Osteological Analysis
Mill Mount
York

Site Code: YMM07
NGR: SE 5945 5102

Report No 0808
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Prepared for

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Summary

In June 2007 York Osteoarchaeology Ltd was commissioned by Mike Griffiths and Associates to carry out the osteological analysis of a single skeleton (1557). The skeletal remains were recovered during an archaeological watching brief in November 2005 at Mill Mount, York (NGR SE 5945 5102). Earlier excavations and watching briefs in autumn 2004 and 2005 at Mill Mount produced a total of nineteen skeletons, two cremation burials and 33 assemblages of disarticulated human bone. The cemetery appears to represent a Roman family burial plot.

The skeleton had been interred in a gritstone sarcophagus with a plain lid. The coffin contained a supine extended skeleton that was covered with a thick layer of gypsum and two Roman first to second century coins. The skeleton was that of a child who suffered from a skeletal dysplasia and was probably between eleven and fourteen years old. It is possible that both the dysplasia and physical work had led to the development of skeletal lesions in the spine indicative of physical stress. Muscular trauma to the muscles moving the upper arm was also observed.

Acknowledgements

York Osteoarchaeology Ltd would like to thank Steve Timms of Mike Griffiths and Associates for his help and support.

1.0 INTRODUCTION

In June 2007 York Osteoarchaeology Ltd was commissioned by Mike Griffiths and Associates to carry out the osteological analysis of a single skeleton (1557). The skeletal remains were recovered during an archaeological watching brief in November 2005 at Mill Mount, York (NGR SE 5945 5102).

Plate 1 Sarcophagus *in situ*

The skeleton had been buried in a gritstone sarcophagus with a plain lid. The skeleton lay with its head to the northwest and the feet to the southeast. The bones were covered with a thick layer of gypsum (Plate 1), which was removed carefully in the York Museums Trust store in sterile conditions to reveal an extended skeleton in a supine position. A Roman first to second century coin was found between the thighs of the skeleton and another similar coin under the sacrum.

Previous excavations and watching briefs in autumn 2004 and 2005 at Mill Mount produced a total of nineteen skeletons, two cremation burials and 33 assemblages of disarticulated human bone, which appeared to be part of a Roman family cemetery.

1.1 AIMS AND OBJECTIVES

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

1.2 METHODOLOGY

The skeleton was analysed in detail, assessing the preservation and completeness, as well as determining the age, sex and stature of the individual (Appendix 1). 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.

The skeleton was in a moderate condition (Table 1). It had suffered from some post-mortem fragmentation, but no bone erosion.

Table 1 Summary of osteological and palaeopathological results

Preservation	**Completeness**	**Age**	**Sex**	**Stature**	**Pathology**
Moderate	99%	11-14	-	-	*Bone excavations, intervertebral osteochondrosis,*skeletal dysplasia, arachnoid granulations

The skeleton was 99% complete; some of the hand and foot bones and the left patella were missing (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.

No bone elements were duplicated, indicating an MNI of one individual.

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 as over the age of seventeen).

In this instance, it was particularly difficult to assess the individual's age, because the child suffered from a skeletal dysplasia (a problem affecting growth and development), which meant that parts of the skeleton appeared to be as young as ten years (long bone length, development of the second molars), whilst others were consistent with an age of fourteen to sixteen years (fusion of proximal ulna, development of the premolars). The central sacrum was fused (Plate 2), which usually does not occur until the ages of sixteen to 24. It seemed that this individual was probably around eleven to fourteen years old at the time of death.

Plate 2 Sacrum showing premature fusion

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.

The individual was too young for sexual characteristics to have developed.

2.5 METRIC AND NON-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. In children, it is not possible to assess stature.

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).

The individual had numerous cranial non-metric traits: a left *mastoid foramen extrasutural* (a small hole in the bone behind the ear), *ossicles in the lambdoid suture* (an additional bone in the suture at the back of the head), *ossicle at lambda* (an additional bone at the back of the skull), *ossicles at asterion* and *ossicles at parietal notch* (additional bones in the sutures behind the ear), a *metopic suture* (a retained suture at the centre of the forehead), *precondylar tubercle* (a raised area of bone at the base of the skull and *palatine torus* (raised areas of bone on the palate). These minor anomalies were probably genetic in origin and would not have caused any symptoms.

