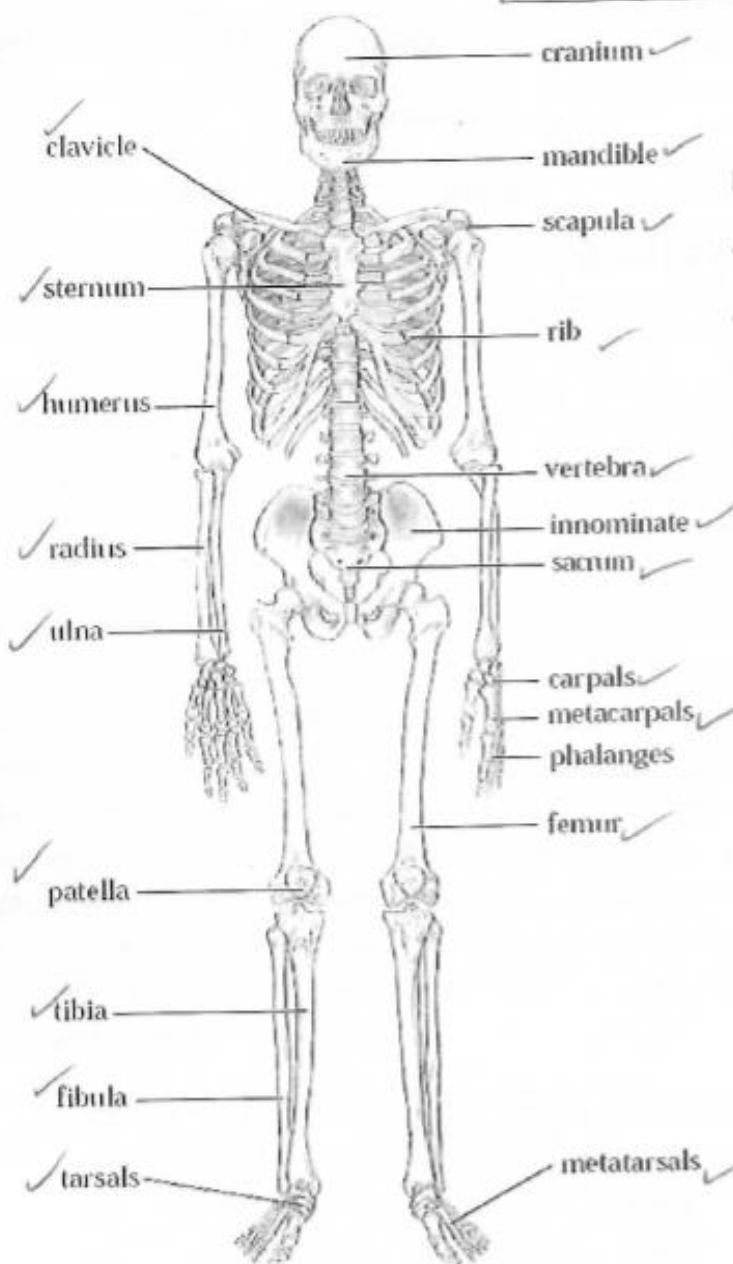
Skeleton Sheet

Site Code: HCR15	Area: <i>outer cemetery</i>	Trench: Trench 2	Context: Skeleton	<i>001 (Levy)</i>		
Date: 28/07/15	Recorded by: <i>KW</i>					
Level: Reduced :-	Skull:	Sacrum:	Feet:			
Grave Type: <i>Pit</i>	Grave Cut: <i>Steep sided ephemeral</i>	Grave Fill: <i>Mid-dk greyish black</i>	Coffin: <i>Not Present</i>			
Orientation: 	Sketch: <i>See photos.</i>					
<p>Description and Notes:</p> <p>Skeletal remains of adult male in a good level of preservation hand excavated in the middle segment of T2, remains are fully articulated with evidence of ligature perimortem activity to be 3/4 Cervical Vertebrae. Evidence of severe Stepped Fracture to be left tibia which has healed, similar extra pathology on right tibia. Both upper limbs + hands present and laid over pelvis, potentially bound; sex given on pelvic girdle + mastoid process. Located to be N of pit Feature and to W W of Structural post holes in T2. Bone at grave appears to be level on bedrock.</p>						
Above			(007)			
			001	Skeleton		
Below			NAT (003) <i>Bedrock</i>			
<p>Finds: Pot <input checked="" type="checkbox"/> Lithic <input type="checkbox"/> Bone <input checked="" type="checkbox"/> Metal <input checked="" type="checkbox"/> Other <input type="checkbox"/></p> <p>Small Finds: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></p>						
<p>Samples: <i>taken from beneath bone remains.</i></p>						
Plan:	Section:	Photo:				
Period:	Group:	Burial Number:				

record sheet based on MoLAS recording system

Mark the bones that were recovered

Skeleton Num: 001



Neonate? ☐

Juvenile? ☐

Adult? ☒

Male? ☐

Female? ☐

Age 25-30
Leopiphrasa
Fusion
Le Dent
eruption.

001

Lifting:
Preservation: Good: ☒ Moderate: ☐ Poor: ☐
Retrieval: Good: ☒ Moderate: ☐ Poor: ☐

Reburied?: Yes ☐ No ☒

Further treatment:

deposited with Water proof trust, an day of estimation.

