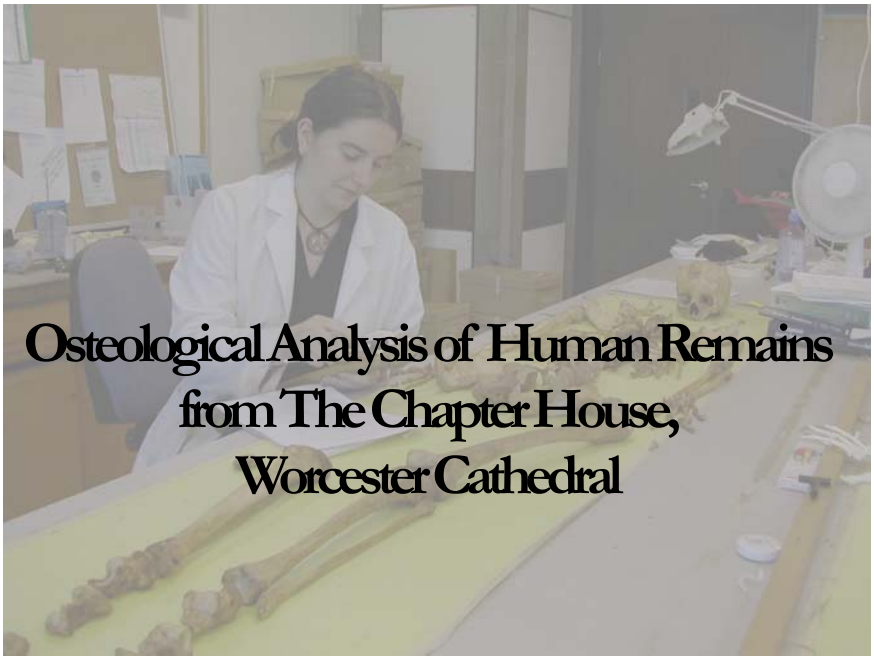

Osteological Analysis of Human Remains from The Chapter House, Worcester Cathedral

A report for Worcester Cathedral

December 2003

Project: PJ 112

1. Introduction

This report contains the results of the osteological analysis of human remains recovered from the Chapter House of Worcester Cathedral during excavations prior to the installation of under floor heating. Worcestershire County Council Archaeological Service recovered 180 skeletons during the archaeological excavation between February and September 2003. The human remains analysed within this report were to be reburied inside the Chapter House prior to the laying of the new floor. Therefore, they were analysed in isolation from the main assemblage.

This sample of excavated remains consisted of one discrete burial that had been disturbed by later, possibly Victorian, construction work. This disturbance resulted in the deposition of unrelated, disarticulated human remains within the discrete grave. However, 3 fills of the grave were removed as distinct and separate contexts ([067], [073] and [1189]) and these (and any human remains they contain) have been treated as such. Context [1189] was found to contain the associated remains of one individual, referred to as Skeleton 1188. The greater part of this report contains the results of osteological analysis of this individual.

The osteological analysis aims to provide a detailed inventory of the skeletal and dental material recovered, the condition of the bone present, completeness of the skeletons and to provide, where possible, the age, sex and stature of the individuals recovered. Any evidence of pathological changes is also noted.

2. Methods and Process

The skeletal material was analysed according to the standards laid out by the guidelines recommended by the British Association of Biological Anthropologists and Osteologists in conjunction with English Heritage (Human Bones from Archaeological Sites: Guidelines for producing assessment documents and analytical reports, 2002).

- Recording of the material was carried out using the recognised descriptions contained in Standards for Data Collection from Human Skeletal Remains by Buikstra and Ubelaker (1994).
- The material was analysed macroscopically and where necessary with the aid of a magnifying glass for identification purposes. Where relevant, digital photographs have been used for illustration.
- The material was analysed without prior knowledge of associated artefacts so that the assessment remained as objective as possible.

