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Trauma at Akhetaten (Tell el-Amarna): Interpersonal Violence or Occupational Hazard

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ABSTRACT

The New Kingdom individuals excavated from the site of Akhetaten, modern day Tell el-Amarna in Middle Egypt, exhibit traumatic injuries relating to construction of the new city. This site is important for Egyptological and bioarchaeological interpretations because the city was only occupied for approximately 15 years. The cemetery provides an archaeological instant in history providing information on the individuals who lived, worked, and died at Akhetaten. A total of 233 individuals have been excavated and analyzed to date. The incidence of forearm fractures as chronic ulnae stress fractures instead of parry fractures are indicated by the presence of Schmorl's nodes, compression fractures of the vertebrae, spondylolysis, and degenerative joint disease. In addition, five males from the site exhibit traumatic healed scapular injuries, extremely similar to trauma discovered from contemporary faunal analysis of pig bones, not related to butchery, at Akhetaten.

This thesis is approved for recommendation
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DEDICATION

This thesis is dedicated to Phillip Eugene Vance Jr.

TABLE OF CONTENTS

LIST OF TABLES

I. INTRODUCTION

Akhetaten, called Tell el-Amarna in modern day Egypt, is an 18th Dynasty New Kingdom city located in Middle Egypt. The city was created by Amenhotep IV, the son of Amenhotep the III. Five years into Amenhotep IV's reign, he changed his name to Akhenaten while subsequently building a new capital city away from the traditional religious and political centers. The motivations behind this move are debated by Egyptologists. However, the relocation more likely involved religious motivations, instead of a fight for survival against the growing strength of the Amun priesthood. The power of the priests was dependent on the generosity of the king making the priesthood powerful because of, not in exception to, the authority of the king (Darnell and Manassa 2007:36).

As Akhetaten was placed on a brand new site, an entire town and religious center was constructed in a short time. The location enclosed an area of over 200 square kilometers on the west bank of the Nile River, harboring an estimated population of 20,000 to 50,000 (Reeves 2005:119). This represents a single occupation archaeologically, providing an approximately fifteen year time frame of ancient Egyptian history, life, and death.

The cemeteries of Akhetaten are important for bioarchaeological analyses. Typically, places of interments contain the accumulation of a society's deceased individuals over a large time period, often extending hundreds of years. When studying human remains, this presents an interpretive problem because the frequencies of age, death, disease, stature, and trauma collected from the dead give an average of fluctuating circumstances from the entire time represented in the cemetery.

To illustrate the changes which can occur in a couple hundred years, an example is necessary. During the Second Intermediate Period in ancient Egypt, the Hyksos ruled and

brought with them composite bows and chariots. This technology can cause different injuries in comparison to the contemporary ancient Egyptian technology. The trauma sustained by an individual falling out of a chariot at fast speeds is quite different than someone falling out of a boat, the typical transportation for ancient Egyptians. If a cemetery spanned from before or during the early Second Intermediate Period and into the New Kingdom 18th Dynasty, the type of trauma witnessed in the skeletons would represent an average of quite different periods in ancient Egyptian history and technology.

Since interpretations of the skeletons do not represent an average from a long time span, instead an archaeological instant from ancient Egypt, much can be learned about the way of life at Akhetaten. Although many adult inhabitants of Akhetaten likely traveled from all over the country to arrive at the new city and only individuals dying at an age under approximately fifteen years may have been born and raised at Akhetaten, the interments still signify the events of Egypt during an archaeologically short period of time.

Since 1892, Tell el-Amarna has been the location of multiple excavations. Tombs of the nobles and officials at Akhetaten were discovered early in the site's archaeological history. The tombs were either unfinished and the would-be inhabitants moved to another city when Akhetaten was abandoned or the tombs were emptied and bodies transferred to more traditional interment sites. In 2002, the first two cemeteries of the lower and middle classes were discovered by Helen Fenwick of the University of Hull. Eventually, five cemeteries were located during the Desert Hinterland Survey project.

The extent of the construction in the city is necessary to comprehend because the extensive building program led to occupational injuries in the architects and craftsmen involved in manual labor. In addition, most lower class individuals not involved in construction likely

spent a significant amount of time taking care of the builders, involving other activity patterns of manual labor.

An innovative construction technique was utilized in which the massive blocks typically used in the construction of temples were replaced by a brick-like form of architecture called talatat. These small stone blocks were much cheaper to produce because the logistical manpower to quarry, transport, and set in place large blocks was not necessary. The talatat measured approximately 52 by 26 by 24 centimeters which would have been possible for a single individual to carry.

A multitude of buildings and access to the various sections of the city were created. A royal road connects two parts of Akhetaten, the North City and the Central City. Other major architectural features include the Northern Riverside Palace, the Great Ramp, North Palace, and North Suburb. Multiple temples, palaces, an artificial lake, barracks, record offices, workshops, a House of Life, agricultural sections, husbandry areas, and other administrative structures including a library and archival buildings were erected to support daily political and religious affairs. In addition, two walled workmen subsections of the city have been discovered east of the city proper. One of the workmen's villages contained 64 houses and outlying chapels. The tasks of these individuals are likely similar to those at Deir el-Medina including preparing, servicing in a religious manner, maintenance, safeguarding, and perhaps later, dismantling the royal necropolis. The remainder of the population of Akhetaten also resided in houses, varying in size and quality based on political standing and wealth.

Three necropoleis of the city were constructed in the cliffs for nobles and royalty. The royal tomb and burial site was located down the center of the cliffs in a wadi. Private individuals were interred flanking the wadi in the eastern cliffs and south of the main center of the city.

Cemeteries of the common individuals have also been discovered in the desert between the Nile River and the cliffs.

The summary of building and construction discovered at Tell el-Amarna from the ancient city exemplifies the massive work managed by the individuals involved in construction. The intensive activity involved in this building program could potentially cause many occupational injuries, particularly in the forearms and the vertebrae. Fractures exhibited in the ulnae are often interpreted as parry fractures. This research will examine the question of ulnae fractures and their association with hard work in comparison to violence. If the fractures are likely chronic ulnae stress fractures, occurring from the intense use of the arms in building activities involving lifting and unloading carts and boats in addition to manual labor to support the working population, then the skeletons should reflect a distribution of injuries supporting labor not violence. If the distal ulnae fractures are related to chronic stress fractures and not interpersonal violence as parry fractures, compression fractures of the vertebrae, degenerative joint disease, Schmorl's nodes, and spondylolysis should be present in large numbers of the population due to the extensive manual labor involved in constructing a new city and supporting the individuals involved in the building program.

Specifically, the hypotheses studied in this analysis include:

- If ulnae fractures are associated with interpersonal violence as parry fractures, the amount of compression fractures of the vertebrae, degenerative joint disease, Schmorl's nodes, and Spondylolysis should not be present in high rates.
- If the ulnae fractures are associated with occupational hazards as chronic ulnae stress fractures, the amount of compression fractures of the vertebrae, degenerative joint disease, Schmorl's nodes, and spondylolysis should be present in high rates.

- If the females have more ulnae fractures in comparison to the males, a low percentage of the pathologies and trauma should be present in the remainder of the skeleton due to the fractures occurring from interpersonal violence.
- If the females have fewer ulnae fractures in comparison to the males, a high percentage of the pathologies and trauma should be present in the remainder of the skeleton due to the fractures occurring from occupational hazards.
- If the females have fewer ulnae fractures in comparison to the males, the males will have a high rate of vertebral trauma in the lower portion of the vertebral column, more as progressing down the spine, due to the lifting and unloading movements involved in their activity patterns.
- If females have fewer ulnae fractures in comparison to the males, the females will have a higher rate of vertebral trauma in the upper portion of the vertebral column and less progressing down the spine, due to activity patterns involving carrying weight on top of the head.

To test the hypotheses, the original raw data recorded by the Amarna osteology team in 2006-2011 was used. This process is explained in greater detail in the materials and method section and in the first portion of the appendix titled Explanation and Critique of the Burial Forms Used by the Amarna Osteology Team. In a later publication, statistical analysis will take place involving chi square tests, to support the conclusions reached in this study.

II. AKHENATEN AND THE ATEN

In order to fully comprehend the interpretations of interpersonal or occupational violence at Akhetaten, the social, environmental, and political circumstances of the city must be understood. The conditions are directly related to stress inhabitants may have felt leading to interpersonal violence or a possibly a distracted mind allowing for more occupational accidents. For example, individuals who are stressed or under situations of political pressure may be more prone to interpersonal violence in comparison to individuals in a peaceful and stable society. The circumstances involved in daily life at Akhetaten have profound effects on the likelihood for injury or violent encounters. The information presented below involving life at Akhetaten is summarized from common Egyptological knowledge including Darnell and Manassa (2007) and Dodson (2009).

The new capital Akhetaten, meaning "Horizon of the Aten", is important in the underlying theology of Atenism. This site in Middle Egypt on the eastern bank of the Nile River is a bay where one could observe the sun rising in the morning. The cliffs across from the bay were separated in the middle by a large wadi, creating the akhet sign meaning horizon. Other than the transfer of the religious cult to Akhetaten, administration and military infrastructure were also relocated. However, in certain cities throughout ancient Egypt, some administrative functions remained in their nome.

The temples created in Akhetaten for the worship of the Aten varied dramatically from earlier counterparts. Consisting mainly of open courts, the sunlight was allowed into the entire temple instead of having a closed off sanctuary. The religious functions normally carried out by priests were not necessary in many cases, due to the Aten physically being in the temple (Darnell and Manassa 2007:30).

Although Akhenaten did not appropriate Akhetaten from a different cult, the site may have been related to nearby cities. Hermopolis, a religious center dedicated to Djehuty and the Ogdoad, is situated across the Nile River and north of Akhetaten approximately fifteen kilometers. The Ogdoad is an extremely important concept in ancient Egyptian religion. This group consists of eight deities in four pairs of males and females personifying the fundamental creation elements. These pairs were the original partitions from oneness at the beginning of time. Various texts include multiple creation accounts from ancient Egyptian history. Every version comprises the division of primordial unity into multiple balanced pairs.

Hermopolis was considered the birthplace of the eight creator deities of the Ogdoad. However, this site was not the only important location related to their cult. Medinet Habu was the Theban home of the eight creator deities, a place important in Amarna Period history due to the construction of Amenhotep III's mortuary temple and jubilee city of Malqata in the site's environs.

The connection of Hermopolis across the river from Akhetaten is intriguing, as this appears to continue policies of Amenhotep III. Akhenaten placed his new city in the vicinity of the first occasion of creation and Amenhotep III placed his city and mortuary temple surrounding the location where the creator gods were interred at Thebes (Darnell and Manassa 2007:38). During the festivals in Thebes, Amenhotep III became the solar deity traveling between harbors of Malqata and Thebes, even changing barks to represent the day and night. At Akhetaten, Akhenaten journeyed through the city on a gilded chariot as the human manifestation of the sun rising and every evening traveled out of the horizon as the Aten set. Both Akhetaten and Malqata represent stages where the king could exhibit his divinity and both sites each contained administration buildings relating to civil and military activities.

In the city of Akhetaten and also Amenhotep III's jubilee festival in the city of Malqata, the kings attempted to utilize power from one account of Egyptian creation. For Akhenaten's father, the jubilee festival allowed the king to be completely divine while remaining as ruler on earth. Akhenaten therefore needed to maintain his status as divinity on earth after Amenhotep III's death. Since Akhenaten was physically and officially the child of a god on earth, Akhenaten and Nefertiti ruled Egypt as the initial pair of creator deities by living as if every day was the original instance of creation (Darnell and Manassa 2007:37).

The artistic style transformed during Akhenaten's reign. A sense of movement and feel of the moment was expressed through the art relating to Atenism. Aspects of the artistic cannon were already present during the reign of Akhenaten's father, Amenhotep III, especially during the heb sed festival at Malqata (Darnel and Manassa 2007:30-31). Akhenaten's aspiration to harken back to the moment of creation also explains the artistic transformation. This is especially apparent in the depictions of Akhenaten and Nefertiti represented as androgynous, because they are the first of the male and female pairs representing the Akhetaten equivalent of the Ogdoad.

The king and queen exhibit aspects of fecundity and pregnancy where the stomach, thighs, and backsides are fatty. This style of art is a continuation of the heb sed artistic canon depicted by Amenhotep III representing the same purpose (Darnell and Manassa 2007:40). Some statues of Akhenaten in the Gempaaten temple at Karnak show the king without male genitalia even though he is nude and wearing a false beard.

The alterations to the artistic style show Akhenaten as a god on earth ruling as a creator deity (Darnell and Manassa 2007:41). In the Hermopolitan version of the creation histories, Atum, Shu, and Tefnut begin the creative process by dividing oneness of the primordial waters

into pairs of balance including light and dark, moisture and dryness, and male and female. The Akhetaten account is played by the Aten, Akhenaten, and Nefertiti in their respective roles. While the Aten was the object of royal worship, the remainder of Egypt focused their religious activity around the triad of king, queen, and solar disk.

The changes in religion were not immediate upon coronation of Amenhotep IV. In the first four years of Akhenaten's reign, he ruled with his original nomen Amenhotep IV, involving the god Amun not the Aten. During this time, the Aten was given the same amount of prominence as other gods in Egyptian religion. When the move to Akhetaten took place, images and the name of Amun were periodically removed from monuments throughout Egypt and down into the Nubian territories. By removing the names of the gods from religious structures, most of the ancient Egyptian population would not have been affected as they were not permitted access into many locations in the temples. However, by closing the temples in their entirety, all of the civilization was affected. Temples owned their own property and livestock. The religious institutions also received donations from the king and royal family. After being given to the gods, commercial goods would be redistributed throughout the population. By closing the temples, access to goods may have been more difficult for the common people. Places of worship also held festival days where work would be excused to celebrate the holiday, providing rhythm in the daily life cycle (Darnell and Manassa 2007:34).

However, by Akhenaten and Nefertiti dividing from the creator deity, the royal family must deny the existence of other deities as they have not yet been created from the oneness. This relates back to Amenhotep III when his heb sed festival recreated primal time and he ruled on earth as the solar deity.

Royal women in iconography during the time of Akhenaten play a much different role in comparison to earlier periods. From the onset of the new city, Nefertiti, the Great Royal Wife of the king, is as prominently displayed as Akhenaten. Her size was similar to the king showing her status as equal to her husband. Six daughters were conceived by the royal couple including Merytaten, Meketaten, Ankhesenpaaten, Neferneferuaten the Younger, Neferneferure, and Setepenre. Some Egyptologists believe Nefertiti may also be the mother of Tutankhaten instead of Akhenaten's secondary wife Kiye (see Dodson 2009) and most Egyptologists believe Akhenaten to be the father.

Scenes of the royal family are common in the new city, particularly in depicting daily life activities. These intimate representations are not typical of earlier time periods in ancient Egyptian history. Male offspring are never depicted in these family portraits or in portraits of Akhenaten, Nefertiti, and their children worshipping the Aten. Kiye, another royal female however, was depicted. The lack of male offspring signifies an expression of solar theology.

The prominence of females in Akhenaten's art relates to Atenism. The Aten disk can have each ray represented by a goddess, manifesting the solar deity in a feminine aspect. Akhenaten, being the son of the sun, was infatuated with a multitude of feminine manifestations through his daughters and Nefertiti. The intimate scenes discussed above of royal family life represent Akhenaten and his daughters as the solar disk with arms (Darnell and Manassa 2007:43). If Akhenaten acknowledged a male child in his portrayals, he would have acknowledged another generation was born and creation persisted. The lack of depictions of Tutankhaten may relate to Akhenaten's desire to remain young, although late in the king's reign, Tutankhaten is listed as a "King's Son" on a block from Hermopolis (See Darnell and Manassa 2007).

The daily chariot ride through Akhetaten and offerings to the Aten by the only divine offspring of the solar creator deity substituted for rituals of the annual festivals in other cities throughout Egypt, especially Thebes. Akhetaten was placed in a repetitive loop of time in which the royal couple ruled as gods on earth imitating the Aten, the other existing deity. After the king's death, the remaining rulers were unable to maintain the world at the fictitious moment of creation (Darnell and Manassa 2007:44).

III. FRACTURES AND TRAUMA

Much can be learned from past people through the injuries exhibited on their skeletons. Healing success of fractures and knowledge of medicine within a society provide insight into daily life activities, environmental challenges, interpersonal relations, and occupational hazards faced by ancient people.

Fractures in skeletal remains can occur for multiple reasons. Sometimes, bones can be fractured through taphonomic processes not related to the physical activities of the deceased's life. In other cases, an individual may injure their body during life through forces involving bending, compression, dynamic, narrow focus, shearing, static, tension, torsion, or wide focus forces. Systemic diseases such as osteoporosis may weaken bone and leave the structure vulnerable to spontaneous fracture or fracture from minor trauma. Metabolic disturbances and nutritional deficiencies can cause major problems for bones.

There are four main types of fractures (see White 2012 for additional details involving classification of fractures). The first is a complete fracture. This occurs when the broken ends of a bone separate. In a closed fracture, also called a simple fracture, the skin stays intact. An incomplete fracture, also called an infraction, is a discontinuity which does not bifurcate the bone. An open fracture, also called a compound fracture, is when the skin is perforated by part of a broken bone.

Other fractures types exist, related to the four previously mentioned. Compression fractures occur from the tissue of the bone collapsing. A displaced fracture occurs when a fracture gap is produced from separated broken ends, frequently remaining at an abnormal angle. Greenstick fractures, most frequently found in children, involve the bending of bone on one side and breaking on the other similar to a bent tree branch. A linear fracture follows the long axis of

the bone. A complete fracture, with the broken bone staying in the normal position and alignment, is termed a nondisplaced fracture. An oblique fracture is a clean break positioned diagonally to the long axis of the bone. Perpendicular to the long axis of the bone, a transverse fracture occurs as a clean square break. A torus fracture, also called a buckle fracture, is produced from the bending of the bone creating a raised buckle on one side and not breaking on the other. In addition, fractures can be classified as intra-articular meaning to involve a joint or extra-articular, not involving a joint.

Specific fracture types may also occur from other mechanisms. Avulsion occurs when small pieces of bone detach where connective tissue such as ligaments or tendons attach. A "V" shaped notch created from almost vertical forces, applied by a sharp-edged heavy instrument, creates a cleft fracture. Comminuted fractures, also called multi-fragmentary, create three or more pieces of bone. Depressed fractures result from a pushing force causing fragments of bone to be depressed below the adjacent surface. A fatigue fracture results when over long periods of time, a bone is exposed to intermittent stress. Hinge fractures are created from a peeling or flap of bone which is still connected at one side, caused by sharp forces across the bone's cortical surface. Broken fragments which embed into each other create impacted or compacted fractures. Pathological fractures occur when disease has made bone brittle or weak, for example from an infection. Segmental fractures result from the breaking into two or more places of a long bone. A simple fracture, also named a single fracture, is a solitary discontinuity along one line producing two segments of bone. Torsional fractures created by twisting cause a spiral fracture. Stress fractures may be produced from bone cracks resulting from repeat overuse and strain often creating a nondisplaced line or crack called a hairline fracture.

In some cases, fracture lines are present which help the osteologist to understand the type of force used to alter the bone. Concentric fracture lines take on a concentric ring pattern around the area where force was applied. Radiating fracture lines spread outward from an impact point where force was applied. The types of forces applied can vary as well. Blunt force trauma is an injury due to a force producing a wide area of impact. Chemical trauma is physical damage from toxic substances whether created immediately from a chemical burn or long term through poisoning over a period of time. Discontinuities resulting from the effects of heat on tissue create heat trauma. Projectile trauma involves blunt and sharp trauma in combination. The cutting of bone from the use of a toothed instrument is sawing trauma. Sharp trauma results from a compressing or shearing dynamic blow with a narrow area of focus.

As apparent from above, the characteristics of bone trauma differ dramatically depending on the type of bone involved and the features of the object striking the bone. Blunt objects striking bone fracture differently than sharp objects stabbing bone. In addition, weakened bone whether pathological or due to metabolic conditions, may lead to a pathological fracture from the abnormal stresses placed on the bones. Determining if an injury predisposed an individual to other health problems or whether health problems predisposed the individual to trauma is difficult. However, this must be kept in mind during analysis of human remains.

Fractures may also take place postmortem due to taphonomic processes or archaeological actions. To the bioarchaeologist, antemortem fractures and postmortem fractures may be distinguished by the absence or presence of a callus. Calluses are hard tissue which forms at the location of a broken bone during the healing process. Perimortem fractures exist as well, occurring around the time of death without callus formation.

However, when a fracture completely heals, the presence of the injury can be removed entirely, the bone lacking any signs of earlier fracture. Bone repair commences as soon as the fracture occurs. Haversian canal blood vessels, the periosteum, and the bone marrow are often ruptured during a fracture. A hematoma is formed from blood flowing into the fracture site and coagulating to seal off the blood vessels. Torn at the fracture location and pulled away from the broken bone ends, the periosteum stimulates the osteogenic layer to commence callus formation. This creates repair tissue for the fracture in the form of a natural splint. First consisting of fibrous connective tissue bridging broken bone surfaces tying them together, the callus is mineralized within two days to form woven bone from osteoblast activity creating the primary bony callus. This primary callus takes approximately six weeks to form. The woven bone callus is later transformed into lamellar bone, and then mostly haversian bone. The evidence of the fracture may only be visible in radiographs if the broken bone ends are close to the original position and if movement at the fracture location is limited, particularly by immobilization of the bone. Eventually, further remodeling may obliterate any evidence of the fracture.

Age, blood supply to the injured site, diet, health, fragment alignment, and movement at the fracture location of the individual all affect the rate of fracture repair. Continued movement at the injured location may cause some fractures to never heal. Often, in the appendicular skeletons, nonunions may develop. This could cause pseudarthrosis, a new joint, to develop at the fracture location.

Fractures should not be analyzed in isolation from the remainder of the skeleton. In any fracture, adjacent bone may contain subsequent pathological complications from the original injury including deformity, degenerative joint disease, infection, and tissue death. Fractures and trauma may result from an accident, cultural practice such as a sport, interpersonal violence,

occupational injuries, or therapeutic treatment. Without looking at the skeleton as a whole, patterns produced by specific kinds of injuries perhaps received at the same traumatic event, may be missed.

The sequence of traumatic healed injuries is important. Every bone type does not heal at the same rate. The rate varies between individuals and depends on the health and life history stage of each person. At the time of death, if all injuries are entirely healed, the order in which the trauma occurred cannot be determined. However, by studying healed injuries in their entirety, a better understanding of how the deceased individual lived becomes apparent.

One must also keep in mind the potential for certain aspects of skeletons to be overlooked in the bioarchaeological record. Small thin bones may not be recovered during excavation. For example, the thin nasal bones may be lost during excavation or destroyed by taphonomic processes. Another issue may involve the weight of the ground pressing around the skeletons. At times, the weight of the ground can break or fracture pieces of bone which are not strong enough to hold the forces of the soil or sand. For example, individuals laid in a grave on their backs may have postmortem fractured or broken pelvic bones due to the weight of the ground snapping off the pubic symphyses.

IV. VIOLENCE AND FOREARM ANATOMY AND FRACTURES

In violent encounters, bones are not the only aspect of the body receiving trauma. Soft tissue may be injured from bruising, cuts, and internal damage not showing in the bioarchaeological record causing interpretation of interpersonal violence to be underestimated in every situation. However, interpretations of violence must be made with caution as such analyses affect perceptions of familial, political, and social relationships. In addition, trauma frequency population studies must consider the physical environment and social environment as each can have profound impacts on the other.

Urban and rural communities in a cross-cultural study show trends in the pattern of interpersonal violence (Judd 2006:324). Males participate more frequently in assaults causing most commonly contusions, hematomas, and lacerations while dislocations and fractures make up the minority of lesions, approximately 30% or less. The preferred site of attack is the skull in most societies, although exceptions do exist as this is culturally mediated. For example, in Western society, boxing is a public sport and is frequently imitated as the proper form of defense or attack. Nasal trauma is often used in analyses as a measure of violence (for example Alvrus 1999). The frequency of healed facial fractures discovered in a sample may not be a complete representation, as many of the small thin bones may not have been recovered during excavation.

In humans, the forearm is adapted for stability more than mobility. Bipedalism allowed the forearm to be placed in space providing the unique mobility of the upper extremity. The radioulnar joints allow for pronation and supination, movements important in most daily living activities. In addition, the forearm functions as the origin for muscle insertions on the hand. This unique anatomy causes fractures involving forearm bones to present difficulties not

encountered with fractures of other long bones, and may cause significant alterations to the upper limb functions if harmed.

Therefore, the forearm is a complex structure involving muscles, tendons, bones, and joints. Functioning as one unit, the radius and ulna contact each other only at the proximal and distal ends. In movements involving rotation, the radius rotates close to the rather immobile ulna. The two bones directly articulate at the elbow to the humerus, creating the ulnohumeral and radiocapitellar joints. Only the radius articulates directly to the carpal bones forming the radiocarpal joint at the wrist with the lunate and scaphoid. The radius and ulna articulate distally and proximally at the distal radioulnar joint. For rotation to proceed in a typical manner, the ulna is fairly straight. However, the bone contains a slight bow and the radius exhibits a pronounced curve. Intricate muscle groups exert forces on different parts of the bones throughout the forearm often causing displacement during forearm fractures. The radius and ulna are connected through the supinator, pronator teres, and pronator quadratus. Many other muscles are involved in the position of the forearm bones during fractures as well (see Bucholz *et al.* 2010).

Ulnar fractures are infrequent and may involve the olecranon or shaft. In adults, olecranon fractures are more typical and result from direct trauma of a fall on the point of the elbow. Most diaphyseal fractures are due to falling from a standing height or direct blow. From direct or indirect trauma, diaphyseal fractures may result as well and are prone to severe displacement, infection, malunion, and nonunion due to the proximity of the bone to the surface of the skin (Katzenburg and Saunders 2008:362). Forearm open fractures can result in significant disability from damage to the associated tendons and nerves, leading to a delay in healing from bone loss. Ulnae and radii shaft fractures are frequently displaced due to the

significant force causing the fracture in adults and the pulling of fracture fragments by the forearm muscles. Due to the displacement and instability, pain, deformity, swelling, and loss of function frequently occur.

Shaft fracture configuration of the radius and ulna differs depending on the injury mechanism and gradation of violence involved. Fractures of low-energy are frequently not comminuted and are typically short oblique or transverse type whereas trauma of high energy regularly causes fractures of a comminuted or segmental type (Bucholz *et al.* 2010:883).

Injuries caused by indirect force include the Colle's fracture and Smith's fracture. The Colle's fracture is associated with a fall on the outstretched palm of the hand while the distal radius is forced posteriorly and the anterior surface fractures transversely on the volar surface. The ulna may be fractured as well on the distal portion, particularly the styloid process. The Smith's fracture is similar to the Colle's fracture. However, the distal radius is angulated volarly. The ulna is not usually injured from this fracture (Katzenburg and Saunders 2008:226-227).

An isolated fracture of the ulnar shaft resulting from a defensive direct blow is called a nightstick fracture and can be exhibited along any site of the length of the ulna. This injury is frequently more stable than other injuries to the forearm (Bucholz *et al.* 2010:882). The presence or absence of the ipsilateral forearm bone recorded for trauma data collection is necessary because the isolation of the fracture affects etiological interpretations.

The parry fracture can be seen as an injury caused by direct force and can cautiously be used as an indicator of interpersonal violence. However, the eponym proposes a specific injury mechanism, producing problems in bioarchaeological interpretations (Judd 2008:1659). Parry creates an image of someone fending off a blow even though the mechanism of injury may have

been something else. The essential component of the definition is the blow, which distinguishes the lesion from other fractures of the forearm and can be confirmed in clinical settings, not from undocumented skeletons.