Appendix 2: Visual Inventory of HCSK001



Halton Castle Skeleton Collection

Adult Skeleton Inventory

Skeleton Number: SK001

Grave Number:

Cut Number:

Fill Number:

Number of boxes: 2

Accession Number: 2015-2/5/1+2

Red Box Number: N/A

Recorder: CUB + CRD

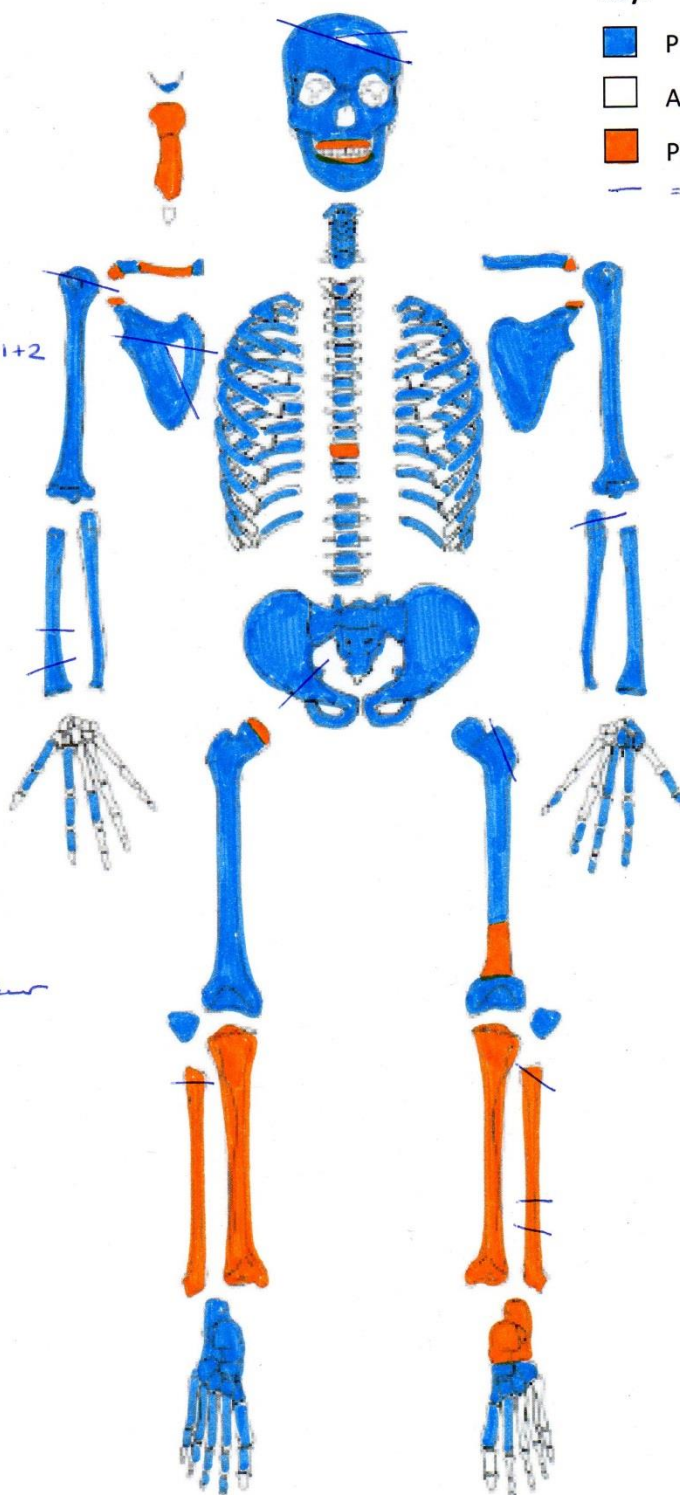
Date: 30/9/2015

Notes:

abscess at 46, 14, 34 + 135
 Dental abscess
 compressed fracture to T11
 crisis to sternum
 SA to both shoulders +
 hip + left foot
 possible fracture to
 clavicle
 Fracture to both tibia +
 fibula
 clearly visible evident
 deposits evident to
 lower limbs
 relating to distal left femur
 acromioclavicular of LS.

Key:

- Present
- Absent
- Pathology
- = PM Break



Appendix 3: Inventory of HCSK001

Skeleton Number: 001 Grave: Cut: Fill: Red Box Number: Date: 30/9/15
 Accession Number: 2015-213112

Skeletal Inventory:

P = Present. A = Absent.

Cranial:

Bone:	L	M	R	Bone:	L	M	R
Frontal	.....	P	.....	Sphenoid	.....	P	.....
Parietal	P	.....	P	Lacrima	P	.....	P
Occipital	.....	P	.....	Ethmoid	.....	P	.....
Temporal	P	.....	P	Vomer	.....	P	.....
Zygomatic	P	.....	P	Nasal	P	.....	P
Maxilla	P	.....	P	I.N.C.	P	.....	P
Palatine	P	.....	P	Hyoid	.....	P	.....
Mandible	.....	P	.....	Thyroid	.....	A	.....

Postcranial:

Bone:		L	M	R	Bone:	L	M	R
Sacrum	S1	.....	P	.....	Scapula	P	.....	P
	S2	.....	P	.....	Clavicle	P	.....	P
	S3	.....	P	.....	Manubrium	.....	P	.....
	S4	.....	P	.....	Sternal Body	.....	P	.....
	S5	.....	P	.....	Xiphoid	.....	A	.....
Os Coxae	Coccyx	.....	A	.....	Patella	P	.....	P
	Ilium	.....	P	P	1 st Rib	P	.....	P
	Ischium	.....	P	P	2 nd Rib	P	.....	P
	Pubis	.....	P	P	3 rd to 12 th Rib	10 (of 10)	.....	10 (of 10)
	Acetabulum	.....	P	P				
	Auric. Surface	.....	P	P				

Comments:

Carla Burrell.

Student Number: 383791.