2.1. Reasons for the Analysis

Osteological analysis was carried out to record and ascertain:

- Inventory of the skeletal material
- Condition of the bone present
- Completeness of the Associated Skeletal Remains
- Sex Determination
- Age Assessment
- Non-metric Traits
- Stature
- Skeletal Pathology
- Dental Pathology

3. Inventory of Skeletal Material

3.1 Introduction

An inventory of the skeletal material was recorded in tabular form. Each bone has been recorded as being absent or present. The long bones are recorded according to the presence or absence of the proximal, middle and distal sections and also the proximal and distal joint surfaces. The percentage of completeness of the bones of the axial skeleton (with the exception of the spine) is recorded in categories of > 75%, 75-50%, 50-25% and <25%. This detailed recording is necessary to understand the nature of the preservation of the skeletal material and any constraints that the condition of material may put on the ensuing analysis. From the perspective of future research, a detailed inventory also allows an accurate calculation of prevalence rates of pathological conditions such as fractures and joint diseases and should prove more fruitful for future reassessment should the skeletal material be reinterred.

3.2 Observations

Context [1189] was observed to contain the associated remains of one individual, referred to as Skeleton 1188, which was recorded in tabular form on Sheet B (see Appendix).

3.3 Results

Context [1189] contained an almost complete human skeleton. Whilst the majority of these skeletal elements were found to be disturbed and disarticulated in the grave, analysis of the remains demonstrates that these are highly likely to be the remains of one individual, recorded as Skeleton 1188, with two intrusive skeletal elements, one adult and one juvenile. The human bones recovered could clearly be paired and articulated. Only one adult element was duplicated; of the three zygomatic bones present two were a pair and considered to be part of Skeleton 1188, the remainder being classed as intrusive.

4. Condition of the Bone Present

4.1. Introduction

The condition of the bone was assessed macroscopically and recorded according to the categories and descriptions referred to by Behrensmeyer (1978).

4.2. Observations

The surfaces of the bones present in context [1189] were observed to be in good condition with joint and diaphyses intact. Some post-mortem damage had occurred. The bones of Skeleton 1188 were noted to be brittle and fragile.

4.3. Results

Skeleton 1188 was, overall, in good condition and graded as 1-3 (Behrensmeyer 1978).

5. Completeness of Skeletons

5.1 Introduction

This is a guide to the overall completeness of an articulated individual's skeletal remains and is calculated according to the percentage of the bones present in relation the total number of bones in a complete human skeleton. This is gauged through an assessment of the amount of material representing different areas of the body. A complete skeleton comprises of:

Skull = 20%

Torso = 40%

Arms = 20%

Legs = 20%

5.2 Observations

Skeleton 1188 was observed to have most of its skeletal elements present, including the small bones of the hands. However, a significant portion of the torso was absent. Since preservation conditions were good on the whole, it is assumed that the likely cause of the lack of torso is the post-depositional disturbance.

5.3 Results

Skeleton 1188 was estimated to consist of at least 75% of its original skeletal content (Buikstra and Ubelaker 1994).

6. Age Assessment

6.1 Introduction

There are a number of techniques available for assessing the age of both adult and juvenile remains. Juveniles can be accurately assessed by observing the stage of development of skeletal growth, dental eruption and tooth formation. The assessment of adult remains is based on the changes observed in particular joints in the body, namely the auricular surface, pubic symphysis and costal rib ends. These changes are consistent with the ageing of the skeleton but fall into broad age ranges. These categories are Young Adult (20-34 years), Middle Adult (35-49 years) and Old Adult (50+ years) (Buikstra and Ubelaker 1994). Cranial suture closure and dental attrition are not considered reliable techniques for age estimation. This is due to the high level of individual variation found from the results of analyses using these techniques.

6.2 Observations

The remains of Skeleton 1188 were observed to be fully developed, the epiphyses of the surviving long bones being fused to the diaphyses with no evidence of fusion lines. This indicated that these remains were those of an adult. The auricular surface, pubic symphyses and costal rib ends had all survived enabling a good estimation of age at death. The auricular surfaces and pubic symphyses were placed in stage 8 (Lovejoy et al. 1985) and 6 (Brooks and Suchey 1990) respectively. The costal ribs demonstrated those morphological changes associated with phase 6 (Isçan et al. 1984) although it was unclear as to whether these costal ends belonged to the upper ribs, upon which this technique should be based. Thus, the costal rib phase result should only be taken as a very approximate estimation of age.

