Osteological Analysis
Heronbridge
Chester
Cheshire

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Summary

York Osteoarchaeology Ltd was commissioned by the Chester Archaeological Society to carry out the osteological analysis of two skeletons recovered during archaeological excavations at Heronbridge, Chester (SJ 410 635). The skeletons had been interred in a mass grave, which was partly excavated in 2004. They were laid out in extended positions on their backs and partly overlaid one another. The skeletons have been radiocarbon dated to 530 to 660 AD and are thought to belong to the Battle of Chester 613 AD.

Osteological analysis revealed that both skeletons were male. Skeleton 1 was aged between 36 and 45, while Skeleton 2 was a young adult, aged between eighteen and 25 years. Both men suffered from physical strain on the spine. Skeleton 1 also showed evidence for joint degeneration in the spine and shoulders.

Skeleton 1 had battle injuries, which were well-healed and had been inflicted some time before death. Skeleton 1 had also suffered from a probable defence injury to the right thumb and a stab wound through the abdomen. Both individuals also suffered from several peri-mortem (at death) blade injuries, which were concentrated on the skull and were fatal. The skeletal evidence suggests that these men had died in battle and were probably buried soon after death in a mass grave together with other battle victims.

Acknowledgements

York Osteoarchaeology Ltd would like to thank Dr David Mason of the Chester Archaeological Society for his help and support.

1.0 INTRODUCTION

In September 2004 York Osteoarchaeology Ltd was commissioned by the Chester Archaeological Society to carry out the osteological analysis of two complete skeletons. The skeletons had been excavated in 2004 during an archaeological excavation at Heronbridge, Chester (SJ 410 635). This is a known multi-period site, which lies two kilometres to the south of Chester.

The site is a Scheduled Ancient Monument and includes the remains of a Roman roadside settlement that was occupied from AD 80 to at least AD 350. Evidence of Roman stone buildings, a shrine or temple, a quay, and a cemetery has been found (Mason, *pers. comm.*). A large sub-oval earthwork, which is as yet undated, is thought to have been a defensive earthwork. Medieval field systems and enclosures, possibly associated with a deserted medieval village have also been found at Heronbridge.

The skeletons had been interred beside one another in a mass grave, which had been partly excavated in 1930. Skeleton 1 lay against the northern edge of the 1930s excavation trench, while Skeleton 2 overlay Skeleton 1, to the north of it. The skull of skeleton 1 rested on the shoulder of Skeleton 2. The mass grave consisted of two rows of skeletons, aligned west to east, with the upper row along the eastern edge of the mass grave overlying the feet and lower legs of the lower row skeletons to the west. Approximately twenty skeletons were excavated and analysed in 1930 and the results of their analysis will be compared with the results from the 2004 excavations.

A number of animal bone fragments were found amongst the skeletal remains and are thought to have been residual. A ferrous object, thought to have been a nail, was recovered from beside the skull of Skeleton 1.

The mass grave is thought to cut Roman buildings and therefore thought to post-date the Roman period (Mason *pers. comm.*.). The burials have been radiocarbon dated to between 530 to 660 AD and are thus thought to date to the Battle of Chester AD 613, between King Aethelfrith of Northumbria and the forces of Gwynedd and Powys, or may derive from the later battle near Chester in AD 905, between Norse-Irish settlers, led by Ingimund and the inhabitants of Chester (*ibid*).

1.1 AIMS AND OBJECTIVES

The aim of the skeletal analysis was to determine the age, sex and stature of the skeletons, as well as to record and diagnose any skeletal manifestations of disease and trauma.

1.2 METHODOLOGY

The skeletons and disarticulated remains were analysed in detail, assessing the preservation and completeness, as well as determining the age, sex and stature of the individuals (Appendix A). All pathological lesions were recorded and described. The results of the osteological, palaeopathological and dental analysis were compared with those gained by Davies (1933), through his analysis of fourteen skeletons from the same mass grave.

2.0 OSTEOLOGICAL ANALYSIS

Osteological analysis is concerned with the determination of the identity of a skeleton, by estimating its age, sex and stature. Robusticity and non-metric traits can provide further information on the appearance and familial affinities of the individual studied. This information is essential in order to determine the prevalence of disease types and age-related changes. It is crucial for identifying gender dimorphism in occupation, lifestyle and diet, as well as the role of different age groups in society.

2.1 PRESERVATION

Skeletal preservation depends upon a number of factors, including the age and sex of the individual as well as the size, shape and robusticity of the bone. Burial environment, post-depositional disturbance and treatment following excavation can also have a considerable impact on bone condition. Preservation of human skeletal remains is assessed subjectively, depending upon the severity of bone surface erosion and post-mortem breaks, but disregarding completeness.

Preservation was assessed using a grading system of five categories: very poor, poor, moderate, good and excellent. Excellent preservation implied no bone surface erosion and very few or no breaks, whereas very poor preservation indicated complete or almost complete loss of the bone surface due to erosion and severe fragmentation.

Both skeletons were in a good condition (Table 1). They exhibited little erosion, but had suffered from several post-mortem breaks. The skulls were extremely fragmented, which this can probably be attributed to their fragility following substantial peri-mortem cranial trauma.