There were two post-cranial non-metric traits: These included a notch (vastus notch) on the right patella (knee cap) and Allen's fossae (areas of exposed trabecular bone at the femoral necks). The majority of these non-metric traits were not observed in the skeletons previously excavated at Mill Mount (Holst 2005 and 2006).

2.6 CONCLUSION

Osteological analysis of the skeleton established that this individual was a child with a developmental disorder that was aged between eleven and fourteen years old. The preservation was moderate, and was almost entirely complete. The skeleton exhibited a considerable number of cranial non-metric traits, most of which were not common in the previously examined Mill Mount skeletons.

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.

The skeleton displayed evidence of a possible unidentified skeletal dysplasia (growth disturbance). Determining age-at-death in this individual was difficult. The second molars were almost fully developed, with the roots still open, an event normally occurring around eleven years of age. The premolars, however, were completely formed, which does not usually occur until fourteen years of age. The skeleton showed similar discrepancies with regards to age determination. Measurements of the long bones were consistent with an age of nine-and-a-half to ten-and-a-half years, implying delayed growth. Most of the bony fusion suggested an age above eight and below fourteen years. The left ulna, however, was partly fused, which occurs normally around twelve to sixteen years . The sacrum was also fused at its centre, which does not normally occur until sixteen to 24 years (Scheuer and Black 2000b; see Plate 2)). It is notable that another burial from Mill Mount (Skeleton 1511), an eleven to thirteen year old adolescent, also suffered from premature fusion of the sacrum (Holst 2006).

There are many different types of skeletal dysplasia and the exact type is unlikely to be identified. A similar case of skeletal dysplasia was noted at Melton, East Yorkshire in a skeleton dating from the Early Iron Age (Caffell and Holst 2007). This individual had died aged between eleven and fourteen years old, but suffered from numerous pathological conditions as well as the dysplasia.

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 2000), 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.

Intervertebral osteochondrosis is a condition associated with intervertebral disc degeneration, characterised by rugged crescent-shaped lesions at the anterior part of the vertebral body surfaces (Kelley 1982). Comparable to Schmorl's nodes, intervertebral osteochondrosis is probably caused by stress, resulting in herniation of the discs. However, osteochondrosis is thought to develop later than Schmorl's nodes, between the second and third decade of life.

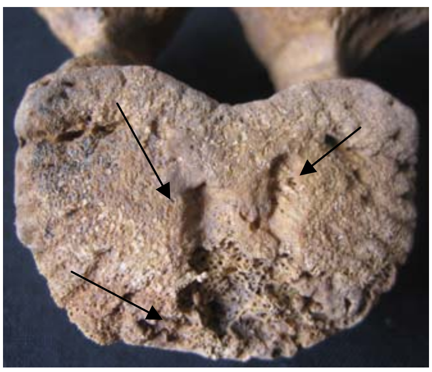

Plate 3 Vertebra with Schmorl's nodes and intervertebral osteochondrosis

Two vertebrae, the tenth and twelfth thoracic vertebrae were affected by both Schmorl's nodes and also intervertebral osteochondrosis (Plate 3). The lesions were irregularly-shaped, with destruction of the anterior vertebral rim. The association between the distribution and expression of Schmorl's nodes and osteochondrosis supports the theory that these lesions have the same cause. However, it is unusual for both to occur in a child, particularly the osteochondrosis, so this may be related to the individual's skeletal dysplasia.

Arachnoid granulations are small, well-defined depressions on the inner (endocranial) surface of the skull. They tend to cluster at the frontal and parietal, especially at the border between these three skull parts (Mann and Murphy 1990, 26). They are common in all populations and have a tendency to increase in number and depth with advancing age. The cause for the formation of *arachnoid granulations* has not yet been understood. Older females tend to be predominantly affected, especially following menopause, although males do exhibit the lesions as well. Unusually, this child had a lesion on the internal surface of the frontal bone (forehead) that resembled arachnoid granulations. The depression on the skull was smoother and less clearly defined than normal arachnoid granulations, but it is possible that this lesion had the same cause and was also related to this child's skeletal dysplasia.

