13. An overview of the palaeopathological analyses of the medieval human remains from Ballyhanna, Co. Donegal

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Human palaeopathology has been defined as the scientific study of disease processes in past populations through the examination of human remains (Aufderheide & Rodríguez-Martin 1998, 1). It examines how diseases have evolved and changed over periods of time and how humans have adapted to their ever-changing environments (Roberts & Manchester 2005, 1). There are two main types of evidence that may be used to study disease processes in an archaeological population: biological and cultural evidence. Biological evidence, or primary evidence, consists of the data that can be collected through a detailed examination of skeletal or mummified remains (Wells 1964, 23). Cultural evidence, or secondary evidence, is information about disease processes that can be collated through the study of contemporary documentary, iconographic (art) or archaeological evidence (ibid.). Combining these two approaches to the study of disease in past populations is referred to as adopting a biocultural approach. If the skeletal data alone were examined for evidence of disease in an archaeological population, then the large number of diseases that affect only the soft tissue would not be represented in the interpretation. Careful examination of secondary evidence is essential, therefore, in ascertaining as accurate a representation as possible of disease and the experience of disease in an archaeological population.

In 2003, an excavation in advance of the construction of the N15 Bundoran–Ballyshannon Bypass was conducted at Ballyhanna townland, Co. Donegal, by Brian Ó Donnchadha of Irish Archaeological Consultancy Ltd on behalf of Donegal County Council and the National Roads Authority (NRA). The excavation revealed a church and a medieval cemetery containing approximately 1,275 burials—one of the largest medieval Gaelic cemetery populations excavated in Ireland to date (Ó Donnchadha 2007; MacDonagh, this volume). Analysis of the adult human skeletal remains from Ballyhanna is ongoing at present. This paper, therefore, refers to only a sub-sample of the entire population and focuses only on the biological (primary) data that have been collected so far. At a later date the data recorded from the initial examination of the skeletal remains will be re-examined within the framework of historical, archaeological, documentary and iconographic evidence, thereby building up a wider picture of the community represented by the skeletons from Ballyhanna. The adult skeletal remains are currently being examined, in conjunction with Róisín McCarthy (this volume), to assess age at death, sex and stature. In addition, for each individual detailed notes are made of any evidence of disease or antemortem trauma that may be apparent on the skeleton. The aim of this paper is to outline briefly some of the common and more unusual pathological lesions (or indicators of disease) that have been recorded on the Ballyhanna skeletons analysed so far. For the purposes of this paper the diseases discussed will be grouped under the following headings: congenital anomalies, joint diseases, infectious diseases and neoplastic diseases. It is not possible to include in this paper all the different diseases and disease processes that have been observed on the Ballyhanna skeletons. Therefore, dental

diseases, metabolic diseases (affecting the metabolism of an individual, e.g. diseases caused by excesses or deficiencies in diet), endocrine diseases (caused by an imbalance of hormones) and incidences of antemortem trauma have been omitted to allow the disease processes described to be examined in greater detail.

Congenital anomalies

Congenital anomalies are abnormalities or malformations of the skeleton that normally occur during foetal development in the uterus and are therefore present at birth or become evident soon after birth (Aufderheide & Rodríguez-Martin 1998, 51). Congenital anomalies are often caused by genetic disturbance during development (Barnes 1994, 2; Sarry El-Din & El-Shafy El Banna 2006, 200), although other factors, for example environmental factors, may also contribute towards the development of congenital malformations (ibid.). There are a number of relatively common minor skeletal congenital defects that may have little or no impact on the individual in life (e.g. spina bifida occulta). Severe developmental defects may be incompatible with life, however, causing the infant to die before or soon after birth (Roberts & Manchester 2005, 50). In skeletal material congenital abnormalities are often found in the thorax (chest) region of the skeleton, frequently affecting the vertebrae and ribs.

Spina bifida occulta

Spina bifida occulta refers to the incomplete union of the vertebrae at one or more of the neural arches (the neural arches are the bony structures that protect the spinal cord during life). This is one of the most frequently recorded congenital abnormalities in archaeological skeletal material. Although any vertebra may show this developmental defect, it is commonly located at the base of the spine in the sacral vertebrae. Complete spina bifida occulta describes a condition where all the sacral neural arches are unfused; this has been identified in only one individual from Ballyhanna to date, SK 581, a young male adult (Illus. 1). It is likely that this minor developmental defect caused no clinical symptoms to this young man during life.

Illus. 1—A young adult male, SK 581, showing complete spina bifida occulta (Catriona McKenzie).

Illus. 2—Fifth lumbar vertebra showing bilateral spondylolysis from SK 434, a young adult of indeterminate sex (Catriona McKenzie).