6.3 Results

Analysis of the auricular surfaces of Skeleton 1188 revealed features that suggested this individual was an adult of at least 50 years of age and may even have been significantly older (Lovejoy et al. 1985). The age estimation from the pubic symphysis and the rib ends were corroborated this. This individual was highly likely to have been an older adult at the time of death (Buikstra and Ubelaker 1994).

7. Sex Determination

7.1 Introduction

Determination of the biological sex of adult skeletal remains is well established and is largely based upon an assessment of the morphological features exhibited by the skull and the pelvis. These features reflect the sexual dimorphism displayed between males and females and develop as the individual matures. These features are, therefore, not observably marked during adolescence and there are no reliable techniques for determining the sex of juvenile remains, except for DNA analysis. Sex determination is relatively accurate, some researchers reporting a success rate of 95% of known in tests on known sex samples (Phenice 1969). Techniques generally used include descriptive methods, metric analysis and discriminant functions depending on the completeness of the skeletal material.

7.2 Observations

A good assessment of the biological sex of Skeleton 1188 could be made due to the almost complete preservation of the pelvis and the recovery of several indicative cranial elements. The sub-pubic concavity, ischio-pubic ramus, greater sciatic notch and preauricular sulcus were all observable on the pelvis, whilst the supraorbital margin, mastoid processes, glabella and jaw shape were all assessed from the skull (Buikstra and Ubelaker 1994).

7.3 Results

The elements of the pelvis recovered from Skeleton 1188 suggested that this individual was male (Phenice 1969). Whilst the pelvis demonstrated several ambiguous features, which could possibly have been male, the skull was large with robust, masculine features. The individual was, therefore, ascribed to the category of Male (Buikstra and Ubelaker 1994).

8. Non-Metric Traits

8.1 Introduction

Non-metric traits are morphological features that occur both in bone and dentition. These features have no functional purpose and occur in some individuals and not in others. The origins of non-metric traits have now been shown to be highly complex, each having its own aetiology and each being influenced to differing extents by genetics, the environment, age and sex of the individual and by physical activity. Generally, the analysis of these traits requires a large sample size. Non-metric traits have been recorded for these skeletons in order to allow future comparisons with findings from contemporary assemblages in the Worcestershire area.

8.2 Observations

The level of preservation of skeleton 1188 allowed observation of many of the non-metric traits. Observations were noted on recording sheet I (contained in the archive).

8.3 Results

The presence of a left mastoid foramen exsutural and a right parietal foramen was recorded for Skeleton 1188.

9. Stature and Metric Analysis

9.1 Introduction

Stature of adult individuals can be reconstructed from measurements of long bones of the skeleton. Since the long bones of adolescents have not yet fully developed it is not possible to provide an estimate of stature for juveniles. Stature is the result of many factors including genetics and environmental influences, such as malnutrition and poor health. Height can be

used as an indicator of health status and there is a wide range of literature on the relationships between height, health and social status.

9.2 Observations

The right femur and tibia were complete and used as the basis for estimation of stature of Skeleton 1188.

9.3 Results

The stature of the individual represented by these skeletal remains was calculated as being 1.75m or 5’8”.

10. Skeletal Pathology

10.1 Introduction

Palaeopathology is the study of diseases of past peoples and can be used to infer the health status of groups of individuals within a population as well as indicate the overall success of the adaptation of a population to its surrounding environment. Pathologies are categorised according to their aetiologies; e.g. congenital, metabolic, infectious, traumatic, neoplastic etc. Any pathological modifications to the bone are described. The size and location of any lesion is also noted. Distribution of lesions about the skeleton should be noted to allow diagnosis. A differential diagnosis for any pathological lesions should be provided.

10.2 Observations

Several significant pathological changes were observed in the skeletal remains of this individual. These included:

1) Severe pathological changes to the left knee joint, including destruction of the knee joint surface (distal femur, proximal tibia) through massive lytic (destructive) lesions (See Figures 1 to 4). Blastic (formative) bony remodelling observed also, particularly around the proximal tibia on the posterior surface, prolific spiculated and porotic new lamellar bone formation has occurred. A cloaca or sinus is present in the anterior tibia on the proximal side, which would have allowed pus to drain out of the bone. These changes are indicative of a chronic non-specific infection resulting in septic arthritis of the left knee.