Skeleton Number: 001 Grave: Cut: Fill: Red Box Number: Date: 30/9/15
 Accession Number: 2015.213112

Vertebrae:

Bone: Centrum Neural Arch Dens Anterior Arch

C1 P P P

C2 P P P

Bone: Centrum Neural Arch Bone: Centrum Neural Arch

C3 P P T7 P P

C4 P P T8 P P

C5 P P T9 P P

C6 P P T10 P P

C7 P P T11 P P

T1 P P T12 P P

T2 P P L1 P P

T3 P P L2 P P

T4 P P L3 P P

T5 P P L4 P P

T6 P P L5 P P

Long Bones:

Left Bone: Prox. Epi. Prox. 3rd Med. 3rd Dis 3rd Dis. Epi.

Humerus P P P

Ulna P P P

Radius P P P

Femur P P P

Tibia P P P

Fibula P P P

Comments:

Skeleton Number: 001 Grave: Cut: Fill: Red Box Number: Date: 3/9/15
 Accession Number: 2015-21511-2

Right Bone:	Prox. Epi.	Prox. 3rd	Med. 3rd	Dis 3rd	Dis. Epi.
Humerus	P	P	P.....	.....
Ulna	P	P	P.....	.....
Radius	P	P	P.....	.....
Femur	P	P	P.....	.....
Tibia	P	P	P.....	.....
Fibula	P	P	P.....	.....

Extremities:

Bone:	L	R	Bone:	L	R
Scaphoid	P	A	Calcaneus	P	P
Lunate	P	A	Talus	P	P
Hamate	A	A	Cuboid	P	P
Capitate	A	A	Navicular	P	P
Pisiform	P	A	Medial Cuneiform	P	P
Triquetrum	P	A	Intermediate Cuneiform	P	P
Trapezium	P	A	Lateral Cuneiform	P	P
Trapezoid	P	A	Metatarsals 1 st	P	P
Metacarpals 1 st	A	P	2 nd	P	P
2 nd	P	P	3 rd	A	P
3 rd	P	A	4 th	A	P
4 th	A	A	5 th	A	P
5 th	A	A	Proximal Phalanges	0	5
Proximal Phalanges	3	3	Medial Phalanges	0	2
Medial Phalanges	4	1	Distal Phalanges	0	0
Distal Phalanges	4	0	Sesamoids	2	2
Sesamoids	0	0			

Comments:

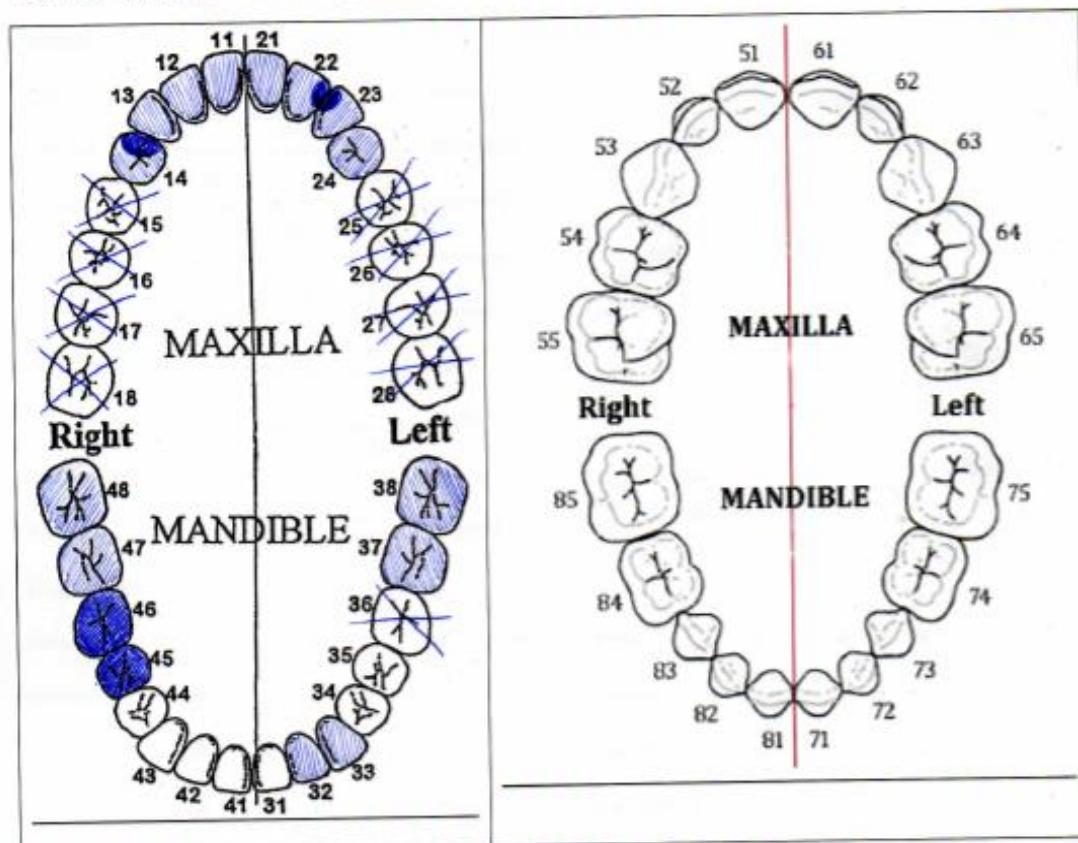
Carla Burrell.

Student Number: 383791.

Skeleton Number: 001 Grave: Cut: Fill: Red Box Number: Date: 30/9/15
 Accession Number: 2015.2/5/1+2

Dentition:

Coloured = Present. Blank = Absent/Post-mortem loss. Cross stroke = Absent/Ante-mortem loss.



Comments:

Abcesses at 46, 14, 34 + 35.
 Caries at 14, 22 + 23
 45 + 46 are root only.
 Periodontal disease evident.

