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FULL ANALYSIS OF HUMAN REMAINS FROM FIELD 265 OF THE A1 WIDENING SCHEME

Introduction

During excavations in February 2016, two inhumation burials and a small quantity of disarticulated bone was identified in Field 265, Scotch Corner, North Yorkshire, by Northern Archaeological Associates. Radiocarbon dates revealed that SK 31508 and SK 31534 dated to the early medieval period (651calAD and 890calAD respectively). This document presents the objectives, methods and results of the analysis of these remains. Upon analysis, Context (31519) contained only animal bone and was thus not considered here.

Objectives

The skeletal assessment aimed to determine age and sex, as well as any manifestations of disease from which the individuals may have suffered.

Methodology

The human remains were analysed in detail, assessing the preservation and completeness, as well as determining the age, sex and stature of the individuals. All pathological lesions were recorded and described. A summary of the osteological and palaeopathological data for the disarticulated skeletal material is provided in Table 1.

Osteological Analysis

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 (Henderson 1987, Garland and Janaway 1989, Janaway 1996, Spriggs 1989). Preservation of human skeletal remains is assessed subjectively, depending upon the severity of bone surface erosion and post-mortem breaks, but disregarding completeness. Preservation is important, as it can have a large impact on the quantity and quality of information that it is possible to obtain from the skeletal remains.

Surface preservation, concerning the condition of the bone cortex, was assessed using the seven-category grading system defined by McKinley (2004), ranging from 0 (excellent) to 5+ (extremely poor). Excellent preservation implied no bone surface erosion and a clear surface morphology, whereas extremely poor preservation indicated heavy and penetrating erosion of the bone surface resulting in complete loss of surface morphology and modification of the bone profile. Surface preservation could be variable throughout an individual skeleton, so the condition of the majority of bones in the skeleton was taken as the preservation grade for the whole skeleton. The degree of fragmentation was recorded, using categories ranging from 'minimal' (little or no fragmentation of bones) to 'extreme' (extensive fragmentation with bones in multiple small fragments). Finally, the completeness of the skeletons was assessed and expressed as a percentage: the higher the percentage, the more complete the skeleton.

Both Skeleton 31508 and Skeleton 31534 were poorly preserved, with abrasion of the bone cortex. Skeleton 31508, was heavily fragmented and only 70% complete, while Skeleton 31534 was only slightly fragmented and 100% complete.

The single disarticulated human bone from Context (31501) was very well preserved, with minimal loss of surface detail, and represented less than 5% of the original skeletal element.

A count of the 'minimum number of individuals' (MNI) recovered from a cemetery is carried out as standard procedure during osteological assessments of inhumations in order to establish how many individuals were 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, such as the hip joints and cranial elements. The MNI for the human remains recovered from Field 265 was two, based on two left femoral heads.

Age is usually determined using standard ageing techniques, as specified in Scheuer and Black (2000a; 2000b) and Cox (2000). Age estimation in adults 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 (Lovejoy et al 1985; Meindl and Lovejoy 1989). 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).

Skeleton 31534 appeared to be a mature adult (46 years+) based on the degenerative changes observed in the pelvis. Due to the heavily fragmented and incomplete nature of Skeleton 31508, it was not possible to accurately assess the individual's age. Based on the completion of the root of the individual's permanent second molar and their unfused proximal femur they would have likely between thirteen and nineteen years of age when they died. The size and thickness of the skull vault from Context (31501) would suggest that it belonged to either an adolescent or an adult.

Sex determination is usually 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.

It was only possible to determine the sex of Skeleton 31534; based on the morphological traits observed in the pelvic region and the skull, combined with metric analysis, the individual was thought to be a male.

The term 'ancestry' is used to describe the genetic background of individuals. An attempt was made to determine the ancestry of both individuals based on the visual appearance of traits in the cranial skeleton, as described by Byers (2010, 154-165). A metric method was also applied based on eight cranial measurements (Byers 2010, 168-171). Unfortunately, the expression of the various traits used to define ancestral groups can be ambiguous and assessing them is subjective; consequently, it can be very difficult to determine ancestry (*ibid*, 152-154). Based on visual assessment of Skeleton 31534, a mixture of traits was observed. The individual exhibited straight femoral shafts and a prognathic maxilla (both considered African morphological traits), while also exhibiting a parabolic palate and a lack of nasal guttering (both considered Caucasian morphological traits). The other skeleton was not sufficiently well preserved to assess ancestry.

Stature depends on two main factors, heredity and environment; it 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, but preferably using the combined femur and tibia. The bone is measured on an osteometric board, and stature is then calculated using a regression formula developed upon individuals of known stature (Trotter 1970). Where possible, bones from the legs were used in preference to those of the upper limb as these carry the lowest error margin (*ibid*).

Different formulae have been developed for different ancestral groups (Trotter 1970). Consequently, where ancestry had been identified as 'white' or 'black', the 'white' or 'black' regression formulae were applied. Where individuals were assessed as mixed ancestry, or ancestry was unknown, the choice of which formula to use was an issue. According to Byers (2010, 153), individuals with mixed white and black traits should be classified as black, so applying the black formula could be appropriate.