Table 1 Summary of osteological and palaeopathological results

Preservation	**Completeness**	**Age**	**Sex**	**Stature**	**Pathology**
Good	85%	36-45	Male	175.9 ± 2.99cm	Spinal DJD, Schmorl's nodes, DJD in clavicles, periostitis of left tibia, *enthesopathies*, four healed cranial depression injuries, three peri-mortem cranial blade injuries, a blade injury to the first proximal hand phalanx and the second lumbar vertebra
Good	90%	18-25	Male	176.4 ± 2.99cm	Schmorl's nodes, *coxa vara*, *cribra orbitalia*, five cranial peri-mortem blade injuries

The absence of some of the bones, including the right lower arm, right foot and left fibula of Skeleton 1 meant that it was 85% complete. The right fibula and foot of Skeleton 2 was missing, which meant that this individual was 90% complete (see Table 1).

2.2 MINIMUM NUMBER OF INDIVIDUALS

A count of the 'minimum number of individuals' (MNI) recovered from a cemetery is carried out as standard procedure in osteological reports on inhumations in order to establish how many individuals are represented by the articulated and disarticulated human bones (without taking the archaeologically defined graves into account). The MNI is calculated by counting all long bone ends, as well as other larger skeletal elements recovered. The largest number of these is then taken as the MNI. The MNI is likely to be lower than the actual number of skeletons which would have been interred on the site, but represents the minimum number of individuals which can be scientifically proven to be present.

The presence of an additional fourth and fifth metacarpal (palm bones) suggested a MNI of three individuals.

2.3 ASSESSMENT OF AGE

Age was determined using standard ageing techniques, as specified in Scheuer and Black (2000a; 2000b) and Cox (2000). Age estimation relies on the presence of the pelvis and uses different stages of bone development and degeneration in order to calculate the age of an individual. Age is split into a number of categories, from foetus (up to 40 weeks in *utero*), neonate (around the time of birth), infant (newborn to one year), juvenile (1-12 years), adolescent (13-17 years), young adult (ya; 18-25 years), young middle adult (yma; 26-35 years), old middle adult (oma; 36 to 45 years, mature adult (ma; 46+) to adult (an individual whose age could not be determined more accurately as over the age of seventeen).

Age was established using dental wear, as well as the deterioration of the joints of the pelvis and ribs. These criteria suggested that Skeleton 1 was aged between 36 and 45 years. Some of the joints of Skeleton 2 had not completed development and were in the process of fusing to the long bone shafts. This, together with the ageing criteria used to estimate age in Skeleton 1 suggested that this individual was a young adult, probably aged between 19 and 24 years (see Table 1).

2.4 SEX DETERMINATION

Sex determination was carried out using standard osteological techniques, such as those described by Mays and Cox (2000). Assessment of sex in both males and females relies on the preservation of the skull and the pelvis and can only be carried out once sexual characteristics have developed, during late puberty and early adulthood.

On the basis of the characteristics of the skulls and hips as well as measurements of the long bone joints, both skeletons were found to be male.

2.5 METRIC ANALYSIS

Stature depends on two main factors, heredity and environment. However, stature can also fluctuate between chronological periods. Stature can only be established in skeletons if at least one complete and fully fused long bone is present. The bone is measured on an osteometric board, and stature is then calculated using a regression formula developed upon individuals of known stature. In this instance, both mean were of similar height. Based on measurements of the tibia and femur, Skeleton 1 was 175.9cm tall, with a standard error of 2.99cm, while Skeleton 2 was 176.4cm tall, with the same standard error.

The men were tall for the Anglo-Saxon period as the Anglo-Saxon male mean stature was 172.3cm (calculated by Caffell 1997).

Leg measurements were obtained from the femora and tibiae and used to calculate robusticity indices. The *platymeria* index is a method of calculating the shape and robusticity of the femoral shaft. The femora of both skeletons were *platymeric* (broad and flat). The *platycnemia* index of the tibiae was calculated in order to establish the degree of tibial shaft flatness (the right tibial shaft was incomplete). The tibial shafts of Skeleton 1 were *eurycnemic* (of average dimensions), while the left tibial shaft of Skeleton 2 was flatter.

It was not possible to measure the crania, because severe trauma had caused considerable fragmentation of both skulls. Although both crania were reconstructed, the subsequent distortion was too severe to carry out accurate measurements and cranial shape calculations.

In general, the skeletons were tall and robust and measurements suggested that they had well-developed arm and leg muscles.

2.6 NON-METRIC TRAITS

Non-metric traits are additional sutures, facets, bony processes, canals and foramina, which occur in a minority of skeletons and are believed to suggest hereditary affiliation between skeletons (Saunders 1989). The origins of non-metric traits have been extensively discussed in the osteological literature and it is now thought that while most non-metric traits have genetic origins, some can be produced by factors such as mechanical stress (Kennedy 1989) or environment (Trinkhaus 1978).

A total of thirty cranial (skull) and thirty post-cranial (bones of the body and limbs) non-metric traits were selected from the osteological literature (Buikstra and Ubelaker 1994, Finnegan 1978, Berry and Berry 1967) and recorded. The majority of non-metric traits were observed on the skull. These were anomalies that would not have affected the individual.