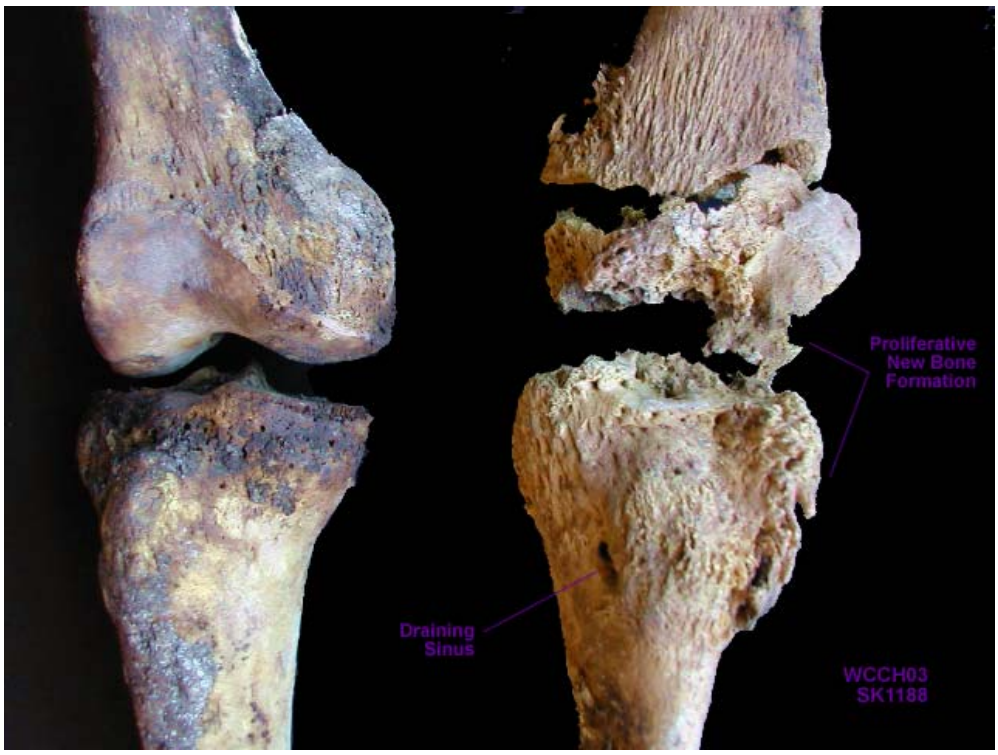

Figure 1: Septic Arthritis with Chronic Osteomyelitis of the left knee joint. Anterior View.

Figure 2: Proliferative bone formation on the posterior aspect of the left tibia.

