# Osteological Analysis

# Land North of 25 & 27 Welton Road

# Brough

# East Yorkshire

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York Osteoarchaeology Ltd was commissioned by MAP Archaeological Consultancy Ltd to carry out the osteological analysis of four skeletons. The skeletal remains were recovered during archaeological investigations in September 2006 on land north of 25 and 27 Welton Road, Brough, East Yorkshire (NGR SE 9393 2700) during the excavation of foundation trenches for a bungalow and garage.

Based on pottery recovered from the graves, the skeletons are thought to date to the Romano-British period. One skeleton was possibly buried in a prone position, while another skeleton was buried supine and extended. Two of the burials were too disturbed for their position and orientation to be ascertained.

Osteological analysis revealed that the cemetery contained a mature male adult, a young adult, who was probably male, a five to six year old juvenile and a neonate. The mature adult male was riddled with pathology: he had osteoarthritis, degenerative joint disease, inflammation of the shins, fractured ribs and a fractured collar bone, a small benign tumour and a blood clot that had become bony. Pronounced muscle attachment sites suggested a life of rigorous physical activity. The younger male showed evidence for congenital anomalies of the spine that might have caused a slight limp. Both males had lesions in the eye orbits indicative of iron deficiency anaemia during childhood.

The juvenile showed lines on the teeth, suggesting that it had suffered from physical stress, caused by malnutrition or disease in the last two or three years of its life.

**Acknowledgements**

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## 1.0 INTRODUCTION

In October 2007 York Osteoarchaeology Ltd was commissioned by MAP Archaeological Consultancy Ltd to carry out the osteological analysis of four skeletons. The skeletal remains had been excavated in September 2006 during an archaeological investigation on land north of 25 and 27 Welton Road, Brough, East Yorkshire (NGR SE 9393 2700) during the foundation excavations for a house and garage.

The skeletons were thought to date to the Romano-British period. They were found close to a Roman road immediately to the north of the Roman fort of Petuaria and 2km to the south of a Roman villa at Brough.

One of the adults was buried in a prone position, with the legs bent upwards at the knees. This individual lay with the head to the east and the feet to the west. The second adult lay in a supine extended position, with the head to the west and the feet to the east. The positions of two children could not be identified, as these were disturbed. However, it is likely that Skeleton 2007 shared a grave with one of the adults, Skeleton 2005. No grave goods were recovered with any of the burials, but residual pottery sherds and animal bones were found in the grave fills.

### 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 were analysed in detail, assessing the preservation and completeness, calculating the minimum number of individuals present as well as determining the age, sex and stature of the individuals (Appendix A). All pathological lesions were recorded and described.

## 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.

Skeletons 1009 and 2005 were well-preserved, with slight surface erosion and minimal fragmentation (Table 1). Skeleton 1005 was in an excellent condition, but Skeleton 2007 had suffered slightly more damage, with severe erosion of the bone surface and greater fragmentation.

Table 1 Summary of osteological and palaeopathological results

| **Skeleton No** | **Preservation** | **Completeness** | **Age** | **Sex** | **Stature (cm)** | **Pathology** |
|---|---|---|---|---|---|---|
| 1005 | Excellent | 80% | Young adult | Male? | - | Spinal congenital anomaly, sacral congenital anomaly, Schmorl's nodes, DJD in hips, bone excavations, *coxa vara, cribra orbitalia* |
| 1009 | Good | 30% | Neonate | - | - | - |
| 2005 | Good | 90% | 46+ | Male | | Spinal DJD and OA, Schmorl's nodes, DJD in shoulders, hips, OA in left hip and proximal femur, *enthesopathies*, bone excavations, *coxa vara*, periosteal inflammatory lesions on tibiae, ossified haematoma on left femur, *cribra orbitalia*, fractured left clavicle, 2 fractured ribs, button osteoma |
| 2007 | Moderate | 55% | 5-6 years | - | - | Bone excavations, endocranial depressed lesions |

The completeness of the skeletons was varied, ranging from 30% to 90% (see Table 1). The two children were the least complete, probably due to the disarticulated nature of the burials.

## 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 bone part most commonly found was the left humerus, which gave an MNI of four individuals: two adults, one juvenile and one neonate.

## 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; 36-45 years), mature adult (ma; 46+) to adult (an individual whose age could not be determined more accurately than that they were eighteen or over).