Cranial traits are more likely to be genetic in origin than those noted on the remaining part of the skeleton, which can often be affected by mechanical stress. The latter included third trochanters, which are small raised areas at the back of the femora at the attachments of the *gluteus maximus* bottom muscle. The raised areas are thought to reflect strain on the muscle. Other post-cranial traits observed included *peroneal* tubercles (articular facets) on the left calcanei (ankle bones) of both skeletons. Additionally, lateral tibial squatting facets were noted on the distal tibiae of Skeleton 2. These facets are thought to be caused by habitual squatting, and may therefore be activity-related. None of these traits would have caused any symptoms.

Cranial non-metric traits observed included *ossicles in the lambdoid suture* of Skeleton 1 and *mastoid foramen extrasutural* and *sutural mastoid foramen* (small depressions on the skull surface) on the temporal bones of the same skeleton. The cranium of Skeleton 2 also exhibited a parietal foramen (small hole) at the top of the skull, *absent zygomaticofacial foramen* (absent small hole in one of the facial bones) and *ossicle at asterion* (an additional bone in the suture behind the ear). These minor anomalies were probably genetic in origin.

2.7 CONCLUSION

The osteological analysis of the skeletal remains established that the two complete skeletons were males, one of whom was young, while the other was middle aged. Both men were tall and strongly built. It is probable that they habitually carried out physical work.

Davies' report (1933; 46) on the skeletons excavated in 1930 suggests that these were male. Age could be established in fourteen of these individuals, two of which were young (younger than 35 years), while five individuals were aged under 60 and a further three were more mature adults. Considering the difficulties in estimating age in skeletal remains, it is probable that Davies overestimated the age of these individuals by up to twenty years. Davies (*ibid*; 47) suggests that stature was moderate to short compared with contemporary British standards, suggesting that these individuals may have been shorter than those excavated in the 2004 season. The 1930 skeletons also appeared robust with well-marked muscle attachments, similar to Skeleton 1 and 2.

3.0 PATHOLOGICAL ANALYSIS

Pathological conditions (disease) can manifest themselves on the skeleton, especially when these are chronic conditions or the result of trauma to the bone. The bone elements to which muscles attach can also provide information on muscle trauma and excessive use of muscles.

3.1 INFECTION

Evidence for infection was observed in Skeleton 1. The infection was characterised by superficial inflammatory lesions on the lateral surfaces of the left tibia (Plate 1); tibiae are the most likely bones to show evidence for inflammation because they are more vulnerable than to knocks than other parts of the body. The type of skeletal lesion (lamellar bone) on Skeleton 1's shin bone suggested that the inflammation was receding.

Plate 1 Inflammation in the form of lamellar bone (striations) on the left tibia of Skeleton 1

Inflammatory lesions on human bones can be indicative of infectious diseases, such as leprosy and syphilis, and of non-specific localised infection, such as varicose veins, leg ulcers or trauma to the shins. However, the lesions only form in the bone if the inflammation is chronic and long-standing (Roberts and Manchester 1995, 125). Evidence for infection was common before the introduction of antibiotics and is therefore frequently observed in populations derived from archaeological contexts.

3.2 METABOLIC CONDITIONS

Skeleton 2 suffered from fine pitting of the eye orbits, termed *cribra orbitalia*. This tends to develop during childhood and often recedes during adolescence or early adulthood. It is thought to be related to iron deficiency anaemia, which was one of the most common metabolic conditions in the past. Symptoms of iron deficiency anaemia include gastro-intestinal disturbance, shortness of breath, fatigue, pallor and palpitations (Roberts and Manchester 1995, 167).

The causes of iron deficiency anaemia are complex, as factors affecting the development of anaemia include environment, hygiene, and diet (Stuart-Macadam 1992, 160). All of these factors can affect the pathogen load (bacteria) in a population, which often contributes to a high prevalence of iron deficiency (*ibid*). In single individuals, other causes of iron deficiency include severe blood loss following injury and destruction of red blood cells (Kent 1992, 2), cancer and parasitic gut infection (Roberts and Manchester 1995, 166). The cause *cribra orbitalia* could not be identified in this individual.

3.3 DEGENERATIVE JOINT DISEASE

The term joint disease encompasses a large number of conditions with different causes, which all affect the articular joints of the skeleton. Factors influencing joint disease include physical activity, occupation, workload and advancing age, which manifest as degenerative joint disease and osteoarthritis. Alternatively, joint changes may have inflammatory causes in the *spondyloarthropathies*, such as sceptic or rheumatoid arthritis. Different joint diseases affect the articular joints in a different way, and it is the type of lesion, together with the distribution of skeletal manifestations, which determines the diagnosis.

The most common type of joint disease observed tends to be degenerative joint disease (DJD). DJD is characterised by both bone formation (osteophytes) and bone resorption (porosity) at and around the articular surfaces of the joints, which can cause great discomfort and disability (Rogers 2001).