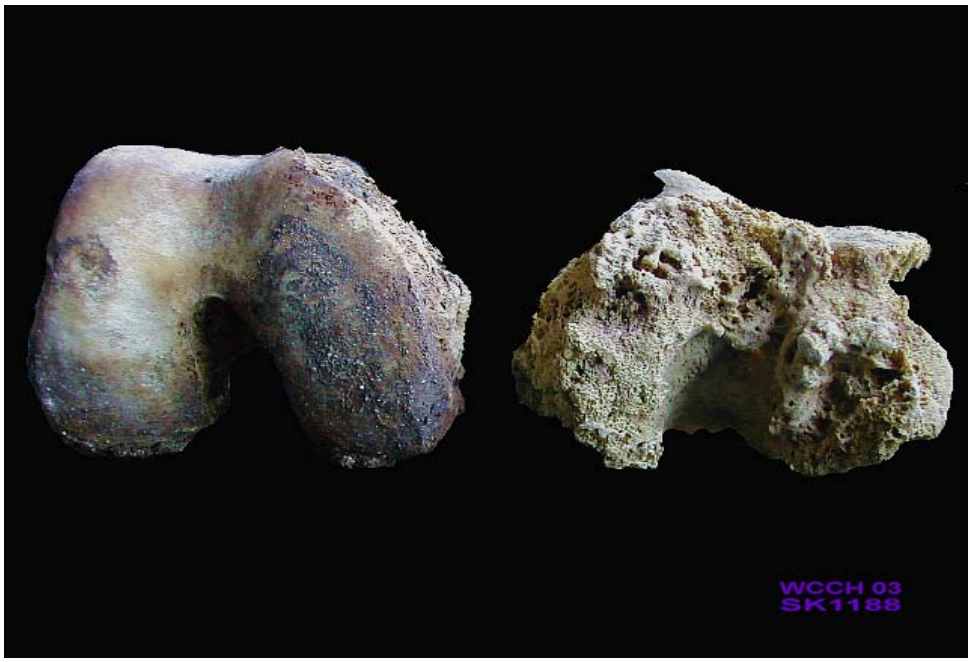

Figure 3: Destruction of the subchondral bone surface of the left femur. Inferior View.

Figure 4: Massive lytic lesions destroying the joint surface of the left tibia. Superior View.

2) Scoliosis or lateral curvature of the lower thoracic vertebrae. This area of the body was not well preserved so it was not possible to trace the full extent of this disease through the upper vertebrae.

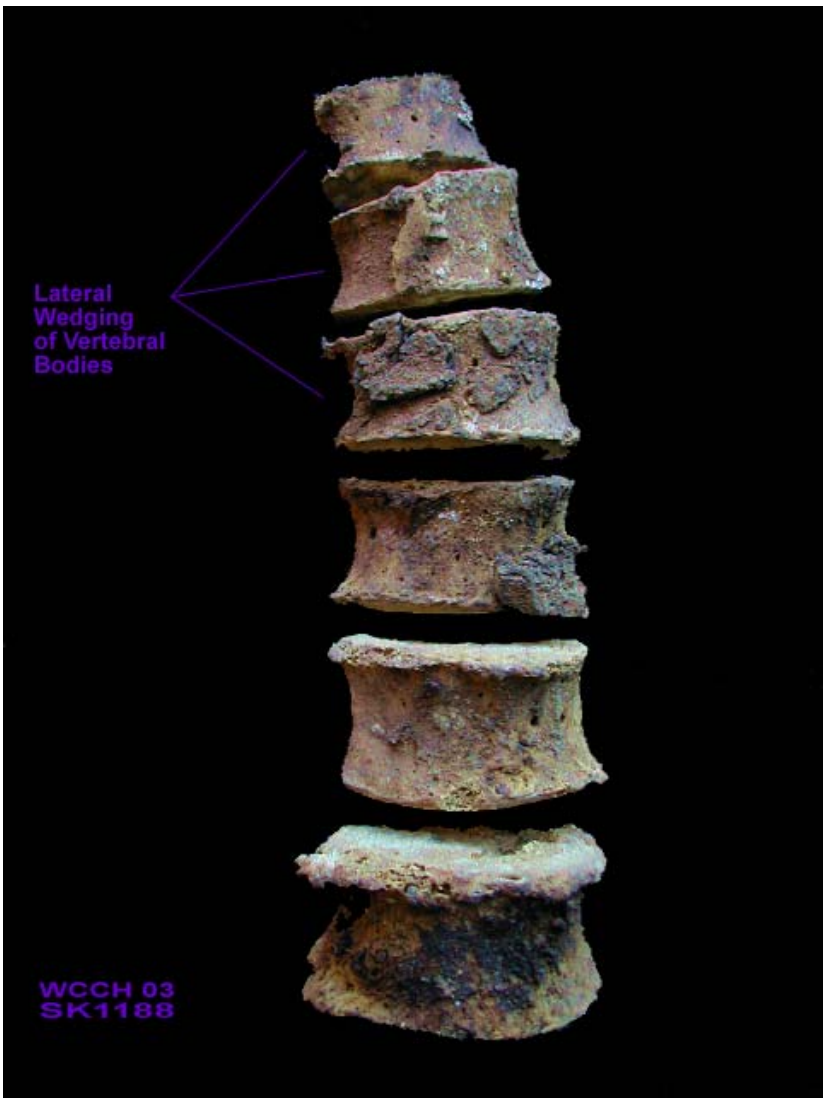

Figure 5: Lateral wedging of the surviving thoracic and lumbar vertebrae due to congenital scoliosis.