Age estimation of the skeletons was based on as many criteria as possible. Two of the four skeletons were adults (see Table 1), the oldest of which (Skeleton 2005) was at least 46 years old, but probably much older, based on dental wear and hip joint degeneration. The second adult (Skeleton 1005) was aged between 20 and 25 years according to the dental wear and morphology of the anterior hip joints, but much older when examining the posterior hip joints. It is possible, however, that a congenital anomaly in the lower spine (described below) caused a slight limp that led to secondary degenerative joint disease in his hips much earlier than would be expected in a healthy adult. These joints were therefore ignored for the age estimation, which was based on the remaining ageing criteria.

Based on the long bone length, the skeletal and dental development, Skeleton 2007 was aged between five and six years old. Skeleton 1009 was extremely young, somewhere between late stage foetus and about 1 month old. The age estimate was based on long bone measurements and skeletal development (no teeth were present).

## 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.

Determining the sex of Skeleton 1005 was difficult, and it was only tentatively identified as a possible male. The pelvis is the most reliable indicator of biological sex, but unfortunately, both the skull and the pelvis exhibited skeletal criteria that pointed to both a male and a female, although the male or undetermined traits predominated. However, the sacrum was extremely curved, suggesting a male. The long bone measurements were also mixed; some bones were as robust as would be expected in a male skeleton, while others were more delicate, as in a female. It is clear, though, that the bones all belonged to the same skeleton.

The sex determination of Skeleton 2005 was based on the skull, pelvis and long bone robusticity and was clearly 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.

The living height of the two adults could be established. Stature was calculated from the right femur and tibia for both skeletons. This gave a height of 161.1cm (±2.99cm) for Skeleton 1005 and of 168.5cm (±2.99cm) for Skeleton 2005. The stature of both skeletons was lower than the mean stature for Roman males calculated by Caffell (1997), which was 169.03cm.

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. All four adult femora were *platymeric* (broad and flat). The *platycnemia* index of the tibiae was calculated in order to establish the degree of tibial shaft flatness. The left tibia of Skeleton 1005 and the right tibia of Skeleton 2005 was *eurycnemic* (of average dimensions), while the left tibia of Skeleton 2005 was flatter (*mesocnemic*). The right tibia of Skeleton 1005 was *platycnemic* (very flat).

The cranium of Skeleton 2005 was sufficiently intact for limited measurements to be taken. The cranial index is calculated to describe the shape of the cranial vault. The cranial index was 80.8, which placed it in the *brachycrany* range, i.e. the cranium was broad or round.

## 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.

No traits were noted in the neonate (Skeleton 1009). Numerous cranial non-metric traits were noted in the remaining skeletons. These included *an ossicle in lambdoid* (an additional bone in the suture at the back of the head) and *parietal foramen* (a small hole in the bones of the sides of the skull) in Skeletons 2005 and 2007. *Extrasutural and sutural mastoid foramen* (a small hole near the ear bone), *ossicle at parietal notch* (small bone in the suture behind the ear) and a *precondylar tubercle* (a small lump at the base of the skull) were observed in Skeleton 2005. Skeleton 1005 had *absent zygomaticofacial foramen* (cheek bones devoid of small holes), and *bridging of supraorbital notch* (a small bony bridge at the anterior margin of the eye orbit). None of these traits would have had any affect on the individuals.

Post-cranial traits were not observed in juvenile Skeleton 2007. Traits noted in Skeleton 1005 included an *emarginated patella* (appears as if a bite was taken out of the medial side of the knee cap), *peroneal tubercle* (a small lump on the side of the heel bone). The following traits were noted in both adult skeletons: *double* *anterior calcaneal facets* (a divided anterior joint surface of the heel bone) and *double inferior talar facet* (the same on the matching ankle bone). Skeleton 2005 also had post-cranial non-metric traits: *circumflex sulcus* (a groove on the medial side of the shoulder blade), *Poirier's facet* (an extension of the femoral joint surface) *exostosis in both trochanteric fossae* (small spicules of bone in the hip region).

2.7 CONCLUSION

Osteological analysis of the four skeletons from Brough established that the cemetery group consisted of two adults, one of whom was a mature male, while the other was a young adult of ambiguous sex, though probably also male. A juvenile and a neonate were also found. The adults were short for the Roman period. The fact that Skeleton 2005 and 2007 shared a grave as well as some cranial non-metric traits may suggest that these individuals shared a family link.