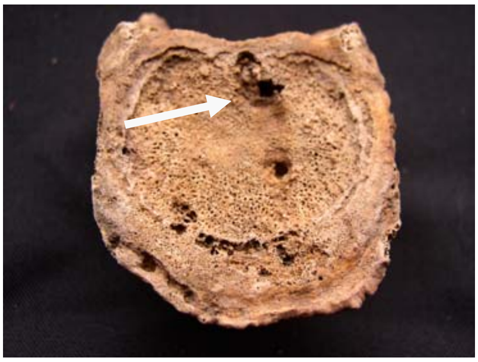

Plate 2 DJD and Schmorl's node (arrow) on thoracic vertebra of Skeleton 1

Skeleton 1 suffered from moderate porosity on the lateral clavicle joints (shoulders), as well as mild porosity and osteophyte formation on the vertebral bodies of the fifth to eleventh thoracic vertebrae and the third to fifth lumbar vertebrae (Plate 2). The intervertebral discs are the 'shock absorbers' of the spine, but these can degenerate as a result of gradual desiccation, which then causes transmission of the stress from the vertebral discs to the articular facets and ligaments (Hirsh 1983, 123). Spinal osteophytes (outgrowths of bone) form in response to the constant stress that is placed on the spine as a result of human posture (Roberts and Manchester 1995, 106) to compensate. Increasing stress or activity can therefore lead to increased size and prevalence of osteophytes (*ibid*). No evidence for DJD was noted in Skeleton 2, which was not unexpected, considering this man's young age.

A different condition which affects the spine is Schmorl's nodes. Schmorl's nodes are indentations in the upper and lower surfaces of the vertebral bodies (see Plate 2), most commonly in the lower thoracic vertebrae (Hilton *et al* 1976). Schmorl's nodes can result from damage to the intervertebral discs, which then impinge onto the vertebral body surface (Rogers 2001), and may cause necrosis (death) of the surrounding tissue. Rupture of the discs only occurs if sufficient axial compressive forces are causing pressure on the central part of the discs; frequent lifting or carrying of heavy loads can cause this.

Plate 3 Schmorl's node on lumbar vertebrae of Skeleton 1

Schmorl's nodes were observed on the fifth to eleventh thoracic vertebrae of Skeleton 1 and the sixth thoracic to fifth lumbar vertebrae of Skeleton 2 (Plate 3). The high prevalence of Schmorl's nodes in this assemblage was similar to that found in soldiers from a mass grave from the Battle of Towton AD 1461 (Coughlan and Holst 2000, 68). This was attributed to the physical stresses the soldiers must have undergone, either through carrying weights on their marches, or during civilian life, in their daily activities.

3.4 TRAUMA

3.4.1 Muscular Trauma

Occasionally, it is possible to infer trauma to the soft tissue on the bones, in the form of ligamentous or muscular trauma. This is expressed through the formation of bony processes (*enthesopathies*) at the site of ligament attachments. Additionally, it is possible to observe bone defects at the site of muscle insertions, which are the result of constant micro-trauma and are usually activity-related (Hawkey and Merbs 1995, 334).

Muscle trauma in the form of cortical bone defects was observed on the ulnae of Skeleton 2, at the attachment sites for *brachialis* (elbow muscle). This muscle is responsible for flexing the forearm (Stone and Stone 1990). Further upper limb muscle trauma was noted on the left humerus of Skeleton 2, at the attachment site of *triceps*, which extends the forearm, and aids in adduction. The evidence suggests that Skeleton 2 carried out activities which required flexion and extension of the forearm, used for activities, such as lifting objects.

Several cases of muscular trauma were also observed in the lower limbs of Skeleton 1. They included *enthesopathies* on the attachment sites of the Achilles' tendon at both feet and on the tibiae at the attachment site of soleus. These muscles cause the tip of the foot to move downwards, an action required for walking, climbing and squatting. The skeleton also showed evidence for muscular strain to *gluteus maximus*, the main muscle of the bottom. This muscle extends and laterally rotates the hip joint and extends the trunk. It is possible that Skeleton 1 sustained the leg and foot *enthesopathies* through activities such as long-distance walking. Skeleton 1 also displayed cortical defects at the attachment sites of subscapularis on both humeri, which is one of the rotator cuff muscles and medially rotates the arm, assists in extension and flexion, abduction and adduction (Stone and Stone 1990).

3.4.2 Circulatory Disease

The femora of Skeleton 2 displayed some shortening of the femoral necks, also termed *coxa vara*. This condition can have a number of different causes, including Perthes' disease (inflammation of the hip joint, probably due to interference of blood supply), slipped femoral epiphysis (hip joint) or a*vascular necrosis* (death of bone due to limited blood supply). However, the lack of evidence for joint disease and other skeletal manifestations helpful for a diagnosis means that this individual suffered from shortening of the femoral neck with an undiagnosed cause.