This fracture occurs from a direct blow to the forearm while the arm is elevated to protect the head. The ulna receives the full force of the blow and the radius may also break if there is enough force. In bioarchaeology, a parry fracture may only be observed as a possible parry fracture as the ultimate cause of the injury, on which the definition of the parry fracture rests, is unknown (Judd 2008:1661). An additional caution must be taken when analyzing parry fractures as the injured individual may have been an assailant, a victim, or a participant in a mutually agreeable confrontation such as a sport like wrestling, seen on many tomb scenes in ancient Egypt.

Judd outlined four requirements for characterizing a forearm injury as a parry fracture to allow for greater ease to objectively compare forearm injuries rather than depending on subjective verbal descriptions (2008:1661-1665). The first condition is the absence of radial involvement. Next, the fracture line is less than or equal to 45°. Third, the location must be below the midshaft less than 0.5 adjusted distance to the lesion center. To calculate the adjusted lesion, Judd divided the distance between the center of the lesion and the distal articular surface by the bone length (2008:1660). Lastly, minor misalignment less than 10° in any plane or horizontal apposition from the diaphysis less than 50% is necessary. Unfortunately, ulnae fractures are not the focus of any research questions from the Amarna osteology team. The team would have employed Judd's (2008) data collection procedures to differentiate the causes of ulnae fractures, had a study of forearms occurred.

Differential diagnosis also needs to be considered as the parry fracture can be confused with a chronic ulna stress fracture (Judd 2008:1665). Forces are exerting loads on bone throughout every physical activity. Forces from the ground, joint reaction, and muscle forces stress bone through the application of force over bone areas (Bucholz *et al.* 2010:518). This causes local deformation or length changes termed strain. Stress refers to a measurement of the load applied which produces bone deformation or strain in certain directions. This fracture does not involve the radius and commonly results from force bearing down at 90 degrees from the elbow allowing for the lifting of heavy loads. Stress lesions are characterized by perfect alignment spindle-shaped smooth layers of periosteal bone or fusiform swelling around the shaft and site at the junction of the middle and distal thirds of the shaft (Judd 2008:1664). This injury can occur during farming activities such as shoveling and sport-like activities such as rowing, swimming, and weight-lifting (Judd 2008:1665 and Bucholz *et al.* 2010:526). Even in clinical practice, the incomplete stress fracture may not be distinguished from the healed parry fracture when the etiology of the trauma is undetermined.

An example of the parry fracture differential diagnosis is necessary. Judd studied the Kerma culture of Bronze Age Nubia (approximately 2500-1500 BC) for forearm trauma analysis (2008). This culture may be compared to the Akhetaten population as both groups lived in the Nile Valley during Dynastic Egypt. For each element, multiple aspects of data were recorded including sex, side injured, presence or absence of ipsilateral bone, length of injured bone, callus length, distance from distal articular surface to lesion center, maximum misalignment in any direction, apposition of the two fractured ends once healed, and angle of fracture line from horizontal plane (Judd 2008:1660).

Multiple injuries were present in the forearm. Thirty-eight individuals had forearm trauma, four with injuries of the same forearm harming both bones. Seven other individuals had isolated radial fractures lacking an uninjured ipsilateral ulna characteristic of an indirect injury mechanism. Females displaying these fractures conformed to the typical fracture pattern of Colle's. Three males had single radial injuries showing the typical trauma of some degree of shaft rotation from falling onto an outstretched hand.

Concerning isolated ulna fractures, 28 occurred among eight females and 19 males. Of these fractures, 21 were classified as parry fractures from the metrical and macroscopic criteria. Three other bones fulfilled all quantitative criteria for parry fractures except the inclusion of the ipsilateral radius. Two females show ulnar head trauma resulting possibly from a direct blow or quick twisting action frequently accompanying an indirect force. A third female ulna injury involved an unaligned oblique injury, not a parry fracture. This was also apparent in one male where the distal shaft was entirely unopposed medioposteriorly forming an “S” shape.

Twenty-one out of 32 shaft fractures of the ulna exhibited the proposed criteria for a parry fracture, excluding the ultimate injury mechanism, the blow. 1.9% of females (3/157) may have been involved as an attacker, opponent, or victim in a violent confrontation. The involvement of females in interpersonal violence may have been as high as 5.1% (8/157) when a more liberal estimate of interpersonal violence including every direct force injury, lacking radial involvement while meeting other parry criteria are included. However, the missing ipsilateral radius greatly weakens the argument as this is an important aspect in analyzing parry fractures. If the parry fracture was only identified by simply occurring on the ulna, 6.4% (10/157) of females would have shown the lesion. This is a significantly greater number than the females with injuries corresponding to the full parry criteria, only three out of 157. In this situation, Judd

discovered the role of females in violent encounters is vastly overestimated when parry fracture criteria are not utilized. In terms of direct force ulna injuries among males, the parry criteria did not alter the frequency significantly. Twenty direct force ulna fractures were exhibited by 19 males out of 121 (15.7%). Two other males exhibited indirect force ulna injuries. When the parry criteria were applied, males showed a vastly higher frequency of direct force ulna injury (19/121) compared to females (3/137). If only looking at the presence of a fracture by site of the ulna, a substantial difference would have been observed between males and females (21/121 and 10/157 respectively). Six ulnae from urban individuals did not exhibit misalignment, were in 100% apposition, and may have been stress fractures instead of parry fractures.

A Monteggia fracture can be caused by direct or indirect force. The fracture is fairly uncommon, occurring in approximately 5% of all forearm fractures (Bucholz *et al.* 2010:882). This happens when the proximal ulna is fractured dislocating the radial head. This injury happens when one falls against a sharp edge or takes a direct blow to the posterior forearm when the arm is raised high in front of the face to deflect a blow (Judd 2008:1662)**.** A paired rotational fracture causes gross deformity from rotation of the bone shafts. This results from indirect force as well, such as falling onto the outstretched hand when the force of the impact is transmitted up the shaft to create an oblique fracture line. A transverse line on the radius or the breaking of both bones indicates a direct blow.

Another type of forearm trauma is the Galeazzi fracture and dislocation. This injury involves a fracture of the radius at the middle and distal thirds. Large forces causing the radial shaft fracture are transmitted to the ulna through the interosseous membrane. Dislocation of the ulnar head and tearing of the triangular fibrocartilage complex occurs making the entire distal

radioulnar joint unstable (Bucholz *et al.* 2010:882). This could cause the ulnar styloid to fracture and in some cases, both the radius and ulna will have fractured shafts.

Related to a Galeazzi fracture, an Essex-Lopresti injury occurs from a fall onto the outstretched hand causing radioulnar dissociation (Bucholz *et al.* 2010:882). This results in a fracture of the radius head and disruption of the interosseous membrane and distal radial ulnar joint causing radius migration proximally. The proximal migration of the radius and distal radial ulnar joint disruption are associated with the Galeazzi fracture.

Falls are a common occurrence in any society, particularly in Akhetaten due to the intense construction activity occurring in a short time span. Falls can account for multiple types of forearm injuries (see above). The severity of injuries sustained during falls is related to the height from which one fell, with the risk of death increasing with the height of the fall (Steedman 1989:260). Other factors are involved as well such as the position of the body upon landing, the surface landed upon, and objects encountered during the fall**.** For example, a person falling down a flight of stairs with other individuals or building supplies on the structure would probably have a significantly different injury pattern than an individual who slipped and fell off of a roof directly onto the ground.

Falls down stairs are not easily classified contrary to free falls which are organized based on the length of the fall. The way in which a body slides, falls, or tumbles down stairs may depend on the cause of the fall (Wyatt *et al.* 1999:32-33). A fall could occur due to a push, a collapse after a medical condition, or the influence of alcohol may affect the capability of an individual to protect their body during a fall. Alcohol intoxication may cause more serious injuries by negatively affecting natural tendencies to protect the body during landing. This

affects the pattern and severity of injuries experienced. The steepness of stairs or the impaction against obstacles on the stairs will also affect the pattern of trauma.

V. VERTEBRAL ANATOMY AND INJURIES

There are 24 moveable vertebrae in the body including seven cervical, 12 thoracic, and five lumbar vertebrae. The sacrum and coccyx are part of the vertebrae and are fused and therefore immobile, making the vertebral column composed of 33 elements. Cervical vertebrae are located in the neck region, thoracic vertebrae in the thorax, and lumbar vertebrae are located superior to the pelvis.

Synovial joints allow the vertebrae to adjacently articulate with each other. Having two superior and two inferior articular facets, controlling movement is possible between the successive vertebrae. Ligaments and muscles hold together the individual vertebrae as a flexible unit within the vertebral column.

Each vertebra has three primary functions. The first is to bear the weight of the body. Next, the vertebrae must anchor muscles and ligaments. Lastly, the vertebrae must protect the spinal cord. Due to the increasing weight load necessary to hold up the body, vertebrae are larger caudally. This and the other two functions performed give the vertebrae distinctive characteristics allowing many to be recognized without the entire vertebral column. However, some vertebrae are harder to identify on their own due to having similar morphology, including vertebrae present in the mid-cervical or mid-thoracic regions.

During life, the successive vertebrae are divided by intervertebral disks made of concentric rings of fibrocartilage. The soft tissue inside of the vertebral disk is necessary for vertebral column movement. The intervertebral disks are fairly thick, making up over one-fifth of the total height of the vertebral column during life and contributing to the longitudinal curvature distinctive in bipedal vertebrae. The thoracic portion is concave anteriorly and the cervical and lumbar regions are dorsally concave thus allowing for bipedal posture.

The variation in shape of the different vertebrae parts correspond to functions performed in different areas of the vertebral column. The neck is the most flexible portion where cervical bodies are small with thick intervertebral disks and large vertebral foramina. The disks in the thoracic region are thinner and the superior and inferior articular facets are parallel. Second to the cervical region in mobility, the lumbar region has thick disks and cup-shaped articular facets. The thoracic and lumbar vertebrae permit anteroposterior bending of the vertebral column which is more restricted in the thoracic section. Thoracic vertebrae facilitate medial and lateral rotation and are limited in medial and lateral bending of the vertebral column due to attachment with the ribs. Axial twisting of the vertebral column is limited in the lumbar region.

As with all bones of the body, variation exists in the vertebral column. Individuals may have different numbers of vertebrae for each type. This difference can exist in over ten percent of a total skeletal population (White 2012:131). Commonly, one vertebral element shifts from the normal category to an adjacent category. The most frequent alteration from the normal pattern involves an extra thoracic or lumbar vertebra, with a shift towards 13 thoracic and four lumbar vertebrae.

Each of the three types of vertebrae present in the spinal column can fracture differently. However, the position of the spine at the traumatic moment and structural predispositions of the vertebral column may alter the resulting injury (Bucholz *et al.* 2010:1283). When high loads are placed on the cervical vertebrae, bone tends to fail first instead of ligaments or the intervertebral disc. Cervical vertebrae are the most likely to have neurologic injury associated with the trauma inflicted on bone, in contrast to thoracic and lumbar vertebrae. This is partially because of diseases weakening bone structures, for example osteoporosis, tending to involve a high incidence of low-energy fractures in the thoracic region, rarely resulting in spinal cord injury

(Bucholz *et al.* 2010:1284). The lower instead of the upper cervical vertebrae are more likely to involve spinal cord damage in fractures and dislocations due to spinal canal dimensions and injury mechanisms (Bucholz *et al.* 2010:1313).

Vertebral column injuries tend to group around junctional areas including the occiput to the second cervical vertebra, the cervico-thoracic junction the last cervical to first thoracic vertebra, and the thoracolumbar junction involving the eleventh thoracic to the second lumbar (Bucholz *et al.* 2010:1284). These spinal locations signify areas of stress concentration in which rigid segments of the spine meet a more flexible portion. The junctional zones are also transition regions where the predominant movement patterns between the vertebrae transform from facet joint orientation permitting side-bending, flexion-extension, and cervical spine rotation to primarily thoracic spine rotation, to zero rotation in the lumbar region. Severe canal occlusions of the lumbar vertebrae frequently do not involve neurologic injury. Fracture-dislocations of the vertebral column are often involved with neurologic injury. Burst-type fracture patterns manifesting in injury of the spinal cord represent a more severe type of vertebral column disruption and greater collapse of the vertebral body, a more severe level of deformity, and greater occlusion of the spinal canal than burst-type trauma lacking spinal cord involvement.

Schmorl's nodes are a pathology commonly recognized in archaeological populations. This holds true for Akhetaten as well. The term Schmorl's node describes the prolapsed intervertebral disc substance entering the body of the vertebrae (see Faccia and Williams 2008). This can occur on the superior or inferior surfaces of the body. The term Schmorl's node is also used to describe the prolapsed disc eventually created on the vertebral surface of the affected bone.

The formation of the osteological lesion involves fluid traveling through a break in the cartilaginous endplate and erodes into the body of the vertebrae. This produces small cavities in the vertebral body surface and thus creates changes in pressure within the bone from the intruding fluid. To combat further progression of the material into the vertebral body, an osseous barrier is created. The osseous lesion, upon completion, is smooth and can be located on either the superior or inferior surfaces.

Schmorl's nodes can occur due to congenital spinal defects, traumatic events, and senescent processes (Faccia and Williams 2008:30). When this pathology transpires from trauma, fractures of the endplate occur from high axial loading, creating deformation and rupture of the intervertebral disc.

Spondylolysis, also termed separate neural arch, is a vertebral fracture where a traumatic event caused the neural arch to separate from the vertebral body. This trauma should be viewed as a fracture instead of a developmental mistake. Human anatomy makes individuals susceptible to spondylolysis due to the lumbar curve, posterior sacrum flexing in relation to the lumbar vertebrae, and other lower back features permitting bipedal locomotion.

The lumbar region is the most common place to see spondylolysis expressed. The separation tends to occur in the region between the inferior and superior articular processes and normally is bilateral and complete, separating the vertebra into two different parts where an anterior section contains the vertebral body and a posterior portion retaining the neural arch. Many variations of this normal pattern exist including dissolution of the pedicles and laminae or an incomplete lysis ranging from hardly discernible to almost complete separation. Spondylolysis may be expressed unilaterally or bilaterally.

Complete, bilateral spondylolysis is often followed by spondylolisthesis which is a slipping of the anterior portion of the vertebral column superior to the traumatic region. With spondylolysis, the protective bone structure is broken allowing gravity to displace the vertebral column forward to the extent allowed by the soft tissue. This slipping may vary dramatically from hardly discernible to complete, when the body of the damaged vertebra slips off the vertebra body below. In response to the vertebral slipping, osteophytes are developed on the superior margin of the vertebra directly inferior to the traumatized vertebra. The osteophytes function to extend the vertebra surface forward to increase stability with the superior slipped vertebra.

This condition tends to occur in active individuals involved in heavy labor, particularly from lifting heavy weights (Merbs 1989:166-167). Acute trauma may trigger spondylolysis. However, most cases seem to develop slowly over time as fatigue or stress fracture. Individuals injured from acute trauma in a partial separation may not proceed to complete separation, instead correcting the injury after removal of the stress forcing the initial development. Activities likely to induce spondylolysis comprise hyperextension and hyperflexion of the lower back in addition to jarring forces (Merbs 1989:167). Therefore, a single stress fracture is not predominantly at fault for spondylolysis, a combination is responsible. Bipedal hominids, due to the lower back construction and movement, are subject to separation under almost any form of extraordinary stress and in certain circumstances, even ordinary stress.

Arthritis is common in human populations as part of the normal aging process. However, this pathology is especially rampant for individuals involved in load-bearing activities. This pathology involves the inflammation of a joint involving soft tissue. Inflammation may occur as the result of trauma or from bone and joint infections. The most common form of arthritis is

osteoarthritis, more aptly termed degenerative joint disease, characterized by articular cartilage destruction in a joint causing the formation of bony lipping and osteophytes at the edges of adjacent bone in the joint. This form of joint inflammation occurs mostly in load bearing joints. In particular, the spine, hips, and knees are commonly involved. Eburnation is frequently associated with degenerative joint disease. Eburnation occurs when cartilage is destroyed and the subchondral bone is exposed, producing an ivory, polished appearance on the joint surfaces.

The age of appearance of degenerative joint disease is influenced by multiple factors including age, genetic predisposition, hormones, mechanical stress, and sex. The secondary form of this pathology involves trauma or bacterial invasion at a joint.

VI. SET AND ISFET

There are a few indicators of violence present in the Akhetaten population. One individual was likely involved in armed conflict (see Dabbs and Schaffer 2008). The other phenomenon present in the Akhetaten population possibly involving violence is present in the scapulae. The scapulae have been analyzed in this study to understand the trauma in context of the cultural, religious, and political aspects of life in Akhetaten.

Bones from pigs are a common discovery at archaeological sites throughout ancient Egypt. Pig bones are frequently unearthed in the lower status areas of a city, whereas fish and other choice cuts of meat are primarily located in the higher status dwellings. At Tell el-Amarna, the pig bone distribution follows the typical pattern of being more common in the lower status dwellings and outlying villages (Kemp 2010:7).

The concept of duality was extremely important in ancient Egyptian religion. One notion in particular underlies much of ancient Egyptian life, religion, and thought namely, chaos and order, or in ancient Egyptian isfet and ma'at. The duality of the ancient Egyptian life varied from day and night, light and dark, and desert land versus the plentiful soil surrounding the Nile River for example. The gods balanced each other in this duality. Set, sometimes represented as a pig, is strongly associated with isfet whereas Ma'at is the goddess of truth and order. This sense of chaos and unknown is apparent through Set's association with the desert and the dangerous confusion and disturbance one may be confronted with while traveling through the dry environment. Being a god of chaos and violence, the name the "Red One", is fitting for a god of the desert personifying anger and rage. By opposing Ma'at and being of the desert, Set endangered all life through the destruction of vegetation.

Set was also associated with solar theology. He repelled Apep by standing in the bow of Amun's barque to protect the god. In addition, Set was incorporated into the Ogdoad as the brother of Osiris, Isis, and Nephthys. In fact, in ancient Egyptian mythology, Set murdered his brother Osiris, who later was brought back to life by his sister-wife Isis. This associated Set as the rebellious foe of the rightful king of Egypt, a bringer of strife. In addition, this made Set and Horus into a duality representing Upper and Lower Egypt respectively, one god balancing the other in the two halves of the country. This is supported through Set's depictions which sometimes show him wearing the white crown or double crown, not the red crown.

The beliefs around Set transformed through time. Slightly before the New Kingdom, during the Second Intermediate Period, the Hyksos associated their own god Baal with Set, making Set important in their rule. During the New Kingdom, the "Red One" is represented as a malevolent individual creating havoc and committing crimes. He was also associated with disease, illness, civil unrest, and invasion of foreigners. Set was additionally linked with bad weather and storms.

Set was not always depicted in a negative light. At times, the god would use his cunning and strength to aid the ancient Egyptians and other gods. He is associated with metals, especially iron. The ancient Egyptian word for iron literally meant the "bones of Set" (Wilkinson 2003:199). Set is associated with kingship and many kings have their strength compared to the god. In addition, Set and Horus flank the sema-tawy relief in some statuary, representing the unification of Upper and Lower Egypt.

Set was depicted in many different forms of iconography. The god was associated with multiple animals, some of which the ancient Egyptians found to be potentially harmful, including the antelope, crocodile, donkey, goat, hippopotamus, pig, and various fish (Wilkinson 2003:200).

Set is also shown as a creature not associated with any known animal. The god is depicted with a curved head, ears which were tall and square topped, and containing an erect tail which was arrow-like. Set was the animal appearing on the 11th Upper Egyptian nome standard which was impaled with a knife to avoid latent destructive forces of the god. Due to the fear of Set's image, often the god was visually depicted by one of the other animals mentioned above, a form of circumlocution to avoid bringing about the negative energy of the god. Often when Set was represented in this manner, the god was represented as a donkey with a knife stuck into his head. Images of potentially dangerous gods and deities are often harmed in some way to halt the bad forces. For example, snakes are sometimes cut in half, rendering the negative forces from their image useless. Set was also represented in human form with the head of the unknown Set creature, especially during the New Kingdom.

Set was venerated throughout multiple sites in ancient Egypt. Sacrifices and killing of animals representing Set are part of the religious practices in his worship. Early in ancient Egyptian history, the god Set was slaughtered sacrificially through the killing of a red ox or the strangling of a desert bird (Wilkinson 2003:200). There are also numerous references throughout most of ancient Egyptian history starting with the Predynastic period forward, where the king hunted a hippopotamus in the marshes to symbolically conquer Set. This represented Horus, the king on earth, expelling isfet through Set.

Pigs were domestically kept at Akhetaten. A minimum of seven sets of pig pens have been discovered below the chapels on the adjacent hillside from the village of the workmen (Luff and Brothwell 2007:524). A pig excavated from a trash dump located outside the workmen's village exhibited either intentional treatment of a visible surface abnormality or ritual marking of the pig scalp and skull (Luff and Brothwell 2007:528). A shallow crater is present on the left

flattened frontal bones. Rough new bone formation is present on the endocranial surface. When the animals are forced to live in overcrowded environments, pigs may become aggressive, injuring the surrounding animals. An alternative explanation presented by Luff and Brothwell is the possible training of individuals who would be surgeons practicing trephination, even though additional supporting evidence has not been discovered (2007:529). Four frontal bone fragments from pigs have so far been discovered exhibiting the depressed wound and indicating evidence of healing (Kemp 2010:7).

Tony Legge, a faunal analysis expert discovered traumatic injuries on three complete pig scapulae from Akhetaten (Kemp 2010:6-7). A blade appears to have pierced through the bone with a violent force, breaking the neck of the scapulae in one instance. The wound width, two specimens measuring 30 millimeters and 40 millimeters, indicates metal spears or dagger blades were likely utilized instead of an arrow. The three scapulae indicate extensive healing of the traumatized bone, a progression spanning many months. Pierced from above, the scapula was entered by the blade above the scapular spine in one instance. In the two others, the trauma occurred below the scapular spine. This location should have protected the animal if a blow was delivered due to the natural bone form. However, in the later samples, the point entered the body from the side of the animals. Later, the pigs were slaughtered for consumption evidenced by normal butchery cut marks indicating disarticulation and filleting.

The wounds from the pig frontal bones showing depressed and healed fractures in addition to the pig scapulae were evidently not intended to be lethal. Hunting incidents are not likely to be the cause of the injuries due to the extensive healing seen on the bones. The faunal experts suggested the wounds were intended to inflict systemic torture in a possible ritual (see Kemp 2010).

Multiple scapulae from adult males at Akhetaten have been pierced antemortem (see Zabecki and Rose 2010:8-9 and Kemp 2011:5). Photographs of male and pig scapular injuries are available in the appendix. In 2007, the discovery of an atypical healed fracture pattern on Individual 39 came to light. During the next year, another skeleton was showing a similar fracture pattern suggesting a possible common cause between the injuries. In 2010, another individual was noted expressing the same trauma.

The male scapulae injuries appear to match the traumatic injuries performed on the pig scapulae discussed above. As the entire sample of injuries exhibit healing, the wounds would not have been lethal. The trauma would have likely left open wounds, difficult to dress and sanitize by the injured people. Therefore, the individuals were taken care of after the infliction of trauma.

Further analysis of the human scapulae was conducted during the 2011 season. The Amarna osteology team reanalyzed all of the human remains, keeping in mind the delicate nature of the scapulae, as these bones are very thin and likely to be injured by postmortem damage. Five cases have been uncovered in total with clear healing around the wounds in four of the individuals (Kemp 2011:5). The five individuals are all males between the ages of 25-50+ years old. The wounds seem to have been inflicted without damaging the ribs in the process. Therefore, the individuals appear to have been injured at the shoulder by stabbing at an angle piercing muscle while avoiding damage to the body cavity, jeopardizing life. One of the injured scapulae was compared to a plastic teaching skeleton in order to determine the position of the injured individual when the traumatic event occurred. The position when the scapulae match indicates an individual lying on the ground with their arm out to the side at approximately 90 degrees, subjecting the shoulder blade to the traumatic injuries while at the same time lowering

the risk of deeper penetration through the ribs and into the body cavity. The individuals with scapular injuries all exhibit other forms of trauma including fractures, degenerative joint disease, and Schmorl's nodes suggesting activity patterns involved in manual labor.

Table 1 – Demography of Males with Scapular Modification

Individual	Sex	Age
39	Male	35+
56	Male	40+
102	Male	35-45
142	Male	30-50
191	Male	25-35

Perhaps the scapular injuries are an unknown punishment for certain crimes which occurred at Akhetaten or throughout ancient Egypt. Set as the god could not have existed at this time, as he was not yet born in the cosmology of Akhenaten. Only the Aten, Akhenaten, and Nefertiti existed as gods. It is likely the duality seen in much of ancient Egyptian life could still be expressed even though the gods Set and Ma'at were not technically created. If the punishments were intended to stop an individual acting as Set, thus conquering chaos, perhaps a ritual stabbing as mentioned above to the Set like creatures and images, was enacted on criminals at Akhetaten partaking in a certain crime.

It is also possible the individuals could be acting out a religious ceremony where one conquers chaos. Perhaps this ritual only took place for a certain section of the society, like the individuals living in the workmen's villages away from the sight and direct influence of Akhenaten.

Many individuals living at Akhetaten were old enough to remember the other gods in the ancient Egyptian pantheon before Akhenaten's alterations. Individuals could have retained some aspect of their religious past in dealing with problems and daily life. This is supported from the

discovery of various amulets depicting gods such as Bes, Hathor, and Tuaret, who were technically not yet born at Akhetaten throughout the homes and workmen's village (see Silverman *et al.* 2006:40,120).

The scapular modifications cannot be viewed as a form of human sacrifice. This practice is only known to have occurred during at the early Dynastic royal tombs at Abydos, particularly King Aha, and possibly during the Nagada II phase at Nagada and Adaïma (see Shaw 2003). A criminal punishment is much different in comparison to a religious sacrifice and the two must not be confused.

VII. MATERIALS AND METHODS

Excavation and analysis of human remains discovered at Tell el-Amarna has been ongoing since 2005. The excavations of the individuals are discussed in great detail by year on the Amarna Project website (see www.amarnaproject.com).

Of the five cemeteries of the common people discovered by the Desert Hinterland project, some cemeteries were extensively disturbed from ancient grave robbing activity. However, in 2003, adjacent to the South Tombs, a cemetery was discovered which had been washed out during a past flood. This left many bones and pottery sherds spread throughout the wadi. Barry Kemp showed photographs of the remains discovered in the wadi and spoke to Jerome Rose about a bioarchaeological study. In 2005, bones were collected from the wadi surface and analyzed, showing good preservation and the representation of all age and sex categories (see Rose 2006). Bones were dry brushed and sorted by type and side. The remains were examined for evidence of age, sex, and pathology.

The nine areas of the wadi where skeletal remains were collected did not vary from each other in their analysis. Therefore, the data can be interpreted as a single collection. This collection signifies burials washed out from the wadi margins and solitary bones were transported to the surface through grave robbing. Therefore, this skeletal sample is from an entire cemetery and can be utilized for comparison with the excavated samples discussed below.

The skeletal sample used in this analysis comes from multiple areas of the cemeteries discovered at the site. Three excavation seasons were carried out in 2006-2008 yielding the complete or partial remains of 96 individuals from the South Tombs Cemetery. Lindsay Ambridge and Mary Shepperson supervised the cemetery excavations in 2006, and Wendy Dolling took over in 2007 and 2008.

In 2009, Mary Shepperson and Anna Stevens supervised cemetery excavation occurring behind the Tomb of Ay, a continuation of the previous archaeological seasons. An additional area was opened for excavation near the wadi mouth, termed the lower cemetery location in contrast to the upper cemetery region where previous excavation had occurred. In 2009, 62 individuals were recovered with 13 isolated skulls and an additional four isolated mandibles.