## 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 CONGENITAL CONDITIONS

Heredity and environment can predispose an individual to congenital anomalies, and these are commonly observed in archaeological populations. Individual anomalies, however, tend to occur in one, rather than in a number of skeletons (Turkel 1989), and can vary in prevalence between populations. Most congenital conditions observed in skeletons are simple anomalies that do not affect the person exhibiting the defect.

Skeleton 1005 had several congenital anomalies of the lower spine. The individual had supernumerary vertebrae; there were six instead of five lumbar vertebrae. The sixth lumbar vertebra showed unilateral sacralisation (looking partly like the sacrum) (Plate 1). This is one of the most common developmental anomalies affecting the spine, with sacralisation or lumbarisation occurring in 3-5% of the population (Aufderheide and Rodríguez-Martín 1998, 65). Unilateral sacralisation, as occurred here, can lead to the development of scoliosis (curvature of the spine) later in life (*ibid.*). It is possible that this individual walked with a limp and the degenerative joint disease (DJD) in the joints of the hip and sacrum was thus a secondary complication of the congenital anomaly, particularly as it is unusual to observe DJD in such a young adult.

**Plate 1** Partial sacralisation of the sixth lumbar vertebra of SK 1005

Furthermore, the man's 12th thoracic vertebra was partly lumbarised (had taken on the appearance of a lumbar vertebra) and the 11th thoracic vertebra was in appearance like the 12th thoracic vertebra. The anomalies only affected the right side of the vertebrae, while the left sides were normal in appearance.

Both adult males had short and horizontal femoral necks. This condition (coxa vara) is not present at birth, but develops slowly due to a congenital ossification defect of the femoral neck (Salter 1999). In severe cases, the muscles of the hip cannot hold the pelvis level during walking, and the individual will have a lurching (although painless) type of limp (*ibid*). However, in neither individual was the condition severe.

## 3.2 METABOLIC CONDITIONS

Both male adults suffered from fine pitting in the left eye orbits, termed *cribra orbitalia* (see Table 1). The lesions were mild in both skeletons. The condition 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).

## 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.

### 3.3.1 DJD

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).

Skeleton 1005, despite his young age, suffered from both DJD of the sacro-iliac joints (joints between the sacrum and hips, as discussed above). It is possible that this was a secondary complication resulting from the sacralisation of the sixth lumbar vertebra, which was unilateral. This can cause spinal deformities leading to strain on the hips.

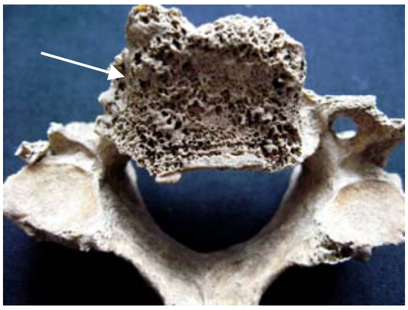

**Plate 2** Cervical vertebra of SK 2005 with DJD

All of the vertebrae of Skeleton 2005 with the exception of the seventh cervical vertebra exhibited evidence for mild to severe DJD on the vertebral bodies (Plate 2). Two cervical, three thoracic and one lumbar vertebra also had slight to severe DJD on the vertebral articular facets. Both porosity and osteophyte formation were widespread. These changes were probably linked to the mature age of the individual, but could also have been worsened by a compression fracture of the eighth thoracic vertebra, which may have altered the forces acting on the joints.

Degenerative changes were seen in several non-spinal joints of Skeleton 2005, most of which had porosity at the joint surface. These included both shoulders (lateral clavicles and right glenoid) and the right hip.

### 3.3.2 Osteoarthritis

Osteoarthritis is a degenerative joint disease characterised by the deterioration of the joint cartilage, leading to exposure of the underlying bony joint surface. The resulting bone to bone contact can produce polishing of the bone termed 'eburnation', which is the most apparent expression of osteoarthritis. Osteoarthritis can be the result of mechanical stress and other factors, including lifestyle, food acquisition and preparation, social status, sex and general health (Larsen 1997, 179).

Skeleton 2005 also suffered from spinal osteoarthritis in the form of eburnation, osteophytes and porosity in three of the vertebral apophyseal joints in the neck and central spine. Much more severe OA was noted in the left hip joint (Plate 2), where porosity, osteophyte formation, cysts and eburnation were so severe that the femoral joint could hardly be moved inside the hip socket. This would have led to severe walking difficulties. The fact that eburnation was present, does, however suggest that the joint was still being used.