Spondylolysis

Spondylolysis is another minor developmental defect affecting the vertebral column that is regularly recorded in the Ballyhanna skeletal material (Illus. 2). In cases of bilateral spondylolysis the vertebral bodies do not fuse correctly; this causes the vertebra to remain separated into two distinct segments instead of fusing as normal into one entity. Although any vertebra can be affected by spondylolysis, it is frequently recorded on the fourth and fifth lumbar vertebrae (in the lower back). In some clinical cases spondylolysis may cause instability in the vertebral column, which may result in sporadic pain often in the lower back and legs (Roberts & Manchester 2005, 57).

Joint disease

Evidence of joint diseases is present on some of the earliest human remains examined (for examples see Brothwell 1981, 143). From prehistoric skeletal remains to contemporary modern clinical cases, lesions indicative of joint disease are frequently recorded on the human skeleton. In total, more than 250 different joint diseases have been identified in the clinical literature (Rogers 1989, 289), but only a few of these are regularly recorded in archaeological skeletal remains. As part of the analysis of the Ballyhanna skeletons, each of the joint surfaces is being carefully examined on every skeleton for evidence of joint disease. Cases of osteoarthritis are evident and may be caused by a number of factors, including trauma, age-related degeneration of the bone and/or mechanical stress (bending and lifting). In the Ballyhanna collection, the spine is the area of the skeleton most commonly affected by joint disease. Two indicators of joint disease that are commonly found on the spine will be described below.

Joint lesions of the spinal column

Vertebral osteophytes are nodules of new bone that are often located on the margins of the upper or lower surfaces of the vertebral bodies (Illus. 3). During life the vertebrae are

Illus. 3—Vertebral osteophytes in the lumbar region from SK 757B, an elderly male (Catriona McKenzie).

separated by fibrous intervertebral discs, which prevent the bones in the spine from rubbing directly against each other during movements such as bending and lifting. With increasing age it is common for the intervertebral discs to degenerate; this in turn causes irritation at the margins of the vertebral body, which stimulates the formation of new nodules of bone (osteophytes). The body often creates new bone at the margins of a joint affected by joint disease to increase the size of the joint surface and therefore reduce stress on the joint (Aufderheide & Rodríguez-Martin 1998, 94; Buikstra & Ubelaker 1994, 121; Mays 2002, 127). Osteophytes are frequently recorded in the vertebrae of the Ballyhanna skeletons, often in the lower back. These lesions may be caused by age-related degeneration of the bone and/or by mechanical stress (due to bending, lifting and carrying heavy loads).

Schmorl's nodes are another commonly recorded lesion. They are evidenced by depressions on the upper or lower surfaces of the vertebral bodies. Schmorl's nodes are caused by degeneration of the intervertebral disc, which may protrude through the vertebral surface facing the disc and extend into the vertebral body (Buikstra & Ubelaker 1994, 121). This produces a characteristic indentation in the corresponding vertebral body (Illus. 4). Although the specific cause of Schmorl's nodes is unknown, it is likely that they are caused by carrying heavy loads on the back (Coughlan & Holst 2000, 68). In addition, different factors, such as trauma or an underlying disease process (for example osteoporosis, a disease in which loss of bone density and deterioration in the organisation of the bone tissue results in increased bone fragility), may weaken the bone structure, thereby increasing the likelihood of the development of Schmorl's nodes.

Illus. 4—A Schmorl's node on the upper surface of the first lumbar vertebra from SK 809, a middle-aged male who was between 35 and 50 years of age at death (Catriona McKenzie).

These lesions are common in older individuals, who are naturally affected by deterioration in bone quality with increasing age. Nonetheless, these two lesions indicative of degenerative joint disease have been recorded in individuals as young as 17–25 years of age from the Ballyhanna skeletal collection. This supports the theory that degenerative joint disease may also be a mechanically induced condition, caused by bending and lifting during everyday activities. If degenerative joint diseases are found to be commonplace among younger individuals, this may indicate that those affected were routinely engaged in heavy physical labour.

Infectious disease

An individual can suffer from a specific infection in which the causative organism is known (e.g. tuberculosis, which is caused by a variety of mycobacteria, but most commonly *Mycobacterium tuberculosis* or *Mycobacterium bovis*), or a non-specific infection in which the causative organism is unknown.

Non-specific infections

Periostitis and osteomyelitis are both examples of non-specific infections that are commonly being recorded on the Ballyhanna skeletal material. Periostitis is an inflammation of the periosteum (which is the outermost layer of bone on the post-cranial skeleton with the exception of the joint surfaces) caused by trauma or infection (White 2000, 392). The lesions are evident as reactive, woven, plaque-like bone affecting only the outermost layer of bone. In the Ballyhanna skeletal material there is a high prevalence of periostitis; it is frequently located on the longbones and the ribs of the adult individuals.