3.4.3 Weapon Trauma

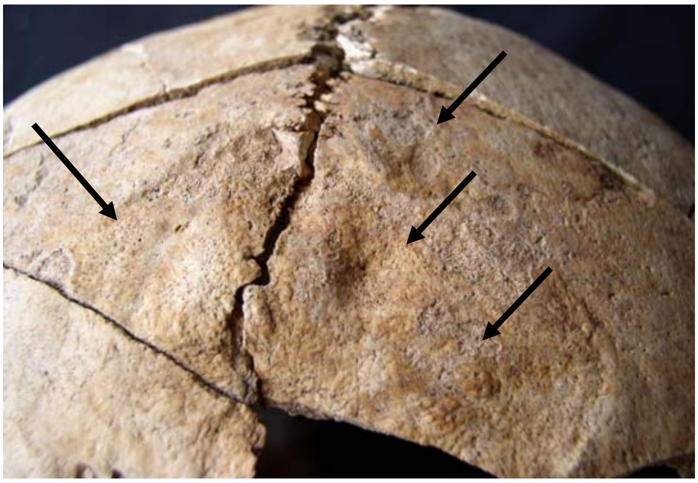

Plate 4 Healed depression fractures on skull of Skeleton 1

This most striking type of pathology, in this case, was the high prevalence of weapon trauma observed in these two individuals. Skeleton 1 had suffered from four healed depression injuries on the skull, which were thought to have been caused some time before death. All four injuries were roughly circular in shape, with irregular edges and contours, and were between 10.0 to 15.5 mm in diameter (Plate 4). The injuries were located around the bregma (approximately just above the hair line above the forehead). They were probably inflicted with the same blunt force weapon, such as a hammer. Fortuitously for the victim, none of the blows had penetrated the skull, thus aiding survival. The presence of these injuries suggests that this individual was a war veteran, who had survived earlier battles.

Plate 5 Cut in thumb of Skeleton 1

This individual also displayed a number of peri-mortem ('at death') injuries. The least severe blade wound was a shallow cut, observed on the thumb (probably the right side, although this was not clear) (Plate 5). It is possible that this was a defence injury. The injury showed no evidence of healing.

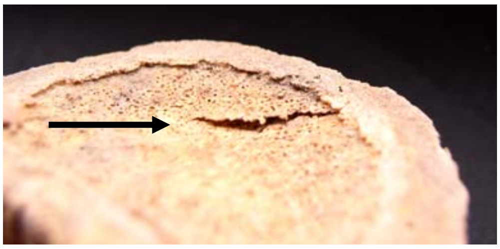

Plate 6 Cut in second lumbar vertebra of Skeleton 1

A further blade injury was noted on the anterior surface of the second lumbar vertebra. A stab wound had penetrated this bone from the front, with the tip of the blade cutting through the vertebra, into the intervertebral disk. The first lumbar vertebra above the injury had not been affected. It is probable that the attack came from the right and front of the victim, stabbing towards the back and left. The bladed weapon, which was almost certainly a fine sword, long dagger or knife, therefore cut through the lower abdomen of the victim, with the tip of the weapon entering the vertebra.

Plate 7 Two of the three peri-mortem cuts on the skull of Skeleton 1

In addition to the two post-cranial injuries, this man also exhibited evidence for four peri-mortem skull injuries. All of these were blade cuts, concentrated on the very top of the skull. It was possible to sequence three of the cuts, on the basis of the fractures lines emanating from them, which ran into one another.

The first injury sliced across the right parietal, with the attacker probably standing to the right of the victim. This cut was 85.8mm long. The second blade injury was perpendicular to the first, thus creating a cross or X-shape on the right parietal (Plate 7). This cut extended onto the frontal (forehead) and was 114.7mm long, probably deriving from the front and right side of the victim. The fracture lines from this cut ran into those from the first injury, indicating that this cut was later. The third blade injury was less easy to define, running across the left part of the frontal to the centre of the left parietal and was 94.8mm long. This injury did not exhibit the sharp, smooth cut surface, characterising the other two cuts. However, it is probable that this injury was also caused by a bladed weapon. The victim may have fallen by this point and the weapon may have been obstructed by something from entire penetration of the skull, thus just shattering the bone in a linear fashion. It is probable that the attacker stood on the left side of his victim. The fracture lines originating from this injury ran into those created by the earlier blows.

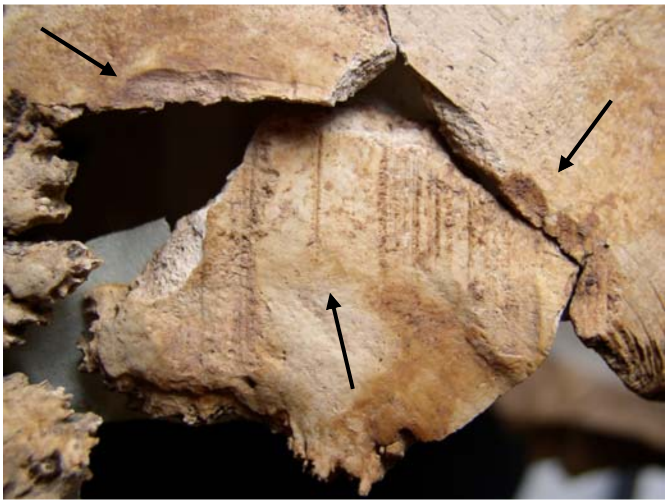

Plate 8 Shallow cut mark at the right ear of Skeleton 1

A fourth bladed injury, which could not be sequenced, was located on the right parietal, just behind the ear (Plate 8). This was a shallow injury, which did not penetrate the skull bone. The upper limit of the injury was clearly defined by a relatively deep horizontal line, from which vertical lines of irregular length emanated downwards, almost in a comb-like manner, but irregularly spaced. The appearance of this injury suggests that a bladed weapon, with a worn, irregular edge was used to deal a glancing blow to the right side of the head, almost parallel to the side of the head. It is probable that this was carried out with the handle end of a sword or dagger blade. Whether this was a failed attack on the head, or was done in a deliberate fashion could not be established. However, it was a very different injury to those observed in the ear region of the Towton AD1461 battle victims, which were characterised by shallow horizontal cuts and were interpreted as cutting ears off as trophies.