In 2010, excavations continued. Mary Shepperson supervised the upper site archaeology while Anna Stevens supervised the lower cemetery. A new location was opened at the wadi mouth site supervised by Melinda King Wetzel. During this excavation season, 75 individuals and one cluster individual were discovered in addition to 14 isolated skulls.

Table 2 – Summary of Skeletal Remains Excavated by Year at Tell el-Amarna

Year	Minimum Number of Individuals	Cluster Individual	Isolated Skulls	Isolated Mandibles
2005	53			
2006	27			
2007	29		33	
2008	38			3
2009	62		13	4
2010	75	1	14	
Total	284	1	60	7

This table reflects the archaeology reports, not the additional cluster individuals put together by the Amarna osteology team.

The site of Akhetaten has been extensively disturbed by ancient grave robbing activity. This has led to the heads and torsos receiving the greatest amount of attention while mainly permitting the lower legs and feet to remain undisturbed. Many bone clusters exist as well as some articulated individuals, especially in the lowest level of the site. The amount of burial

goods varies dramatically throughout the interments starting with the lack of any items to brick tombs, wooden coffins, and a wooden anthropoid sarcophagus.

Jerome Rose and Melissa Zabecki conducted osteological analyses on the remains in 2006 and 2007. During the 2008 through 2010 seasons, field school students assisted in the study. Bones were cleaned through dry brushing and all soil was sieved. After sorting the skeletal remains by excavation squares and bone clusters, clusters were arranged in anatomical order and remained on tables in order to match the random bones to the clusters in an attempt to produce complete skeletons from the tampered remains. When the archaeologists discover a skeleton, the remains are given an individual number. At times, multiple bones are discovered together which cannot be delineated in the field into separate individuals. However, the remains are still provided an individual number. When the groups of bones come back to the lab, if more than 50% of an individual is present, the Amarna osteology team separates the bones into individuals and provides the skeletons with cluster numbers. Therefore, cluster individuals were put together in the lab. An individual is a person who was recognized during excavation as a single person and provided with an individual number. The numbers vary between cluster and individual burials. Cluster individuals have identification numbers beginning with the letter "C". In contrast, individual numbers commence the identification sequence with the letter "I". Every individual and skull was analyzed for evidence supporting age, sex, and pathology. Skulls can rarely be matched back to a skeleton, and therefore any skulls not clearly belonging to an individual are analyzed separately. Frequently, mandibles are discovered with the isolated skulls, suggesting the head was tossed aside when skin and other connective tissues were still attached. In addition, each possible osteological measurement was taken using the strategies and procedures set forth in Buikstra and Ubelaker (1994), a minimum set of data every physical

anthropological analysis should include in their study to allow for cross-cultural and cross-temporal analyses of human remains.

In 2011, Jerome Rose, Melissa Zabecki, Robert Taylor Montgomery, Bill Schwab, Dolores Burke, and Gretchen Dabbs conducted analysis and examination of the previously excavated skeletons from 2006-2010 at Tell el-Amarna. Since excavations were not allowed during the revolution, new skeletons were not recovered.

Skeletal remains or other artifacts are not allowed to leave Egypt. Therefore, this study is based on the data collected by the Amarna osteology team as post excavation analysis of the raw data. The information was compiled in three forms. First, the individual members of the team compiled their measurements and findings on skeletal data sheets for each individual person discovered, henceforth referred to as burial forms. Then, in 2011 burial descriptions were written out for each individual or cluster individual. The burial descriptions were written by three individuals in the field and were used in this analysis during the rough draft phase. After the descriptions were completed, this information was entered into a database. At the present time, the database is in the first phase, as much of the data has not yet been corrected and scrutinized. The database contains multiple specialized tables including all individuals exhibiting specific pathologies or the demography of the skeletons for example. Consequently, inconsistencies exist. When this occurred, data was taken from the first set of papers, the burial forms used by the individuals working with the skeletons, as inconsistencies are less likely to exist with the original data. The burial forms had been scanned to build a computerized set of data for the individuals excavated. This was the basis for analysis used in this research.

The adult burial forms filled out by the Amarna osteology team individual analyzing each skeleton included many different sections following Buikstra and Ubelaker (1994). To conserve

space and weight during transportation of the forms back to the United States, the Buikstra and Ubelaker (1994) data collection sheets were condensed as small as possible and evolved to include additional information as research questions were added. For a full description and critique of the burial forms used at Tell el-Amarna by the Amarna osteology team, see the first section of the appendix.

As with most children, the ancient Egyptians enjoyed childhood. This life stage is represented in the archaeological record through the discovery of toys and games, especially from Lahun in the Middle Kingdom. Interpreting what constitutes a toy is not easy as many items may have religious significance or be something adults partake in as well. However, evidence does exist supporting the determination of some objects as toys. Many dolls have been recovered, some with moveable arms and including multiple changes of wardrobe in addition to having fine flax hair (Janssen and Janssen 2007:39-41). However, not all figurines of women can assumed to be toys because in the tombs of men, many fertility figures of women are present in a religious sense to help in rebirth in the afterlife. Also at Lahun, conical pieces of wood twirled by whipping string have been recovered (Szpakowska 2008:54). Many mud objects shaped into the form of animals such as hippopotami, pigs, apes, and birds have been recovered at the same site and are thought to be toys as well (Szpakowska 2008:54-55).

However, the life of a child does not only consist of playing. Gradually, the child will be introduced into adult work, likely first through role play and then by sharing the activities of the parents. For the poor of ancient Egypt, having extra hands to help with the running of the household would provide an important economic benefit. However, for the upper class society, servants or hired workers would be accomplishing necessary tasks. Tomb scenes show juveniles accompanying their parents in bringing offerings to the dead and the gods. Additionally, girls

are shown with the elder female mourners at funerals, imitating the same posture and attitude of the older women. Boys and girls are depicted in agricultural scenes, partaking in adult work and boys are also shown watching cattle and flocks (see Janssen and Janssen 2007).

The timing of marriage in the life of the ancient Egyptians is not yet entirely understood. Evidence does not exist for an elaborate religious and legal wedding ceremony as practiced today. Detailed accounts of the traditional activities occurring on the day of the "entering the spouse's house" or "founding a house" do not exist (Strouhal 1992:54). Instead, details about marriages are gleaned from fictional passages often involving royalty, not commoners. Marriage seemed to involve a man and a woman entering a home together and spending the night, typically the woman moving into the home of the man. Twelve to 13 years is the age at which girls are thought to have reached puberty, 14 for boys (Strouhal 1992:51-52). Marriage likely took place between the ages of 12-14 years for girls. For royal families, marriages to insure political alliances often occurred much earlier. It is also interesting to note 12 years is the age at which a young king usually rules without his co-ruler. However, marriage cannot be assumed to coincide exactly with the timing of the performing of adult labor and household activities.

The surviving literature of ancient Egypt provides a rich record of autobiographies, instructional texts, stories, and scientific analysis to name a few categories. In the Instruction of Ani, the individual is advised to "Take a wife while you are still young, so that she can bear you a son" (Strouhal 1992:51). Ptolemaic documents from much later in ancient Egyptian history are discussed by Strouhal as well, in which the youngest age for a male to marry was 15 and to "marry at 20, so that you can have a son while you are still young" (1992:51-52).

The age at which a child would have commenced taking on adult activities is difficult to determine based on tomb scenes and other depictions due to the artistic canons utilized in ancient Egypt. This emphasizes the importance of using bioarchaeological material to aid in the analysis of cultural life stages in a society. Bones show the repeated stress an individual took on throughout their life, for example frequently lifting heavy loads. The ages at which these injuries start to occur consistently throughout society would shed light on to the ages at which children took on the activities of adults and help to recreate an image of what those activities would have involved.

As the above shows, ancient Egyptians did not practice adult activities and chores following the life stages present in modern day Western society. Therefore, juveniles need to be included in the analysis from approximately eight years of age and up to determine when injuries relating to adult labor and life appear. Unfortunately, due to the incompleteness of the juvenile forms and lack of a bone inventory, this analysis could not include individuals less than 12 years of age.

The standard age divisions present in Buikstra and Ubelaker (1994) do not work for this interpretation. Therefore, this analysis created new age ranges in order to have accurate life stages based on ancient Egyptian society. The first stage is Fetal and is at any point in time before birth. Infant is the second stage ranging from after birth to 2.9 years. Next is the life stage Child, ranging from 3-11.9 years. Young Adult follows and spans the years 12-14.9. The fifth stage is the Adult Phase I, ranging 15-24.9 years. The following stage is Adult Phase II, measuring 25-29.9 years of age. Adult Phase III is the next life stage and ranges from 30-39.9 years. Finally, Old Adult is the last term and is for individuals aged 40 years or older.

When the estimates were utilized by the Amarna osteology team conducting the analysis on the skeletons, many age ranges were listed such as older adult and adult which are not present in Buikstra and Ubelaker's analysis (1994:9). Throughout this study, when the skeletons were not provided a numerical estimate, the same word originally utilized by the Amarna osteology team is employed. Without knowing the numerical estimate of an age range, guessing the proper life stage based on the term adult for example, would be almost impossible.

Table 3 – Life Stage Aging Used in Analysis

Life Stage	Age
Fetal	Before Birth
Infant	After Birth-2.9 Years
Child	3-11.9 Years
Young Adult	12-14.9 Years
Adult Phase I	15-24.9 Years
Adult Phase II	25-29.9 Years
Adult Phase III	30-39.9 Years
Old Adult	40+ Years

However, many of the age ranges provided by the Amarna osteology team cannot be narrowed down to fit exactly into one of the specified life stage categories. This in part is due to the skeletal completeness of each individual not having enough bones recovered to narrow down the possible age range. For this analysis, when an estimate of age crosses multiple life stages, the stage including 50 percent or more of the estimated age range is used. When a symbol was used to indicate less than or greater than, the life stage estimates are assumed to be close to the original number which expresses the less than or greater than symbol. For example, an individual given the age >2.5-4.5 by the Amarna osteology team would still be considered a child even though their age range spans infant and child which ranges from after birth-2.9 and then 3-11.9 respectively. Due to the inability of the Amarna osteology team to narrow the >2.5-

4.5 age range, a defining characteristic for aging in the skeleton must not have been expressed, suggesting the individual is close to the estimated age. Therefore, when less than or greater than symbols were used, in this analysis the symbols are not included in the life stage calculation since they cannot be given a solid estimation of where to begin or end in estimating the individual's age. If the ages given by the anthropologists fall exactly over two categories, for example 20-30 straddles Adult Phase I at 15-24 and Adult Phase II at 25-29.9, the individual is grouped into the older category if the age range is above Young Adult. If the individual is below Young Adult, the younger life stage will be taken if two are equally encompassing an individual. When the scores span three life stages, the average of the age estimate is taken and wherever the estimate falls in the life stage categories, is where the individual was placed. For example, an individual aged 9-15.5 spans Child at 3-11.9, Young Adult 12-14.9, and Adult Phase I at 15-24 with an expression of 2.9, 2.9, and .5 years in each life stage respectively. The average age of the 9-15.5 estimate is 12.25 and thus the individual falls into the Young Adult life stage spanning 12-14.9 years. See Appendix Table I – Demography and Completeness of Skeletal Remains at Akhetaten for more information.

VIII. RESULTS

The skeletal sample consists of 233 individuals. This number of individuals is different than the recorded number by the excavators mentioned above because the Amarna osteology team has been able to piece together additional individuals and separate out bones not belonging to a single individual. There are 42 males, ten probable males, 62 females, six probable females, 21 indeterminate meaning the bones able to be sexed were not present, one unknown indicating the ambiguous nature of the bones which express sexual characteristics, and 91 not applicable (N/A) individuals who are unable to be sexed due to their young age not expressing sexual characteristics. This does not include the isolated mandibles, skulls, or other bones discovered as they may belong to individuals already counted.

Table 4 – Skeletal Sample by Sex

Sex	Total Individuals
Male	42
Probable Male	10
Female	62
Probable Female	6
Indeterminate	21
Unknown	1
N/A	91
Total Sample	233

Indeterminate indicates the bones necessary to sex the adult individual are not present. Unknown indicates an ambiguous skeleton with the bones present to determine sex and "N/A" stands for not applicable, indicating the individual is too young to sex.

Table 5 – Number of Individuals in Each Life Stage

Life Stage	Number of Individuals
Fetal	3
Infant	33
Child	40
Young Adult	14
Adult Phase I	43
Adult Phase II	7
Adult Phase III	33
Old Adult	36
*Adult**	23
*Older Adult**	1
Total	233

The "*" refers to the individuals labeled by the Amarna osteology team as adult or older adult without listing a numerical age estimation or following the standards set forth in Buikstra and Ubelaker (1994), thus not permitting the individuals to fit into a life stage used in this analysis.

The average age at death of the Akhetaten population is 20.781 years. See Appendix Table II – Average Age at Death Calculation for more information about the average age at death and adjusted average age at death. This figure was calculated by converting all 233 individuals into years, including the three fetal individuals who were in utero at the time of death. However, the individuals categorized as adult or the one person listed as older adult, not following the age ranges in the standards of Buikstra and Ubelaker (1994), could not be included in this analysis because a numerical age was not associated with their age estimation. Therefore, the 24 individuals aged as adult or older adult by the Amarna osteology team are subtracted from the total sample of 233 individuals, making the adjusted total 209. Many of the 209 individuals had a range of years or months listed as their age at death estimation. When this occurred, the average of the time span listed was calculated and used for analysis. In addition, when the time spans estimated by the Amarna osteology team used a less than sign or other mathematical

symbol, the number without the symbol was used, for example 50+ would simply be analyzed as 50 since the other end of the age range is unknown. Due to the three fetal individuals who were in utero at the time of death, zero represents the time of conception instead of the time of birth, so the fetal individuals can be included in the average age at death calculation.

To come up with the age at death of individuals who died in utero, the procedure used in this analysis is as follows:

1. 365 [Days] / 12 [Months in a Year] = 30.417 Average Number of Days in Month
2. Gestation Age in Weeks of the Individual x 7 = Age in Days
3. Age in Days / 30.417 [Average Number of Days in Month] = Age in Months
4. Age in Months / 12 [Months in a Year] = Age in Years
5. 9 [Months Pregnant] x 30.417 [Average Number of Days in Month] / 7 [Number of Days in a Week] = 39.108 Weeks Pregnant
6. $\frac{39.108}{X}$ [Weeks Pregnant] = $\frac{52.143}{12}$ [Weeks per Year] → X=9 Months Pregnant

To come up with the age at death of individuals who did not die in utero, the procedure used in this analysis is as follows:

1. 9 [Months Pregnant] / 12 [Months in a Year] = .75
2. Every individual who did not die in utero has .75 added to their age to account for their time in utero.

To come up with the average age at death of the entire population, the procedure used in this analysis is as follows:

1. All 209 individuals were added together to get a total age of the population = 4343.17
2. The total age was then divided by 209 [the number of individuals] to get an average of 20.781 years as an average age at death, including the nine months spent in utero.

The average age at death was also calculated without the three gestational individuals. The sample consisted of the 209 skeletons given an age or age range by the Amarna osteology team. When an age range was listed, the average was used. The sum of the age at death of the 209 individuals was calculated to be 4187.13. However, the three Fetal individuals are excluded making the sample size 206 individuals. The total age of individuals at death was divided by the sample size, 206. Thus, the calculated age at death without the three individuals in the Fetal life stage totals 20.33 years.

This calculation of the average age at death of the population without the three Fetal individuals appears larger than the adjusted average age at death calculated. However, the average is less than the adjusted average because the gestational time of .75 was added to every individual in the adjusted total and this is reflected in the average. Therefore, if one subtracts .75 from the adjusted age at death average, the total becomes 20.03 years. By removing the Fetal individuals from the average age at death, there was a three tenths of a year gain in the average age at death between the two sets of data. Therefore, including the three Fetal individuals in the sample size to come up with the average did not greatly skew the data. However, if the individuals who were only given subjective terminology instead had age ranges, their inclusion into the average age at death would have raised the age at death average significantly.

To determine sample size, knowing which bones were present relating to the pathologies discussed in this analysis was crucial. Just because a bone did not survive does not mean the individual did or did not have a certain pathology. Therefore, including someone lacking the bone in which a specific pathology would be expressed would not be accurate. The sample sizes presented below include individuals who are estimated to have one or all of the bones present based on the burial forms. The sample size needs to account for the age at which individuals

may start engaging in adult activities where they may be injured in the same manner as adults. Therefore, individuals under 12 years of age are eliminated from this sample. Ideally, individuals eight years of age and up would be included in the analysis. However, the lack of a bone inventory form makes this problematic. If their age spans over the 12 years of age margin, the skeleton is included only if 50 percent or more of the estimate falls over 12 years of age. If the estimated age is a number with a less than sign and if the number is at least over a year above 12 years, the individual is included.

The number of individuals with radii present is 157 out of 233. For more information, see Appendix Table III – Radii and Ulnae Bone Presence or Absence by Individual. The adjusted sample size based on the adult age range is 110 individuals with at least one radius present.

Out of the 233 individuals, 168 had at least one ulnae present. Of those 168, there are 115 individuals with at least one ulnae present above 12 years of age. The total includes 33 males, six probable males, 53 females, six probable females, five indeterminate individuals, one unknown, and 11 not applicable (N/A) indicating the lack of sexual characteristics to determine sex.

Out of the 233 individuals, 192 have at least one cervical vertebrae present. See Appendix Table IV – Cervical Vertebrae Bone Presence or Absence by Individual for more information. By adjusting for individuals above 12 years of age, the sample size adjusts to 126. The total includes 38 males, six probable males, 57 females, five probable females, ten indeterminate, one unknown, and nine not applicable (N/A) indicating the lack of sexual characteristics expressed in the young skeletal remains to indicate sex.

The individuals with at least one thoracic vertebra present total 201. For more information, see Appendix Table V – Thoracic Vertebrae Bone Presence or Absence by Individual. To adjust for the adult age range, there are 134 individuals in the sample size above 12 years of age. Out of the 134 skeletons, 38 are male, nine are probable male, 59 are female, five are probable female, nine are indeterminate individuals, one is unknown, and 13 are not applicable (N/A) due to the lack of sexual characteristics distinguishing sex.

There are 202 individuals out of 233 who have at least one lumbar vertebra. See Appendix Table VI – Lumbar Vertebrae Bone Presence or Absence by Individual for more information. To adjust for the adult age range, 137 individuals are above the age of 12 years. The 137 skeletons consist of 38 males, nine probable males, 59 females, five probable females, 11 indeterminate individuals, one unknown, and 14 not applicable (N/A) due to the lack of sexual characteristics determining sex.

Fractures of the ulnae are present 23 times in 22 individuals. For more information, see Appendix Table VII – Ulnae Fractures by Individual. Six males exhibited seven of the fractures. Twelve females exhibited 12 fractures. Three indeterminate individuals exhibited three fractures. One probable male exhibited one fracture as well. To adjust the sample size to account for adult activities, 167 individuals are above the age of 12 years in which 115 had at least one ulnae present.

The ages ranged from 20-50+ years. The six males ranged in age from 20-50 years old. The 12 females are ages 25-50 years. Two of the indeterminate individuals cannot be narrowed down in age due to the term adult used by the Amarna osteology team lacking numerical age estimation. The third individual is age 35-50+ years old. The probable male is 20-35 years old.

The distal ulnae was the predominate location for fractures. Nineteen of the 23 fractures occurred on the distal portion of the ulnae. The other four were present slightly below midshaft, half way between the midshaft and distal end, 1/3 proximal end, and on the midshaft.

The sexes varied by side injured. For the males, every fracture occurred on the left ulnae except for the one individual who was injured twice. He had a fracture on both ulnae. For the females, seven of the 12 fractures occurred on the right and five on the left. For the indeterminate individuals, two fractures occurred on the left side and one on the right. The probable male had a fracture located on the left ulna as well. In total, 14 fractures occurred on the left ulnae and nine on the right. Of the four non-distal fractures, slightly below midshaft and half way between midshaft and distal end occurred on the right side. The 1/3 proximal end and midshaft fracture occurred on the left ulnae.

To determine the type of fracture expressed in the individuals with broken ulnae, Judd's criteria would be ideal (2008:1661). Multiple aspects of the fracture are necessary to consider. First, the radius must not be involved. Secondly, a fracture line greater than or equal to 45 degrees must be present. The injury must be present on the distal segment of the shaft, half the adjusted distance to the center of the lesion. In addition, the distal portion must be minimally displaced, less than or greater to ten degrees in any plane or apposed horizontally in relation to the proximal portion by less than 50 percent. However, the pathological sections of the burial forms do not indicate a measurement of the precise location where trauma occurred. Therefore, this step of the criteria cannot be completed. In addition, the fracture lines and displacement must be estimated from the burial forms. Ideally, the pathology will be drawn on the forearm drawings and not only verbally described.

Of the 23 fractures in 22 individuals (8%; n=286), eight may immediately be removed from the list of possible parry fractures. Two are not located on the distal shaft and can thus be eliminated. Six other individuals are missing the ipsilateral radius to allow for determination of radial involvement and are thus eliminated. Therefore, 14 individuals have the ipsilateral radius, none of which express involvement from the original fracture.

Unfortunately, the details on the burial forms of the 14 remaining individuals did not provide a great amount of detail. Two males and one female do not have the fracture drawn onto the skeleton images. In terms of the other individuals, five seem to have calluses drawn on the ulnae and do not reveal the angle represented by the fracture line. One other individual has a callus or multiple fracture lines drawn on the ulna. The extent of the injury is extremely unclear. Only two of the 14 burial forms mentioned displacement. Two of the individuals mentioned above lacking details of the fracture line have minimal displacement. However, the terms used to describe the displacement are subjective. Three fractures, two of which belong to the single male with two fractures, do not have a fracture line drawn on their skeleton representing the 45 degree or more angle requirement. Lastly, two remaining individuals, both female, meet the criterion of a fracture line greater than or equal to 45 degrees. The lines were drawn on the pathology sheets and mention of displacement was nonexistent. Therefore, only two females closely resemble the requirements to better estimate a parry fracture versus other forearm trauma.

Compression fractures of the vertebrae appear in multiple skeletons of the Akhetaten population. See Appendix Table VIII – Compression Fractures of the Vertebrae by Individual for more information. The sample affected by this pathology consists of 28 individuals totaling five males, three probable males, 15 females, two probable females, and three indeterminate individuals.

The age range of the sample exhibiting compression fractures spanned from 16-50+ years. The males range from 25-45 years in addition to one individual only termed by the Amarna osteology team as adult, lacking numerical age estimation. The probable males spanned 16-40 years. The females are 18-50+ years. The two probable females both were given ages between 40-50 years. The three indeterminate individuals ranged from 18-50 years and in addition, included an individual termed by the Amarna osteology team simply as adult, lacking numerical age estimation.

To determine vertebrae affected, any vertebrae mentioned by the Amarna osteology team as compressed together were included. For example, if the third lumbar was compressed onto the fourth lumbar, both lumbar vertebrae were counted. However, often the compression fractures are listed only as "L3", standing for the third lumbar, and the effect on the surrounding vertebrae are not noted, making interpretation of the complete injury difficult. In addition, the terms compression and collapsed vertebrae seem to be used interchangeably on the burial forms. Therefore, any individual with a compression fracture or collapsed vertebrae listed on the burial form is included in this analysis.

The compressed vertebrae varied by sex. In terms of the five males, 13 vertebrae exhibit compression. None of the males exhibit compressed cervical vertebrae. The thoracic and lumbar vertebrae are both exuding the pathology totaling nine thoracic and four lumbar affected for the male sample. Two males only had the fractures in the thoracic region and two others only in the lumbar portion. The remaining male exhibited four thoracic and one lumbar vertebrae affected by the pathology. The three probable males showed 17 vertebrae with compression fractures. Each probable male had multiple locations on the vertebrae affected. Two males only had thoracic and lumbar fractures and the remaining individual had compressed vertebrae in all

three locations. The 15 females exhibited 30 vertebrae and one possible vertebra affected by the pathology. All three regions of the spine were affected. Six females only exhibited the pathology in the thoracic region, including the individual with the possible compression fracture, and six others only in the lumbar portion. Two other females have both the thoracic and lumbar areas showing the fractures. The remaining female exhibits the pathology on the cervical and lumbar regions. The two probable females differ in the location of the injuries. One probable female only has the pathology in the cervical vertebrae and the other only in the thoracic. The probable females total four vertebrae fractured. The three indeterminate individuals only were affected in the lumbar region. Five vertebrae are affected in the three indeterminate individuals.

The expression of the pathology by life stage varied. The trauma is found in five Adult Phase I individuals (12%; n=43), two in Adult Phase II (29%; n=7), nine in Adult Phase III (27%; n=33), and ten Old Adult individuals (28%; n=36). The remaining two individuals were listed as adult on the burial forms and thus could not be placed into a life stage category in this analysis due to lacking numerical age estimation. In the Adult Phase I, the second thoracic was the most common vertebra affected from being expressed twice out of five individuals. In addition, for one individual, the first thoracic was listed as a possible expression. Therefore, if the pathology exists on the first thoracic for the individual, two skeletons in the sample also show the first thoracic affected. However, the Adult Phase I total includes one individual with two unknown thoracic and two unknown lumbar vertebrae affected. Therefore, one of the lumbar vertebrae or other thoracic could potentially tie for the most common vertebrae affected. The two Adult Phase II individuals did not overlap in their expression of compressed vertebrae. In terms of the nine individuals in Adult Phase III, the third and fourth lumbar vertebrae are both expressed four times, thus in a tie for highest expression. For the Old Adult individuals, the first

and second thoracic vertebrae are tied for the highest expression, both having three individuals with the pathology. Both of the adults, termed as such by the Amarna osteology team, have lumbar vertebrae showing compression fractures while one individual is lacking a known position of the affected bone in the vertebral column.

Schmorl's nodes were present in 53 individuals (23%; n=233). Of the 53 skeletons, 18 were male, five were probable male, 23 were female, three were probable female, and four were indeterminate expressing a total of 294 Schmorl's nodes. Only one individual expressed this pathology on a cervical vertebra. Twenty-two was the highest number of the Schmorl's nodes noted on an individual and was present on two different skeletons. In terms of the lumbar and thoracic vertebrae, the 18 males expressed 120 Schmorl's nodes and the five probable males exhibited 32. Of the females, 126 were present on the 23 individuals. Three probable females showed eight and the four indeterminate individuals expressed seven Schmorl's nodes. The males exhibited 98 on the thoracic region (19%; n=511) and 54 on the lumbar (24%; n=224). For the females, out of the 126 Schmorl's nodes present, 85 were visible on the thoracic (13%; n=637) and 49 on the lumbar (17%; n=289). For the indeterminate individual, six were present on the thoracic and one on the lumbar.

The incidence of Schmorl's nodes varied by life stage. This pathology was not present in the Fetal, Infant, Child, or Young Adult stages. The individuals in Adult Phase I expressed 14 (33%; n=43), the Adult Phase II individuals showed three (43%; n=7), the Adult Phase III individuals have 16 (49%; n=33), Old Adults express 16 (44%; n=36), and four others could not be broken down into the life stages due to the terms used by the Amarna osteology team lacking an age estimation or age range from the standards in Buikstra and Ubelaker (1994).

Table 6 – Schmorl's Nodes Present by Sex and Life Stage in Individuals

Life Stage	Number of Individuals	Male	Probable Male	Female	Probable Female	Indeterminate
Adult Phase I	14	2	3	8	1	
Adult Phase II	3	2	1			
Adult Phase III	16	7		7	1	1
Old Adult	16	6		8	1	1
*Other**	4	1	1			2
Total	53					

Only life stages with individuals containing the pathology are included in the table. "*" Refers to the individuals who were not given an age estimation by the Amarna osteology team, only a term like "adult" which did not follow the standards set forth in Buikstra and Ubelaker (1994).