Osteomyelitis is a more severe bone infection. It can be caused by a localised infection or by a generalised primary infection. The diagnosis of osteomyelitis is generally unproblematic, as the infection exhibits distinctive pathological lesions whereby the bone becomes enlarged and deformed. Roberts & Manchester (2005, 168) outline three processes that contribute towards osteomyelitis: bone destruction, pus formation and simultaneous bone repair. A bone affected by osteomyelitis will often have one or more sinuses in it, through which pus-filled abscesses would have drained into the surrounding body tissue.

Illustration 5 shows a severe case of osteomyelitis on the left femur (thigh bone); the hip joint and entire bone shaft are affected by the severe bone infection. This infection is non-specific and could have been caused either by a general infection or a localised infection. A general infection, for instance an ear, throat, sinus or chest infection, may cause disease-producing bacteria to be transported through septicaemia—a blood infection—from the primarily affected area. This could have resulted in the severe bone infection of the left femur. Alternatively, the osteomyelitis in this case could have been caused by a localised infection such as a leg ulcer. Although the cause of the osteomyelitis in this case will probably remain unknown, clinical cases of osteomyelitis indicate that this individual would have been seriously ill with fever, pain and immobility in the lower limb. In medieval Ireland, in the pre-antibiotic era, there would have been a high mortality risk if an individual suffered from such a severe infection. The presence of the chronic bony lesions indicates, however, that this individual must have survived the initial acute phase of the infection and survived for a long time with this infection.

Illus. 5—Osteomyelitis present on the left femur from SK 984, a middle-aged adult of indeterminate sex, between 35 and 50 years of age at death (Catriona McKenzie).

Specific infection

So far the only evidence for specific infection is a suspected case of tuberculosis. As stated, tuberculosis is an infectious disease commonly caused by *Mycobacterium tuberculosis* or *Mycobacterium bovis*. Skeletal changes caused by the tuberculosis infection are relatively uncommon, occurring in as few as 5–7% of cases in the pre-antibiotic era (Aufderheide & Rodríguez-Martin 1998, 133). The spine is the most common location to find lesions that may indicate tuberculosis. It has been estimated that the spine is affected in 50% of all cases of the infection that have skeletal involvement (ibid., 135).

Bony lesions that may aid in the identification of spinal tuberculosis in skeletal material have been described in detail by Aufderheide & Rodríguez-Martin (1998, 133), Ortner (2002, 230–5) and Roberts & Manchester (2005, 188). The main characteristics include lesions, primarily located in the lower thoracic and upper lumbar vertebrae; destructive lesions that produce cavities in the trabecular bone (spongy bone found mainly in the vertebrae, pelvis, skull and at the ends of the limb bones), frequently with little or no new bone formation; weakening of the trabecular bone, which may lead to collapsed vertebrae and kyphosis (bending of the spine); and, lastly, usually the involvement of between one and four vertebrae. Biomolecular studies have, through the study of ancient DNA, confirmed the osteological diagnosis of tuberculosis in a number of cases (see Mays et al. 2001 for examples). These studies have demonstrated that positive identification of tuberculosis in skeletal material is possible through the careful examination of pathological lesions.

SK 882 is the skeleton of a probable female individual aged 35–45 years at death. Malignant lytic lesions found on the vertebrae, with no evidence of healing, suggested a diagnosis of tuberculosis (Illus. 6). There were no vertebral fractures present, but this is likely to be because of extensive bone loss. The degree of kyphosis on SK 882 was not recordable owing to the fragmentation of the vertebrae, but observations of the individual vertebrae suggest that it was likely to have been very severe. In addition to the vertebral lesions, the presence of periostitis (as outlined above) on the ribs may also be considered additional evidence of a lung disease such as tuberculosis. Modern clinical symptoms for all forms of chronic tuberculosis include fever, fatigue, night sweats, loss of appetite and loss of weight.

Illus. 6—Vertebra showing bone loss possibly due to tuberculosis from SK 882, a middle-aged female, between 35 and 50 years of age at death (Catriona McKenzie).

In addition, symptoms of pulmonary tuberculosis include coughing, chest pains and production of blood-stained sputum. This female individual would have been very sick and debilitated. The spinal lesions and kyphosis would have caused an obvious physical spinal deformity. Considering the severity of this disease process, it is likely that this individual received some form of support and/or care during the illness.

Neoplastic disease

The term neoplasm refers to tumours that may be either benign or malignant. Benign tumours remain at the primary site of formation and do not spread throughout the body. In contrast, malignant tumours, or cancer, spread to other tissues throughout the body, primarily through the bloodstream or lymphatic system (Marks & Hamilton 2007, 218; Mays 2002, 127). On the Ballyhanna skeletons two individuals, discussed below, exhibit evidence of neoplastic lesions.