It was possible to determine the stature of Skeleton 31534. Based on measurements of the right tibia and femur the individual would have been approximately 183.4m tall (5'12") if they were Caucasian or 177.3m tall (5'10") if they were of African ancestry. Both calculations, however, reveal that the individual would have been considerably taller than the mean for the period of 172cm (Roberts and Cox 2003, 195), but would have fallen within the normal stature range (*ibid*).

Leg measurements could only be obtained from the femora and tibiae of Skeleton 31534, which were used to calculate the shape and robusticity of the femoral shaft (*platymeric* index) and the tibial shaft (*platycnemic* index; Bass 1987). Both of the individual's femoral shafts were *platymeric* (broad and flattened from front to back), and their tibiae *eurycnemic* (broad).

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. Only the adult skeleton exhibited non-metric traits, which included bilateral ossicles in the lambdoid (small bones within the suture at the back of the skull), a Poirier's facet (small extension to the articulation of the proximal femur) and bilateral lateral tibial squatting facets (small extensions to the distal articulation of the tibia). A full list of observed non-metrics traits is available in the catalogue.

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. All bones were examined macroscopically for evidence of pathological changes.

Heredity and environment can influence the embryological development of an individual, leading to the formation of a congenital defect or anomaly (Barnes 1994). The most severe defects are often lethal, and if the baby is not miscarried or stillborn, it will usually die shortly after birth. Such severe defects are rarely seen in archaeological populations, but the less severe expressions often are, and in many of these cases the individual affected will have been unaware of their condition. Moreover, the frequency with which these minor anomalies occur may provide information on the occurrence of the severe expressions of these defects in the population involved (*ibid*), and may provide information on maternal health (Sture 2001).

Skeleton 31534 (mature adult male) had a developmental anomaly that affected their manubrium and sternum (breastbone). The manubrium was longer on the left side than the right and the sternum was wider at the distal end than the proximal. However, these morphological changes were slight and unlikely to have affected the individual in any way.

The styloid processes of both third metacarpals (palm bones) of Skeleton 31534 had failed to unite with the base of the shafts. Such anomalies occur during development when the separate pre-ossification centres which form the styloid fail to unite with the base of the metacarpal (Barnes 2012, 150), creating an extra ossicle between the capitates and trapezoid (wrist bones; *ibid*).

Trauma can damage the blood supply to part of a joint surface leading to localised death of the tissue, which can then become detached from the joint surface (Roberts and Manchester 1995). Such lesions are referred to as *osteochondritis dissecans* and are visible in the skeletal remains as a roughly circular, porous hollow in the surface of the joint. A sub-ovoid lesion was recorded on the distal articulation of the right first metatarsal (arch of the foot) of Skeleton 31534; the lesion had smooth rounded edges and a roughened base and was likely the result of *osteochondritis dissecans*.

Bone tissue cannot respond quickly to an infectious disease, so evidence of any acute illness with a quick resolution (i.e. the patient recovers or dies within a short space of time) will not be seen in the skeleton (Roberts and Manchester 1995). However, bone can respond to the presence of a chronic infection through laying down new bone. Initially, this new bone is disorganised and termed 'woven bone', but with time, as healing takes place, this bone is remodelled and becomes transformed into more organised 'lamellar bone'. The presence of woven bone therefore indicates an infection that was active at the time of death, and lamellar bone indicates an infection that had healed; the presence of both together can suggest a recurring, or long-standing infection (*ibid*). Although the new bone deposition may have been associated with a specific disease in life, it is usually impossible to diagnose this from the bones alone.

Maxillary sinusitis commonly occurs as a result of upper respiratory tract infections, pollution, smoke, dust, allergies, or a dental abscess that penetrate the sinus cavity (Roberts and Manchester 1995). Sinusitis was observed in Skeleton 31534, which was likely caused by a large dental abscess in the maxilla of this individual.

The most common type of joint disease observed tends to be degenerative joint changes (DJC). DJC is characterised by both bone formation (osteophytes) and bone resorption (porosity) at and around the articular surfaces of the joints, which can cause discomfort and disability (Rogers 2000). Skeleton 31534 exhibited degenerative changes to the medial ends of both clavicles (joint between the collarbone and breastbone) and auricular surfaces (hips). Further degenerative changes were also observed in the same individual's spine, affecting the bodies of one cervical and four thoracic vertebrae.

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 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. Indentations, indicative of Schmorl's nodes were present on the bodies of six thoracic and four lumbar vertebrae belonging to Skeleton 31534.

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 teeth and jaws were examined macroscopically for evidence of pathological changes.

Skeleton 31508 had a total of four teeth and six tooth sockets, while Skeleton 31534 had a total of 32 teeth and 32 tooth positions.

Calculus (mineralised dental plaque) is commonly observed in archaeological populations whose dental hygiene was not as rigorous as it is today. If plaque is not removed from the teeth effectively (or on a regular basis) then these plaque deposits mineralise and form concretions of calculus on the tooth crowns or roots (if these are exposed), along the line of the gums. Mineralisation of plaque can also be common when the diet is high in protein (Roberts and Manchester 1995; Hillson 1996). Skeleton 31534 had flecks to moderate deposits of calculus, predominantly on the buccal and lingual surfaces of 29 of 32 teeth.