Plate 9 Skull of Skeleton 2 with two visible blade injuries

It is probable that Skeleton 1 was attacked by one or several individuals with bladed weapons. He suffered a defence injury to the thumb, as well as three fatal cranial blade injuries and one cranial injury which may have been related to trophy-gathering. Whether the abdominal stab wound was the first injury, or last injury this individual had suffered could not be established. However, it is probable that this man was not wearing protective clothing.

Skeleton 2 suffered from five cranial weapon injuries, all of which were peri-mortem (Plate 9). The first injury was a blade cut through the centre of the skull, which probably came form the right side of the victim. The cut was a severe, vertical blow, causing a wide rift in the top of the skull and splitting the skull in two through the emanating fracture lines. This cut was 66.6mm long (Plate 9 and 10) and showed evidence of internal bevelling, which is caused when the skull is hit from the outside with considerable force.

Three further injuries followed, which could only be partly sequenced. A further cut, which was 71.3mm long, sliced off the very back of the skull (Plate 10 and 11). This was carried out with some force using a fine bladed weapon, such as a sword. Fracture lines originating from the cut ran downwards into the foramen magnum, the hole at the base of the skull, into which the spinal cord runs.

Plate 10 The central and back cuts on the skull of Skeleton 2

Two further injuries were noted on the frontal bone (forehead), which also post-dated the first injury (see Plate 9). The first cut derived from the right of the victim, towards the front, and was 38.3mm long, thus cutting diagonally across the frontal bone. This injury had produced fracture lines, which ran downwards and to the back of the skull.

Plate 11 The central and back cuts on the skull of Skeleton 2

A fourth injury was noted in the centre of the forehead, running in the same direction as the previous cut. It was 24.5mm long, and came from the front and right of the victim, at an oblique angle.

The final injury was noted on the right zygomatic (cheek bone) of this man (Plate 12). It could not be sequenced, but considering that the attacker was moving further towards the face of his victim, this is likely to be the final injury inflicted. The cut penetrated the zygomatic bone from above, with the tip of the weapon at the nose end of the bone. The weapon would have passed just in front of the eye of the victim. The cut was very fine, suggesting that it was carried out using a fine sword or large knife, and was 27.5mm long.

Plate 12 A blade injury on the right cheek bone of Skeleton 2

Skeleton 2 did not exhibit any injuries on the torso, suggesting that he may have been wearing some type of body protection. However, the severity and extent of his cranial injuries implies that he was not wearing a helmet when attacked. At least two of his cranial injuries would have been fatal, thus rendering the other injuries ‘superfluous’. It is therefore possible that the attacker was experiencing a ‘red mist’ affect, when losing all sense of proportion in the midst of battle.

3.5 CONCLUSION

The skeletal evidence suggests that these men suffered from a variety of pathological conditions. Skeleton 1 suffered from joint degeneration of the spine and shoulders, as well as damage to the vertebral discs in the lower spine, which was probably the result of carrying heavy loads. He also suffered from muscular trauma, indicative of walking and rotator cuff strain. Four healed skull injuries suggest that this man was a battle veteran, who had successfully survived a previous conflict. However, the extent of his four cranial blade injuries, as well as a stab wound to the abdomen bear witness to the ferocity of his last encounter.

Skeleton 2 was a young, healthy man, with the exception of an episode of possible iron deficiency during childhood. He had also been subject to a vicious attack, which left him with five cranial injuries, probably inflicted one after the other. Although the first injury split his head in half and was probably fatal, the attacker continued to assault his victim.

The report on the skeletal remains excavated in 1930 does not describe the general health of the skeletons analysed. Notably, nine of the skulls analysed by Davies (1933, 47) exhibited evidence for injury, thought to have been inflicted using bladed weapons '...of long leverage…' such as long-swords. Because the injuries occurred on the top of the skull, Davies suggests that the attackers may have been on horseback (*ibid*). Davies also describes a healed depression injury on the left parietal of Skeleton 17.

The evidence from the 1933 report on the skeletons suggests that the individuals suffered similar injuries to those excavated in the 2004 season, including both healed depression injuries, as well as peri-mortem blade wounds, which were inflicted primarily to the skull.

4.0 DENTAL HEALTH

Analysis of the teeth from archaeological populations provides vital clues about health, diet and oral hygiene, as well as information about environmental and congenital conditions. All 32 teeth survived in the jaws of both skeletons. The severe periodontal disease (receding gums) observed in the jaws of Skeleton 1 had not caused any tooth loss. The jaw bone had receded considerably, exposing the roots of the surviving teeth to the formation of dental plaque concretions (calculus), which is commonly observed in archaeological populations. Calculus mineralises and forms concretions on the tooth crowns, along the line of the gums. Calculus was observed to a slight degree on almost all teeth in both individuals and would have irritated the gums and further aggravated the periodontal disease.