Bone excavations at the attachment of the costoclavicular ligaments were noted on both clavicles; muscular trauma at this site is very common in populations from archaeological contexts. Further upper arm muscle trauma was noted at the attachment sites for *teres major*. These muscles are responsible for movements of the upper arm and shoulder (Stone and Stone 1990).

This individual is likely to have suffered from a skeletal dysplasia that affected its growth and development. This meant that while some parts of the skeletal development were delayed, others appeared to have accelerated. It is possible that the skeletal dysplasia contributed to the development of Schmorl's nodes and intervertebral osteochondrosis (lesions of the vertebrae indicative of physical stress) that are normally observed in young adults or middle-aged adults. Similarly, the child displayed a lesion on the internal surface of the skull that is similar to those usually observed in post-menopausal women, perhaps also suggesting an accelerated ageing process.

The child also showed evidence for muscular trauma to the muscles moving the arm at the shoulder, perhaps suggesting that it had been involved in physical work despite its condition.

4.0 DENTAL HEALTH

A total of 29 teeth were recovered. The wisdom teeth had not yet erupted and a first incisor was lost ante-mortem.

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 dental wear was very mild, reflecting the individual's young age.

Calculus (dental plaque) 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. Calculus was observed in two teeth (7%), and was moderate. Calculus was common in the other Mill Mount skeletons (Holst 2005, 2006).

Dental 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). The skeleton suffered from a small cavity (Plate 4), affecting the chewing surface of the first left mandibular molar. The remainder of skeletons from Mill Mount had a lower than average prevalence of cavities for the Roman period.

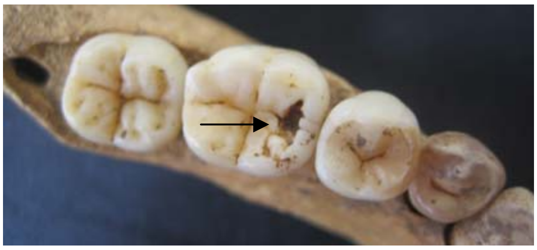

Plate 4 Dental cavity in first molar

The dental health of this child was good with little plaque and one cavity.

5.0 FUNERARY RITUAL

The burial of the adolescent was very similar to that of the other nineteen inhumations at Mill Mount, both in the burial position (supine extended) and the orientation (head to the northwest and feet to the southeast). However, the presence of the sarcophagus, gypsum and two coins in this burial (between the thighs and beneath the sacrum) distinguish it from the remainder of the cemetery population.

The coins may be associated with the journey of the body to the afterlife. Coins were a common addition in burials, thought to be included in order to pay Charon for the crossing of the river Styx in his boat (Alcock 1996, 48). No artefacts were recovered from any of the other Mill Mount burials, with the exception of coffin nails.

Roman gypsum burials often contained young females, and in fact women are found twice as often in sarcophagi as men (Morris 1992, 88). However, examples from York illustrate that young infants, adolescents (Wenham 1968, 41), double or even triple interments could be also interred in this manner (Morrison *pers. comm.*). One of the two Trenholme Drive sarcophagi contained a skeleton thought to have belonged to a boy aged fourteen years (Wenham 1968, 41), though how the child's sex was established is not known. This adolescent was also laid in an extended supine position, with the legs close together and had been covered with a small quantity of gypsum, which covered the legs well (Plate 5), but was very sparse over the upper body (*ibid*). This is the only gypsum burial from the Trentholme Drive.

Plate 5 Gypsum partly removed from skeleton

It appears from the gypsum that the adolescent from Trentholme Drive had been covered with gypsum when naked, suggesting that it must have been fleshed, unlike the Mill Mount adolescent, which was skeletonised when it was covered with gypsum. When comparing the gypsum burials from York, it was found that all of the surviving examples, except the burial from 89 The Mount had impressions of fleshed individuals in the gypsum, thus rendering the Mill Mount and 89 The Mount burials somewhat unusual. It is not known why gypsum was used in burials; though it is possible that it was used to preserve the body for the afterlife. However, this was clearly not the case at Mill Mount. Some researchers have put the idea forward that the gypsum was used to prevent grave robbing (Alcock 1996, 45), which is the more likely explanation in this case.