Multiple hereditary exostoses

Multiple hereditary exostoses (MHE) may be classed as both a genetic developmental disorder and a neoplastic disease. This disease causes numerous benign bony tumours to grow throughout the skeleton (although not affecting the skull). Initially, tumours typically form on the ends of the longbones, but as the disease progresses the bony growths may spread to the longbone shafts and begin to form on most of the skeleton. The condition normally begins to manifest itself in childhood, often between the ages of 6 and 8 years (Aufderheide & Rodríguez-Martin 1998, 361). Clinical symptoms reported by sufferers of MHE include pain at the site of the lesions and interference with normal movement and impinged nerves, including compression of the spinal cord. Often there may be associated thinning of the bone, which may make the individual likely to suffer from pathological fractures. As the disease progresses, it is possible for the benign growths to turn cancerous: this occurs in approximately 2–10% of individuals affected (ibid.).

One skeleton, SK 331, a young male who died between the ages of 25 and 35, was likely to have had MHE. Most of the bones were affected by large bony nodules. The presence of

Illus. 7—Left and right upper arm bones showing bony nodules possibly indicative of MHE from SK 331, a young male (Catriona McKenzie).

Illus. 8—Lower right leg bones from SK 331, a young male, possibly indicative of MHE (Catriona McKenzie).

these benign tumours creates abnormal bone shapes that are most apparent on the upper and lower limbs (Illus. 7). The longbones were shortened in length, and on the lower limb the two leg bones, the tibiae and fibulae, had fused together (Illus. 8). The bony swellings would have caused this young man to have a physically debilitating condition, probably since he was a young child. The fact that he survived to adulthood suggests that he was afforded some form of support by his family or community during life.

Metastatic carcinoma

Metastasised neoplastic lesions are caused by cancer. They are cancerous lesions that have spread from the primary site of formation and are found on secondary sites throughout the skeleton. Metastatic lesions are usually found at sites that have high contents of trabecular (spongy) bone: the vertebrae, pelvis, sternum (breastbone) and skull. Melikian (2006, 143) highlights the fact that some primary cancers are more likely to cause metastatic lesions than others, including prostate, kidney, lung, thyroid and breast cancer. Two main types of metastatic lesions may be apparent: firstly, lytic lesions, which can completely perforate the bone; secondly, small areas of new bone growth (sometimes spicules, needle-like structures). Metastases from prostate cancer are usually evident as new bone growth, while those from other primary cancers, such as lung, thyroid and kidney cancer, are usually lytic in nature (Aufderheide & Rodríguez-Martin 1998, 388). Breast cancer may produce lesions that are a mixture of the two processes—both bone-forming and bone-destroying metastases.

One individual from Ballyhanna, SK 671, has been identified as having multiple metastatic lesions, both lytic lesions and spicules of new bone growth evident on the skull (Illus. 9). The skeleton is that of a female who was a young adult, between 18 and 35 years

Illus. 9—Skull from SK 671, a young female, showing bone-destroying cancerous lesions (Catriona McKenzie).

of age at death. A precise diagnosis for the primary cancer is not possible; however, the presence of both lytic lesions and new bone growth on the cranial vault in this young female suggest that the primary cancer may have been breast cancer.

Conclusion

The purpose of this paper was to provide a brief overview of some of the common and unusual pathologies that have been recorded on the Ballyhanna skeletal collection to date. The diseases outlined here deal predominantly with individual cases, as population-based inferences on the prevalence of diseases cannot be inferred with any accuracy until the analysis of skeletal remains has been completed. This initial analysis is only the starting-point for reconstructing information about the community who were buried at Ballyhanna. At later stages of the research vital information from secondary sources will be analysed, and the end result of the project will combine a variety of scientific investigations in an attempt to glean as much information as is possible about the Ballyhanna community. This large skeletal collection is unique in that it provides a large sample from a medieval Gaelic population. Although large medieval populations have been examined from Ireland before, they have generally come from medieval towns in the south and east and other places likely to have been influenced by incoming populations of Vikings and Anglo-Normans. Examples of such sites include Temple Lane in Dublin (Ó Donnabháin & Cosgrave 1994), St Peter's Church, Waterford (Power 1994), and Tintern Abbey, Co. Wexford (Ó Donnabháin 1991). The Ballyhanna skeletal collection provides the opportunity to record primary data from a predominantly Gaelic area; these data will then be compared with

other large medieval collections recorded from both Britain and Ireland. Through adopting a biocultural approach it is hoped that this research will provide a greater understanding of lifestyles, diet, health and economy in a medieval Gaelic population.

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