3) Degenerative Joint Disease in the lower spine, namely the lower thoracic and lumbar vertebrae. This was indicated by the presence of osteophytes on the anterior aspects of several of the vertebral bodies. None of the bodies were fused together.

4) Fracture of the left scaphoid around the waist of the wrist bone. The continued use of the wrist has resulted in secondary osteoarthritic changes including bony outgrowths, porosity

of joint surfaces, formation of a pseudoarthoses and eburnation between the articular surfaces of the remaining scaphoid (proximal pole), the trapezium and trapezoid.

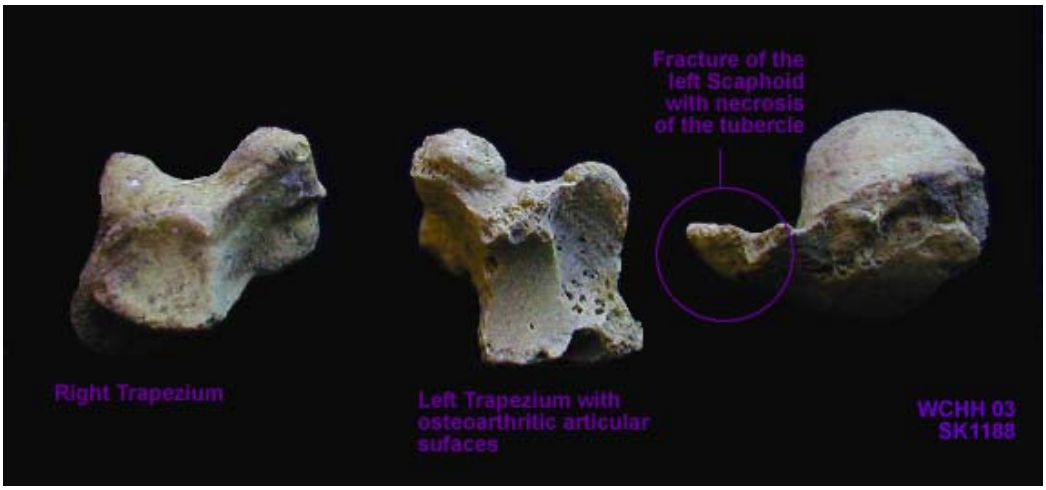

Figure 6. Fracture of the left Scaphoid with necrosis of the scaphoid tubercle. Secondary changes to its associated wrist bone, the trapezium, can be seen when compared to its counterpart. The articular surfaces of the left trapezium are enlarged, porotic and eburnated, indicating that the bone underwent secondary osteoarthritic changes following continued use of the wrist.

5) Osteochondritis Dissecans in the left acetabulum. The small joint mouse appears to have healed and is preserved as a small, irregular mass, sub-circular in shape, protruding from the joint surface.

Figure 7: The small, subcircular lesion caused by minor trauma to the left acetabulum suggestive of Osteochondritis Dissecans

10.3 Results

Skeleton 1188 demonstrates several pathological changes of different aetiologies. The pathological changes observed in the left knee are likely to be associated with a chronic infection or osteomyelitis, which has spread into the knee joint itself. This is known as septic arthritis and can be caused, more commonly in the elderly, by direct infection of the area or from the spread of bacteria through the blood (haematogenous) from more remote location (Roberts and Manchester 1997). Clinically, the knee is one of the most common sites for this infection and in adults is common in debilitated older individuals (Aufderheide and Rodriguez-Martin 1998). Needless to say, an infection of such a chronic nature would have been associated with a great deal of pain and swelling. A protective muscle spasm about the joint, along with the pain created by movement of the joint would have immobilised this individual. Today, the only method of treatment is surgery (Salter 2000). It is likely that an individual with such a condition would have received some form of palliative care, such as is illustrated in figure 8 below.

Figure 8: Late 15th century depiction of treatment of a knee injury (from Siraisi 1990)

A differential diagnosis of this condition is that it could be related to a specific infection, namely tuberculosis. However, it would be expected that the proliferative blastic or formative bony remodelling is more consistent with a non-specific septic arthritis (Roberts and Manchester 1997).