#1 left second molar selected for ^{14}C + Strontium analysis &

Abnormalities: Distinct changes to left foot, 11 away from spine.
 OA to both acromioclavicular joints, to all T vert's and right fem head.
 Possible fracture to right clavicle
 Fracture to both distal humeri, midshaft radius
 Compression fracture to T11, T12.
 Swelling to left distal femur, infection from fracture? - mbs?
 Lesions to sternum - infection?
 Sacralisation of the L5 - congenital defect
 Perforations to all lower limb bones.

Percentage of Skeleton: > 75%

Photographs taken: Yes

Radiographs taken: T.S.A.

Carla Burrell.

Student Number: 383791.

Appendix 4: Post-Excavation Analysis of HCSK001

Skeleton Number: 56001 Grave: _____ Cut: _____ Fill: _____ Red Box Number: _____ Date: 30/9/13
 Accession Number: 2015-21511+2

General:

Adult

✓
.....

Subadult

.....

MNI:

1
.....

Comments: Some enamel remains present

Sex Estimation :

0 = Undetermined Sex. 1 = Female. 2 = Probable Female. 3 = Ambiguous Sex. 4 = Probable Male. 5 = Male.

Pelvis:

	L	R	Skull:	L	M	R
Greater Sciatic Notch	S	S	Nuchal Crest	.....	4	.....
Subpubic Angle	S	S	Mastoid Process	S	.....	S
Pre auricular Sulcus	S	S	Supra-Orbital Margin	S	.....	S
Ventral Arc	S	S	Glabella	.....	S	.....
Subpubic Concavity	S	S	Mental Eminence	.....	S	.....
Ischiopubic Ramus Ridge	S	S				

Humeral Head (mm):

	L	R	Femoral Head (mm):	L	R
Females <43mm	.....	.....	Female <43.5mm	.....	.....
Indeterminate 43-47mm	44	.....	Indeterminate 43.5-46.5mm	.....	.....
Male >47mm	.....	.....	Male >46.5mm	49	48

Overall Estimation:

Male
.....

Comments:

Age Estimation:

Overall Development of Dentition

21+ +/-

Dental Attrition

45+

Pubic Symphysis

	L	R	Auricular Surface	L	R
Phase	S	S	Phase	6	6
Age	45-6	45-6	Age	45-49	45-49

Carla Burrell.

Student Number: 383791.

Skeleton Number: 5001 Grave: _____ Cut: _____ Fill: _____ Red Box Number: _____ Date: 30/1/15
 Accession Number: 2015-215112

For Immature remains - Stage of Union:

0 = Unobservable. 1 = open. 2 = Partial Union. 3 = Complete Union.

Epiphyseal Fusion:

Bone:	Epiphysis:	L	R	Bone:	Epiphysis:	L	R
Scapula	Coracoid	.....	.....	Os Coxae	Iliac Crest	.....	.....
	Acromion	.....	.....		Triradiate	.....	.....
Clavical	Sternal	<u>3</u>	<u>3</u>		Ischiopubic Ramus	.....	.....
Humerus	Head	.....	.....	Femur	Head	.....	.....
	Distal	.....	.....		Greater Trochanter	.....	.....
	Distal Epicondyle	.....	.....		Distal	.....	.....
Radius	Proximal	.....	.....	Tibia	Proximal	.....	.....
	Distal	.....	.....		Distal	.....	.....
Ulna	Proximal	.....	.....	Fibula	Proximal	.....	.....
	Distal	.....	.....		Distal	.....	.....

Primary Ossification Centres:

Bone:	Area of Union:	Stage of Union:
Cervical Vertebrae	Neural arches to each other	.....
	Neural arches to centrum	.....
Thoracic Vertebrae	Neural arches to each other	.....
	Neural arches to centrum	.....
Lumbar Vertebrae	Neural arches to each other	.....
	Neural arches to centrum	.....

Overall Estimation: 45 to 49 Comments: _____

Carla Burrell.

Student Number: 383791.

Skeleton Number: SC001 Grave: _____ Cut: _____ Fill: _____ Red Box Number: _____ Date: 30/9/13
 Accession Number: 2015-215112

Stature Estimation:

Left Bone:	Length (cm):	Pieces:	Epi/Di:	Age:
Humerus	<u>32.6</u>	<u>1</u>	<u>Ep</u>	_____
Ulna	<u>26.7</u>	<u>2</u>	<u>Ep</u>	_____
Radius	<u>24.4</u>	<u>1</u>	<u>Ep</u>	_____
Femur	<u>46.7</u>	<u>1</u>	<u>Ep</u>	_____
* Tibia	<u>34.3</u>	<u>1</u>	<u>Ep</u>	_____ *
Fibula	_____	_____	_____	_____

Right Bone:	Length (cm):	Pieces:	Epi/Di:	Age:
Humerus	_____	_____	_____	_____
Ulna	<u>26.7</u>	<u>2</u>	<u>Ep</u>	_____
Radius	_____	_____	_____	_____
Femur	<u>46.2</u>	<u>1</u>	<u>Ep</u>	_____
* Tibia	<u>35.3</u>	<u>1</u>	<u>Ep</u>	_____ *
* Fibula	<u>34.8</u>	<u>2</u>	<u>Ep</u>	_____ *

Estimated Stature: 172.0 cm +/- 3.3 cm. 5 ft 7.7 in.

Comments:

* = Fracture present.
 Malunion evident in fractured bones.
 Stature estimation does not include fractured bones.

Abnormalities:

See inventory.

Photographs taken: Yes

Radiographs taken: To be Arranged.

Carla Burrell.

Student Number: 383791.