**Plate 3** Femoral ball joint of SK 205 with severe osteoarthritis

### 3.3.3 Schmorl's Nodes

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, 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. Schmorl's nodes were observed in the lower thoracic and lumbar spines of the two males, Skeletons 1005 and 2005.

## 3.4 TRAUMA

Despite the small size of the group, trauma was widespread. Skeleton 2005 had several fractures, including an oblique fracture of the central shaft of the left clavicle (collar bone). The fractured ends had overlapped considerably, causing shortening of the bone by almost 3cm (Plate 3). The clavicle was slightly kinked instead of the usual smooth bend. Clavicle fractures are amongst the most common fractures in modern patients (Dandy and Edwards 1998, 181). Many are caused by landing on an outstretched hand or by direct impact against a bone, as is caused by being thrown off a horse and landing on the ground. The clavicle fracture

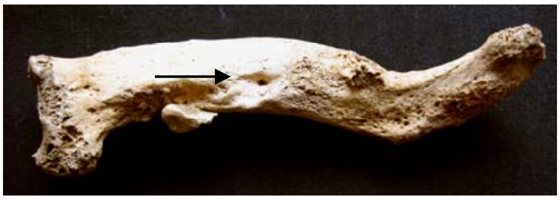

**Plate 4** Well-healed clavicle fracture of SK 2005

was well-healed, and as clavicles take around six weeks to heal (*ibid*, 182), this injury was at least this old. The fracture site was smooth on the superior surface, but very irregular in appearance on the inferior surface.

A single compression fracture was observed in the eighth thoracic vertebra of Skeleton 2005, which may have been caused at the same time as the clavicular fracture, or may have been the result of a different accident. Compression injuries are caused by vertical force, such as falling and landing on the feet or bottom (Dandy and Edwards 1998, 155). The fracture caused slight compression of the anterior vertebral body.

The same individual also suffered from two rib fractures. The fractured rib fragments could not be matched to any of the ribs and therefore siding was not possible, but it was clear that they derived from a central and a lower rib shaft. Both fractures were well-healed and could have occurred at the same occasion. The external surface of the ribs was smooth, while the internal (lung) surface was thickened and slightly irregular. The rib fractures were located at the shafts of the ribs, suggesting a side impact. Isolated cracks can heal quickly and are often treated in the same way as severe bruises (Dandy and Edwards 1998, 159).

Single rib fractures are often caused by a direct blow to the chest, back or side, although in elderly patients ribs can break as a result of severe coughing fits (Dandy and Edwards 1998, 159). Alternatively, rib fractures have been observed following falls and compression of the chest. Broken ribs can be very painful and cause complications such as breathing problems, limitation of chest movement, perforation of the lung, liver or heart, *atelectasia* (failure of the lung to expand normally) and secondary infection or respiratory failure (Dandy and Edwards 1998).

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). All the skeletons with the exception of the neonate showed evidence for muscular trauma.

The juvenile (Skeleton 2007) exhibited bone excavations at the attachments sites of *soleus* on the tibiae, which plantar flexes the foot (pushes the foot downwards) and on the femora for *gluteus maximus* (involved in abduction and rotation of the thigh and extension of the thigh and trunk) (Stone and Stone 1990). Skeleton 1005 also had bone excavations at the latter site.

Skeleton 1005 had deep bone excavations at the clavicles for the costoclavicular ligament. Muscular trauma at this site is very common in skeletons from archaeological backgrounds. Furthermore, both humeri (upper arm bones) of Skeleton 1005 showed large bone excavations at the attachment sites for *pectoralis major* and *teres major* (Plate 5). These are muscles of the rotator cuff and are responsible for adducting and rotating the arms.

**Plate 5** Right humerus of SK 1005 with bone excavations for *pectoralis* and *teres major*

The bones of Skeleton 2005 (mature adult male) were robust, with well-developed muscle attachment sites. This man showed evidence for widespread muscular trauma. He had bone excavations at the clavicle for the *deltoid* muscle (abducts, flexes, extends and rotates the arm), at the left humerus for *supraspinatus* (abduction of arm) and *subscapularis* (medially rotates arm, assists in all other arm movements), at the scapulae for *teres major* (medially rotates, adducts and extends arm) and *infraspinatus* (laterally rotates arm, abducts arm, adducts arm) (Stone and Stone, 1990). All the muscles affected were part of the rotator cuff.