Scoliosis is thought to be a congenital condition, which develops during childhood and adolescence. This abnormal development of the vertebrae results in an irreversible lateral curvature of the spine (Salter 2000). Unfortunately, the preservation of the spine in this individual did not allow the full extent of the pathology to be investigated. It may be possible that the degenerative joint disease seen in the lower spine is, at least in part, attributable to the excessive stresses placed on the vertebrae as a result of the curvature. However, degenerative joint disease is also associated with age.

Osteochondritis Dissecans, seen in the left acetabulum of Skeleton 1188, is believed to occur a circulatory disorder, possibly as the result of localised trauma to the joint (Roberts and

Manchester 1997, Salter 2000). Revascularisation of the separated piece of bone leads to the retention of the "joint mouse" on the joint surface. There are no clinical symptoms associated with this condition (Salter 2000).

The last condition discussed is also traumatic in origin. The fracture of the scaphoid in the left wrist is common in young adults, especially in males and is usually the result of a fall onto an open hand with the wrist flexed upwards (dorsiflexed) and turned inwards (radially deviated) (Salter 2000). The scaphoid is the bone that takes the force of the fall when the wrist is in this position. These fractures are frequently associated with avascular necrosis or disturbance of the blood supply to the bone, non-union of the two halves of the bone and secondary osteoarthritic changes. In this particular example, the fracture has occurred through the waist of the bone, in such a fashion that the distal portion of the bone has not survived due to necrosis. The proximal pole has survived due to continuing blood supply and bony remodelling has occurred to compensate for the loss of the distal scaphoid tubercle. This testifies to the fact that this injury is likely to have occurred a considerable amount of time before death.

11. Dental Pathology

11.1 Introduction

Dental pathologies recorded can provide a wide range of information. For example, calculus, caries, abscesses and periodontal disease may be indicative of poor oral hygiene, infection or high sugar intake. Enamel hypoplasia is the product of defective enamel growth and is linked to poor nutrition and health status during childhood. Congenital abnormalities can also noted such as those that are genetic in origin or those that are the result of pathologies such as syphilis.

11.2 Observations

All the dentition of Skeleton 1188 was observable. Fourteen teeth were recorded as having been lost ante-mortem, most of these being molars. Seven teeth were lost post-mortem. Eleven teeth were present, the majority of being anterior dentition. All of the teeth had a minor amount of calculus; there were neither caries nor any hypoplastic enamel defects. The teeth present had been subject to considerable attrition, possibly due to a combination of age and the ante-mortem loss of most of the molar dentition. There were no observable abscesses.

11.3 Results

Skeleton 1188 showed no obvious signs of infection or inflammation in the jaw. Lack of any major caries and the presence of only small amounts of calculus demonstrates that oral hygiene is likely to have been reasonably good. The lack of major enamel hypoplastic defects may indicate that the individual did not suffer any sustained periods of childhood stress from malnutrition or disease. This may be associated with being privilege to a higher social status.

12. Conclusion

The table below summarises the findings of the osteological analysis of Skeleton 1188:

	Skeleton 1188
Condition	Good 1-3. Bones brittle/friable
Completeness	75%+
Age	50+ (old adult)
Sex	Male
Stature	1.75m (5'8")
Skeletal Pathology	Septic arthritis, fracture of the scaphoid, scoliosis, osteochondritis dissecans.
Dental Pathology	Minor calculus

The results of the osteoarchaeological analysis of Skeleton 1188 suggest that this individual was an older male of at least 50 years of age. His childhood appears have been healthy, there being no evidence of serious long-term diseases or malnutrition. He attained a stature of 1.75m or 5'8", which is above the average of 1.71m of the medieval period (Roberts and Manchester 1997). This indicates that he enjoyed a comparably higher social status. This may have contributed to his comparative longevity. He had scoliosis of the spine, sustained minor trauma to his left hip and also a fracture to the left scaphoid, leading to subsequent osteoarthritis of the left wrist. Degenerative changes were also seen in the lower spine. Latterly, he contracted an infection in his left knee, which turned into a contracted, chronic septic arthritis, a painful and debilitating condition.

The location of this burial in the Chapter House and the associated stone cyst point to this individual being of social significance. The evidence from the osteological analysis may concur with this inference. However, the finds from this analysis needs setting in the context of, firstly, the remainder of the archaeological and documentary evidence and secondly, the osteological data to be derived from the rest of the population excavated. This population would offer a rare and unique insight into medieval Worcester and the lifestyle of the population that occupied the area.