The expression of Schmorl's nodes varied throughout the vertebral column. Only one individual, a probable male, expressed a Schmorl's node in the cervical region on the inferior side of the seventh vertebra. For more information, see Appendix Table IX – Schmorl's Nodes on the Cervical Vertebrae by Individual. In the thoracic region, 189 of the pathology are present with 60 superior (32%) and 122 inferior (65%). See Appendix Table X – Total of the Thoracic and Lumbar Schmorl's Nodes by Individual and see Appendix Table XI – Schmorl's Nodes on the Thoracic Vertebrae by Individual. In two skeletons, seven are on an inferior portion of the vertebrae. However, their exact location is unknown. There are also seven Schmorl's nodes with an unknown anatomical position in the thoracic region of four skeletons. One is present on the inferior of the first thoracic (.5%; n=189). The third inferior expresses a single node (.5%; n=189). The fourth superior exhibits a single node as well (.5%; n=189). The fourth inferior has two (1%; n=189). The fifth superior exhibits three (2%; n=189) while the fifth inferior shows five (3%; n=189) in addition to the sixth superior having five as well (3%; n=189). Ten are present on the sixth inferior portion (5%; n=189). The seventh thoracic superior has six (3%; n=189) and the inferior contains 16 (9%; n=189). The eighth superior contains seven (4%;

n=189) and the inferior exhibits 13 (7%; n=189). The ninth superior expresses eight (4%; n=189) and the inferior 14 (7%; n=189). Seven are present on the superior portion of the tenth thoracic (4%; n=189) and 15 are on the inferior sides (8%; n=189). For the eleventh thoracic, eight are superior (4%; n=189) and 22 are inferior (12%; n=189). Fifteen are exhibited on the superior of the twelfth (8%; n=189) and 16 on the inferior (9%; n=189).

In terms of the lumbar portion of the vertebral column, out of 104 Schmorl's nodes, 64 are superior (62%; n=104), 39 inferior (38%; n=104), and one is at an unknown location and position. See Appendix Table XII – Schmorl's Nodes on the Lumbar Vertebrae by Individual for more information. On every lumbar vertebra, at least one individual has a Schmorl's node present. The first lumbar has 14 on both the superior (14%; n=104) and inferior (14%; n=104). Twenty are exhibited on the second superior lumbar (19%; n=104). Ten are visible on the inferior portion of the second lumbar (10%; n=104). On the third, 15 are superior (14%; n=104) and nine inferior (9%; n=104). Eight are superior (8%; n=104) and five inferior on the fourth lumbar (5%; n=104). For the fifth, seven Schmorl's nodes are superior (7%; n=104) and one is inferior (1%; n=104).

Spondylolysis was exhibited in the skeletal remains of the individuals at Akhetaten. See Appendix Table XIII – Expression of Spondylolysis by Individual for more information. Nineteen individuals exhibited the pathology including ten males (24%; n=42), two probable males (20%; n=10), five females (8%; n=62), one probable female (17%; n=6), and one not applicable (N/A) meaning they were too young to sex due to sexual characteristics not yet expressed (1%; n=91). The ages of the individuals expressing spondylolysis ranged from 10-50 years old. The age range of the males is 15-50 years. In terms of the probable males, the ages

spanned 15-24 years. The females ranged in age from 20-50 years old. The probable female ranged in age from 25-35 years. The not applicable individual (N/A) spanned 10-15.5 years.

In general, spondylolysis was expressed on the fifth lumbar vertebrae in the majority of cases. For the males, nine of the ten (90%) had the pathology on the fifth lumbar with the tenth male aged 20-24, exhibiting the pathology on the fourth lumbar. The probable males also exhibited spondylolysis on the fifth lumbar. This was not an exception with the females as each of the five females exhibited the condition on the fifth lumbar. The probable female and the 10-15.5 year old also expressed the pathology on the fifth lumbar.

Overall, the presence of bilateral or unilateral spondylolysis was not recorded frequently on the burial forms. However, in some cases the condition was noted in greater detail. For the males, only four individuals (40%; n=10) were recorded with pertinent information. Two expressed the condition in a bilateral nature and two in a unilateral right nature. Unfortunately, for the probable males, bilateral or unilateral presence was not recorded. Of the females, one expressed unilateral spondylolysis (20%; n=5), the oldest individual of the females ranging from 40-50 years in age. The probable female did not have the condition recorded in greater detail. The 10-15.5 year old expressed spondylolysis as unilateral right.

The presence or lack of fusion was indicated on the burial forms for every individual expressing spondylolysis. Each of ten males and two probable males healed without fusion (100%; n=12). All females except the oldest individual expressing unilateral spondylolysis, healed without fusion (80%; n=5). The probable female and 10-15.5 year old also healed without fusion of the elements.

Table 7 – Summary of Spondylolysis by Sex

Sex	Individuals with Spondylolysis
Male	10
Probable Male	2
Female	5
Probable Female	1
N/A	1
Total	19

"N/A" indicates infant or juvenile skeletons too young to show or have preserved bones determining sexual characteristics.

Spondylolysis also varies by life stage. Out of the 19 individuals expressing this pathology, one is a Young Adult (7%; n=14), eight are Adult Phase I individuals (19%; n=43), one is in Adult Phase II (14%; n=7), five are in Adult Phase III (15%; n=33), and four are Old Adults (11%; n=36). Therefore, individuals ranging 15-24.9 years old as Adult Phase I, expressed the highest presence of spondylolysis followed by Adult Phase III, spanning the years 30-39.9.

Table 8 – Individuals with Spondylolysis by Life Stage

Stage	Presence of Spondylolysis
Young Adult	1
Adult Phase I	8
Adult Phase II	1
Adult Phase III	5
Old Adult	4
Total	19

The vertebrae express degenerative joint disease. See Appendix Table XIV – Degenerative Joint Disease by Individual for the Vertebrae for more information. The cervical, thoracic, and lumbar vertebrae exhibit this pathology in 68 individuals out of the 89 individuals

expressing degenerative joint disease (76%). The vertebral areas affected overlap to where multiple individuals have this pathology in many locations on the spine. Thirty-one individuals and one possible expression are listed for the cervical, 49 and one possible expression for the thoracic, and 57 with two possible expressions on the lumbar. Twenty-two males (52%; n=42), four probable males (40%; n=10), 33 females (53%; n=62), three probable females (50%; n=6), and six indeterminate individuals (29%; n=21) express this trauma.

The ages of the individuals expressing this condition range from 16-59 years. One male individual is also aged as an older adult and not assigned numerical age estimation. The other males span from 18-59 years and the females from 20-50+ years. The probable males range from 16-40 years old with one listed as only an adult lacking numerical age estimation while probable females range from 25-50 years. The indeterminate individuals range from 18-50 years and also have three individuals only listed as an adult without numerical age estimation.

Each individual did not have the same number of vertebrae affected by degenerative joint disease. Out of the 22 males, two only had the pathology in one region of the vertebral column (9%; n=22), the thoracic area. Twelve other individuals expressed this pathology in two regions of the spine (55%; n=22). Of these 12 males, only one preserved degenerative joint disease in the cervical and thoracic area (8%; n=12), the others showed the pathology in the thoracic and lumbar. The disease never skipped over the thoracic region to be expressed in the cervical and lumbar areas. Eight other males exhibited degenerative joint disease in the three main portions of the vertebral column (36%; n=22). The probable males had two individuals with only one region involved (50%; n=4), one with two affected (25%; n=4), and one with all three (25%; n=4). For the 33 females, the vertebral regions affected by the disease were completely even. Eleven had only one vertebral area involved (33%; n=33), 11 others had two regions (33%;

n=33), and 11 different individuals had all three major regions affected (33%; n=33). The probable females have two individuals with all three vertebral areas (67%; n=3) and one with only a single region, the lumbar, involved (33%; n=3). For the indeterminate individuals, three only had one region affected (50%; n=6), one had two areas (17%; n=6), one had three regions (17%; n=6), and one has an unknown number of vertebral areas affected due to the lack of detail present in the burial form (17%; n=6).

The expression of degenerative joint disease differs between the sexes of the people of Akhetaten. In the males, the thoracic region is affected by the pathology 22 times (45%; n=49) followed by the lumbar at 19 (33%; n=57) and the cervical totaling nine (29%; n=31). The probable males had the highest expression in the lumbar region, totaling three individuals (5%; n=57). For the cervical and thoracic, the highest total was tied at two. The females had more individuals with degenerative joint disease in the lumbar vertebrae, totaling 29 expressions of the disease (51%; n=57). The thoracic was the second highest totaling 21 (43%; n=49), followed by the cervical with 16 (52%; n=31). The probable females were tied for the highest expression in the thoracic and lumbar vertebrae, both totaling three (6%; n=49 and 5%; n=57). The cervical region was only affected twice (7%; n=31). The indeterminate individuals have one individual who may have one or all vertebrae affected by the pathology. However, the lack of information in the burial forms makes this unclear. The other individuals show the highest disease presence in the lumbar region, measuring four (7%; n=57). The cervical and thoracic are tied for two individuals (7%; n=31 and 4%; n=49).

The life stages exhibit varying rates of degenerative joint disease. For the cervical vertebrae, two individuals were categorized as adults by the Amarna osteology team and thus due to lacking an age estimation, were unable to be given a life stage for this analysis. The

remaining 30 individuals consist of one in Adult Phase I (2%; n=43), two in Adult Phase II (29%; n=7), eight in Adult Phase III (24%; n=33), and 19 Old Adult individuals (53%; n=36). In terms of the thoracic vertebrae, five individuals were unable to be placed in life stages due to the Amarna osteology team using the term adult four times and older adult once without an age estimation. The other 45 individuals include three in Adult Phase I (7%; n=43), four in Adult Phase II (57%; n=7), 12 in Adult Phase III (36%; n=33), and 26 are Old Adults (72%; n=36). Of the 59 individuals with lumbar vertebrae affected by the pathology, six are unable to be placed in life stages due to the Amarna osteology team employing the term adult five times and older adult once without an age estimation. The other 53 people consist of four in Adult Phase I (9%; n=43), two in Adult Phase II (29%; n=7), 18 in Adult Phase III (55%; n=33), and 29 are Old Adults (81%; n=36).

Table 9 – Degenerative Joint Disease of the Cervical Vertebrae by Life Stage and Sex

Life Stage	Total	M	PM	F	PF	I	Total Examined by Life Stage	Percentage Affected by Life Stage
Adult Phase I	1			1			43	2%
Adult Phase II	2		1	1			7	29%
Adult Phase III	8	3	1	4			33	24%
Old Adult	19	6		9	2	2	36	53%
*Adult**	2			1		1	24	N/A
Total	32	9	2	16	2	3	143	

"M" and "F" indicate male and female respectively. "PM" and "PF" indicate probable male and probable female. "I" indicates indeterminate, referring to individuals lacking the bones to determine sexual characteristics. Life stages and sexes lacking an individual expressing the degenerative joint disease are not listed in the table. The "*" indicates terms used by the Amarna osteology team on the burial forms lacking an age estimation or stage used in Buikstra and Ubelaker (1994). "N/A" indicates the inability to calculate a percentage for the individuals lacking life stages.

Table 10 – Degenerative Joint Disease of the Thoracic Vertebrae by Life Stage and Sex

Life Stage	Total	M	PM	F	PF	I	Total Examined by Life Stage	Percentage Affected by Life Stage
Adult Phase I	3	2		1			43	7%
Adult Phase II	4	2	1	1			7	57%
Adult Phase III	12	6	1	5			33	36%
Old Adult	26	11		11	2	2	36	72%
*Adult**	4			3		1	23	N/A
*Older Adult**	1	1					1	N/A
Total	50	22	2	21	2	3	143	

"M" and "F" indicate male and female respectively. "PM" and "PF" indicate probable male and probable female. "I" indicates indeterminate, referring to individuals lacking the bones to determine sexual characteristics. Life stages and sexes lacking an individual expressing the degenerative joint disease are not listed in the table. The "*" indicates terms used by the Amarna osteology team on the burial forms lacking an age estimation or stage used in Buikstra and Ubelaker (1994). "N/A" indicates the inability to calculate a percentage for the individuals lacking life stages.

Table 11 – Degenerative Joint Disease of the Lumbar Vertebrae by Life Stage and Sex

Life Stage	Total	M	PM	F	PF	I	Total Examined by Life Stage	Percentage Affected by Life Stage
Adult Phase I	4	1	1	1		1	43	9%
Adult Phase II	2	1	1				7	29%
Adult Phase III	18	6		11	1		33	55%
Old Adult	29	10		15	2	2	36	81%
*Adult**	5		1	2		2	23	N/A
*Older Adult**	1	1					1	N/A
Total	59	19	3	29	3	5	143	

"M" and "F" indicate male and female respectively. "PM" and "PF" indicate probable male and probable female. "I" indicates indeterminate, referring to individuals lacking the bones to determine sexual characteristics. Life stages and sexes lacking an individual expressing the degenerative joint disease are not listed in the table. The "*" indicates terms used by the Amarna osteology team on the burial forms lacking an age estimation or stage used in Buikstra and

Ubelaker (1994). "N/A" indicates the inability to calculate a percentage for the individuals lacking life stages.

IX. DISCUSSION

Life at Akhetaten for many individuals consisted of hard labor, paving the way for occupational injuries. Trauma from extensive manual labor is to be expected from a city built from the ground up in a short time frame. This is partially expressed from the average age at death of this sample without the three individuals in utero at the time of death, calculated to 20.33 years. This average age at death is of course slightly skewed due to the dangerous time of childbirth for the mother and infant leading to many early deaths in comparison to males. In addition, the individuals termed adult and the older adult, lacking numerical age estimation, would have caused the average age at death to significantly rise if the individuals could have been included in the calculations.

The incidence of ulnae fractures appears at first glance to be heavily biased towards female trauma. Individuals over the age of 12 years with more than 50% of one ulna present total 115 individuals. All following fractures have been rounded to two decimal points. Therefore, out of all individuals over the age of 12 years with at least one ulna present, 8% have a fracture on the bone (n=286). A total of 23 fractures in 22 individuals were present in which seven of 39 males (18%) exhibited seven fractures, 12 of 53 females (23%) showed 12 fractures, and three of five indeterminate individuals (60%) expressed fractures. However, simply because more females exhibit fractures on the distal portions of the ulnae does not support the theory of females raising their arms in defense to protect against an unknown attacker. Out of the 23 individual fractures, 19 (83%) were located on the distal end suggesting a common type of injury between males and females.

As is apparent from the discussions of forearm injuries above, distal ulnae fractures have multiple causes. A chronic stress fracture of the ulnae seems to be a decent candidate for many

of the injuries, particularly due to the extensive construction and labor involved in creating a new city from the ground up and supporting the work force with resources such as food, for example through grinding grains. Many models exist showing women on their knees partaking in this activity. Not all males needed to be involved in construction work to obtain stress fractures. Males are known to have worked professionally washing laundry in the Nile River in ancient Egyptian society. Stress fractures resulting from repeated overuse and strain create fractures very similar to parry fractures. Fractures from repeated use could have been caused from the multiple activities involved in supporting the work force and the actual individuals involved in constructing the new city.

Other skeletal elements strongly support evidence of occupational injury through manual labor. Schmorl's nodes are indicators of traumatic events over an individual's life and in rare cases, a single stressful event. This pathology would be expected in the construction of a new city, in particular when individuals carry and maneuver talatat blocks to create new buildings. The Schmorl's nodes are present throughout the cervical, thoracic, and lumbar regions 294 times in 53 individuals. Only one individual expressed this pathology in a cervical vertebra. The thoracic and lumbar region included the remaining 293 Schmorl's nodes. In terms of the thoracic, the total of affected individuals having at least one vertebra in the thoracic region consists of 18 of 38 males (47%), five of nine probable males (56%), 23 of 59 females (39%), three of five probable females (60%), and four of nine indeterminate individuals (45%). The lumbar total of affected individuals having at least one lumbar vertebra present includes 18 of 38 males (47%), five of nine probable males (56%), 23 of 59 females (39%), three of five probable females (60%), and four of 11 indeterminate individuals (36%). As only one cervical vertebra expressed a Schmorl's node, the predominance of activity causing injury involved the lower back

region. This pathology commonly occurs in situations involving heavy loads placed on the spine, an activity pattern expected in construction work and in taking care of individuals involved in the building endeavors. Lower back trauma would particularly be expected through the lifting and unloading of boats and carts full of building supplies and other materials.

Caused by similar injuries to the vertebral column, another injury present in the human remains from Akhetaten is compression fractures, resulting when the bone tissue collapses. In the 28 individuals affected by this pathology, 69 bones show expression of the trauma. The total number of individuals with compression fractures includes five males exhibiting 13 vertebrae affected, three probable males with 17 bones expressing the pathology, 15 females having 30 and one possible expression due to the unclear nature of the burial forms, two probable females with four affected bones, and three indeterminate individuals with five vertebrae expressing the pathology. This trauma also supports the activity patterns involved in construction and in taking care of the working population.

Also relating to vertebral traumatic injuries, spondylolysis was present in 19 people. The sample consists of individuals including ten males (24%; n=42), two probable males (20%; n=10), five females (8%; n=62), one probable female (17%; n=6), and one not applicable (N/A) meaning the individual was too young to sex due to sexual characteristics not yet expressed (1%; n=91). The ages of the individuals expressing spondylolysis ranged from 10-50 years old. Although this is a small sample size, twice as many males exhibit spondylolysis when compared to females (10:5). However, when the males and females are combined with the probable males and probable females respectively, the calculation does not total the same ratio with the 12 males measuring 63% (n=19) in comparison to the females at 32% (n=19).

Spondylolysis occurs in an attempt to stop vertebral slipping. This trauma can occur from an acute traumatic event. However, most cases of spondylolysis develop slowly over time as stress or fatigue fractures, particularly in individuals involved in heavy labor and lifting. This would make sense in a society where males are carrying heavy loads in construction activity for their occupation.

However, the pathology most supportive of occupational hazards is degenerative joint disease. This disease is present in at least one joint in 89 individuals. The total number of joints affected by this pathology calculates to 497. For degenerative joint disease, individuals aged less than 15 years of age do not express any form of this pathology. However, for the life stage Adult Phase I, 36 joints express some form of degenerative joint disease (7%; n=497). For the other life stages, Adult Phase II includes 15 (3%; n=497), Adult Phase III consists of 174 (35%; n=497), Old Adult includes 242 (49%; n=497), and the adult and older adult terms used by the Amarna osteology team total 30 (6%; n=497). The Adult Phase I individuals include 36 joints out of 43 total individuals in the life stage expressing at least one form of degenerative joint disease. In terms of the Adult Phase II, there are 15 joints affected out of seven total individuals in the life stage. There are 33 Adult Phase III individuals in the life stage, of which 174 joints express the pathology. The Old Adults consist of 36 individuals in the life stage of which 242 joints express the pathology. For the adults and older adult termed by the Amarna osteology team, 24 exist in the category and 30 joints express the pathology. However, the ranges in age observed by the Amarna osteology team cannot be determined from purely the words adult and older adult.

The vertebrae express this pathology as well. Out of the 89 individuals, 68 express degenerative joint disease in at least one vertebra (76%; n=89). Of the 68 individuals, 31

expressions are on the cervical (46%; n=68), 49 on the thoracic (72%; n=68), and 57 on the lumbar (84%; n=68). This totals 137 expressions because individuals often have multiple areas of the vertebral column affected by the disease. The totals add up to over 100% because one individual may have more than one vertebral location affected by the pathology. These totals do not include possible expressions listed above. The joint is affected in 50% of the males and 53% of the females. The affected individuals include 22 out of 42 males (52%), four out of ten probable males (40%), 33 out of 62 females (53%), three out of six probable females (50%), and six out of 21 indeterminate individuals (29%). The percent of individuals with degenerative joint disease in the cervical vertebrae of the various life stages include one out of 43 in Adult Phase I (2%), two out of seven in Adult Phase II (29%), eight out of 33 in Adult Phase III (24%), 19 out of 36 in Old Adult individuals (53%), and two out of 24 adults (8%) termed as such by the Amarna osteology team. In terms of the thoracic vertebrae percentage by life stage, the Adult Phase I individuals total three out of 43 (7%), four out of seven in Adult Phase II (57%), 12 out of 33 in Adult Phase III (36%), 26 out of 36 in the Old Adult individuals (72%), and the adult and older adult termed as such by the Amarna osteology team include five out of 24 (21%). The lumbar vertebrae life stage percentage consists of four out of 43 (9%) in Adult Phase I, two out of seven in Adult Phase II (29%), 18 out of 33 in Adult Phase III (55%), 29 out of 36 in Old Adult (81%), and adult and older adult termed as such by the Amarna osteology team include six out of 24 individuals (25%).

Degenerative joint disease in addition to the other pathologies and trauma listed above was frequently discovered in the skeletal remains of the individuals living in Akhetaten. Future research could include looking at life stages to determine the possible average working age

population due to the distribution of injuries and trauma, keeping in mind how injuries occur from activity patterns and also from normal aging.

In addition to the occupational hazards exhibited in the skeletal remains, potential criminal punishments or rituals may be present as well. The five individuals and pigs showing the non-lethal scapular modification bring to light an interesting phenomenon at Akhetaten. The intentional puncture of human beings and animals may relate to the attempt of the individuals in the city or workmen's village to control isfet by incapacitating a chaotic force for a short period of time. This should not be interpreted as human sacrifice, instead, as a punishment for criminal activities through ritual.

Future analyses need to account for the different life stages present in ancient Egyptian society. The category of ages used to analyze the human remains need to be adjusted to fit ancient Egyptian life, not reflecting modern day age categories. In addition, terms like adult and old adult simply used as an age need to be avoided. The terms are extremely subjective and make many analyses and interpretation of data difficult or impossible due to the vague nature expressed by the terms. In all situations, numerical age estimations should be provided, even if spanning many years. Due to the site history of Akhetaten, many human remains have been disturbed, thus leaving the lower portion of the body in situ. Fully grown and fused leg bones can span a very large potential age range. However, a numerical estimate is always more clear in comparison to a vague term indicating age. Also, by including a numerical age range, the individuals can be placed into life stages, or span multiple life stages, allowing for a more complete interpretation of the pathology and trauma exhibited in the skeletal remains.

By including a juvenile bone inventory, significantly greater detail will be available to future researchers interested in discovering the ages at which juveniles by our standards, but

adults by ancient Egyptian standards, took on various activities. In addition, a new juvenile drawing should be created depicting the proper number of bones on a skeleton to make the absence and presence of juvenile bones completely clear.

By keeping in mind the life stages of ancient Egyptians, the expression of degenerative joint disease should appear in their skeletons much earlier than modern populations. Therefore, individuals should still be studied for degenerative joint disease whether or not the skeletons were categorized as juvenile by the Amarna osteology team. One cannot avoid looking for pathology and trauma simply due to age. In addition, the individual filling out the extra data collection form should first check the adult and juvenile burial forms filled out by the Amarna osteology team individuals to see if degenerative joint disease is listed. In some cases, the Amarna osteology team did note the pathology on the forms, but the extra data collection sheet was not included for the juveniles and adults. If the presence of the pathology was written by the Amarna osteology team individuals, the person with the extra data collection form should conduct their interpretation of the disease and then compare their results with those reached by the Amarna osteology team individuals to eliminate contradicting data. The future seasons of analysis are rectifying this confusion by having a team of individuals conduct all data collection for the entire skeleton. The two sets of forms should continue to be used in conjunction as they force the Amarna osteology team to look at the trauma in two different ways, as joints and as individual bones.

Other changes to the burial forms should involve the inclusion of a bone inventory with the percentage of bone complete, not purely a listing of presence and absence, of the feet, hands, ribs, and vertebrae for adults, juveniles, and infants. Knowing which percentage of the bone is present can allow for some pathological and trauma analysis to continue, even if a portion of the

bone is missing. For example, the vertebral body can indicate Schmorl's nodes. Other parts of the vertebrae do not need to be present in order to analyze this pathology.

The forearms and vertebral trauma including compression fractures, degenerative joint disease, Schmorl's nodes, and spondylolysis, suggest occupational injuries, not interpersonal violence. The extensive manual labor involved in constructing a new city and supporting the individuals involved in the building program are present in high percentages of the skeletons. Therefore, the majority of the injuries present in the individuals from Akhetaten are attributed to occupational injuries, not interpersonal violence.

To conclude the extent of trauma present in the Akhetaten population, the percentage of preserved bones expressing trauma supports the high level of occupational injuries. In total, 286 ulnae bones were recovered, 23 of which exhibited fractures. The percentages of individuals by sex with the fractures include 12% of the males, 11% of the females, and 43% of the indeterminate individuals. For the Schmorl's nodes in the thoracic region, the percent of individuals by sex with the pathology include 19% of the males, 13% of the females, and 11% of the indeterminate individuals. The percentage of individuals by sex with the trauma exhibited in the lumbar region total 24% of the males, 17% of the females, and 3% of the indeterminate individuals. The percentage of individuals by sex with compression fractures in all three regions of the vertebrae includes 3% of the males, 3% of the females, and 4% of the indeterminate individuals. For spondylolysis, 5% of the males and 2% of the females have the pathology by bone presence. In terms of degenerative joint disease of the vertebrae, the percentage of individuals by sex affected by the pathology in the cervical region includes 3% of the males, 5% of the females, and 29% of the indeterminate individuals. The same calculation for the thoracic region includes 4% of the males, 4% of the females, and 4% of the indeterminate individuals.

The percentage of individuals affected by the pathology in the lumbar region by sex includes 6% of the males, 11% of the females, and 11% of the indeterminate individuals.

Table 12 – Percentage of Preserved Bones Exhibiting Trauma by Sex

Trauma	Percent Males	Percent Females
Ulnae Fractures	12%	11%
Schmorl's Nodes - Thoracic	19%	13%
Schmorl's Nodes - Lumbar	24%	17%
Vertebral Compression Fractures	3%	3%
Spondylolysis	5%	2%
Degenerative Joint Disease – Cervical	3%	5%
Degenerative Joint Disease – Thoracic	4%	4%
Degenerative Joint Disease – Lumbar	6%	11%

Percentages by sex include probable males and probable females combined with males and females respectively.

These percentages all support the existence of occupational hazards, not interpersonal violence. Therefore, the distal ulnae fractures are likely chronic stress fractures instead of purely parry fractures. This is supported by the forearm and vertebral trauma including compression fractures, degenerative joint disease, Schmorl's nodes, and spondylolysis. The extensive manual labor involved in constructing a new city and supporting the individuals involved in the building program are present in high percentages of the skeletons. Therefore, the majority of the injuries present in the individuals from Akhetaten are attributed to occupational injuries, not interpersonal violence. The injury pattern seems to generally progress as hypothesized with males exhibiting greater trauma in the lower portions of the spine due to activity patterns involving lifting items and unloading carts and boats. The females do exhibit greater cervical

trauma in comparison to the males, particularly degenerative joint disease. However, the females also exhibit a high percentage of lumbar injuries suggesting activity patterns also involving the lifting of heavy items and continual use of the lower back. The present analysis illustrates the extreme amount of trauma present in the population, reflecting the dedication and hard work put forth by the citizens of Akhetaten whether due to religious motivations or simply the ability to start a new life with a stable occupation to provide for one's family.

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XI. APPENDIX

Explanation and Critique of the Burial Forms Used by the Amarna Osteology Team

The first page is a general description listing where the body parts were discovered, mortuary characteristics, percentage of skeleton complete, condition of the bone, age, sex, stature, skeletal lesions and trauma, dental lesions and wear, non-skeletal materials included in the burial, cultural material, and any additional information the Amarna osteology team felt was pertinent to include.