Dental wear tends to be more common and severe in archaeological populations than in modern teeth. Severity of the dental wear was assessed using a chart developed by Smith (1984). Each tooth was scored using a grading system ranging from 1 (no wear) to 8 (severe attrition of the whole tooth crown). The surviving teeth showed moderate to severe wear in the case of Skeleton 1, whereas the younger man (Skeleton 2) exhibited slight dental wear.

The anterior dental wear was accompanied by tooth infractions (chipping) on all the anterior teeth in the upper jaw of Skeleton 1. The four anterior maxillary teeth of Skeleton 2 also showed evidence for similar infractions.

It is possible, that these individuals carried out tasks which involved the use of the front teeth as tools.

Plate 13 Dental abscess in maxilla of Skeleton 1

Skeleton 1 suffered from a dental abscess, which was located around the root of the left upper first molar (Plate 13). The infection was localised, causing a hole to form at the base of the tooth roots, which had released pus from the bone into the mouth. It is probable that the infection was extremely painful. Even today, with the availability of antibiotics, dental abscesses can be very persistent. In the past, however, they must have played a more significant role, debilitating and causing extreme pain, weakening of the immune system and, if the infection entered the bloodstream, fatal septicaemia. It is probable that the infection had developed as a result of two large caries lesions (cavities) at the left upper first and second molars (Plate 14).

Cavities are multifactoral in origin, but develop as a result of aggressive bacterial attack in the presence of sucrose (Hillson 1996, 282) and fermentable carbohydrates (Roberts and Manchester 1995, 47).

Plate 14 Cavities in maxilla of Skeleton 1

Dental analysis showed that Skeleton 1 suffered from poor dental health, probably caused by inadequate oral hygiene, or a sucrose-rich or carbohydrate-rich diet. This had led to the formation of dental plaque concretions on the teeth, periodontal disease, large cavities and a dental abscess. Skeleton 2 enjoyed better dental health, although the presence of concretions suggested that his teeth might also have deteriorated, had he lived longer. Chipping of the front teeth of both men may have been caused by a habitual activity.

The dental health of the two men was compared with the information on the individuals excavated in 1930 (Davies 1933). Davies (*ibid*) describes the severe attrition of the individuals' teeth, which is so common in archaeological skeletons. He suggests that the dental wear increased with age, as also observed in the two men described above. Davies (*ibid*) also noted evidence of caries in a small number of the individuals from the mass grave. This suggests that the dental health of those battle victims excavated in 1930 corresponds with that from the men excavated in the 2004 season.

5.0 MORTUARY PRACTICE

The two men analysed had been interred in a battle-related mass grave. They had been laid out in an orderly, Christian manner, with the heads to the west and the feet to the east. They were in a supine, extended position, with the hands on their abdomen. They formed part of a row of skeletons, laid out beside one another in a large pit. Another row of individuals to the east overlaid the row of skeletons initially laid down, so that the upper bodies of the second row overlay the lower legs of those individuals from the first row. A third row of skulls was noted overlying the central row of skeletons. Approximately twenty skeletons buried to the south were excavated in 1930 and removed from the site. Twelve skeletons were uncovered in the 2004 excavation season, only two of which were lifted for analysis and radio carbon dating.

The formal method of burial suggests that those who buried the battle victims, were not in a particular hurry to inter a large number of casualties. The individuals were interred in an orderly manner in the graves, only partly overlying one another. Skull fragments are often shifted from injury sites through the effects of decomposition. However, all the fragments around the injuries were found with the skulls, suggesting that burial had taken place soon after death.

Mass graves relating to battles have been found from the Neolithic to the present day and can be very different in character and size. In some cases, features in the landscape, such as ditches or quarries, were used to inter large quantities of battle casualties. Otherwise, large pits or trenches were excavated for disposal of the dead. Frequently, bodies were placed chaotically in the graves, a situation that must have been more common if a large number of dead had to be buried, or the victors were interring their enemies. The majority of mass graves contain exclusively men, but some, such as a seventeenth century mass grave at Carrickmines Castle, Co Dublin, in Ireland also contained women and children (Fibinger, *pers. comm.*.).

6.0 DISCUSSION AND SUMMARY

Osteological analysis of the skeletal assemblage from Heronbridge near Chester has provided a glimpse into the last moments of those individuals interred in the mass grave. The small group of skeletal remains included two men, one of whom was middle aged, while the other was a young man, in his early twenties. The older man suffered from joint degeneration of the spine and shoulders and ruptured intervertebral discs, as well as from the effects of repetitive muscular injury, which can probably be attributed to hard physical work. It is possible that a kick in the shins, an ulcer, or varicose veins had caused slight inflammation of his left leg. Poor oral hygiene had caused deterioration of his dental health. This included plaque concretions, cavities, receding gums and a pus-releasing abscess.

Skeleton 2, the younger man, had been generally healthy, although he had suffered a probable episode of iron deficiency during childhood. He also suffered from shortening of the femoral necks or uncertain cause, which would have produced no symptoms. His dental health was good in comparison to his counterpart.

Unusually, the cause of death of these two men was clearly apparent. Both had died from a series of blade injuries, which were concentrated on the heads. Skeleton 1 had received four skull blade injuries, as well as a defence injury to the right thumb and a stab wound, which had penetrated the abdomen and entered his spine. Skeleton 2, on the other hand, had received five blade wounds to the skull and face.