13. Inventory of Disarticulated Material

13.1 Introduction

An inventory of the skeletal material was recorded by each individual context. In the instance of disarticulated material, the skeletal elements present was recorded and the minimum number of individuals represented was calculated.

13.2 Observations

Contexts [067] and [073] were observed to contain disarticulated material and were recorded accordingly.

13.3 Results

Context [067] contained the remains of at least four human individuals, three adults and one juvenile. In total, 25 skeletal elements were recovered so it is likely that more individuals may be represented in this context. However, none of these elements could be associated with each other. Four animal bone fragments were also present.

Three of the human skeletal elements were pathological; 1 adult left tibia with healing or remodelled osteitis (infection) (see figures 9 and 10), 1 adult mid-lumbar vertebra showing indications of intervertebral disc disease and osteophytic lipping and 1 adult unsided proximal fibula with evidence of soft tissue trauma.

Figure 9. Osteitis/Infection of the disarticulated tibia from context [067]

Figure 10: Cross Section of Disarticulated Tibia from context [067] showing the extent of the osteitis/infection.

Context [073] contained the remains of at least two individuals, one adult and one juvenile. Six human skeletal elements were recovered in total but none of these could be associated with each other.

14. Condition of the Disarticulated Material

14.1. Introduction

The condition of the bone was assessed macroscopically and recorded according to the categories and descriptions referred to by Behrensmeyer (1978).

14.2. Observations

The surfaces of the bones present in contexts [067] and [073] were observed to be in good condition with joint and diaphyses intact. Some post-mortem damage had occurred, many of the breaks being old and weathered.

14.3. Results

The condition of the bones recovered from contexts [067] and [073] was very good and was classified as grade 1-2 (Behrensmeyer 1978).

15. Conclusion

From the disarticulated material present, it is possible to infer that both adults and juveniles were at some point interred in this area of Chapter House. It is likely that earlier interments were frequently cut through by later burials as well as construction work, indicating the intensity of activity at this site. Despite this periodic disturbance, the skeletal material has survived very well and gives us into the insight, albeit limited, into diseases that were present in medieval Worcester.

16. Acknowledgements

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THE ARCHIVE

Type	No	Type	No
Skeleton Recording Form A	2	Skeleton Recording Form M	1
Skeleton Recording Form B	2	Skeleton Elements Present Form (copies)	2
Skeleton Recording Form C	2	Compact Disc	1
Skeleton Recording Form D	2		
Skeleton Recording Form E	2		
Skeleton Recording Form H	2		
Skeleton Recording Form I	2		
Skeleton Recording Form J	2		
Skeleton Recording Form K	1		

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Inventory of Disarticulated Bone

Context [067]

Number	Element	Age Category	Pathology
1	Left Humerus	Adult	
1	Mid Lumbar Vertebra	Adult	Intervertebral Disc Disease
1	Right Fibula	Adult	
1	Unsided Fibula Head	Adult	
1	Cranial Fragment (Occipital, Parietals)	Adult	
1	Left Tibia	Adult	Osteitis
1	Left Patella	Adult	
1	Left Ischium and Ilium	Adult	
1	Right Parietal	Adult	
1	Right 1st Metacarpal	Adult	
1	Left 5th Metacarpal	Adult	
1	Left 4th Metacarpal	Adult	
2	Proximal Hand Phalanges	Adult	
1	Middle Hand Phalanx	Adult	
1	Distal 1st Phalanx	Adult	
3	Left 2nd Metatarsals	Adult	
1	Left 4th Metatarsal	Adult	
1	Left Rib Fragment	Adult	

1	Unsided Rib Fragment	Adult	
1	Unsided Proximal Fibula	Adult	Soft Tissue Trauma/Exostosis
1	Left Rib	Juvenile	
1	Right Clavicle	Juvenile	

This context also contained 4 animal bone fragments.

Context [073]

Number	Element	Age Category	Pathology
1	Right Navicular	Adult	
1	Left Zygomatic	Juvenile	
2	Proximal Foot Phalanges	Adult	
1	Middle Hand Phalanx	Adult	