The next page consists of four drawings of skeletons in anterior, posterior, left, and right views. The Amarna osteology team colored in the parts of the skeleton which were discovered and used a hash mark type coloring to indicate fragmented bone. Bones which were not present in the analysis were left blank. This provided a simple way to view the skeleton to see which bones were present. In some cases, the drawings were filled in backwards with a lack of color indicating bone presence. However, this was indicated as such by the Amarna osteology team on the forms.

The third page of the adult forms consisted of an adult inventory, age, and sex analysis. Aspects of the pelvis and skull were analyzed and scored for left and right side when possible and by bone type. Then, the Amarna osteology team circled if the skeleton was a female, probable female, indeterminate, probable male, or male. In addition, the pelvis, teeth, and epiphyseal age were estimated.

A bone inventory was listed below the age and sex estimate. The inventory listed different categories of the bone with the bone type or region listed below. Sutures were broken down into seventeen regions and rated based on being in the range of open to obliterated. For the cranial and postcranial inventory, bones were listed and then rated on their presence in the

skeleton, meaning how much the bone was fragmented or complete. The possible categories extended from 100-75%, 75-25%, and less than 25%. Due to this scoring system, if a bone was marked between 25-75%, one had to rely on the drawing completed on the previous page by the Amarna osteology team to determine of more than 50% of the bone was available and thus able to be used in analysis. The vertebrae are listed by their type, cervical, thoracic, lumbar, sacral, and coccyx. The possible number of vertebrae is listed in each category which the Amarna osteology team then circled if the vertebra could be distinguished. Next to the vertebrae numbers, a total was listed allowing for vertebrae lacking known positions on the spinal column to be included. Hands and feet were broken down into carpals/tarsals, metacarpals/metatarsals, phalanges, and sesamoids. The ribs were listed out 1-12 and circled by the individual analyzing the skeleton to indicate which ribs were present for the right and left sides. The vertebrae, ribs, hands, and feet are not broken down or rated based on the percentage of the bone present like the other bone types recorded. Instead, the system is purely of presence and absence. There is an area on the side of the forms where the Amarna osteology team would include notes of a bone being broken or lumbardized. However, this was very rare.

The fourth page involved measurements of the bones for the left and right side. In some cases, measurements were listed on the form for bones not listed in the bone inventory. The bones which were obviously not a mix up based on side or confusion of the bone, especially when only one forearm bone is listed and measured and then a second bone appears in the measurement section, were included in this analysis.

The fifth page is an inventory of the adult skull and teeth. The drawings consisted in the same manner as listed above where bones present are colored in, fragmented bone is hashed, and absent bones do not have color. The teeth are drawn out as well and colored in by the same

method. The drawing indicates maxillary and mandibular teeth and roots in addition to showing the occlusal view to show the absence and presence of cusps.

The next three pages involve standardized measurements for the maxillary and mandibular teeth. The categories listed vary from bone presence, to measurements of teeth, wear, defects, caries, abscesses, linear enamel hypoplasias, to modification.

The ninth page is a pathology narrative. This allows for the Amarna osteology team to write out any pathology or trauma noted on the skeleton, ideally with the side and position, for example left distal ulna. This page was the location for the recording of Schmorl's nodes. In many cases, the Amarna osteology team who later reanalyzed the data provided a summary at the bottom of the narrative of multiple pathologies including Schmorl's nodes. However, sometimes, the summary blatantly contradicted or did not include all of the Schmorl's nodes originally noted by the first Amarna osteology team analyzing the skeletons. For example, one burial form has on their first page for the pathology summary nine Schmorl's nodes written from the reanalysis. However, in the actual pathology narrative, only one vertebra is listed as having two Schmorl's nodes and was not crossed out as incorrect by the individuals conducting reanalysis. For this study, the two sources were combined to reflect the position and vertebrae diagnosed with the pathology.

The next few pages of forms were divided into upper body and spine and then the lower body to record pathology. Images of the pertinent bones are already pictured on the forms. The Amarna osteology team colored in any pathology noted on the relevant bones.

The last two pages, added in 2011, involved transition analysis and an extra data collection form listing abscesses and caries, hypoplasias, anemia indicators, long bone metrics, osteoperiostitis, degenerative joint disease, and trauma to various parts of the body. In each of

the categories, locations on the body which were likely to be affected were listed below each heading and then scored based on the Data Collection Codebook for the Global History of Health Project (see http://global.sbs.ohio-state.edu). The standards required for the Global history of Health Project are different in comparison to those in Buikstra and Ubelaker (1994), thus requiring the extra data collection form. The online project will intends to create databases allowing the reinterpretation of human health history in Europe to see health consequences of cultural and technological change.

The extra data collection form is useful in terms of showing degenerative joint disease by joint, instead of only looking at the evidence presented on the individual bones. Unfortunately, this form is not with all the adult, juvenile, or infant individuals making the frequency expression of various pathologies difficult to identify. Also the form often contradicts some of the written out trauma expressed in the pathology narrative by the original Amarna osteology team analyzing the skeleton. Unfortunately, not all joints are included on the extra data collection form, like the wrist for example. The burial forms were scoured to look for all listings of osteoarthritis, osteophytes, eburnation, lipping, spicules, or degenerative joint disease often indicated by "DJD". The Amarna osteology team was usually clear when lipping or spicules were caused by something other than degenerative joint disease, such as the ossification of a tendon or where a ligament attached. The two sources of data, the burial forms and the extra data collection form, were then combined for this analysis, because if the Amarna osteology team deemed the degenerative joint disease worthy of mentioning in a pathology narrative, the disease should be included. However, the individual scoring the pathology from the extra data collection form should have compared their interpretations with the original recorded information and then corrected any inconsistencies. The original burial forms usually list the

various terms relating to degenerative joint disease in at least three places unlike the extra data collection form. The pathology is listed as a summary on the first page, sometimes listed in the bone inventory in the margins next to the related bone, on the pathology narrative, and drawn onto the summary skeletons or the individual pathology bone drawings. This seems to provide a nice set of checks and balances for the individual analyzing the pathology because this forces the Amarna osteology team to double check they are writing out and drawing all the pertinent information in each location. Also, if the side for example, is not noted down in the narrative, the pathology drawing will usually reflect the proper side and position on the bone where the pathology is represented. At the same time, the individual scoring the extra data collection form during the 2011 reanalysis deemed degenerative joint disease worth noting in their interpretation of the skeleton. Therefore, their interpretation must be included as well. The situation is rather unfortunate as the two sources of information often completely contradict each other.

As this project has continued over many years, the forms have involved small alterations in the way data was presented. The alterations are minor, for example providing a place for a pathology narrative in addition to the individual bone drawings for trauma recording, instead of drawing pathology on the four views of the skeletons. On some sheets which have been updated, the bone inventory percentage of bone present ranges from 100-75%, 75-50%, and 50-0%. This allows for analysis without relying on the skeleton drawings to estimate how much of a bone is present above or below 50% in the previous 75-25% category.

The juvenile forms are different from the adult forms. Juvenile forms were typically used for individuals five years of age up to 20 or more years. As most estimates of an individual's age involve a range, if the range fell into a juvenile category, the form would usually be for a juvenile. However, a range listing 18-25 for example, sometimes was recorded on the adult form

instead. In some cases, both an adult form and a juvenile form would be filled out for the same individual. The front page is the same as the adult form, acting as a general summary of the burial and the bones present. Sex cannot be determined from juveniles. Therefore, "N/A", representing not applicable, is usually listed in the category for sex.

The next page is a juvenile recording form. This page consists of a drawing of teeth and an anterior view of the skeleton which the Amarna osteology team draws in the bones recovered in the same manner listed above with presence being completely colored, fragmented hashed, and absent indicated by a lack of color. In many cases, this drawing is not in the normal anatomical position expected of a skeleton. The arms are not palm up with the thumb facing away from the body. Instead, the thumb is facing the body and the palms are down. Extreme care was necessary when trying to decide how many bones and which bones were recorded on the juvenile forms as a bone inventory was not listed for juveniles. By looking at the juvenile drawing of bone presence and looking at the first page summary of how complete a skeleton was, at times, the Amarna osteology team would estimate the percent complete and then list which bones were missing providing an indirect bone inventory. In some cases, the juvenile drawing, not being in anatomical position, confused the individuals recording to where the ulna would be colored in instead of the radius or vice versa. This was especially apparent when a radius for example, would be measured and an ulna would be drawn on the skeleton. An updated form was later created where the juvenile forms are shown with a skeleton in the correct anatomical position, making an estimated bone inventory more consistent with the measurements provided.

Since a bone inventory was not recorded for juveniles, the presence of bones were determined based on the drawings of the juvenile skeletons. Due to the image of the juvenile

skeleton's vertebrae not including the actual number of vertebrae in a skeleton, the presence or absence are estimated based on what is colored in the drawing. In addition, if the epiphyseal union has a rating of open or above, the presence of at least one vertebra is assumed for this analysis, even if the bone is not drawn on the juvenile skeleton. Pathology narratives if included which mention vertebral injuries also assume the presence of at least one vertebra.

The juvenile forms also include an estimated chronological age with a space for additional comments relating to the aging of the individual. Below this, postcranial measurements are listed in addition to rating the epiphyseal union ranging from unobservable to complete union by bone type. The next pages involve the analysis of teeth, transition analysis, and the extra data collection form already listed above.

Unfortunately, some portions of the extra data collection form, such as degenerative joint disease, were not scored because the individual analyzed was a juvenile. Sometimes, degenerative joint disease would be discussed in the pathology narrative or drawn onto the skeletons, and the form would still not be filled out in entirety. More often than not, the section on the extra data collection form would be crossed out and written next to the section would be the word "juvenile". The age range was rather inconsistent as one individual aged 18-24 was scored using the degenerative joint disease portion, while most other individuals of a similar age have the section crossed out. This is rather unfortunate as juvenile age ranges in Western society cannot be compared to the Akhetaten population. This is especially problematic because the individuals took on adult activities earlier and thus were injured in adult activities at a younger age in comparison to modern day Western society. Therefore, by classifying the juvenile by Western standards, and thus not analyzing the skeleton for degenerative joint disease, information about the age at which various adult activities occurred cannot be interpreted.

Infant forms are similar to the juvenile forms. The infant forms were used for individuals five years of age and below. The first page is the same acting as a summary of the mortuary and skeletal characteristics of the deceased individual. The next page included a drawing of the infant and teeth. A drawing of the left side of the head was placed next to the skeleton as well, in order to indicate cranial bone presence due to the lack of suture fusion. Bones were colored by using the same manner listed above with presence indicated by a completely colored in bone, a hashed in area representing fragments, and a blank area indicating bone absence. Below postcranial measurements, epiphyseal union, and primary ossification centers were respectively measured or rated based on their stage.

All three of the form types involved some degree of inconsistency. Rectification of the inconsistencies is in progress, in particular through the research conducted in this analysis and other ongoing projects noticing where issues exist, allowing future research to be taken from a clean set of data. In terms of determining skeletal sex, indeterminate and unknown were often used interchangeably. Throughout this analysis, indeterminate refers to skeletons lacking the pelvis or skull in a complete enough state to be able to estimate sex. Unknown describes individuals with a preserved pelvis and skull while exhibiting ambiguous measurements and characteristics not obviously male or female. Throughout the burial forms, infants and juveniles have multiple terms used to describe the impossible sex determination. In regards to the sex of all juvenile and infant individuals in this analysis, "N/A" standing for not applicable, is listed to distinguish their inability to be sexed. In terms of age, multiple symbols were integrated into the recorded information to indicate greater than or equal to or less than or equal to for example. Some estimates also used the word approximately to describe an age instead of giving a detailed age range. In this analysis, an isolated age range was sought out as often as possible from the

various burial forms. However, in many cases, an exact range was not listed in any of the forms so the inconsistent estimates present on the burial forms are included.

A bone inventory was not included with the juvenile or infant forms. The bones are drawn onto the anterior facing skeleton lacking a percentage of bone present, fragmented, or absence. The skeleton does not have the proper number of vertebra drawn onto the spinal column so the number of vertebra present is not entirely clear. In some cases, the Amarna osteology team wrote out which vertebra and ribs were present next to the skeleton drawing. However, this was rare. At times, some vertebrae were circled or a note was present saying "fragmentary", making it unclear which vertebrae were in fragments or what percentage of the fragment was present, for example twenty percent of the bone versus 50 percent of the bone. With the vertebrae, knowing which part of the bones was fragmentary would be helpful due to different portions of the vertebrae reflecting different pathologies. In some cases, the number of vertebrae preserved was clear based on the first page listing the percentage of the skeleton's completeness, for example recording almost 100 percent complete except for a few phalanges. If trauma was noted on the skeleton, sheets were typically added into the packet to make clear the precise location on the bones indicating trauma. In this analysis when calculating the number of bones present for the vertebrae, if a possibility was listed or at least one was marked, only one bone is counted for the individual for each section where noted (see Appendix IV, V, and VI).

Photographs of Male and Pig Scapular Injuries

Figure 1 – Individual 39

Photograph from The Amarna Project.

Figure 2 – Individual 56

Photograph from The Amarna Project

Figure 3 – Individual 102

Photograph from The Amarna Project

Figure 4 – Individual 142

Photograph from The Amarna Project

Figure 5 – Individual 191

Photograph from The Amarna Project

Figure 6 – Pig Number 104661

Photograph from The Amarna Project

Appendix Table I – Demography and Completeness of Skeletal Remains at Akhetaten

Individual Number	Sex	Age	Life Stage Age	Percent of Skeleton Complete
C11388	N/A	11.5-12.5	Child	40
C11375	Female	Adult	*Adult*	5
C11395A	Female	30-35	Adult Phase III	15
C11395B	Indeterminate	35-40	Adult Phase III	15
C11396	Female	18-20	Adult Phase I	20
C11551B	N/A	2.5-3.5	Child	40
C11560A	N/A	2.5	Infant	Approximately 10
C11577	N/A	9.5-10.5	Child	35
C11587	N/A	14.5	Young Adult	15
C11594	Indeterminate	18-22	Adult Phase I	15
C11599	Indeterminate	Adult	*Adult*	15
C11616	Indeterminate	Adult	*Adult*	5
C11643A	Probable Male	Adult	*Adult*	10
C11643B	N/A	< 1	Infant	15
C11663	Male	50+	Old Adult	10
C12705A	Female	20-30	Adult Phase II	80
C12705B	Female	35-45	Old Adult	70
C12705C	N/A	7.5 Months	Infant	15
C12705D	N/A	>2.5-4.5	Child	5
C12748	N/A	5-6.5	Child	40
C12776	Indeterminate	Adult	*Adult*	30
C12803A	Male	40-45	Old Adult	80
C12803B	N/A	5.5-6.5	Child	20
C12806	Indeterminate	Adult	*Adult*	30
C12842	Male	Adult	*Adult*	15
C12880A	N/A	2.5-4.5	Child	60
C12880B	N/A	2.5-6.5	Child	75
C13213	N/A	9.5-11.5	Child	5
001	Probable Male	15-23	Adult Phase I	20
002	Probable Male	15-23	Adult Phase I	15
003	Female	20-24	Adult Phase I	15
004	Probable Male	17-23	Adult Phase I	20
005.1	Female	30-39	Adult Phase III	98

005.2	Female	18-24	Adult Phase I	80
005	Indeterminate	18-24	Adult Phase I	20
006	N/A	>14	Young Adult	20
007		*Number Not Included*		
008	Male	18-23	Adult Phase I	80
009	Male	18-24	Adult Phase I	90
010	N/A	4.5-6.5	Child	25-75
011		*Number Not Included*		
012	Female	31-51	Old Adult	90
013	N/A	9-15	Young Adult	>75
014	Indeterminate	Adult	*Adult*	15
015	Probable Female	40-50	Old Adult	95
016	Indeterminate	Adult	*Adult*	40
017	Female	35-40	Adult Phase III	100
018	Indeterminate	Adult	*Adult*	25
019	Female	Adult	*Adult*	20
020	Indeterminate	>18	Adult Phase I	15
021A	Male	20-35	Adult Phase II	15
022	Female	18-23	Adult Phase I	75
023	Male	25-33	Adult Phase II	50
024	Male	15-20	Adult Phase I	80
025	N/A	4-6.5	Child	75
026A	Indeterminate	35-50+	Old Adult	15
026B	Probable Female	20-25	Adult Phase I	15
027A	Indeterminate	35-50	Old Adult	50
027B	Female	20-29	Adult Phase I	15
028	Female	40-50	Old Adult	95
029	Female	30-39	Adult Phase III	35
030	N/A	14.5	Young Adult	10
031	N/A	12.5-15.5	Young Adult	10
032A	N/A	4-6	Child	50
032B	Indeterminate	18-20	Adult Phase I	10
032C	N/A	12.5-15.5	Young Adult	5
033	Male	20-24	Adult Phase I	90
034	Female	35-45	Old Adult	100
035	Probable Female	15-20	Adult Phase I	50

036	Male	20-25	Adult Phase I	75
037	N/A	2-4.5	Child	60
038	N/A	12.5-15.5	Young Adult	60
039	Male	35+	Adult Phase III	Around 90
040	Female	35-45	Old Adult	Almost 100
041	N/A	9-12.5	Child	90-100
042	Male	20-25	Adult Phase I	98
043	Female	40+	Old Adult	70
044	N/A	1-2.5	Infant	25
045	N/A	6.5-9	Child	Almost 100
046	N/A	6-7.5 Months	Infant	5
047	Female	20-25	Adult Phase I	Approximately 50
048	Female	35-39	Adult Phase III	Almost 100
049	Female	35-45	Old Adult	Almost 100
050	N/A	4.5-6 Months	Infant	75
051	N/A	10-15.5	Young Adult	99
052	Female	Young Adult (Early-Mid 20s)	Adult Phase I	50
053	Unknown	20-29	Adult Phase I	Almost 100
054	N/A	3 Months-1	Infant	95
055	Female	35-50	Old Adult	25
056	Male	40+	Old Adult	55
057	Probable Male	16-20	Adult Phase I	85
058	Male	40-49	Old Adult	95
059	Male	35-59	Old Adult	80
060	N/A	1.5	Infant	90
061	Female	25-35	Adult Phase III	95
062A	Male	20-29	Adult Phase I	Almost 100
062B	Female	40-50	Old Adult	Almost 100
062C	N/A	>3.5-6.5	Child	15
063	Female	40-50	Old Adult	85
064	N/A	Approximately 12	Young Adult	95
065	Female	30-39	Adult Phase III	50
066	Male	20-29	Adult Phase I	95
067A	N/A	9-12.5	Child	50
067B	N/A	4.5 Months	Infant	15
067C	Female	20-24	Adult Phase I	10

067D	Male	Older Adult	*Older Adult*	5
068	Female	25-35	Adult Phase III	Almost 100
069A	Female	40-49	Old Adult	Almost 100
069B	N/A	5.5-11.5	Child	10
070	Indeterminate	Adult	*Adult*	40
071	Male	35-45	Old Adult	90
072	Female	30-39	Adult Phase III	50
073	N/A	2-3.5	Child	80
074	Female	40-50	Old Adult	80
075	Female	30-40	Adult Phase III	60
076	N/A	3-4.5	Child	80
077	N/A	4-6.5	Child	80
078	N/A	10.5 Months-1.5	Infant	90
079	Female	25-35	Adult Phase III	95
080	N/A	<10	Child	5
081	N/A	22-25 Gestational Weeks	Fetal	10
082	Female	Adult	*Adult*	20
083	Female	30-39	Adult Phase III	95
084	Male	25-35	Adult Phase III	85
085	Female	Adult	*Adult*	50
086	N/A	9-15.5	Young Adult	25-75
087	N/A	1-2.5	Infant	90
088	N/A	1-1.5	Infant	80
089	Female	35-45	Old Adult	40
090	Female	25-35	Adult Phase III	99
091	N/A	2-3.5	Infant	90
092	Male	25-35	Adult Phase III	95
093	Female	35-50	Old Adult	90
094	N/A	Approximately 1-2.5	Infant	60
095	Probable Female	20-25	Adult Phase I	35
096	Probable Male	Adult	*Adult*	75
097	N/A	2-3.5	Infant	95
098	N/A	1.5	Infant	75
099	Male	25-30	Adult Phase II	100
100	Female	25-35	Adult Phase III	95

101	Male	30-50	Old Adult	80
102	Male	35-45	Old Adult	95
103	Female	20-24	Adult Phase I	60
104	N/A	4-6.5	Child	50
105	N/A	>16.5	Adult Phase I	25
106	Male	35-45	Old Adult	90
107	Male	25-35	Adult Phase III	100
108	Female	25-35	Adult Phase III	100
109	N/A	7-9.5	Child	85
110	Female	25-35	Adult Phase III	80
111	N/A	9-12.5	Child	20
112	N/A	1.5-2.5	Infant	90
113	Female	20-25	Adult Phase I	80
114	Female	35-45	Old Adult	95
115	N/A	23 Gestational Weeks	Fetal	40
116	N/A	2-4.5	Child	40
117	Male	30-50	Old Adult	20
118	N/A	>12.5-17	Young Adult	25
119	Indeterminate	Adult	*Adult*	15
120	Female	20-29	Adult Phase I	95
121	Male	18-24	Adult Phase I	95
122	N/A	6.5-7.5	Child	10
123	Male	18-24	Adult Phase I	90
124	N/A	6-8.5	Child	99
125	Male	25-29	Adult Phase II	90
126	Probable Male	20-24	Adult Phase I	30
127	Female	40-45	Old Adult	95
128	Female	Adult	*Adult*	60
129	N/A	6-8.5	Child	95
130	Probable Male	18-24	Adult Phase I	95
131	Probable Male	20-35	Adult Phase II	90
132	N/A	12.5-15.5	Young Adult	80
133	N/A	7-10	Child	75
134	Female	50+	Old Adult	75
135	Indeterminate	Adult	*Adult*	10
136	Female	25-35	Adult Phase III	80
137	Male	25-35	Adult Phase III	95
138	N/A	1-2.5	Infant	40

139	Male	18-24	Adult Phase I	95
140	N/A	6 Months-1	Infant	25
141	Male	18-24	Adult Phase I	95
142	Male	30-50	Old Adult	70
143	Probable Female	25-35	Adult Phase III	95
144	Male	30-50	Old Adult	60
145	N/A	3-5.5	Child	95
146	N/A	8-10.5	Child	50
147	Female	25-29	Adult Phase II	90
148	N/A	12.5-15.5	Young Adult	85
149	N/A	10-12.5	Child	95
150	Female	20-29	Adult Phase I	95
151	Male	27-38	Adult Phase III	85
152	N/A	5.5-6.5	Child	20
153	Probable Male	25-40	Adult Phase III	70
154	Female	25-35	Adult Phase III	95
155	N/A	34 Gestational Weeks	Fetal	99
156	Indeterminate	Adult	*Adult*	25
157	N/A	3-3.5	Child	20
158	Female	25-35	Adult Phase III	60
159	N/A	7-15	Child	85
160	N/A	7-11.5	Child	50
161	N/A	6 Months-1.5	Infant	95
162	N/A	3-7.5 Months	Infant	50
163	Female	20-25	Adult Phase I	40
164	Male	25-40	Adult Phase III	90
165	N/A	<1 Year	Infant	5
166	Female	18-24	Adult Phase I	90
167	Indeterminate	Adult	*Adult*	5
168	N/A	2.5	Infant	35
169	Indeterminate	Adult	*Adult*	5
170	N/A	11-14.5	Young Adult	70
171	Male	19.5	Adult Phase I	95
172	N/A	6-10.5 Months	Infant	95
173	N/A	6-10.5 Months	Infant	90
174	N/A	2-3.5	Infant	40

175	Probable Female	40-50	Old Adult	90
176	Female	18-24	Adult Phase I	95
177	N/A	1.5-2.5	Infant	60
178	Female	25-35	Adult Phase III	90
179	Indeterminate	Adult	*Adult*	30
180	N/A	2.5-3.5	Child	90
181	N/A	Approximately 1-1.5	Infant	90
182	Female	Adult	*Adult*	30
183	N/A	7.5-10.5 Months	Infant	15
184	N/A	4.5-7.5 Months	Infant	40
185	N/A	1-2.5	Infant	90
186	N/A	2-2.5	Infant	50
187	N/A	7-9.5	Child	60
188A	Female	35-45	Old Adult	85
188B	N/A	> or = 2.5	Infant	5
189	Male	25-35	Adult Phase III	25
190	Male	35-45	Old Adult	80
191	Male	25-35	Adult Phase III	90
192	N/A	3.5-6.5	Child	75
193	Female	25-35	Adult Phase III	75
194	Male	35-50	Old Adult	95

Indeterminate indicates an adult skeleton lacking bones permitting the determination of sex. Unknown indicates bones permitting determination of sex are present, but ambiguous. "N/A" indicates infant or juvenile skeletons too young to show or have preserved bones determining sexual characteristics. Ages are in years unless noted otherwise. Life stage estimates written in italics indicate the word utilized by the Amarna osteology team instead of a numerical estimate or a term used in Buikstra and Ubelaker (1994) and thus not matching the life stages determined for this analysis. This table does not contain individual numbers listed for isolated skulls or mandibles.