Skeleton 2005 also had numerous *enthesopathies*: at the left radius for biceps (supinates hand, flexes forearm), at the scapulae for *triceps* (extends forearm), at the calcanei (heel bones) for the Achilles' tendons (flexes the foot downwards), at the hips for *adductor magnus* (adducts hips at thigh, assists in lateral rotation and extension), on the femora for *gluteus maximus* (involved in abduction and rotation of the thigh and extending the thigh and trunk), on the left hip for *rectus femoris* (extends the leg at the knee joint and flexes the thigh at the hip joint) (Stone and Stone, 1990).

The muscular trauma of Skeleton 2005 suggested that this person placed considerable strain on the muscles of the rotator cuff, responsible for movements of the upper arm, which was probably activity-related. Further muscular trauma was noted at the muscles that extend and flex the forearm, and those muscles that move the thigh at the hip; this appeared to be related to a traumatic incident or occasions, rather than being activity-related.

Skeleton 2005 also showed evidence for a different type of soft tissue trauma. This was an ossified haematoma (blood clot that had become bone) on the lateral border of the left proximal femur. Haematomas can be the result of direct blunt force trauma, or tearing of muscle fibres, causing blood to collect and clot. If the muscle is exercised too soon following the injury, the blood clot may ossify, producing a bony lump at the site of the haematoma. Ossified haematomas tend to resolve after two years, suggesting that the injury was less than two years old.

## 3.5 NEOPLASTIC DISEASE

A button, or ivory, osteoma was observed on the frontal bone of Skeleton 2005. These are the most common type of neoplasm (new growth) seen in archaeological populations, usually affect males more than females, and are entirely benign and symptomless (Aufderheide and Rodríguez-Martín 1998).

## 3.6 CONCLUSION

The children's remains were almost devoid of pathological lesions, with the exception of limited muscular trauma observed on the five to six year old juvenile.

The male young adult (Skeleton 1005) also had little pathology, except for lesions in the eye orbits indicative or iron deficiency anaemia during childhood. He also had several congenital anomalies affecting the lower spine, sacrum and hip joints. The defects would have led to spinal malformations and probably caused secondary joint disease of the hips as a result. This young male showed evidence for muscular trauma affecting the upper arms and thighs, as well as spinal lesions, which together were indicative of physical strain.

The mature male adult showed extensive evidence for disease and trauma that he had experienced throughout life. Similarly to the younger male, he had also suffered from iron deficiency anaemia during childhood.

During adulthood, he was involved in physical activities that placed strain on the muscles of the rotator cuff, moving the upper arm.

This mature man had at least one, if not several accidents that caused fractures of the left collar bone, two ribs, a vertebra, and an ossified blood clot on the left thigh. It is also likely that one or several traumatic incidents had caused the trauma to those muscles that are responsible for flexing and extending the forearm, as well as moving the hip. The fractures had healed well, suggesting that they had occurred some time before death. However, it is likely that at least some of the degenerative joint disease and particularly the osteoarthritis observed in this individual were not merely age-related, but were secondary complications following the traumatic incidents. It is possible that the inflammation on his legs was related to the trauma, or it could be the result of other causes, such as trips, varicose veins or diabetes.

## 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. Skeleton 1009, the neonate, did not have any preserved teeth. A total of 41 permanent teeth were recovered, of which eight belonged to the juvenile. This child also had three deciduous (milk) teeth (Table 2).

Table 2 Summary of dental pathology

| Skeleton No | Number of teeth present | Calculus | Caries | Abscesses | DEH | Infractions | Wear | Periodontitis |
|---|---|---|---|---|---|---|---|---|
| 1005 | 29 teeth (3 lost PM) | 21 | - | - | - | - | Slight to moderate | Slight |
| 2005 | 4 teeth present (8 lost AM, 4 lost PM) (no maxilla) | 2 | 1 | 1 | - | - | Moderate | Considerable |
| 2007 | 3 deciduous teeth, 8 permanent teeth (no mandible) | 2 | 1 | - | 3 | - | Slight | - |

A total of eight of the teeth from Skeleton 2005 had been lost ante-mortem. The causes of ante-mortem tooth loss (the loss of teeth during life) include periodontal disease. Once the tooth has been lost, the empty socket is filled in with bone. This skeleton lost an additional four teeth post-mortem, while Skeleton 1005 lost three teeth after death.