The gypsum burial from Trentholme Drive dated to the 4th century AD; this is the period when gypsum burials were most common in York (Ramm 1971, 190) and it is thought that many of the 60 gypsum burials (Morrison *pers. comm.* 25/04/2008) from York date to this period.

The Mill Mount skeleton had been buried in a gritstone sarcophagus, very similar to a sarcophagus excavated recently at the adjacent site of 89 The Mount. The labour involved in the carving and transportation of the stone sarcophagi suggests that this individual and the mature adult female from 89 The Mount were of high status. This is especially so considering that the other skeletons from Mill mount were buried in wooden coffins, as indicated by nails and stains, with the exception of one child.

A total of 50 further stone sarcophagi are known from York, though it is likely that in the past, the stone coffins were often discarded after their discovery (Morrison *pers. comm.* 25/04/2008). The Women, men and some children have been found in the sarcophagi. However, some of these stone coffins were re-used for the burial of men in the late Roman or early post-Roman period, when the original occupants were often either discarded or moved to one end of the coffin (Morrison *pers. comm.* 25/04/2008).

The burials at Mill Mount are part of an extended cemetery, running from Blossom Street along the Roman road from York towards Tadcaster. Large cemeteries having been discovered at Trentholme Drive, to the south of 89 The Mount, at Mill Mount and on the opposite side of the road at Driffield Terrace. Even far outside the city of York, at Dringhouses, Roman burials have been discovered at the Starting Gate public house at 42–50, Tadcaster Road (Holst 2008) that are thought to be part of the same cemetery.

6.0 DISCUSSION AND SUMMARY

A skeleton was found in a gritstone sarcophagus situated in a Roman family cemetery plot off one of the major Roman roads leading from York to Lincoln. The skeleton had been interred in a supine extended position in the sarcophagus and was covered in gypsum. Roman first to second century AD coins had been placed between the thighs of the skeleton and under the sacrum.

Osteological analysis found that the skeleton was a child, aged between eleven and fourteen years. It suffered from a skeletal dysplasia that meant that it did not grow and develop in the normal sequence. Some of its growth was probably delayed, while the development of its premolars and fusion of the sacrum and left elbow was accelerated. Notably, another adolescent from the site also displayed evidence for premature skeletal fusion.

It is possible that a smooth lesion on the internal surface of the skull, which is normally only observed in mature individuals, was related to this condition. Similarly, lesions seen on two of the vertebrae that are normally only observed in older adolescents and middle aged adults may have been partly connected to the dysplasia and may also have been associated with physical strain. Two muscular trauma lesions to the shoulder area also suggest that this child was carrying out physical work.

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APPENDIX A: OSTEOLOGICAL AND PALAEOPATHOLOGICAL CATALOGUE

Skeleton Number	**1557**
Preservation	Moderate
Completeness	99%
Age	11-14, adolescent
Sex	-
Stature	-
Non-Metric Traits	Ossicle at lambda, ossicle in lambdoid (bilateral), ossicle at pterion (right), ossicle at asterion (bilateral), mastoid foramen extrasutural (left), precondylar tubercle, incomplete foramen ovale (left), palatine torus, Allen's fossa (bilateral), vastus notch (right)
Pathology	Bone excavations, arachnoid granulations, skeletal dysplasia, intervertebral osteochondrosis, Schmorl's nodes
Dental Health	29/30 teeth present, 1/29 teeth with caries, 2/29 teeth with calculus

	Right Dentition								Left Dentition							
Present	-	P	P	P	P	P	P	P	-	P	P	P	P	P	P	-
Calculus	-	-	Mb	-	-	-	-	-	-	-	-	-	-	Mb	-	-
DEH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wear	-	1	2	2	2	2	2	3	-	2	2	2	2	2	1	-
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	-
Calculus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DEH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caries	-	-	-	-	-	-	-	-	-	-	-	-	-	SO	-	-
Wear	-	1	2	2	2	2	3	3	3	3	3	2	2	2	1	-

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