Appendix Table II – Average Age at Death Calculation

Individual Number	Sex	Age	Life Stage Age	Average	Adjusted Age
C11388	N/A	11.5-12.5	Child	12	12.75
C11375	Female	Adult	*Adult*		
C11395A	Female	30-35	Adult Phase III	32.5	33.25
C11395B	Indeterminate	35-40	Adult Phase III	37.5	38.25
C11396	Female	18-20	Adult Phase I	19	19.75
C11551B	N/A	2.5-3.5	Child	3	3.75
C11560A	N/A	2.5	Infant	2.5	3.25
C11577	N/A	9.5-10.5	Child	10	10.75
C11587	N/A	14.5	Young Adult	14.5	15.25
C11594	Indeterminate	18-22	Adult Phase I	20	20.75
C11599	Indeterminate	Adult	*Adult*		
C11616	Indeterminate	Adult	*Adult*		
C11643A	Probable Male	Adult	*Adult*		
C11643B	N/A	< 1	Infant	1	1.75
C11663	Male	50+	Old Adult	50	50.75
C12705A	Female	20-30	Adult Phase II	25	25.75
C12705B	Female	35-45	Old Adult	40	40.75
C12705C	N/A	7.5 Months	Infant	0.625	1.375
C12705D	N/A	>2.5-4.5	Child	3.5	4.25
C12748	N/A	5-6.5	Child	5.75	6.5
C12776	Indeterminate	Adult	*Adult*		
C12803A	Male	40-45	Old Adult	42.5	43.25
C12803B	N/A	5.5-6.5	Child	6	6.75
C12806	Indeterminate	Adult	*Adult*		
C12842	Male	Adult	*Adult*		
C12880A	N/A	2.5-4.5	Child	3.5	4.25
C12880B	N/A	2.5-6.5	Child	4.5	5.25
C13213	N/A	9.5-11.5	Child	10.5	11.25
001	Probable Male	15-23	Adult Phase I	19	19.75
002	Probable Male	15-23	Adult Phase I	19	19.75
003	Female	20-24	Adult Phase I	22	22.75
004	Probable Male	17-23	Adult Phase I	20	20.75
005.1	Female	30-39	Adult Phase III	34.5	35.25
005.2	Female	18-24	Adult Phase I	21	21.75
005	Indeterminate	18-24	Adult Phase I	21	21.75
006	N/A	>14	Young Adult	14	14.75

007		*Number Not Included*			
008	Male	18-23	Adult Phase I	20.5	21.25
009	Male	18-24	Adult Phase I	21	21.75
010	N/A	4.5-6.5	Child	5.5	6.25
011		*Number Not Included*			
012	Female	31-51	Old Adult	41	41.75
013	N/A	9-15	Young Adult	12	12.75
014	Indeterminate	Adult	*Adult*		
015	Probable Female	40-50	Old Adult	45	45.75
016	Indeterminate	Adult	*Adult*		
017	Female	35-40	Adult Phase III	37.5	38.25
018	Indeterminate	Adult	*Adult*		
019	Female	Adult	*Adult*		
020	Indeterminate	>18	Adult Phase I	18	18.75
021A	Male	20-35	Adult Phase II	27.5	28.25
022	Female	18-23	Adult Phase I	20.5	21.25
023	Male	25-33	Adult Phase II	29	29.75
024	Male	15-20	Adult Phase I	17.5	18.25
025	N/A	4-6.5	Child	5.25	6
026A	Indeterminate	35-50+	Old Adult	42.5	43.25
026B	Probable Female	20-25	Adult Phase I	22.5	23.25
027A	Indeterminate	35-50	Old Adult	42.5	43.25
027B	Female	20-29	Adult Phase I	24.5	25.25
028	Female	40-50	Oldest Adult	45	45.75
029	Female	30-39	Adult Phase III	34.5	35.25
030	N/A	14.5	Young Adult	14.5	15.25
031	N/A	12.5-15.5	Young Adult	14	14.75
032A	N/A	4-6	Child	5	5.75
032B	Indeterminate	18-20	Adult Phase I	19	19.75
032C	N/A	12.5-15.5	Young Adult	14	14.75
033	Male	20-24	Adult Phase I	22	22.75
034	Female	35-45	Old Adult	40	40.75
035	Probable Female	15-20	Adult Phase I	17.5	18.25
036	Male	20-25	Adult Phase I	22.5	23.25
037	N/A	2-4.5	Child	3.25	4
038	N/A	12.5-15.5	Young Adult	14	14.75
039	Male	35+	Adult Phase III	35	35.75

040	Female	35-45	Old Adult	40	40.75
041	N/A	9-12.5	Child	10.75	11.5
042	Male	20-25	Adult Phase I	22.5	23.25
043	Female	40+	Old Adult	40	40.75
044	N/A	1-2.5	Infant	1.75	2.5
045	N/A	6.5-9	Child	7.75	8.5
046	N/A	6-7.5 Months	Infant	0.563	1.313
047	Female	20-25	Adult Phase I	22.5	23.25
048	Female	35-39	Adult Phase III	37	37.75
049	Female	35-45	Old Adult	40	40.75
050	N/A	4.5-6 Months	Infant	0.438	1.188
051	N/A	10-15.5	Young Adult	12.75	13.5
052	Female	Young Adult (Early-Mid 20s)	Adult Phase I	22.5	23.25
053	Unknown	20-29	Adult Phase I	24.5	25.25
054	N/A	3 Months-1	Infant	0.625	1.375
055	Female	35-50	Old Adult	42.5	43.25
056	Male	40+	Old Adult	40	40.75
057	Probable Male	16-20	Adult Phase I	18	18.75
058	Male	40-49	Old Adult	44.5	45.25
059	Male	35-59	Old Adult	47	47.75
060	N/A	1.5	Infant	1.5	2.25
061	Female	25-35	Adult Phase III	30	30.75
062A	Male	20-29	Adult Phase I	24.5	25.25
062B	Female	40-50	Old Adult	45	45.75
062C	N/A	>3.5-6.5	Child	5	5.75
063	Female	40-50	Old Adult	45	45.75
064	N/A	Approximately 12	Young Adult	12	12.75
065	Female	30-39	Adult Phase III	34.5	35.25
066	Male	20-29	Adult Phase I	24.5	25.25
067A	N/A	9-12.5	Child	10.75	11.5
067B	N/A	4.5 Months	Infant	0.375	1.125
067C	Female	20-24	Adult Phase I	22	22.75
067D	Male	Older Adult	*Older Adult*		
068	Female	25-35	Adult Phase III	30	30.75
069A	Female	40-49	Old Adult	44.5	45.25
069B	N/A	5.5-11.5	Child	8.5	9.25
070	Indeterminate	Adult	*Adult*		
071	Male	35-45	Old Adult	40	40.75
072	Female	30-39	Adult Phase III	34.5	35.25

073	N/A	2-3.5	Child	2.75	3.5
074	Female	40-50	Old Adult	45	45.75
075	Female	30-40	Adult Phase III	35	35.75
076	N/A	3-4.5	Child	3.75	4.5
077	N/A	4-6.5	Child	5.25	6
078	N/A	10.5 Months-1.5	Infant	1.188	1.938
079	Female	25-35	Adult Phase III	30	30.75
080	N/A	<10	Child	10	10.75
081	N/A	22-25 Gestational Weeks	Fetal	23.5 Weeks	0.451
082	Female	Adult	*Adult*		
083	Female	30-39	Adult Phase III	34.5	35.25
084	Male	25-35	Adult Phase III	30	30.75
085	Female	Adult	*Adult*		
086	N/A	9-15.5	Young Adult	12.25	13
087	N/A	1-2.5	Infant	1.75	2.5
088	N/A	1-1.5	Infant	1.25	2
089	Female	35-45	Old Adult	40	40.75
090	Female	25-35	Adult Phase III	30	30.75
091	N/A	2-3.5	Infant	2.75	3.5
092	Male	25-35	Adult Phase III	30	30.75
093	Female	35-50	Old Adult	42.5	43.25
094	N/A	Approximately 1-2.5	Infant	1.75	2.5
095	Probable Female	20-25	Adult Phase I	22.5	23.25
096	Probable Male	Adult	*Adult*		
097	N/A	2-3.5	Infant	2.75	3.5
098	N/A	1.5	Infant	1.5	2.25
099	Male	25-30	Adult Phase II	27.5	28.25
100	Female	25-35	Adult Phase III	30	30.75
101	Male	30-50	Old Adult	40	40.75
102	Male	35-45	Old Adult	40	40.75
103	Female	20-24	Adult Phase I	22	22.75
104	N/A	4-6.5	Child	5.25	6
105	N/A	>16.5	Adult Phase I	16.5	17.25
106	Male	35-45	Old Adult	40	40.75
107	Male	25-35	Adult Phase III	30	30.75
108	Female	25-35	Adult Phase III	30	30.75

109	N/A	7-9.5	Child	8.25	9
110	Female	25-35	Adult Phase III	30	30.75
111	N/A	9-12.5	Child	10.75	11.5
112	N/A	1.5-2.5	Infant	2	2.75
113	Female	20-25	Adult Phase I	22.5	23.25
114	Female	35-45	Old Adult	40	40.75
115	N/A	23 Gestational Weeks	Fetal	23 Weeks	0.441
116	N/A	2-4.5	Child	3.25	4
117	Male	30-50	Old Adult	40	40.75
118	N/A	>12.5-17	Young Adult	14.75	15.5
119	Indeterminate	Adult	*Adult*		
120	Female	20-29	Adult Phase I	24.5	25.25
121	Male	18-24	Adult Phase I	21	21.75
122	N/A	6.5-7.5	Child	7	7.75
123	Male	18-24	Adult Phase I	21	21.75
124	N/A	6-8.5	Child	7.25	8
125	Male	25-29	Adult Phase II	27	27.75
126	Probable Male	20-24	Adult Phase I	22	22.75
127	Female	40-45	Old Adult	42.5	43.25
128	Female	Adult	*Adult*		
129	N/A	6-8.5	Child	7.25	8
130	Probable Male	18-24	Adult Phase I	21	21.75
131	Probable Male	20-35	Adult Phase II	27.5	28.25
132	N/A	12.5-15.5	Young Adult	14	14.75
133	N/A	7-10	Child	8.5	9.25
134	Female	50+	Old Adult	50	50.75
135	Indeterminate	Adult	*Adult*		
136	Female	25-35	Adult Phase III	30	30.75
137	Male	25-35	Adult Phase III	30	30.75
138	N/A	1-2.5	Infant	1.75	2.5
139	Male	18-24	Adult Phase I	21	21.75
140	N/A	6 Months-1	Infant	0.75	1.5
141	Male	18-24	Adult Phase I	21	21.75
142	Male	30-50	Old Adult	40	40.75
143	Probable Female	25-35	Adult Phase III	30	30.75
144	Male	30-50	Old Adult	40	40.75
145	N/A	3-5.5	Child	4.25	5
146	N/A	8-10.5	Child	9.25	10
147	Female	25-29	Adult Phase II	27	27.75

148	N/A	12.5-15.5	Young Adult	14	14.75
149	N/A	10-12.5	Child	11.25	12
150	Female	20-29	Adult Phase I	24.5	25.25
151	Male	27-38	Adult Phase III	32.5	33.25
152	N/A	5.5-6.5	Child	6	6.75
153	Probable Male	25-40	Adult Phase III	32.5	33.25
154	Female	25-35	Adult Phase III	30	30.75
155	N/A	34 Gestational Weeks	Fetal	34 Weeks	0.652
156	Indeterminate	Adult	*Adult*		
157	N/A	3-3.5	Child	3.25	4
158	Female	25-35	Adult Phase III	30	30.75
159	N/A	7-15	Child	11	11.75
160	N/A	7-11.5	Child	9.25	10
161	N/A	6 Months-1.5	Infant	1	1.75
162	N/A	3-7.5 Months	Infant	0.438	1.188
163	Female	20-25	Adult Phase I	22.5	23.25
164	Male	25-40	Adult Phase III	32.5	33.25
165	N/A	<1 Year	Infant	1	1.75
166	Female	18-24	Adult Phase I	21	21.75
167	Indeterminate	Adult	*Adult*		
168	N/A	2.5	Infant	2.5	3.25
169	Indeterminate	Adult	*Adult*		
170	N/A	11-14.5	Young Adult	12.75	13.5
171	Male	19.5	Adult Phase I	19.5	20.25
172	N/A	6-10.5 Months	Infant	0.688	1.438
173	N/A	6-10.5 Months	Infant	0.688	1.438
174	N/A	2-3.5	Infant	2.75	3.5
175	Probable Female	40-50	Old Adult	45	45.75
176	Female	18-24	Adult Phase I	21	21.75
177	N/A	1.5-2.5	Infant	2	2.75
178	Female	25-35	Adult Phase III	30	30.75
179	Indeterminate	Adult	*Adult*		
180	N/A	2.5-3.5	Child	3	3.75
181	N/A	Approximately 1-1.5	Infant	1.25	2
182	Female	Adult	*Adult*		
183	N/A	7.5-10.5 Months	Infant	0.75	1.5

184	N/A	4.5-7.5 Months	Infant	0.5	1.25
185	N/A	1-2.5	Infant	1.75	2.5
186	N/A	2-2.5	Infant	2.25	3
187	N/A	7-9.5	Child	8.25	9
188A	Female	35-45	Old Adult	40	40.75
188B	N/A	> or = 2.5	Infant	2.5	3.25
189	Male	25-35	Adult Phase III	30	30.75
190	Male	35-45	Old Adult	40	40.75
191	Male	25-35	Adult Phase III	30	30.75
192	N/A	3.5-6.5	Child	5	5.75
193	Female	25-35	Adult Phase III	30	30.75
194	Male	35-50	Old Adult	42.5	43.25
				Sum	4343.17
				Average	20.781

Indeterminate indicates an adult skeleton lacking bones permitting the determination of sex. Unknown indicates bones permitting determination of sex are present, but ambiguous. "N/A" indicates infant or juvenile skeletons too young to show or have preserved bones determining sexual characteristics. Ages are in years unless noted otherwise. Life stage estimates written in italics indicate the word utilized by the Amarna osteology team instead of a numerical estimate or a term used in Buikstra and Ubelaker (1994) and thus not matching the life stages determined for this analysis. Note the calculation of average age at death starts at the time of conception, not at birth for the adjusted average age at death.

Appendix Table III – Radii and Ulnae Bone Presence or Absence by Individual

Individual	Sex	Age	Radius Left	Radius Right	Ulna Left	Ulna Right
C11388	N/A	11.5-12.5	X			
C11375	Female	Adult				
C11395A	Female	30-35				
C11395B	Indeterminate	35-40				
C11396	Female	18-20	X	X	X	X
C11551B	N/A	2.5-3.5	X	X	X	X
C11560A	N/A	2.5				
C11577	N/A	9.5-10.5	X		X	
C11587	N/A	14.5				
C11594	Indeterminate	18-22				
C11599	Indeterminate	Adult				
C11616	Indeterminate	Adult				
C11643A	Probable Male	Adult				X
C11643B	N/A	< 1				
C11663	Male	50+				
C12705A	Female	20-30	X	X	X	X
C12705B	Female	35-45	X			
C12705C	N/A	7.5 Months				
C12705D	N/A	>2.5-4.5	*	*	*	*
C12748	N/A	5-6.5				
C12776	Indeterminate	Adult				
C12803A	Male	40-45	X		X	X
C12803B	N/A	5.5-6.5				
C12806	Indeterminate	Adult				
C12842	Male	Adult				
C12880A	N/A	2.5-4.5	X	X	X	X
C12880B	N/A	2.5-6.5	X	X	X	X
C13213	N/A	9.5-11.5				
001	Probable Male	15-23				
002	Probable Male	15-23				
003	Female	20-24				
004	Probable	17-23				

	Male					
005.1	Female	30-39	X	X	X	X
005.2	Female	18-24	X	X	X	X
005	Indeterminate	18-24				
006	N/A	>14		X		X
007		*Number Not Included*				
008	Male	18-23				
009	Male	18-24	X	X	X	X
010	N/A	4.5-6.5	X	X	X	X
011		*Number Not Included*				
012	Female	31-51	X	X	X	X
013	N/A	9-15	X	X	X	X
014	Indeterminate	Adult				
015	Probable Female	40-50	X	X	X	
016	Indeterminate	Adult	X		X	
017	Female	35-40	X	X	X	X
018	Indeterminate	Adult		X		X
019	Female	Adult				X
020	Indeterminate	>18				
021A	Male	20-35	X		X	
022	Female	18-23				
023	Male	25-33	X		X	
024	Male	15-20	X		X	
025	N/A	4-6.5				
026A	Indeterminate	35-50+			X	
026B	Probable Female	20-25	X	X	X	
027A	Indeterminate	35-50	X	X	X	X
027B	Female	20-29	X		X	
028	Female	40-50	X	X	X	X
029	Female	30-39				
030	N/A	14.5				
031	N/A	12.5-15.5				
032A	N/A	4-6				
032B	Indeterminate	18-20				X
032C	N/A	12.5-15.5				
033	Male	20-24	X	X	X	X

034	Female	35-45	X	X	X	X
035	Probable Female	15-20	X	X		X
036	Male	20-25				
037	N/A	2-4.5				
038	N/A	12.5-15.5				
039	Male	35+	X	X	X	X
040	Female	35-45	X		X	X
041	N/A	9-12.5	X	X	X	X
042	Male	20-25	X	X	X	X
043	Female	40+				X
044	N/A	1-2.5				
045	N/A	6.5-9	X	X	X	X
046	N/A	6-7.5 Months	X			
047	Female	20-25	X	X	X	X
048	Female	35-39	X	X	X	X
049	Female	35-45	X		X	X
050	N/A	4.5-6 Months	X	X	X	X
051	N/A	10-15.5	X	X	X	X
052	Female	Young Adult (Early-Mid 20s)	X	X	X	X
053	Unknown	20-29	X	X	X	X
054	N/A	3 Months-1	X	X	X	X
055	Female	35-50			X	
056	Male	40+	X		X	
057	Probable Male	16-20	X	X	X	X
058	Male	40-49	X	X	X	X
059	Male	35-59		X	X	X
060	N/A	1.5	X	X	X	X
061	Female	25-35	X	X	X	X
062A	Male	20-29	X	X	X	X
062B	Female	40-50	X	X	X	X
062C	N/A	>3.5-6.5	X			
063	Female	40-50		X		X
064	N/A	Approximately 12	X	X	X	X
065	Female	30-39	X		X	
066	Male	20-29	X	X	X	X

067A	N/A	9-12.5		X		X
067B	N/A	4.5 Months			X	
067C	Female	20-24				
067D	Male	Older Adult				
068	Female	25-35	X	X	X	X
069A	Female	40-49	X	X	X	X
069B	N/A	5.5-11.5				X
070	Indeterminate	Adult		X		X
071	Male	35-45	X	X	X	X
072	Female	30-39	X	X	X	X
073	N/A	2-3.5	X	X	X	X
074	Female	40-50	X	X	X	X
075	Female	30-40	X	X	X	X
076	N/A	3-4.5	X	X	X	X
077	N/A	4-6.5	X	X		X
078	N/A	10.5 Months-1.5	X	X		X
079	Female	25-35	X	X	X	X
080	N/A	<10				
081	N/A	22-25 Gestational Weeks			X	X
082	Female	Adult				
083	Female	30-39	X	X	X	X
084	Male	25-35	X	X	X	X
085	Female	Adult	X		X	
086	N/A	9-15.5	X	X	X	X
087	N/A	1-2.5		X	X	X
088	N/A	1-1.5	X	X	X	X
089	Female	35-45	X		X	
090	Female	25-35	X	X	X	X
091	N/A	2-3.5	X	X	X	X
092	Male	25-35	X	X	X	X
093	Female	35-50	X	X	X	X
094	N/A	Approximately 1-2.5				
095	Probable Female	20-25	X	X	X	X
096	Probable Male	Adult	X		X	X

097	N/A	2-3.5	X	X	X	X
098	N/A	1.5	X	X	X	X
099	Male	25-30	X	X	X	X
100	Female	25-35	X	X	X	X
101	Male	30-50	X	X	X	X
102	Male	35-45				
103	Female	20-24	X	X	X	X
104	N/A	4-6.5	X	X	X	X
105	N/A	>16.5		X		X
106	Male	35-45		X		X
107	Male	25-35	X	X	X	X
108	Female	25-35	X	X	X	X
109	N/A	7-9.5	X	X	X	X
110	Female	25-35	X	X	X	X
111	N/A	9-12.5				
112	N/A	1.5-2.5	X	X	X	X
113	Female	20-25	X	X	X	X
114	Female	35-45	X	X	X	X
115	N/A	23 Gestational Weeks				X
116	N/A	2-4.5			X	X
117	Male	30-50				
118	N/A	>12.5-17				
119	Indeterminate	Adult				
120	Female	20-29	X	X	X	X
121	Male	18-24	X	X	X	X
122	N/A	6.5-7.5				
123	Male	18-24	X	X	X	X
124	N/A	6-8.5	X	X	X	X
125	Male	25-29	X			X
126	Probable Male	20-24		X		X
127	Female	40-45	X	X	X	X
128	Female	Adult	X	X	X	X
129	N/A	6-8.5	X	X	X	X
130	Probable Male	18-24	X	X	X	X
131	Probable Male	20-35	X	X	X	X
132	N/A	12.5-15.5				

133	N/A	7-10	X	X	X	X
134	Female	50+	X	X	X	X
135	Indeterminate	Adult				
136	Female	25-35	X	X	X	X
137	Male	25-35	X	X	X	X
138	N/A	1-2.5		X	X	X
139	Male	18-24	X	X	X	X
140	N/A	6 Months-1		X		X
141	Male	18-24		X	X	X
142	Male	30-50				
143	Probable Female	25-35	X	X	X	X
144	Male	30-50	X		X	
145	N/A	3-5.5	X		X	
146	N/A	8-10.5				
147	Female	25-29	X	X	X	X
148	N/A	12.5-15.5	X	X		X
149	N/A	10-12.5	X	X	X	X
150	Female	20-29	X	X	X	X
151	Male	27-38	X		X	X
152	N/A	5.5-6.5				
153	Probable Male	25-40				
154	Female	25-35	X	X	X	
155	N/A	34 Gestational Weeks	X	X	X	X
156	Indeterminate	Adult				
157	N/A	3-3.5			X	
158	Female	25-35				
159	N/A	7-15	X	X	X	X
160	N/A	7-11.5			X	
161	N/A	6 Months-1.5	X	X	X	X
162	N/A	3-7.5 Months	X	X		X
163	Female	20-25	X	X		X
164	Male	25-40	X	X	X	X
165	N/A	<1 Year				
166	Female	18-24	X	X	X	X
167	Indeterminate	Adult				
168	N/A	2.5				X
169	Indeterminate	Adult				

170	N/A	11-14.5	X	X	X	X
171	Male	19.5	X	X	X	X
172	N/A	6-10.5 Months	X	X	X	X
173	N/A	6-10.5 Months	X	X	X	X
174	N/A	2-3.5				
175	Probable Female	40-50	X	X	X	X
176	Female	18-24	X	X	X	X
177	N/A	1.5-2.5		X		X
178	Female	25-35	X	X	X	X
179	Indeterminate	Adult	X		X	
180	N/A	2.5-3.5	X	X	X	X
181	N/A	Approximately 1-1.5	X	X	X	X
182	Female	Adult	X	X	X	X
183	N/A	7.5-10.5 Months				
184	N/A	4.5-7.5 Months	X		X	
185	N/A	1-2.5	X	X	X	X
186	N/A	2-2.5		X	X	
187	N/A	7-9.5	X	X	X	X
188A	Female	35-45	X	X	X	X
188B	N/A	> or = 2.5				
189	Male	25-35				
190	Male	35-45		X		X
191	Male	25-35	X	X	X	X
192	N/A	3.5-6.5	X	X	X	X
193	Female	25-35	X	X	X	X
194	Male	35-50	X	X	X	X

Indeterminate indicates an adult skeleton lacking bones permitting the determination of sex. Unknown indicates bones permitting determination of sex are present, but ambiguous. "N/A" indicates infant or juvenile skeletons too young to show or have preserved bones determining sexual characteristics. Ages are in years unless noted otherwise. An "X" indicates presence, blank indicates absence of bone, and a "*" indicates the burial forms were unclear about the absolute presence of the bone. For example there would be a note to the side of a skeleton mentioning *a radius* was present and not listing the side.

Appendix Table IV – Cervical Vertebrae Bone Presence or Absence by Individual

Individual	Sex	Age	C Total	C1	C2	C3	C4	C5	C6	C7
C11388	N/A	11.5-12.5								
C11375	Female	Adult	2			-	-			
C11395A	Female	30-35	7	X	X	X	X	X	X	X
C11395B	Indeterminate	35-40	6	X	X		X	X	X	X
C11396	Female	18-20	1	-	-	-	-	-	-	-
C11551B	N/A	2.5-3.5	1+	*	*	*	*	*	*	*
C11560A	N/A	2.5	1+	*	*	*	*	*	*	*
C11577	N/A	9.5-10.5								
C11587	N/A	14.5	7	X	X	X	X	X	X	X
C11594	Indeterminate	18-22								
C11599	Indeterminate	Adult								
C11616	Indeterminate	Adult	1+	*	*	*	*	*	*	*
C11643A	Probable Male	Adult								
C11643B	N/A	< 1								
C11663	Male	50+								
C12705A	Female	20-30	6		X	X	X	X	X	X
C12705B	Female	35-45	6		X	X	X	X	X	X
C12705C	N/A	7.5 Months	7	*	*	*	*	*	*	*
C12705D	N/A	>2.5-4.5	1+	*	*	*	*	*	*	*
C12748	N/A	5-6.5	6	X	X	-	-	-	-	-
C12776	Indeterminate	Adult								
C12803A	Male	40-45	5	X	X	X	X	X		
C12803B	N/A	5.5-6.5	1+	*	*	*	*	*	*	*
C12806	Indeterminate	Adult	2		X		X			
C12842	Male	Adult	2		X	X				
C12880A	N/A	2.5-4.5	7	*	*	*	*	*	*	*
C12880B	N/A	2.5-6.5	2	*	*					
C13213	N/A	9.5-11.5								
001	Probable Male	15-23								
002	Probable Male	15-23								
003	Female	20-24	3					X	X	X

004	Probable Male	17-23	4				X	X	X	X
005.1	Female	30-39	5	X	X	-	-	-	-	X
005.2	Female	18-24	6		X	X	X	X	X	X
005	Indeterminate	18-24	3					X	X	X
006	N/A	>14								
007		*Number Not Included*								
008	Male	18-23	7	X	X	X	X	X	X	X
009	Male	18-24	1					*		
010	N/A	4.5-6.5	5	-	-	-	-	-	-	-
011		*Number Not Included*								
012	Female	31-51	7	X	X	X	X	X	X	X
013	N/A	9-15								
014	Indeterminate	Adult								
015	Probable Female	40-50	3		X	X	X			
016	Indeterminate	Adult								
017	Female	35-40	7	X	X	X	X	X	X	X
018	Indeterminate	Adult	4	X	X		X	X		
019	Female	Adult	5			X	X	X	X	X
020	Indeterminate	>18								
021A	Male	20-35	1			X				
022	Female	18-23								
023	Male	25-33	3	-	-	-	-	-	-	-
024	Male	15-20								
025	N/A	4-6.5	7	*	*	*	*	*	*	*
026A	Indeterminate	35-50+	4	-	-	-	-	-	-	
026B	Probable Female	20-25								
027A	Indeterminate	35-50	3		X	X		X		
027B	Female	20-29	1	X						
028	Female	40-50	7	X	X	X	X	X	X	X
029	Female	30-39								
030	N/A	14.5								
031	N/A	12.5-15.5								
032A	N/A	4-6	1	-	-	-	-	-	-	-
032B	Indeterminate	18-20								
032C	N/A	12.5-15.5								
033	Male	20-24	5			X	X	X	X	X

034	Female	35-45	4	X			X	X	X	
035	Probable Female	15-20	5	*	*	*	*	*	*	*
036	Male	20-25	7	X	X	X	X	X	X	X
037	N/A	2-4.5	2+	X	X	*	*	*	*	*
038	N/A	12.5-15.5	1+	*	*	*	*	*	*	*
039	Male	35+	6	X	X	X	X	X	X	
040	Female	35-45	7	X	X	X	X	X	X	X
041	N/A	9-12.5	6	*	*	*	*	*	*	
042	Male	20-25	7	X	X	X	X	X	X	X
043	Female	40+	7	X	X	X	X	X	X	X
044	N/A	1-2.5	4	-	-	-	-	-	-	-
045	N/A	6.5-9	7	X	X	X	X	X	X	X
046	N/A	6-7.5 Months								
047	Female	20-25	6	X	X	X	X	X	X	
048	Female	35-39	7	X	X	X	X	X	X	X
049	Female	35-45	7	X	X	X	X	X	X	X
050	N/A	4.5-6 Months	1+	*	*	*	*	*	*	*
051	N/A	10-15.5	7	X	X	X	X	X	X	X
052	Female	Young Adult (Early-Mid 20s)	7	X	X	X	X	X	X	X
053	Unknown	20-29	7	X	X	X	X	X	X	X
054	N/A	3 Months-1	7	*	*	*	*	*	*	*
055	Female	35-50								
056	Male	40+	6	X	X	X	X	X	X	
057	Probable Male	16-20	7	X	X	X	X	X	X	X
058	Male	40-49	7	X	X	X	X	X	X	X
059	Male	35-59	7	X	X	X	X	X	X	X
060	N/A	1.5	7	*	*	*	*	*	*	*
061	Female	25-35	7	X	X	X	X	X	X	X
062A	Male	20-29	7	X	X	X	X	X	X	X
062B	Female	40-50	7	X	X	X	X	X	X	X
062C	N/A	>3.5-6.5	3	X	X					X
063	Female	40-50	5			X	X	X	X	X
064	N/A	Approximately 12	7	*	*	*	*	*	*	*
065	Female	30-39	5	X	X	X	X			
066	Male	20-29	7	X	X	X	X	X	X	X
067A	N/A	9-12.5	3	-	-	-	-	-	-	-