The osteological analysis of the skeletons from Heronbridge illustrates the brutal nature of their death. The four healed blunt force depression injuries observed on the skull of Skeleton 1, implied that this individual had narrowly survived a previous conflict. In the battle at Heronbridge, he was not so lucky and met a violent death.

The osteological and palaeopathological evidence of the two men excavated in 2004 corresponds with that described by Davies (1933) in his report on the skeletal remains removed in 1930. It appears that the individuals interred in this mass grave were men, in the prime of life. They were strongly built, with well-developed muscles and were generally in good health, with the exception of some dental problems. Some of these men had fought in previous battles. They met their end principally via a number of blade injuries inflicted to the skulls, probably through swords or similar weapons.

It is possible that this group of men were in the midst of the battle, where fighting was close-knit and the most violent. Alternatively, this group of men may have been attacked by soldiers on horseback, although it is more likely that the injuries would be less vertical and rather more oblique if the sword blows had been dealt from horseback.

7.0 FUTURE RECOMMENDATIONS

Unfortunately, the skeletal remains from the 1930s excavated are unobtainable for further research. This, together with the analysis of the currently unexcavated skeletal remains would add further knowledge of this period in history. If such an excavation is undertaken, it is recommended that trained osteologists are present on site, with the aim of gaining the maximum information from these important skeletal remains.

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APPENDIX A: OSTEOLOGICAL AND PALAEOPATHOLOGICAL CATALOGUE

Skeleton Number	**1**
Preservation	Good
Completeness	85%, all bones, apart from the right ulna and radius, right carpals, some of the left hand bones, the left fibula, right foot and parts of the left foot
Age	26-45, old middle adult
Sex	Male
Stature	175.9 ± 2.99 cm
Non-Metric Traits	Ossicle in lambdoid (bilateral), mastoid foramen extrasutural (bilateral), sutural mastoid foramen (bilateral), third trochanter (bilateral), peroneal tubercle (left)
Pathology	Spinal DJD, left tibial periostitis, bone excavations, enthesopathies, four healed cranial blunt force weapon injuries, four peri-mortem bladed cranial weapon injuries, 1 bladed weapon injury to L2, 1 bladed weapon injury to the first proximal hand phalanx, probably right
Dental Health	considerable periodontitis; calculus on 30/32 teeth; moderate wear, infraction of 11/32 teeth, caries on 2/32 teeth, dental abscess at first upper left molar

	Right Dentition								Left Dentition							
Present	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Calculus	Sb	Sb	Sd	sd	Mb	Sb	Sb	Sb	Sb	Fb	Fb	Sb	Fb	-	-	Sd
DEH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caries	-	-	-	-	-	-	-	-	-	-	-	-	-	Ld	Mm	-
Wear	3	5	8	7	5	4	5	6	6	5	4	5	6	8	5	3
Maxilla	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Mandible	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Present	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Calculus	Sd	Sl	Sb	Sb	Sd	Sm	Sl	Sl	Sl	Sb	Sb	Sd	Sl	Sl	Ml	Sa
DEH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wear	3	5	6	5	4	5	5	5	5	5	4	4	5	7	5	3

Skeleton Number	**2**
Preservation	Good
Completeness	90%, all bones except parts of right and left hand, lower sacrum, right fibula, right foot and parts of the left foot
Age	18-25, young adult
Sex	Male
Stature	176.4 ± 2.99 cm
Non-Metric Traits	Parietal foramen (right), ossicle at asterion (right), absent zygomaticofacial foramen (left), third trochanter (bilateral), lateral tibial squatting facet (bilateral), peroneal tubercle (right)
Pathology	Schmorl's nodes, *cribra orbitalia*, *coxa vara*, five peri-mortem cranial blade injuries
Dental Health	calculus on 32/32 teeth; slight to moderate wear; infractions of 4/32 teeth

	Right Dentition								Left Dentition							
Present	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Calculus	Sm	Sm	Sa	Sb	Sb	Sb	Sb	Sb	Sb	Sb	Sb	Sb	Sa	Sa	Sm	Sm
DEH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wear	2	3	4	2	2	3	2	3	3	2	2	3	3	4	3	2
Maxilla	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**

Mandible	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Present	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Calculus	Sd	Sl	Ml	Ml	Ml	Ml	Ml	Ml	Ml	Sa	Ml	Sa	Sa	Sl	Sl	Sl
DEH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wear	2	3	4	2	3	2	3	4	4	3	2	3	2	4	3	2

KEY:
Present - Tooth presence; am - ante-mortem tooth loss; pm - post-mortem tooth loss; p - tooth present; - - jaw not present
Caries - Calculus; F - flecks of calculus; S - slight calculus; M - moderate calculus; H - heavy calculus; a - all surfaces; b - buccal surface; d - distal surface; m - mesial surface; l - lingual surface; o - occlusal surface
DEH - dental enamel hypoplasia; l - lines; g - grooves; p - pits
Caries - caries; s - small lesions; m - moderate lesions; l - large lesions
Wear - dental wear; numbers from 1-8 - slight to severe wear