Appendix 5: Context Sheet of HCSK002

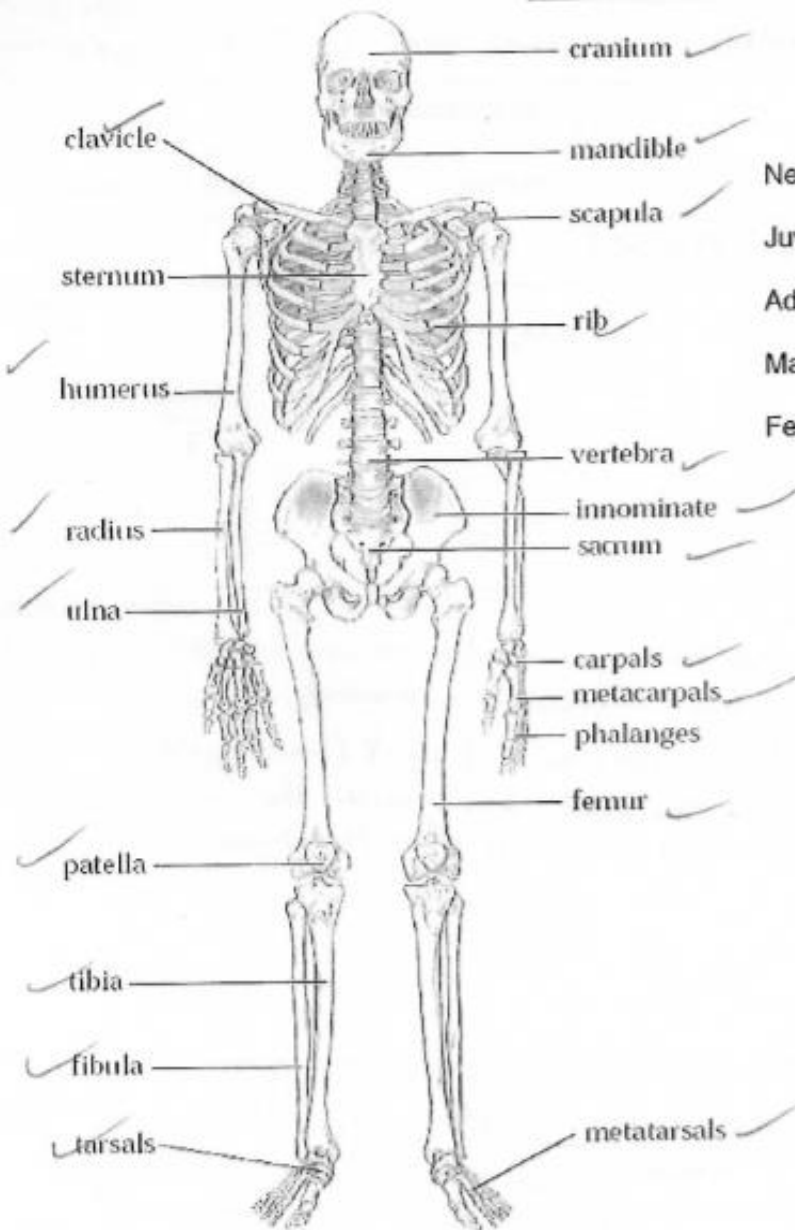
Skeleton Sheet

Site Code: HCRIS		Area: <i>outer Bailey</i>	Trench: <i>Trench 2</i>	Context: Skeleton <i>002</i>	
Date: <i>28/07/15</i>		Recorded by: <i>KW</i>			
Level: Reduced :-		Skull:	Sacrum:	Feet:	
Grave Type: <i>Pit</i>	Grave Cut: <i>See SK 001</i>	Grave Fill: <i>rich-dark greyish black</i>	Coffin: <i>not present</i>		
Orientation: 		Sketch: <i>See SK 001</i>			
Description and Notes: <i>Adult Female (?) skeletal remains uncovered in mid segment of T2, lying articulated with no visible post-mortem pathology, head E-W, placed not disarticulated (possibly thrown?) Right Radius/Ulna over right iliac, left radius/Ulna behind left iliac crest. Skull Cranial is highly fragmented although remnant is well preserved. Legs are pinned slightly to one (N).</i>					
Above				<i>(007)</i>	
				<i>SK 002</i>	Skeleton
Below				<i>NAT (508) bedrock</i>	
Finds: Pot <input checked="" type="checkbox"/> Lithic <input type="checkbox"/> Bone <input checked="" type="checkbox"/> Metal <input type="checkbox"/> Other <input type="checkbox"/>					
Small Finds:					
Samples: <i>from human remains</i>					
Plan:		Section:		Photo:	
Period:		Group:		Burial Number:	

record sheet based on MoLAS recording system

Mark the bones that were recovered

Skeleton Num: *Sk 002.*



Neonate? ☐

Juvenile? ☐

Adult? ☒

Male? ☐

Female? ☒

*Most of process
3rd metacarpal
epiphyseal
fusion.*

002

Lifting:
Preservation: Good: ☐ Moderate: ☒ Poor: ☐
Retrieval: Good: ☒ Moderate: ☐ Poor: ☐

Reburied?: Yes ☐ No ☒

Further treatment:

Deposited with North prairie trust after exhumation.