067B	N/A	4.5 Months	1+	*	*	*	*	*	*	*
067C	Female	20-24	1		X					
067D	Male	Older Adult								
068	Female	25-35	7	X	X	X	X	X	X	X
069A	Female	40-49	7	X	X	X	X	X	X	X
069B	N/A	5.5-11.5	1	X						
070	Indeterminate	Adult	5	X	X	X	X	X		
071	Male	35-45	7	X	X	X	X	X	X	X
072	Female	30-39	5	X			X	X	X	X
073	N/A	2-3.5	7	*	*	*	*	*	*	*
074	Female	40-50	6		X	X	X	X	X	X
075	Female	30-40	7	X	X	X	X	X	X	X
076	N/A	3-4.5	7	*	*	*	*	*	*	*
077	N/A	4-6.5	1+	*	*	*	*	*	*	*
078	N/A	10.5 Months-1.5	1+	*	*	*	*	*	*	*
079	Female	25-35	7	X	X	X	X	X	X	X
080	N/A	<10	1		*					
081	N/A	22-25 Gestational Weeks								
082	Female	Adult	1			X				
083	Female	30-39	7	X	X	X	X	X	X	X
084	Male	25-35	7	X	X	X	X	X	X	X
085	Female	Adult	7	X	X	X	X	X	X	X
086	N/A	9-15.5	7	X	X	X	X	X	X	X
087	N/A	1-2.5	7	*	*	*	*	*	*	*
088	N/A	1-1.5	7	*	*	*	*	*	*	*
089	Female	35-45								
090	Female	25-35	7	X	X	X	X	X	X	X
091	N/A	2-3.5	7	X	X	X	X	X	X	X
092	Male	25-35	7	X	X	X	X	X	X	X
093	Female	35-50	7	X	X	X	X	X	X	X
094	N/A	Approximately 1-2.5	1+	*	*	*	*	*	*	*
095	Probable Female	20-25	3		-	-	-	-		-
096	Probable Male	Adult	5			X	X	X	X	X
097	N/A	2-3.5	7	*	*	*	*	*	*	*
098	N/A	1.5	7	*	*	*	*	*	*	*
099	Male	25-30	7	X	X	X	X	X	X	X

100	Female	25-35	7	X	X	X	X	X	X	X
101	Male	30-50	7	X	X	X	X	X	X	X
102	Male	35-45	7	X	X	X	X	X	X	X
103	Female	20-24	5	X		X	X		X	X
104	N/A	4-6.5	3	*	*	-	-	-	-	-
105	N/A	>16.5								
106	Male	35-45	6		X	X	X	X	X	X
107	Male	25-35	7	X	X	X	X	X	X	X
108	Female	25-35	7	X	X	X	X	X	X	X
109	N/A	7-9.5	7	X	X	X	X	X	X	X
110	Female	25-35	7	X	X	X	X	X	X	X
111	N/A	9-12.5								
112	N/A	1.5-2.5	7	*	*	*	*	*	*	*
113	Female	20-25	4			-	-	-	-	-
114	Female	35-45	7	X	X	X	X	X	X	X
115	N/A	23 Gestational Weeks	1+	*	*	*	*	*	*	*
116	N/A	2-4.5	1+	*	*	*	*	*	*	*
117	Male	30-50	1	X						
118	N/A	>12.5-17	7	*	*	*	*	*	*	*
119	Indeterminate	Adult								
120	Female	20-29	7	X	X	X	X	X	X	X
121	Male	18-24	6	X	X	X	X	X	X	!
122	N/A	6.5-7.5								
123	Male	18-24	6	X	X		X	X	X	X
124	N/A	6-8.5	7	X	X	X	X	X	X	X
125	Male	25-29	7	X	X	X	X	X	X	X
126	Probable Male	20-24								
127	Female	40-45	7	X	X	X	X	X	X	X
128	Female	Adult	7	X	X	X	X	X	X	X
129	N/A	6-8.5	7	*	*	*	*	*	*	*
130	Probable Male	18-24	7	X	X	X	X	X	X	X
131	Probable Male	20-35	7	X	X	X	X	X	X	X
132	N/A	12.5-15.5	2+			*	*	*	*	*
133	N/A	7-10	6	*	*	*	*	*	*	
134	Female	50+	7	X	X	X	X	X	X	X
135	Indeterminate	Adult	4			X	X	X	X	

136	Female	25-35	7	X	X	X	X	X	X	X
137	Male	25-35	7	X	X	X	X	X	X	X
138	N/A	1-2.5	1+	*	*	*	*	*	*	*
139	Male	18-24	7	X	X	X	X	X	X	X
140	N/A	6 Months-1	1+	*	*	*	*	*	*	*
141	Male	18-24	7	X	X	X	X	X	X	X
142	Male	30-50	7	X	X	X	X	X	X	X
143	Probable Female	25-35	6	X	X		X	X	X	X
144	Male	30-50	7	X	X	X	X	X	X	X
145	N/A	3-5.5	7	*	*	*	*	*	*	*
146	N/A	8-10.5	3+	*	*	*	*	*	*	*
147	Female	25-29	5			X	X	X	X	X
148	N/A	12.5-15.5	4	-	-	-	-	-	-	-
149	N/A	10-12.5	7	*	*	*	*	*	*	*
150	Female	20-29	7	X	X	X	X	X	X	X
151	Male	27-38	3			X	X	X		
152	N/A	5.5-6.5								
153	Probable Male	25-40	7	X	X	X	X	X	X	X
154	Female	25-35	5	X	X	X	X	X		
155	N/A	34 Gestational Weeks	7	X	X	X	X	X	X	X
156	Indeterminate	Adult								
157	N/A	3-3.5	7	*	*	*	*	*	*	*
158	Female	25-35	4		X	X			X	X
159	N/A	7-15	7	*	*	*	*	*	*	*
160	N/A	7-11.5	7	*	*	*	*	*	*	*
161	N/A	6 Months-1.5	7	*	*	*	*	*	*	*
162	N/A	3-7.5 Months	4				*	*	*	*
163	Female	20-25	7	X	X	X	X	X	X	X
164	Male	25-40	7	X	X	X	X	X	X	X
165	N/A	<1 Year	1+	*	*	*	*	*	*	*
166	Female	18-24	7	X	X	X	X	X	X	X
167	Indeterminate	Adult								
168	N/A	2.5	7	*	*	*	*	*	*	*
169	Indeterminate	Adult								
170	N/A	11-14.5	7	*	*	*	*	*	*	*
171	Male	19.5	7	*	*	*	*	*	*	*
172	N/A	6-10.5 Months	7	*	*	*	*	*	*	*

173	N/A	6-10.5 Months	7	*	*	*	*	*	*	*
174	N/A	2-3.5								
175	Probable Female	40-50	7	X	X	X	X	X	X	X
176	Female	18-24	7	X	X	X	X	X	X	X
177	N/A	1.5-2.5	7	*	*	*	*	*	*	*
178	Female	25-35	7	X	X	X	X	X	X	X
179	Indeterminate	Adult	3	-	-	-	-	-	-	-
180	N/A	2.5-3.5	7	*	*	*	*	*	*	*
181	N/A	Approximately 1-1.5	7	*	*	*	*	*	*	*
182	Female	Adult								
183	N/A	7.5-10.5 Months								
184	N/A	4.5-7.5 Months	1							*
185	N/A	1-2.5	4		*	*	*		*	
186	N/A	2-2.5	7	*	*	*	*	*	*	*
187	N/A	7-9.5								
188A	Female	35-45	6	X		X	X	X	X	X
188B	N/A	> or = 2.5	2+	-	-	-	-	-	-	-
189	Male	25-35								
190	Male	35-45	3	X	X	X				
191	Male	25-35	7	X	X	X	X	X	X	X
192	N/A	3.5-6.5	7	*	*	*	*	*	*	*
193	Female	25-35	6		X	X	X	X	X	X
194	Male	35-50	7	X	X	X	X	X	X	X

This table includes all individuals with at least one vertebrae present. Indeterminate indicates an adult skeleton lacking bones permitting the determination of sex. Unknown indicates bones permitting determination of sex are present, but ambiguous. "N/A" indicates infant or juvenile skeletons too young to show or have preserved bones determining sexual characteristics. Ages are in years unless noted otherwise. The total cervical lists the known number of vertebrae belonging to the individual skeleton because not all burial forms are clear on which specific vertebrae are present or the bones are too degraded to reveal their exact position in the vertebral column. In addition, some individuals may congenitally have extra vertebrae. When a "+" is listed with a number in the total column, this represents when the skeletal drawings do not correlate with the measurements recorded in which a bone is not colored in on the sheet, but a measurement exists for the bone. This implies at least one bone has survived and is thus marked as such. An "X" indicates presence, blank indicates absence of bone, and a "*" indicates the burial forms were unclear about the absolute presence of a bone and the determination needed to be estimated from the juvenile skeleton drawings on the burial form. Any of the cells marked with a "-" indicate the cells may be the vertebrae listed in the total, but the exact position of the specific bones are unknown. An "!" indicates a vertebra which has taken on the characteristics of a different type of vertebral bone.

Appendix Table V – Thoracic Vertebrae Bone Presence or Absence by Individual

Individual	Sex	Age	T Total	T 1	T 2	T 3	T 4	T 5	T 6	T 7	T 8	T 9	T 10	T 11	T 12
C11388	N/A	11.5-12.5	12	X	X	X	X	X	X	X	X	X	X	X	X
C11375	F	Adult	7	-	-	-	-	-	-	-	-	-	-	-	-
C11395A	F	30-35	4	X	X	X	X								
C11395B	I	35-40	8	-	-	-	-	-	-	-	-	-	-	-	-
C11396	F	18-20	9			X		X	X	X	X	X	X	X	X
C11551B	N/A	2.5-3.5	1+	*	*	*	*	*	*	*	*	*	*	*	*
C11560A	N/A	2.5	1+	*	*	*	*	*	*	*	*	*	*	*	*
C11577	N/A	9.5-10.5													
C11587	N/A	14.5	1	X											
C11594	I	18-22													
C11599	I	Adult													
C11616	I	Adult	1+	*	*	*	*	*	*	*	*	*	*	*	*
C11643A	PM	Adult													
C11643B	N/A	< 1													
C11663	M	50+													
C12705A	F	20-30	9	X	X	X	X	X	X	X	X	X			
C12705B	F	35-45	11	X	-	X	X	X	X	X	-	X	X	X	X
C12705C	N/A	7.5 Months	12	*	*	*	*	*	*	*	*	*	*	*	*
C12705D	N/A	>2.5-4.5	1+	*	*	*	*	*	*	*	*	*	*	*	*
C12748	N/A	5-6.5	7+	-	-	-	-	-	-	-	-	-	-	-	-
C12776	I	Adult													
C12803A	M	40-45	12	X	X	X	X	X	X	X	X	X	X	X	X
C12803B	N/A	5.5-6.5	7+	*	*	*	*	*	*	*	*	*	*	*	*
C12806	I	Adult	3	-	-	-	-	-	-	-	-	-	-	-	-
C12842	M	Adult													
C12880A	N/A	2.5-4.5	12	*	*	*	*	*	*	*	*	*	*	*	*
C12880B	N/A	2.5-6.5	10		*	*	*	*	*		*	*	*	*	
C13213	N/A	9.5-11.5	11		*	*	*	*	*	*	*	*	*	*	*
001	PM	15-23	10		-	-	-	-	-	-	-	-	-	-	-
002	PM	15-23	6							X	X	X	X	X	X
003	F	20-24	12	X	X	X	X	X	X	X	X	X	X	X	X
004	PM	17-23	12	X	X	X	X	X	X	X	X	X	X	X	X
005.1	F	30-39	12	X	X	X	X	X	X	X	X	X	X	X	X
005.2	F	18-24	12	X	X	X	X	X	X	X	X	X	X	X	X
005	I	18-24	12	X	X	X	X	X	X	X	X	X	X	X	X
006	N/A	>14													

007		*Number Not Included*													
008	M	18-23	9	-	-	-	-	-	-	-	-	-	-	-	-
009	M	18-24	2+							*	*	*	*	X	X
010	N/A	4.5-6.5	9	-	-	-	-	-	-	-	-	-	-	-	-
011		*Number Not Included*													
012	F	31-51	1	X											
013	N/A	9-15	12	X	X	X	X	X	X	X	X	X	X	X	X
014	I	Adult													
015	PF	40-50	8					X	X	X	X	X	X	X	X
016	I	Adult													
017	F	35-40	12	X	X	X	X	X	X	X	X	X	X	X	X
018	I	Adult													
019	F	Adult													
020	I	>18													
021A	M	20-35	3	-	-	-	-	-	-	-	-	-	-	-	-
022	F	18-23	1												X
023	M	25-33	1												X
024	M	15-20	12	*	*	*	*	*	*	*	*	*	*	*	*
025	N/A	4-6.5	6	-	-	-	-	-	-	-	-	-	-	-	-
026A	I	35-50+	12	X	X	X	X	X	X	X	X	X	X	X	X
026B	PF	20-25													
027A	I	35-50	3	-	-	-	-	-	-	-	-	-	-	-	X
027B	F	20-29	1	-	-	-	-	-	-	-	-	-	-	-	-
028	F	40-50	10	X	X	X	X	X	X	X	X	X			X
029	F	30-39													
030	N/A	14.5	9				*	*	*	*	*	*	*	*	*
031	N/A	12.5-15.5	10			*	*	*	*	*	*	*	*	*	*
032A	N/A	4-6	8	-	-	-	-	-	-	-	-	-	-	-	-
032B	I	18-20													
032C	N/A	12.5-15.5	12	X	X	X	X	X	X	X	X	X	X	X	X
033	M	20-24	12	X	X	X	X	X	X	X	X	X	X	X	X
034	F	35-45	9				X	X	X	X	X	X	X	X	X
035	PF	15-20	11		*	*	*	*	*	*	*	*	*	*	*
036	M	20-25	12	X	X	X	X	X	X	X	X	X	X	X	X
037	N/A	2-4.5	1+	*	*	*	*	*	*	*	*	*	*	*	*
038	N/A	12.5-15.5	12	*	*	*	*	*	*	*	*	*	*	*	*
039	M	35+	12	X	X	X	X	X	X	X	X	X	X	X	X

040	F	35-45	12	X	X	X	X	X	X	X	X	X	X	X	X
041	N/A	9-12.5	11		*	*	*	*	*	*	*	*	*	*	*
042	M	20-25	12	X	X	X	X	X	X	X	X	X	X	X	X
043	F	40+	12	X	X	X	X	X	X	X	X	X	X	X	X
044	N/A	1-2.5	11	-	-	-	-	-	-	-	-	-	-	-	-
045	N/A	6.5-9	12	X	X	X	X	X	X	X	X	X	X	X	X
046	N/A	6-7.5 Months													
047	F	20-25	8					X	X	X	X	X	X	X	X
048	F	35-39	12	X	X	X	X	X	X	X	X	X	X	X	X
049	F	35-45	12	X	X	X	X	X	X	X	X	X	X	X	X
050	N/A	4.5-6 Months	1+	*	*	*	*	*	*	*	*	*	*	*	*
051	N/A	10-15.5	12	X	X	X	X	X	X	X	X	X	X	X	X
052	F	Young Adult (Early-Mid 20s)	12	X	X	X	X	X	X	X	X	X	X	X	X
053	U	20-29	12	X	X	X	X	X	X	X	X	X	X	X	X
054	N/A	3 Months-1	12	*	*	*	*	*	*	*	*	*	*	*	*
055	F	35-50													
056	M	40+	12	X	X	X	X	X	X	X	X	X	X	X	X
057	PM	16-20	12	X	X	X	X	X	X	X	X	X	X	X	X
058	M	40-49	12	X	X	X	X	X	X	X	X	X	X	X	X
059	M	35-59	12	X	X	X	X	X	X	X	X	X	X	X	X
060	N/A	1.5	12	*	*	*	*	*	*	*	*	*	*	*	*
061	F	25-35	12	X	X	X	X	X	X	X	X	X	X	X	X
062A	M	20-29	12	X	X	X	X	X	X	X	X	X	X	X	X
062B	F	40-50	12	X	X	X	X	X	X	X	X	X	X	X	X
062C	N/A	>3.5-6.5	3	-	-	-	-	-	-	-	-	-	-	-	-
063	F	40-50	10	X	X	X	X	X	X	X	X	X	X		
064	N/A	Approximately 12	11		*	*	*	*	*	*	*	*	*	*	*
065	F	30-39	2	-	-	-	-	-	-	-	-	-	-	-	-
066	M	20-29	12	X	X	X	X	X	X	X	X	X	X	X	X
067A	N/A	9-12.5	12	X	X	X	X	X	X	X	X	X	X	X	X
067B	N/A	4.5 Months	1+	*	*	*	*	*	*	*	*	*	*	*	*
067C	F	20-24	7						X	X	X	X	X	X	X
067D	M	Older Adult	4		-	-	-	-	-	-	-	-	-	-	
068	F	25-35	12	X	X	X	X	X	X	X	X	X	X	X	X
069A	F	40-49	12	X	X	X	X	X	X	X	X	X	X	X	X
069B	N/A	5.5-11.5	4	-	-	-	-	-	-	-	-	-	-	-	-

070	I	Adult	5	-	-	X	X	X	-	-	X	-		-	X
071	M	35-45	12	X	X	X	X	X	X	X	X	X	X	X	X
072	F	30-39	12	X	X	X	X	X	X	X	X	X	X	X	X
073	N/A	2-3.5	12	*	*	*	*	*	*	*	*	*	*	*	*
074	F	40-50	12	X	X	X	X	X	X	X	X	X	X	X	X
075	F	30-40	4	-	-	-	-	-	-	-	-	-	-	-	-
076	N/A	3-4.5	12	*	*	*	*	*	*	*	*	*	*	*	*
077	N/A	4-6.5	1+	*	*	*	*	*	*	*	*	*	*	*	*
078	N/A	10.5 Months-1.5	1+	*	*	*	*	*	*	*	*	*	*	*	*
079	F	25-35	12	X	X	X	X	X	X	X	X	X	X	X	X
080	N/A	<10													
081	N/A	22-25 Gestational Weeks													
082	F	Adult	9	-	-	-	-	-	-	-	-	-	-	-	-
083	F	30-39	12	X	X	X	X	X	X	X	X	X	X	X	X
084	M	25-35	12	X	X	X	X	X	X	X	X	X	X	X	X
085	F	Adult	12	X	X	X	X	X	X	X	X	X	X	X	X
086	N/A	9-15.5	12	*	*	*	*	*	*	*	*	*	*	*	*
087	N/A	1-2.5	12	*	*	*	*	*	*	*	*	*	*	*	*
088	N/A	1-1.5	12	*	*	*	*	*	*	*	*	*	*	*	*
089	F	35-45	7	-	-	-	-	-	-	-	-	-	-	-	-
090	F	25-35	12	X	X	X	X	X	X	X	X	X	X	X	X
091	N/A	2-3.5	12	X	X	X	X	X	X	X	X	X	X	X	X
092	M	25-35	12	X	X	X	X	X	X	X	X	X	X	X	X
093	F	35-50	12	X	X	X	X	X	X	X	X	X	X	X	X
094	N/A	Approximately 1-2.5	1+	*	*	*	*	*	*	*	*	*	*	*	*
095	PF	20-25	10		-	-	-	-	-	-	-	-	-	-	-
096	PM	Adult	12	X	X	X	X	X	X	X	X	X	X	X	X
097	N/A	2-3.5	12	*	*	*	*	*	*	*	*	*	*	*	*
098	N/A	1.5	12	*	*	*	*	*	*	*	*	*	*	*	*
099	M	25-30	12	X	X	X	X	X	X	X	X	X	X	X	X
100	F	25-35	12	X	X	X	X	X	X	X	X	X	X	X	X
101	M	30-50	12	X	X	X	X	X	X	X	X	X	X	X	X
102	M	35-45	12	X	X	X	X	X	X	X	X	X	X	X	X
103	F	20-24	8	-	-	-	-	-	-	-	-	X	X	X	X
104	N/A	4-6.5	12	X	X	X	X	X	X	X	X	X	X	X	X
105	N/A	>16.5													

106	M	35-45	12	X	X	X	X	X	X	X	X	X	X	X	X
107	M	25-35	12	X	X	X	X	X	X	X	X	X	X	X	X
108	F	25-35	12	X	X	X	X	X	X	X	X	X	X	X	X
109	N/A	7-9.5	12	X	X	X	X	X	X	X	X	X	X	X	X
110	F	25-35	12	X	X	X	X	X	X	X	X	X	X	X	X
111	N/A	9-12.5													
112	N/A	1.5-2.5	12	*	*	*	*	*	*	*	*	*	*	*	*
113	F	20-25	12	X	X	X	X	X	X	X	X	X	X	X	X
114	F	35-45	12	X	X	X	X	X	X	X	X	X	X	X	X
115	N/A	23 Gestational Weeks	1+	*	*	*	*	*	*	*	*	*	*	*	*
116	N/A	2-4.5	1+	*	*	*	*	*	*	*	*	*	*	*	*
117	M	30-50	1										-	-	
118	N/A	>12.5-17	3+	*	*	*	*	*	*	*	*	*	*	*	*
119	I	Adult													
120	F	20-29	12	X	X	X	X	X	X	X	X	X	X	X	X
121	M	18-24	13	X	X	X	X	X	X	X	X	X	X	X	X
122	N/A	6.5-7.5													
123	M	18-24	12	X	X	X	X	X	X	X	X	X	X	X	X
124	N/A	6-8.5	13	X	X	X	X	X	X	X	X	X	X	X	X
125	M	25-29	12	X	X	X	X	X	X	X	X	X	X	X	X
126	PM	20-24	6							X	X	X	X	X	X
127	F	40-45	12	X	X	X	X	X	X	X	X	X	X	X	X
128	F	Adult	12	X	X	X	X	X	X	X	X	X	X	X	X
129	N/A	6-8.5	11		*	*	*	*	*	*	*	*	*	*	*
130	PM	18-24	12	X	X	X	X	X	X	X	X	X	X	X	X
131	PM	20-35	12	X	X	X	X	X	X	X	X	X	X	X	X
132	N/A	12.5-15.5	12	*	*	*	*	*	*	*	*	*	*	*	*
133	N/A	7-10	11		*	*	*	*	*	*	*	*	*	*	*
134	F	50+	12	X	X	X	X	X	X	X	X	X	X	X	X
135	I	Adult	11	X	X		X	X	X	X	X	X	X	X	X
136	F	25-35	4		X			X	X						X
137	M	25-35	12	X	X	X	X	X	X	X	X	X	X	X	X
138	N/A	1-2.5	1+	*	*	*	*	*	*	*	*	*	*	*	*
139	M	18-24	12	X	X	X	X	X	X	X	X	X	X	X	X
140	N/A	6 Months-1	11		*	*	*	*	*	*	*	*	*	*	*
141	M	18-24	12	X	X	X	X	X	X	X	X	X	X	X	X
142	M	30-50	12	X	X	X	X	X	X	X	X	X	X	X	X
143	PF	25-35	12	X	X	X	X	X	X	X	X	X	X	X	X

144	M	30-50	12	X	X	X	X	X	X	X	X	X	X	X	X
145	N/A	3-5.5	12	*	*	*	*	*	*	*	*	*	*	*	*
146	N/A	8-10.5	11		*	*	*	*	*	*	*	*	*	*	*
147	F	25-29	10		X	X	X	X	X	X	X	X	X	X	
148	N/A	12.5-15.5	12	X	X	X	X	X	X	X	X	X	X	X	X
149	N/A	10-12.5	12	*	*	*	*	*	*	*	*	*	*	*	*
150	F	20-29	12	X	X	X	X	X	X	X	X	X	X	X	X
151	M	27-38	12	X	X	X	X	X	X	X	X	X	X	X	X
152	N/A	5.5-6.5													
153	PM	25-40	12	X	X	X	X	X	X	X	X	X	X	X	X
154	F	25-35	12	X	X	X	X	X	X	X	X	X	X	X	X
155	N/A	34 Gestational Weeks	12	X	X	X	X	X	X	X	X	X	X	X	X
156	I	Adult													
157	N/A	3-3.5	9				*	*	*	*	*	*	*	*	*
158	F	25-35	12	X	X	X	X	X	X	X	X	X	X	X	X
159	N/A	7-15	12	*	*	*	*	*	*	*	*	*	*	*	*
160	N/A	7-11.5	12	*	*	*	*	*	*	*	*	*	*	*	*
161	N/A	6 Months-1.5	12	*	*	*	*	*	*	*	*	*	*	*	*
162	N/A	3-7.5 Months	12	*	*	*	*	*	*	*	*	*	*	*	*
163	F	20-25	7	X	X	X	X	X	X						X
164	M	25-40	12	X	X	X	X	X	X	X	X	X	X	X	X
165	N/A	<1 Year	6	*	*	*	*	*							
166	F	18-24	12	X	X	X	X	X	X	X	X	X	X	X	X
167	I	Adult													
168	N/A	2.5	12	*	*	*	*	*	*	*	*	*	*	*	*
169	I	Adult													
170	N/A	11-14.5	11		*	*	*	*	*	*	*	*	*	*	*
171	M	19.5	12	*	*	*	*	*	*	*	*	*	*	*	*
172	N/A	6-10.5 Months	12	*	*	*	*	*	*	*	*	*	*	*	*
173	N/A	6-10.5 Months	12	*	*	*	*	*	*	*	*	*	*	*	*
174	N/A	2-3.5													
175	PF	40-50	12	X	X	X	X	X	X	X	X	X	X	X	X
176	F	18-24	12	X	X	X	X	X	X	X	X	X	X	X	X
177	N/A	1.5-2.5	12	*	*	*	*	*	*	*	*	*	*	*	*
178	F	25-35	12	X	X	X	X	X	X	X	X	X	X	X	X
179	I	Adult	2	-	-	-	-	-	-	-	-	-	-	-	-
180	N/A	2.5-3.5	12	*	*	*	*	*	*	*	*	*	*	*	*
181	N/A	Approximately 1-1.5	12	*	*	*	*	*	*	*	*	*	*	*	*

182	F	Adult	2	X	X									
183	N/A	7.5-10.5 Months												
184	N/A	4.5-7.5 Months	12	*	*	*	*	*	*	*	*	*	*	*	*
185	N/A	1-2.5	8	*			*	*	*		*	*		*	*
186	N/A	2-2.5	1+	*	*	*	*	*	*	*	*	*	*	*	*
187	N/A	7-9.5	12	*	*	*	*	*	*	*	*	*	*	*	*
188A	F	35-45	12	X	X	X	X	X	X	X	X	X	X	X	X
188B	N/A	> or = 2.5	4+	-	-	-	-	-	-	-	-	-	-	-	-
189	M	25-35													
190	M	35-45	12	X	X	X	X	X	X	X	X	X	X	X	X
191	M	25-35	12	X	X	X	X	X	X	X	X	X	X	X	X
192	N/A	3.5-6.5	11		*	*	*	*	*	*	*	*	*	*	*
193	F	25-35	12	X	X	X	X	X	X	X	X	X	X	X	X
194	M	35-50	12	X	X	X	X	X	X	X	X	X	X	X	X

This table includes all individuals with at least one vertebrae present. The sexes are indicated by "F" for female, "M" for male, "PF" for probable female, "PM" for probable male, "I" for indeterminate meaning the bones necessary to sex the adult individual are not present, "U" for unknown representing an ambiguous skeleton, and "N/A" for not applicable indicating the individual is too young to sex. Ages are in years unless noted otherwise. The total thoracic lists the known number of vertebrae belonging to the individual skeleton because not all burial forms are clear on which specific vertebrae are present or the bones are too degraded to reveal their exact position in the vertebral column. In addition, some individuals may congenitally have extra vertebrae. When a "+" indicates a number in the total column, this represents when the skeletal drawings do not correlate with the measurements recorded in which a bone is not colored in on the sheet, but a measurement exists for the bone. This implies at least one bone has survived and is thus marked as such. An "X" indicates presence, blank indicates absence of bone, and a "*" indicates the burial forms were unclear about the absolute presence of the bone and the determination needed to be estimated from the juvenile skeleton drawings on the burial form. Any of the cells marked with a "-" indicate the cells may be the vertebrae listed in the total, but the exact position of the specific bones are unknown.