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 wear of the surviving teeth in Skeleton 2005 was variable and irregular, probably as a result of extensive ante-mortem loss in both jaws. There was little to moderate wear on the teeth of Skeleton 1005, which corresponded with the man's young age. Skeleton 2007, the juvenile, also showed little wear, as was expected.

**Plate 6** Teeth of SK 2005 with calculus and caries

Calculus is commonly observed in archaeological populations whose dental hygiene was not as rigorous as it is today: calculus mineralises and forms concretions on the tooth crowns, along the line of the gums. Slight to moderate calculus was present on all 21 of the 29 teeth of Skeleton 1005 and on two of the teeth from Skeletons 2005 (Plate 6) and 2007.

Skeletons 2005 and 2007 had dental caries, each in a molar (see Plate 6). 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). Skeleton 2005 also had an abscess, which was well-healed at the time of death. Dental abscesses occur when bacteria enter the pulp cavity of a tooth causing inflammation and a build-up of pus at the apex of the root. Eventually, a hole forms in the surrounding bone allowing the pus to drain out and relieve the pressure. They can form as a result of dental caries, heavy wear of the teeth, damage to the teeth, or periodontal disease (Roberts and Manchester 1995), and heavy tooth wear seems to be the likely cause here.

Dental enamel hypoplasia (DEH) was only observed in three of the erupting permanent teeth of Skeleton 2007: there were grooves or lines on three of the anterior teeth. DEH is the manifestation of lines, grooves or pits on the crown surface of the teeth, which represent the cessation of crown formation. The defects are caused by periods of severe stress during the first to seventh year of childhood, including malnutrition or disease.

## 5.0 MORTUARY PRACTICE

The skeletons found at Brough were interred in a variety of positions and orientations. Skeletons 2005 (a mature adult male) and Skeleton 2007 (a 5-6 year old juvenile) may have shared a grave, although the juvenile was so disturbed that it was not possible to be certain whether this was the case. However, the head of the juvenile appeared to lie on the upper right thigh of the mature male. Skeleton 2005 was buried in a supine extended position with the head to the west and the feet to the east. Skeleton 1005 was buried in a single grave, to the north-west of the double grave. This individual was buried in a prone position with the legs bent backwards at the knees, so that they overlay his thighs. The head was found at the eastern end of the grave and the knees at the western end. The neonate, Skeleton 1009, was so disturbed that it was not possible to ascertain its position and orientation.

The direction of orientation varies considerably between different Roman cemeteries. At Trentholme Drive in York for example, burial ritual was extremely varied and included double burials (Wenham 1968). It has been argued that orderly burial became increasingly widespread towards the later Roman period, particularly in the fourth century AD (Clarke 1979, 352).

Many Roman cemeteries showed evidence for burial in family plots. This has been indicated by the presence of individuals of different ages and sexes in the same area, but also clusters of non-metric traits (which can suggest family relationships). Because of the relatively small excavation trench, which gave no real insight into the size of the cemetery or quantity of burials at the site, it was not possible to determine whether family groupings existed at Brough. Such family groupings have been most obvious in the large cemeteries, such as Cannington in Somerset (Rahtz *et al* 2000, 63). However, the double burial might suggest that family groupings did exist in this cemetery and this is supported by some shared non-metric traits between the individuals buried there.

Considering that the skeletons at Brough were found widely distributed across the site, it is likely that more burials are present that were not disturbed during the development.

The fact that the human remains recovered lay close to the Roman road could indicate the presence of a cemetery site along the course of the Roman road, which was a popular location for cemeteries during the Roman period as Roman law forbade burial in Roman settlements (Watson 2003, 8).

Other archaeological excavations have been carried out in the local area, including at Melton Water Works near Brough (Holst 2004), at Welton Quarry and at the Melton A63 junction. The former two excavations produced exclusively Bronze Age burials, while the A63 junction excavation produced skeletal remains dating from the Bronze Age, the Iron Age and the Anglo-Saxon period (Caffell and Holst 2007). None of the remains dated to the Roman period and as a result, comparisons between the sites would be of no value.

## 6.0 DISCUSSION AND SUMMARY

The skeletal assemblage from Brough was in a good condition, with most skeletons being well preserved, but often incomplete. Osteological analysis showed that the small group of inhumed skeletons consisted of individuals of all ages, including a neonate, a five to six year old juvenile, a young male and a mature adult male. It is likely that these excavated graves formed part of a larger roadside cemetery.