Appendix 6: Visual Inventory of HCSK002



Halton Castle Skeleton Collection

Adult Skeleton Inventory

Skeleton Number: SK002

Grave Number:

Cut Number:

Fill Number:

Number of boxes: 2

Accession Number: 2015.2/5/3+4

Red Box Number: N/A

Recorder: CLB, ERD

Date: 7/10/2015

Notes:

Fractures on both tibia
Possible rib fracture
Slight fracture to vertebrae
Impression fracture to
4th, 5th & 12th Thoracic
lumbar apophyses.
Calcaneus evident
Iliac evident
Lumbar evident

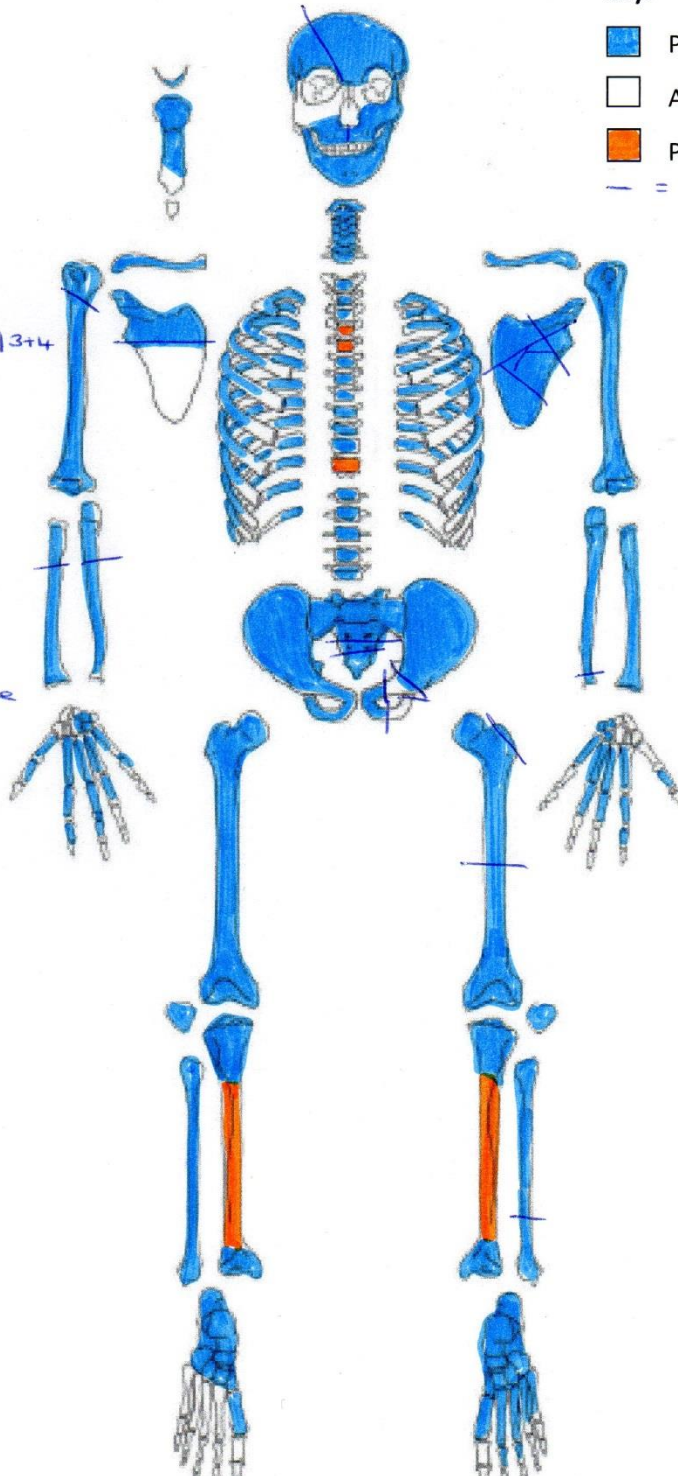
Key:

■ Present

■ Absent

■ Pathology

— = PM Beck



Appendix 7: Inventory of HCSK002

Skeleton Number: S4002 Grave: _____ Cut: _____ Fill: _____ Red Box Number: _____ Date: 7/10/13
 Accession Number: 205-2151374

Skeletal Inventory:

P = Present. A = Absent.

Cranial:

Bone:	L	M	R	Bone:	L	M	R
Frontal	.....	P	.....	Sphenoid	.....	P	.....
Parietal	P	.....	P	Lacrima	A	.....	A
Occipital	.....	P	.....	Ethmoid	.....	A	.....
Temporal	P	.....	P	Vomer	.....	A	.....
Zygomatic	P	.....	A	Nasal	A	.....	A
Maxilla	P	.....	P	I.N.C.	A	.....	A
Palatine	P	.....	P	Hyoid	.....	P	.....
Mandible	.....	P	.....	Thyroid	.....	A	.....

Postcranial:

Bone:		L	M	R	Bone:	L	M	R
Sacrum	S1	.....	P	.....	Scapula	P	.....	P
	S2	.....	P	.....	Clavicle	P	.....	P
	S3	.....	P	.....	Manubrium	.....	P	.....
	S4	.....	P	.....	Sternal Body	.....	P	.....
	S5	.....	P	.....	Xiphoid	.....	A	.....
	Coccyx	.....	P	.....	Patella	P	.....	P
Os Coxae	Ilium	P	.....	P	1 st Rib	P	.....	P
	Ischium	A	.....	P	2 nd Rib	P	.....	P
	Pubis	P	.....	P	3 rd to 12 th Rib	10 (of 10)	.....	10 (of 10)
	Acetabulum	P	.....	P				
	Auric. Surface	P	.....	P				

Comments:

Carla Burrell.

Student Number: 383791.

Skeleton Number: S 2002 Grave:
Accession Number: 2002 213134

Cut:

Fill:

Red Box Number:

Date: 7/10/15

Vertebrae:

Bone: Centrum Neural Arch Dens Anterior Arch

C1	P	P		P

C2	P	P	P	P

Bone: Centrum Neural Arch Bone: Centrum Neural Arch

C3	P	P	T7	P	P

C4	P	P	T8	P	P

C5	P	P	T9	P	P

C6	P	P	T10	P	P

C7	P	P	T11	P	P

T1	P	P	T12	P	P

T2	P	P	L1	P	P

T3	P	P	L2	P	P

T4	P	P	L3	P	P

T5	P	P	L4	P	P

T6	P	P	L5	P	P

Long Bones:

Left Bone: Prox. Epi. Prox. 3rd Med. 3rd Dis 3rd Dis. Epi.