Dental caries (tooth decay) forms when bacteria in the plaque metabolise sugars in the diet and produce acid, which then causes the loss of minerals from the teeth and eventually leads to the formation of a cavity (Zero 1999). Simple sugars can be found naturally in fruits, vegetables, dried fruits and honey, as well as processed, refined sugar; since the latter three contain the most sucrose, they are most cariogenic. Complex sugars are usually less cariogenic and are found in carbohydrates, such as cereals. However, processing carbohydrates, including grinding grains into fine powders or cooking them, will usually increase their cariogenicity. Skeleton 31534 had two large caries on the adjoining surfaces of the left maxillary second premolar and the left maxillary first molar.

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. Abscesses can form as a result of dental caries, heavy wear of the teeth, damage to the teeth, or periodontal disease (Roberts and Manchester 1995). A large abscess, which had eroded the internal and external surface of the left maxilla, was located around socket for the first molar of Skeleton 31534.

Dental enamel hypoplasia (DEH) is the presence of lines, grooves or pits on the surface of the tooth crown, which occur as a result of defective formation of tooth enamel during growth (Hillson 1996). Essentially, they represent a period when the crown formation is halted, and they are caused by periods of severe stress, such as episodes of malnutrition or disease, during the first seven years of childhood. Involvement of the deciduous (milk) teeth can indicate pre-natal stress (Lewis 2007). Grooves were identified on the surfaces of a maxillary lateral incisor and canine belonging to Skeleton 31534.

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Appendix

Table 1 Summary of the osteological and palaeopathological results

Skeleton No	Preservation*			Age	Sex	Stature (cm)	Dental Pathology	Pathology
	SP	F	C					
31508	4 (poor)	Severe	70%	13-19 Adolescent - Young Adult	-	-	-	-
31534	4 (poor)	Slight	100%	46+	Male	183.4 cm or 177.3 cm	Externally and internally penetrating abscess, calculus, caries, DEH and periodontal disease	Agenesis of left and right styloid for MC3. Possible *osteochondritis dissecans* on distal articulation of R MT1. Asymmetry of manubrium and sternum.

* Preservation: SP = surface preservation, graded according to McKinley (2004); F = fragmentation; C = completeness

Table 2 Summary of disarticulated bone

Context	Bone Element	Detailed Description	Side	%	SP	No. Frags	Age	Sex	Other
31501	Cranium vault	Possible frontal fragment	-	<5	2	1	Adult?	-	-

Table 3 Skeletal Catalogue

Skeleton Number	**31508**
Preservation	Poor (Grade 4)
Completeness	70%
Age	13-19 years, adolescent to young adult
Sex	-
Stature	-
Non-Metric Traits	-
Pathology	-
Dental Health	6 tooth positions, 3 teeth lost post-mortem, 4 teeth present (1 loose)

	Right Dentition								Left Dentition							
Present	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calculus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DEH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wear	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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	PM	PM	-	-	-	P	P	PM
Calculus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DEH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Caries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wear	-	-	-	1	-	-	-	2	-	-	-	-	-	1	1	-

Skeleton Number	**31534**
Preservation	Poor (Grade 4)
Completeness	100%
Age	46+ years, mature adult
Sex	Male
Stature	183.4 +/- 2.99 (Caucasian) 177.3+/- 3.53 (African)
Non-Metric Traits	*Ossicle in lambdoid* (bilateral), *parietal foramen* (bilateral), *mastoid foramen extrasutural* (left), *sutural mastoid foramen* (right), *accessory lesser palatine foramen* (right), *bridging of supraorbital notch* (right), *circumflex sulcus* (right), *accessory sacral facet* (left), *Poirier's facet* (left), *exostosis in trochanteric fossa* (left), *third trochanter* (bilateral), *lateral squatting facet* (bilateral).
Pathology	DJD in the left and right clavicles, and auricular surfaces, cervical and thoracic bodies. Schmorl's nodes in the thoracic and lumbar spine. OD on the distal right first metatarsal. Sinusitis, developmental defects in the left and right 3rd metacarpals. Asymmetry of the manubrium and sternum.
Dental Health	6 tooth positions, 3 teeth lost post-mortem, 4 teeth present (1 loose)

	Right Dentition								Left Dentition							
Present	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Calculus	Hbd	Fd	Sl	Fmd	Sb	Sb	Sb	Sb	Sb	Fd	-	-	-	Fb Sdl	Sb Fmd -	Fml
DEH	-	-	-	-	-	-	-	-	-	G	G	-	-	-	-	-
Caries	-	-	-	-	-	-	-	-	-	-	-	-	Md	Lm	-	-
Wear	3	4	5	2	2	2	1	3	3	1	1	2	3	5	3	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	Sbl	Fb Sm	Sld	Sl	Sb Fl	Sbd	Fl	Fl	Fmd	Fmd	Fm	Sb	Fb	Fl	Mlb	Ml Fb
DEH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wear	3	4	5	2	2	2	2	2	2	2	2	2	2	5	4	3