The burials of the children were disturbed and their position and orientation could therefore not be determined. However, it appears that the older child shared a grave with the mature male and it is possible that these individuals were related, as suggested by some shared non-metric traits. Alternatively, they might have died at a similar time and were therefore interred together. Both adults also had one congenital anomaly in common; shortened femoral necks and may also have been related.

The neonate showed no evidence for pathology and it is possible that this baby died during birth or as a result of complications after the birth. The juvenile had suffered from malnutrition or disease some time prior to death, as suggested by lines of arrested growth on its teeth, which indicate that the child's resources were fighting for survival rather than advancing tooth growth. The child also showed evidence for muscular trauma as a result of repetitive activities, suggesting that it must have been physically active at least for some time prior to its death.

One of the adults from the site was a young adult, aged between 20 and 25 years, who was interred on the front, with the legs bent backwards at the knees. He was probably male, although the skeletal characteristics indicative of sex were ambiguous. This individual may also have been unusual in his appearance, perhaps not looking very masculine due to his ambiguous skull and pelvic sexual characteristics, coupled with his spinal congenital anomalies, which caused deformities. However, this person carried out activities, which placed strain on the muscles of the rotator cuff at the upper arm and on the spine, suggesting he was physically active. He also showed evidence for having suffered from iron deficiency anaemia during childhood. This man had healthy teeth with limited plaque formation.

In contrast, the other adult buried at the site had survived to a relatively old age, being at least 45 years old (but probably much older) at the time of death. However, this individual also showed many signs of disease, including several fractures, all of which were well-healed. He had suffered from a collar bone fracture, two rib fractures and a mild vertebral compression fracture, a blood clot on his thigh and widespread muscular trauma that might have been caused by one or several accidents. It is likely that the severe osteoarthritis in his left hip was secondary to an injury. The arthritis was so severe that the leg was almost immovable at the hip. It is likely that this man experienced a side impact or fall from a height that caused all of the injuries. This man also had degenerative disease and osteoarthritis in the spine. Pronounced muscle attachments attest to an active life, with activities involving use of the rotator cuff muscles, flexion and extension of the forearm and movement of the thigh. He suffered from inflammations of the shin, perhaps also secondary to his injuries, but more likely to be the result of varicose veins, diabetes, ulcers or similar conditions. This man lost many teeth during life and had suffered from a dental abscess.

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# APPENDIX A: OSTEOLOGICAL AND PALAEOPATHOLOGICAL CATALOGUE

| **Skeleton Number** | **1005** |
|---|---|
| Preservation | Excellent |
| Completeness | 80%, all but left ulna, parts of skull, parts of left foot and hand |
| Age | Young adult, 20-25 years |
| Sex | Male? |
| Stature | 161.05 ± 2.99cm |
| Non-Metric Traits | Absent zygomaticofacial foramen (bilateral), bridging of supraorbital notch (right), emarginate patella (bilateral), peroneal tubercle (right), double anterior calcaneal facets (right), medial talar facet (right) |
| Pathology | Schmorl's nodes, 6th lumbar vertebra, partial sacralisation of L6, partial lumbarization of T12, DJD in sacroiliac joints, bone excavations for teres major, pectoralis major, costoclavicular ligament, gluteus maximus, *cribra orbitalia* |
| Dental Health | 29 teeth, 2 teeth lost post-mortem, wear 1-4, calculus 21/29 teeth, slight periodontitis |

| | Right Dentition | | | | | | | | Left Dentition | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Present | P | P | P | P | P | P | P | PM | P | PM | P | P | P | P | P | PM |
| Calculus | Sd | Sa | Sl | - | - | Sb | - | - | - | - | - | - | - | Mb | Fa | - |
| DEH | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Caries | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Wear | 1 | 3 | 4 | 2 | 2 | 2 | 3 | - | 4 | - | 2 | 2 | 2 | 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 | Sa | Ml | Ml | Sl | Sb | Sl | Fa | - | Fb | Fb | Sa | Sa | Ma | Sl | Sl | Sa |
| DEH | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Caries | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Wear | 1 | 2 | 3 | 2 | 2 | 2 | 3 | 4 | 4 | 3 | 3 | 2 | 2 | 3 | 2 | 1 |