Humerus	.....	P	P	P	.....
		
Ulna	.....	P	P	P	.....
		
Radius	.....	P	P	P	.....
		
Femur	.....	P	P	P	.....
		
Tibia	.....	P	P	P	.....
		
Fibula	.....	P	P	P	.....
		

Comments:

Carla Burrell.

Student Number: 383791.

Skeleton Number: SKE002 Grave: 20.5.2131314
 Accession Number: 20.5.2131314

Cut:

Fill:

Red Box Number:

Date: 7/10/13

Right Bone:	Prox. Epi.	Prox. 3rd	Med. 3rd	Dis 3rd	Dis. Epi.
Humerus	P	P	P.....	.....
Ulna	P	P	P.....	.....
Radius	P	P	P.....	.....
Femur	P	P	P.....	.....
Tibia	P	P	P.....	.....
Fibula	P	P	P.....	.....

Extremities:

Bone:	L	R	Bone:	L	R
Scaphoid	A	A	Calcaneus	P	P
Lunate	P	A	Talus	P	P
Hamate	P	P	Cuboid	P	P
Capitate	A	A	Navicular	P	P
Pisiform	A	A	Medial Cuneiform	P	P
Triquetrum	P	P	Intermediate Cuneiform	P	P
Trapezium	A	P	Lateral Cuneiform	P	P
Trapezoid	P	P	Metatarsals	1 st P	A
Metacarpals	1 st P	P	2 nd P	P	A
	2 nd P	P	3 rd P	P	A
	3 rd P	P	4 th P	P	A
	4 th P	P	5 th P	P	A
	5 th A	A	Proximal Phalanges	2	0
Proximal Phalanges	5	4	Medial Phalanges	0	0
Medial Phalanges	2	1	Distal Phalanges	0	0
Distal Phalanges	0	0	Sesamoids	1	1
Sesamoids	0	0			

Comments:

Carla Burrell.

Student Number: 383791.

Skeleton Number: 383791 Grave: 20.5.215/24
 Accession Number: 20.5.215/24

Cut:

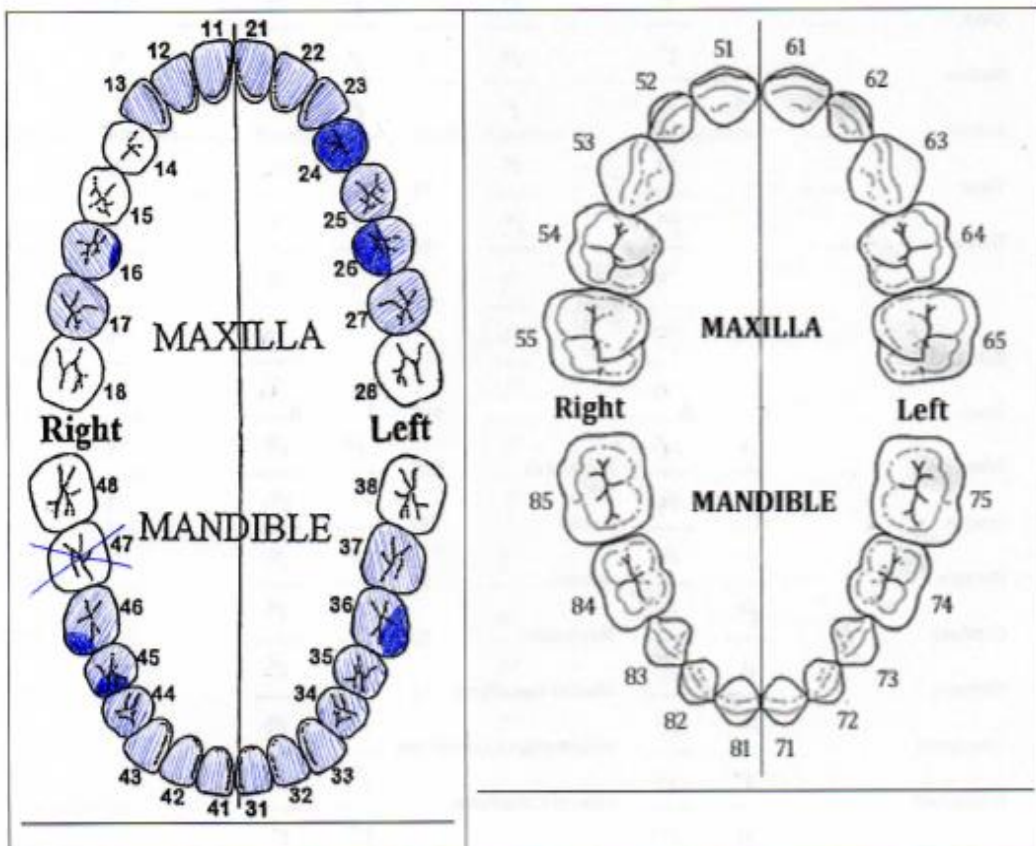
Fill:

Red Box Number:

Date: 21.01.5

Dentition:

Coloured = Present. Blank = Absent/Post-mortem loss. Cross stroke = Absent/Ante-mortem loss.



Comments:

Calculus evident
 Caries evident at 16, 26, 24, 36, 43 & 46
 24 is a root only.
 LHM evident

Radiographs needed of 3rd Molars

* Left second maxillary molar selected for ^{14}C and strontium analysis *

Abnormalities:

Persons taken to a
 Possible r.b. fracture
 curvature to the vertebral column - congenital?
 compression fractures to 4th, 5th & 12th Thoracic vertebrae
 Humeral fracture.