| **Skeleton Number** | **1009** |
|---|---|
| Preservation | Good |
| Completeness | 30%, parts of skull, left humerus, right scapula and clavicle, some ribs and vertebral fragments only |
| Age | Neonate |
| Sex | - |
| Stature | - |
| Non-Metric Traits | - |
| Pathology | - |
| Dental Health | No teeth |

| **Skeleton Number** | **2005** |
|---|---|
| Preservation | Good |
| Completeness | 90%, all except patellae, parts of hands, scapulae, hips and facial part of cranium |
| Age | 46+ years |
| Sex | Male |
| Stature | 168.5 ± 2.99cm |
| Non-Metric Traits | Ossicles in lambdoid suture (bilateral), mastoid foramen extrasutural (bilateral), ossicle at parietal notch (right), sutural mastoid foramen (bilateral), precondylar tubercle, incomplete |

| | |
|---|---|
| | foramen ovale (bilateral), circumflex sulcus (bilateral), Poirier's facet (right), double anterior calcaneal facet (bilateral), double inferior talar facet (right) |
| Pathology | Compression fractures of T8 , spinal DJD, spinal osteoarthritis, Schmorl's nodes, DJD in lateral clavicles, left medial clavicle, right glenoid, right acetabulum, auricular surfaces, osteoarthritis in left hip rendering the joint almost immovable, periosteal inflammation on both tibial shafts, ossified haematoma on left proximal lateral femur, fractured and well-healed left clavicle, two fractured and healed rib shat fragments, *cribra orbitalia*, coxa vara, button osteoma on frontal, enthesopathies for Achilles tendons, adductor magnus, interosseous sacroiliac ligament, gluteus maximus, acetabular labrum, rectus femoris, biceps, triceps; bone excavations for supraspinatus, subscapularis, teres major, infraspinatus, deltoid, pectoralis major, costoclavicular ligament |
| Dental Health | 4 teeth present, 8 teeth lost ante-mortem, 4 teeth lost post-mortem, 1-4 teeth with caries, 2/4 teeth with calculus, considerable periodontitis, wear 3-6, one abscess at lower right 1st molar |

| | Right Dentition | | | | | | | | Left Dentition | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Present | - | - | - | - | - | - | - | - | P | - | - | - | - | - | - | - |
| Calculus | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| DEH | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Caries | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Wear | - | - | - | - | - | - | - | - | 4 | - | - | - | - | - | - | - |
| 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 | AM | PM | AM | PM | AM | AM | PM | PM | AM | AM | AM | AM | P | NP |
| Calculus | Sa | Sa | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| DEH | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Caries | - | Sd | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Wear | 3 | 6 | - | - | - | - | - | - | - | - | - | - | - | - | 5 | - |

| | |
|---|---|
| **Skeleton Number** | **2007** |
| Preservation | Moderate |
| Completeness | 55%, most of legs, upper skull, parts of humeri, ulnae, ribs, maxilla and feet |
| Age | 5-6, juvenile |
| Sex | - |
| Stature | - |
| Non-Metric Traits | Ossicle at lambdoid (bilateral), parietal foramen |
| Pathology | Bone excavations for soleus and gluteus maximus, depressed lesions on the inner skull surface similar to arachnoid granulations |
| Dental Health | 3 deciduous teeth, 1/3 with calculus, 1/3 with caries; 8 erupting permanent teeth, all from the maxilla, 3 of which have DEH lesions |

| | Right Dentition | | | | | Left Dentition | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Present | P | PM | P | PM | PM | PM | PM | PM | PM | P |
| Calculus | Sa | - | - | - | - | - | - | - | - | - |
| DEH | - | - | - | - | - | - | - | - | - | - |
| Caries | Md | - | - | - | - | - | - | - | - | - |
| Wear | 1 | - | 2 | - | - | - | - | - | - | 2 |
| Maxilla | **e** | **d** | **c** | **b** | **a** | **a** | **b** | **c** | **d** | **e** |
| Mandible | **e** | **d** | **c** | **b** | **a** | **a** | **b** | **c** | **d** | **e** |
| Present | - | - | - | - | - | - | - | - | - | - |
| Calculus | - | - | - | - | - | - | - | - | - | - |
| DEH | - | - | - | - | - | - | - | - | - | - |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Caries | - | - | - | - | - | - | - | - | - | - |
| Wear | - | - | - | - | - | - | - | - | - | - |

**KEY:**
Present - Tooth presence; am - ante-mortem tooth loss; pm - post-mortem tooth loss; p - tooth present; p (u) – tooth present but unerupted - - 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