Percentage of Skeleton:

77.5%

Photographs taken:

Yes

Radiographs taken:

To Be Arranged

Carla Burrell.

Student Number: 383791.

Appendix 8: Post-Excavation Analysis of HCSK002

Skeleton Number: 5002 Grave: _____ Cut: _____ Fill: _____ Red Box Number: _____ Date: 02/01/13
 Accession Number: 2013-2151314

General:

Adult ☒ Subadult _____
 MNI: 1 Comments: Animal bones present

Sex Estimation :

0 = Undetermined Sex. 1 = Female. 2 = Probable Female. 3 = Ambiguous Sex. 4 = Probable Male. 5 = Male.

Pelvis:	L	R	Skull:	L	M	R
Greater Sciatic Notch	<u>1</u>	<u>1</u>	Nuchal Crest	<u>1</u>	<u>1</u>	<u>1</u>
Subpubic Angle	<u>1</u>	<u>1</u>	Mastoid Process	<u>1</u>	<u>1</u>	<u>1</u>
Pre auricular Sulcus	<u>2</u>	<u>2</u>	Supra-Orbital Margin	<u>1</u>	<u>1</u>	<u>1</u>
Ventral Arc	<u>1</u>	<u>1</u>	Glabella	<u>1</u>	<u>1</u>	<u>1</u>
Subpubic Concavity	<u>1</u>	<u>1</u>	Mental Eminence	<u>1</u>	<u>1</u>	<u>1</u>
Ischiopubic Ramus Ridge	<u>1</u>	<u>1</u>				

Humeral Head (mm):	L	R	Femoral Head (mm):	L	R
Females <43mm	<u>41</u>	<u>41</u>	Female <43.5mm	<u>44</u>	<u>44</u>
Indeterminate 43-47mm	<u>44</u>	<u>44</u>	Indeterminate 43.5-46.5mm	<u>44</u>	<u>44</u>
Male >47mm	<u>44</u>	<u>44</u>	Male >46.5mm	<u>44</u>	<u>44</u>

Overall Estimation: Female Comments: _____

Age Estimation:

Overall Development of Dentition 21+ +/- No 3rd Molars

Dental Attrition 35-43

Pubic Symphysis	L	R	Auricular Surface	L	R
Phase	<u>4</u>	<u>4</u>	Phase	<u>3</u>	<u>3</u>
Age	<u>35-2</u>	<u>38-2</u>	Age	<u>20-34</u>	<u>20-34</u>

Carla Burrell.

Student Number: 383791.

Skeleton Number: SK2 Grave: Cut: Fill: Red Box Number: Date: 21/5/34
 Accession Number: 2013-2151314

For Immature remains - Stage of Union:

0 = Unobservable. 1 = open. 2 = Partial Union. 3 = Complete Union.

Epiphyseal Fusion:

Bone:	Epiphysis:	L	R	Bone:	Epiphysis:	L	R
Scapula	Coracoid	.....	.....	Os Coxae	Iliac Crest	.....	.....
	Acromion	.....	.....		Triradiate	.....	.....
Clavical	Sternal	<u>3</u>	<u>3</u>	Femur	Ischiopubic Ramus	.....	.....
					
Humerus	Head	.....	.....	Femur	Head	.....	.....
	Distal	.....	.....		Greater Trochanter	.....	.....
	Distal Epicondyle	.....	.....		Distal	.....	.....
Radius	Proximal	.....	.....	Tibia	Proximal	.....	.....
	Distal	.....	.....		Distal	.....	.....
Ulna	Proximal	.....	.....	Fibula	Proximal	.....	.....
	Distal	.....	.....		Distal	.....	.....

Primary Ossification Centres:

Bone:	Area of Union:	Stage of Union:
Cervical Vertebrae	Neural arches to each other	.....
	Neural arches to centrum	.....
Thoracic Vertebrae	Neural arches to each other	.....
	Neural arches to centrum	.....
Lumbar Vertebrae	Neural arches to each other	.....
	Neural arches to centrum	.....

Overall Estimation: 30 to 34 Comments:

Carla Burrell.

Student Number: 383791.

Skeleton Number: SEA 2 Grave: _____ Cut: _____ Fill: _____ Red Box Number: _____ Date: 7/10/13
 Accession Number: 2013.2.13.314

Stature Estimation:

Left Bone:	Length (cm):	Pieces:	Epi/Di:	Age:
Humerus	<u>34.1</u>	<u>1</u>	<u>Ep</u>	_____
Ulna	<u>28.1</u>	<u>2</u>	<u>Ep</u>	_____
Radius	<u>24.4</u>	<u>1</u>	<u>Ep</u>	_____
Femur	<u>47.9</u>	<u>2</u>	<u>Ep</u>	_____
Tibia	<u>36.2</u>	<u>1</u>	<u>Ep</u>	_____
Fibula	<u>35.1</u>	<u>2</u>	<u>Ep</u>	_____

Right Bone:	Length (cm):	Pieces:	Epi/Di:	Age:
Humerus	_____	_____	_____	_____
Ulna	<u>26.4</u>	<u>2</u>	<u>Ep</u>	_____
Radius	<u>24.3</u>	<u>2</u>	<u>Ep</u>	_____
Femur	<u>48.4</u>	<u>1</u>	<u>Ep</u>	_____
Tibia	<u>32.3</u>	<u>1</u>	<u>Ep</u>	_____
Fibula	<u>36.7</u>	<u>1</u>	<u>Ep</u>	_____

Estimated Stature: 171.6 cm +/- 3.5 cm. 5 ft 7.5 in.

Comments:

Abnormalities:

See inventory.

Photographs taken: Yes

Radiographs taken: To Be Arranged.

Carla Burrell.

Student Number: 383791.