Appendix Table VI – Lumbar Vertebrae Bone Presence or Absence by Individual

Individual	Sex	Age	L Total	L1	L2	L3	L4	L5
C11388	N/A	11.5-12.5	5	X	X	X	X	X
C11375	Female	Adult	5	X	X	X	X	X
C11395A	Female	30-35						
C11395B	Indeterminate	35-40	3	-	-	-	-	-
C11396	Female	18-20	5	X	X	X	X	X
C11551B	N/A	2.5-3.5	1+	*	*	*	*	*
C11560A	N/A	2.5	1+	*	*	*	*	*
C11577	N/A	9.5-10.5	1	*				
C11587	N/A	14.5						
C11594	Indeterminate	18-22						
C11599	Indeterminate	Adult						
C11616	Indeterminate	Adult	1+	*	*	*	*	*
C11643A	Probable Male	Adult						
C11643B	N/A	< 1						
C11663	Male	50+						
C12705A	Female	20-30	4		X	X	X	X
C12705B	Female	35-45	5	X	X	X	X	X
C12705C	N/A	7.5 Months	5	*	*	*	*	*
C12705D	N/A	>2.5-4.5	1+	*	*	*	*	*
C12748	N/A	5-6.5	1+	*	*	*	*	*
C12776	Indeterminate	Adult						
C12803A	Male	40-45	5	X	X	X	X	X
C12803B	N/A	5.5-6.5	1+	*	*	*	*	*
C12806	Indeterminate	Adult	1	-	-	-	-	-
C12842	Male	Adult	1		X			
C12880A	N/A	2.5-4.5	5	*	*	*	*	*
C12880B	N/A	2.5-6.5	5	*	*	*	*	*
C13213	N/A	9.5-11.5						
001	Probable Male	15-23	5	X	X	X	X	X
002	Probable Male	15-23	5	X	X	X	X	X
003	Female	20-24	5	X	X	X	X	X
004	Probable Male	17-23	5	X	X	X	X	X

005.1	Female	30-39	5	X	X	X	X	X
005.2	Female	18-24	5	X	X	X	X	X
005	Indeterminate	18-24	5	X	X	X	X	X
006	N/A	>14	1					*
007		*Number Not Included*						
008	Male	18-23						
009	Male	18-24	5	X	X	*	*	X
010	N/A	4.5-6.5	3	-	-	-	-	-
011		*Number Not Included*						
012	Female	31-51						
013	N/A	9-15	5	X	X	X	X	X
014	Indeterminate	Adult	1	-	-	-	-	-
015	Probable Female	40-50	5	X	X	X	X	X
016	Indeterminate	Adult						
017	Female	35-40	5	X	X	X	X	X
018	Indeterminate	Adult						
019	Female	Adult						
020	Indeterminate	>18						
021A	Male	20-35	2				X	X
022	Female	18-23	5	X	X	X	X	X
023	Male	25-33	5	X	X	X	X	X
024	Male	15-20	5	*	*	*	*	*
025	N/A	4-6.5	5	X	X	X	X	X
026A	Indeterminate	35-50+	4	X	X	-	-	-
026B	Probable Female	20-25						
027A	Indeterminate	35-50	5	X	X	X	X	X
027B	Female	20-29	5	X	X	X	X	X
028	Female	40-50	5	X	X	X	X	X
029	Female	30-39	3			X	X	X
030	N/A	14.5	5	*	*	*	*	*
031	N/A	12.5-15.5	5	*	*	*	*	*
032A	N/A	4-6						
032B	Indeterminate	18-20	4	*	*	*	*	
032C	N/A	12.5-15.5	1	-	-	-	-	-
033	Male	20-24	4	X	X	X	X	
034	Female	35-45	5	X	X	X	X	X

035	Probable Female	15-20	5	*	*	*	*	*
036	Male	20-25	5	X	X	X	X	X
037	N/A	2-4.5	1+	*	*	*	*	*
038	N/A	12.5-15.5	5	*	*	*	*	*
039	Male	35+	5	X	X	X	X	X
040	Female	35-45	5	X	X	X	X	X
041	N/A	9-12.5	5	*	*	*	*	X
042	Male	20-25	5	X	X	X	X	X
043	Female	40+	5	X	X	X	X	X
044	N/A	1-2.5	3	-	-	-	-	-
045	N/A	6.5-9	5	X	X	X	X	X
046	N/A	6-7.5 Months						
047	Female	20-25	4	X	X	X	X	
048	Female	35-39	5	X	X	X	X	X
049	Female	35-45	5	X	X	X	X	X
050	N/A	4.5-6 Months	1+	*	*	*	*	*
051	N/A	10-15.5	5	X	X	X	X	X
052	Female	Young Adult (Early-Mid 20s)	5	X	X	X	X	X
053	Unknown	20-29	5	X	X	X	X	X
054	N/A	3 Months-1	5	*	*	*	*	*
055	Female	35-50	2	-	-	-	-	-
056	Male	40+	5	X	X	X	X	X
057	Probable Male	16-20	5	X	X	X	X	X
058	Male	40-49	5	X	X	X	X	X
059	Male	35-59	5	X	X	X	X	X
060	N/A	1.5	5	*	*	*	*	*
061	Female	25-35	5	X	X	X	X	X
062A	Male	20-29	5	X	X	X	X	X
062B	Female	40-50	5	X	X	X	X	X
062C	N/A	>3.5-6.5	4	-	-	-	X	X
063	Female	40-50	4		X	X	X	X
064	N/A	Approximately 12	5	*	*	*	*	*
065	Female	30-39	5	X	X	X	X	X
066	Male	20-29	5	X	X	X	X	X
067A	N/A	9-12.5	5	X	X	X	X	X
067B	N/A	4.5 Months	1+	*	*	*	*	*

067C	Female	20-24	2	X	X			
067D	Male	Older Adult	3			X	X	X
068	Female	25-35	5	X	X	X	X	X
069A	Female	40-49	5	X	X	X	X	X
069B	N/A	5.5-11.5	2	-	-	-	-	-
070	Indeterminate	Adult	1	X				
071	Male	35-45	5	X	X	X	X	X
072	Female	30-39	5	X	X	X	X	X
073	N/A	2-3.5	5	*	*	*	*	*
074	Female	40-50	5	X	X	X	X	X
075	Female	30-40	3	-	-	-	-	
076	N/A	3-4.5	5	*	*	*	*	*
077	N/A	4-6.5	1+	*	*	*	*	*
078	N/A	10.5 Months-1.5	1+	*	*	*	*	X
079	Female	25-35	5	X	X	X	X	X
080	N/A	<10						
081	N/A	22-25 Gestational Weeks						
082	Female	Adult	2	-	-	-	-	-
083	Female	30-39	5	X	X	X	X	X
084	Male	25-35	5	X	X	X	X	X
085	Female	Adult	5	X	X	X	X	X
086	N/A	9-15.5	5	*	*	*	*	*
087	N/A	1-2.5	5	*	*	*	*	*
088	N/A	1-1.5	5	*	*	*	*	*
089	Female	35-45	5	X	X	X	X	X
090	Female	25-35	5	X	X	X	X	X
091	N/A	2-3.5	5	X	X	X	X	X
092	Male	25-35	5	X	X	X	X	X
093	Female	35-50	5	X	X	X	X	X
094	N/A	Approximately 1-2.5	1+	*	*	*	*	*
095	Probable Female	20-25	5	X	X	X	X	X
096	Probable Male	Adult	5	X	X	X	X	X
097	N/A	2-3.5	4	*	*	*	*	
098	N/A	1.5	5	*	*	*	*	*
099	Male	25-30	5	X	X	X	X	X
100	Female	25-35	5	X	X	X	X	X

101	Male	30-50	5	X	X	X	X	X
102	Male	35-45	5	X	X	X	X	X
103	Female	20-24	5	X	X	X	X	X
104	N/A	4-6.5	5	X	X	X	X	X
105	N/A	>16.5						
106	Male	35-45	5	X	X	X	X	X
107	Male	25-35	5	X	X	X	X	X
108	Female	25-35	5	X	X	X	X	X
109	N/A	7-9.5	5	X	X	X	X	X
110	Female	25-35	5	X	X	X	X	X
111	N/A	9-12.5						
112	N/A	1.5-2.5	5	*	*	*	*	*
113	Female	20-25	5	X	X	X	X	X
114	Female	35-45	5	X	X	X	X	X
115	N/A	23 Gestational Weeks	1+	*	*	*	*	*
116	N/A	2-4.5	1+	*	*	*	*	*
117	Male	30-50						
118	N/A	>12.5-17	2+	*	*	*	*	*
119	Indeterminate	Adult						
120	Female	20-29	5	X	X	X	X	X
121	Male	18-24	5	X	X	X	X	X
122	N/A	6.5-7.5						
123	Male	18-24	5	X	X	X	X	X
124	N/A	6-8.5	4	!	X	X	X	X
125	Male	25-29	5	X	X	X	X	X
126	Probable Male	20-24	5	X	X	X	X	X
127	Female	40-45	5	X	X	X	X	X
128	Female	Adult	3	X	X	X		
129	N/A	6-8.5	5	*	*	*	*	*
130	Probable Male	18-24	5	X	X	X	X	X
131	Probable Male	20-35	5	X	X	X	X	X
132	N/A	12.5-15.5	3+	*	*	*		
133	N/A	7-10	5	*	*	*	*	*
134	Female	50+	5	X	X	X	X	X
135	Indeterminate	Adult	5	X	X	X	X	X
136	Female	25-35	3	X	X			X

137	Male	25-35	5	X	X	X	X	X
138	N/A	1-2.5	1+	*	*	*	*	*
139	Male	18-24	5	X	X	X	X	X
140	N/A	6 Months-1	5	*	*	*	*	*
141	Male	18-24	5	X	X	X	X	X
142	Male	30-50	6	X	X	X	X	X
143	Probable Female	25-35	5	X	X	X	X	X
144	Male	30-50	3	X	X	X		
145	N/A	3-5.5	5	*	*	*	*	*
146	N/A	8-10.5	5	*	*	*	*	*
147	Female	25-29	1	X				
148	N/A	12.5-15.5	3	-	-	-	-	-
149	N/A	10-12.5	5	*	*	*	*	*
150	Female	20-29	5	X	X	X	X	X
151	Male	27-38	5	X	X	X	X	X
152	N/A	5.5-6.5						
153	Probable Male	25-40	5	X	X	X	X	X
154	Female	25-35	5	X	X	X	X	X
155	N/A	34 Gestational Weeks	5	X	X	X	X	X
156	Indeterminate	Adult						
157	N/A	3-3.5	5	*	*	*	*	*
158	Female	25-35	5	X	X	X	X	X
159	N/A	7-15	5	*	*	*	*	*
160	N/A	7-11.5	5	*	*	*	*	*
161	N/A	6 Months-1.5	5	*	*	*	*	*
162	N/A	3-7.5 Months	5	*	*	*	*	*
163	Female	20-25	1				X	
164	Male	25-40	5	X	X	X	X	X
165	N/A	<1 Year	1+	*	*	*	*	*
166	Female	18-24	5	X	X	X	X	X
167	Indeterminate	Adult						
168	N/A	2.5	5	*	*	*	*	*
169	Indeterminate	Adult						
170	N/A	11-14.5	5	*	*	*	*	*
171	Male	19.5	5	*	*	*	*	*
172	N/A	6-10.5 Months	5	*	*	*	*	*
173	N/A	6-10.5 Months	5	*	*	*	*	*

174	N/A	2-3.5						
175	Probable Female	40-50	5	X	X	X	X	X
176	Female	18-24	5	X	X	X	X	X
177	N/A	1.5-2.5	5	*	*	*	*	*
178	Female	25-35	5	X	X	X	X	X
179	Indeterminate	Adult	5	X	X	X	X	X
180	N/A	2.5-3.5	5	*	*	*	*	*
181	N/A	Approximately 1-1.5	5	*	*	*	*	*
182	Female	Adult	3	X	X	X		
183	N/A	7.5-10.5 Months						
184	N/A	4.5-7.5 Months	1	*				
185	N/A	1-2.5	5	*	*	*	*	*
186	N/A	2-2.5	1+	*	*	*	*	*
187	N/A	7-9.5	5	*	*	*	*	*
188A	Female	35-45	5	X	X	X	X	X
188B	N/A	> or = 2.5						
189	Male	25-35						
190	Male	35-45	5	X	X	X	X	X
191	Male	25-35	5	X	X	X	X	X
192	N/A	3.5-6.5	5	*	*	*	*	*
193	Female	25-35	4	X	X	X		X
194	Male	35-50	5	X	X	X	X	X

This table includes all individuals with at least one vertebrae present. Indeterminate indicates an adult skeleton lacking bones permitting the determination of sex. Unknown indicates bones permitting determination of sex are present, but ambiguous. "N/A" indicates infant or juvenile skeletons too young to show or have preserved bones determining sexual characteristics. Ages are in years unless noted otherwise. The total lumbar lists the known number of vertebrae belonging to the individual skeleton because not all burial forms are clear on which specific vertebrae are present or the bones are too degraded to reveal their exact position in the vertebral column. In addition, some individuals may congenitally have extra vertebrae. When a "+" indicates a number in the total column, this represents when the skeletal drawings do not correlate with the measurements recorded in which a bone is not colored in on the sheet, but a measurement exists for the bone. This implies at least one bone has survived and is thus marked as such. An "X" indicates presence, blank indicates absence of bone, and a "*" indicates the burial forms were unclear about the absolute presence of the bone and the determination needed to be estimated from the juvenile skeleton drawings on the burial form. Any of the cells marked with a "-" indicate the cells may be the vertebrae listed in the total, but the exact position of the specific bones are unknown. An "!" indicates a vertebra which has taken on the characteristics of a different type of vertebral bone.

Appendix Table VII – Ulnae Fractures by Individual

Individual	Sex	Age	Side	Location of Trauma
C12803A	Male	40-45	Left	Distal
021A	Male	20-35	Left	Distal
026A	Indeterminate	35-50+	Left	Distal
034	Female	35-45	Right	Distal
040	Female	35-45	Right	Slightly Below Midshaft
043	Female	40+	Right	Distal
055	Female	35-50	Left	Distal
059	Male	35-39	Left	Distal
065	Female	30-39	Left	Distal
069A	Female	40-49	Right	Distal
070	Indeterminate	Adult	Right	Half Way between Midshaft and Distal End
071	Male	35-45	Left	Distal
074	Female	40-50	Left	1/3 Proximal End
083	Female	30-39	Right	Distal
089	Female	35-45	Left	Distal
110	Female	25-35	Left	Midshaft
127	Female	40-45	Right	Distal
131	Probable Male	20-35	Left	Distal
179	Indeterminate	Adult	Left	Distal
188A	Female	35-45	Right	Distal
191	Male	25-35	Left	Distal
194	Male	35-50	Left	Distal
194	Male	35-50	Right	Distal

Indeterminate indicates an adult skeleton lacking bones permitting the determination of sex.
Ages are in years unless noted otherwise.

Appendix Table VIII – Compression Fractures of the Vertebrae by Individual

Individual	Sex	Age	VT	CT	C1	C2	C3	C4	C5	C6	C7	TT	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	LT	L1	L2	L3	L4	L5
C11396	F	18-20	4									2	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
C12705A	F	20-30	1									1									X									
C12806	I	A	1																						1	-	-	-	-	-
C12842	M	A	1																						1		X			
005	I	18-24	3																						3		X	X	X	
015	PF	40-50	2	2		X	X																							
027A	I	35-50	1																						1				X	
028	F	40-50	1																						1					X
043	F	40+	1																						1	X				
057	PM	16-20	2									1		X											1					X
062B	F	40-50	2									2										X	X							
068	F	25-35	1																						1				X	
069A	F	40-49	4									4	X									X	X	X						

071	M	35-45	3								3	X	X	X															
075	F	30-40	1																					1				X	
079	F	25-35	2																					2				X	X
083	F	30-39	3	2				X	X															1			X		
090	F	25-35	1																					1			X		
092	M	25-35	2								2	X	X																
120	F	20-29	3								3	X			X	X													
131	PM	20-35	11	7	X	X	X	X	X	X	X	1												X	3	X	X	X		
134	F	50+	3									1												X	2	X	X			
153	PM	25-40	4								3		X					X		X				1					X
164	M	25-40	5								4			X	X	X	X							1			X		
175	PF	40-50	2								2	X	X																
176	F	18-24	2								2	*	X	X															
188A	F	35-45	1								1		X																
191	M	25-35	2																					2			X	X	

Female and male are indicated by “F” and “M”. “PM” indicates probable male whereas “PF” indicates probable female. Indeterminate indicated by an “I” is an adult skeleton lacking bones permitting the determination of sex. “U” stands for unknown and indicates bones permitting determination of sex are present, but ambiguous. Ages are in years unless noted otherwise. “A” indicates adult. “VT” indicates total vertebrae showing compression fractures by individual. “CT” indicates cervical vertebrae total, “TT” signifies thoracic vertebrae total, and “LT” indicates lumbar total. A “-” indicates the possible presence of a compression fracture in which the total affected vertebrae are known, but the exact position could not be determined. A “*” indicates a possible compression fracture noted on the burial forms.

Appendix Table IX – Schmorl's Nodes on the Cervical Vertebrae by Individual

Individual	Sex	Age	Cervical Total	Cervical Total Superior	Cervical Total Inferior	C1	C2	C3	C4	C5	C6	C7
096	PM	Adult	1		1							1

"PM" signifies a probable male. The age estimate "adult" was the word utilized by the Amarna osteology team instead of a numerical estimate or a term used in Buikstra and Ubelaker (1994) and thus not matching the life stages determined for this analysis.

Appendix Table X – Total of the Thoracic and Lumbar Schmorl's Nodes by Individual

Individual	Sex	Age	Total SN	T Total	T Total S	T Total I	L Total	L Total S	L Total I
C11395B	Indeterminate	35-40	1	1	-	-			
C11396	Female	18-20	1	1	-	-			
C12705A	Female	20-30	1	1		1			
C12705B	Female	35-45	9	7	2	5	2	2	
C12806	Indeterminate	Adult	1	1	-	-			
001	Probable Male	15-23	2	1		1	1	1	
005.1	Female	30-39	13	6	2	4	7	5	2
005.2	Female	18-24	4	4	1	3			
009	Male	18-24	4	3	1	2	1	1	
021A	Male	20-35	3				3	2	1
026A	Indeterminate	35-50+	4	4		4			
028	Female	40-50	4	4	-	-			
043	Female	40+	19	13	4	9	6	2	4
057	Probable Male	16-20	14	12	4	8	2	1	1
058	Male	40-49	13	7	3	4	6	4	2
062B	Female	40-50	1	1		1			
065	Female	30-39	5				5	5	
067D	Male	Older Adult	3	3		3			
069A	Female	40-49	3	3	2	1			
071	Male	35-45	22	9	4	5	13	8	5
074	Female	40-50	2				2		2
079	Female	25-35	5	4		4	1	1	
084	Male	25-35	4	3		3	1	1	
092	Male	25-35	3	3	1	2			
093	Female	35-50	2	1		1	1		1
095	Probable Female	20-25	5	1		1	4	3	1
096	Probable Male	Adult	5	3	1	2	1		1
099	Male	25-30	22	14	6	8	8	4	4
101	Male	30-50	1	1	1				

103	Female	20-24	2				2	1	1
107	Male	25-35	6	3	1	2	3	2	1
113	Female	20-25	1				1	1	
120	Female	20-29	21	16	4	12	5	2	3
126	Probable Male	20-24	11	11	6	5			
127	Female	40-45	20	15	5	10	5	3	2
131	Probable Male	20-35	1				1		1
137	Male	25-35	3	1		2	1	1	
139	Male	18-24	2				2	2	
142	Male	30-50	1				1	1	
143	Probable Female	25-35	2	2	1	1			
144	Male	30-50	10	5	1	4	5	2	3
151	Male	27-38	1	1		1			
154	Female	25-35	3				3	2	1
158	Female	25-35	3	1		1	2		2
164	Male	25-40	1	1	1				
166	Female	18-24	1				1	1	
175	Probable Female	40-50	1	1		1			
176	Female	18-24	4	2		2	2	2	
178	Female	25-35	1	1	1				
179	Indeterminate	Adult	1				1	1	
190	Male	35-45	20	16	8	8	4	3	1
191	Male	25-35	1				1	-	-
193	Female	25-35	1	1		1			

This table lists any individual who has a Schmorl's node on the thoracic or lumbar vertebrae. Indeterminate indicates an adult skeleton lacking bones permitting the determination of sex. Unknown indicates bones permitting determination of sex are present but ambiguous. "N/A" indicates infant or juvenile skeletons too young to show or have preserved bones determining sexual characteristics. Ages are in years unless noted otherwise. The age estimate "adult" and "older adult" were the words utilized by the Amarna osteology team instead of a numerical estimate or a term used in Buikstra and Ubelaker (1994) and thus not matching the life stages determined for this analysis. "SN" indicates Schmorl's node. "S" and "I" indicate superior and inferior surfaces for the location of the Schmorl's nodes. A "-" indicates the possible presence of a Schmorl's node in which the total are known, but the exact position could not be determined. A "*" indicates a discrepancy in the burial forms so the number or position of the Schmorl's node on the vertebra is an estimate.

Appendix Table XI – Schmorl's Nodes on the Thoracic Vertebrae by Individual

Individual	Sex	Age	TT	T1S	T1I	T1S	T1I	T2S	T2I	T3S	T3I	T4S	T4I	T5S	T5I	T6S	T6I	T7S	T7I	T8S	T8I	T9S	T9I	T10S	T10I	T11S	T11I	T12S	T12I
C11395B	I	35-40	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C11396	F	18-20	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C12705A	F	20-30	1		1																		1						
C12705B	F	35-45	7	2	5																1		1		1	1	1	1	1
C12806	I	A	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
001	PM	15-23	1		1																						1		
05.1	F	30-39	6	2	4														1			1			1		1	1	1
05.2	F	18-24	4	1	3												1		1	1	1								
009	M	18-24	3	1	2																						1	1	1
021A	M	20-35																											
026A	I	35-50+	4		4		-		-		-		-		-		-		-		-		-		-		-		-
028	F	40-50	4	-	-													-	-	-	-	-	-	-	-				
043	F	40+	13	4	9		1*							1	1		1		1	1	1	1	1		1		1	1	1
057	PM	16-	12	4	8										1		1	1	1		1	1	1		1	1	1	1	1

		20																											
058	M	40-49	7	3	4								1	1		1	1				1	1	1						
062B	F	40-50	1		1														1										
065	F	30-39																											
067D	M	OA	3		3				-		-		-		-		-		-		-		-		-		-		
069A	F	40-49	3	2	1																				1	1		1	
071	M	35-45	9	4	5													1	1			1	1	1			2	1	1
074	F	40-50																											
079	F	25-35	4		4												1		1						1				1
084	M	25-35	3		3																						2		1
092	M	25-35	3	1	2														1	1	1								
093	F	35-50	1		1																								1
095	PF	20-25	1		1																						1		
096	PM	A	3	1	2															1	1								1
099	M	25-30	14	6	8										1	1	1		1	1	1	1	1	1	1	1	1	1	1
101	M	30-50	1	1																			1						
103	F	20-24																											

107	M	25-35	3	1	2														1		1							1	
113	F	20-25																											
120	F	20-29	16	4	12												1	1	1		1		2		3	1	2	2	2
126	PM	20-24	11	6	5													1	1	1	1	1	1	1	1	1	1	1	
127	F	40-45	15	5	10						1	1	1		1		1	1	1		1		1	1	1	1	1	1	1
131	PM	20-35																											
137	M	25-35	2		2												1		1										
139	M	18-24																											
142	M	30-50																											
143	PF	25-35	2	1	1														1					1					
144	M	30-50	5	1	4																		1		1		1	1	1
151	M	27-38	1		1																		1						
154	F	25-35																											
158	F	25-35	1		1																						1		
164	M	25-40	1	1												1													
166	F	18-24																											
175	PF	40-	1		1																						1		

		50																											
176	F	18-24	2		2																				1		1		
178	F	25-35	1	1												1													
179	I	A																											
190	M	35-45	16	8	8									1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
191	M	25-35																											
193	F	25-35	1		1																						1		

This table lists any individual who has a Schmorl's node on the thoracic or lumbar vertebrae. Female and male are indicated by "F" and "M". Indeterminate indicated by an "I" is an adult skeleton lacking bones permitting the determination of sex. "U" stands for unknown and indicates bones permitting determination of sex are present, but ambiguous. "PM" indicates probable male whereas "PF" indicates probable female. "N/A" indicates infant or juvenile skeletons too young to show or have preserved bones determining sexual characteristics. Ages are in years unless noted otherwise. "A" indicates adult and "OA" indicates older adult as signified on the burial forms not the life stages used in this analysis. "TT" indicates thoracic vertebrae total. "TTS" indicates thoracic vertebrae superior total and "TTI" signifies thoracic vertebrae inferior total. "S" and "I" indicate superior and inferior surfaces for the location of the Schmorl's nodes. A "-" indicates the possible presence of a Schmorl's node in which the total are known, but the exact position could not be determined. A "*" indicates a discrepancy in the burial forms so the number or position of the Schmorl's node on the vertebra is an estimate.

Appendix Table XII – Schmorl's Nodes on the Lumbar Vertebrae by Individual

Individual	Sex	Age	L Total	L Total S	L Total I	L1 S	L1 I	L2 S	L2 I	L3 S	L3 I	L4 S	L4 I	L5 S	L5 I
C11395B	I	35-40													
C11396	F	18-20													
C12705A	F	20-30													
C12705B	F	35-45	2	2		1		1							
C12806	I	A													
001	PM	15-23	1	1						1					
005.1	F	30-39	7	5	2	1	2	2		1		1			
005.2	F	18-24													
009	M	18-24	1	1		1									
021A	M	20-35	3	2	1							1	1	1	
026A	I	35-50+													
028	F	40-50													
043	F	40+	6	2	4	1	1	1	1		1		1		
057	PM	16-20	2	1	1			1			1				
058	M	40-49	6	4	2			1	1	1	1	1		1	
062B	F	40-50													
065	F	30-39	5	5		1		1		1		1		1	
067D	M	OA													

069A	F	40-49													
071	M	35-45	13	8	5	2			3	3	1		1	3	
074	F	40-50	2		2		2								
079	F	25-35	1	1				1							
084	M	25-35	1	1						1					
092	M	25-35													
093	F	35-50	1		1		1								
095	PF	20-25	4	3	1	1		1	1	1					
096	PM	A	1		1						1				
099	M	25-30	8	4	4	1	1	1		1	1	1	1		1
101	M	30-50													
103	F	20-24	2	1	1		1			1					
107	M	25-35	3	2	1	1		1					1		
113	F	20-25	1	1				1*							
120	F	20-29	5	2	3		1	1	1	1	1				
126	PM	20-24													
127	F	40-45	5	3	2	1	1	1	1	1					
131	PM	20-35	1		1		1								
137	M	25-35	1	1						1					
139	M	18-24	2	2				1				1			

142	M	30-50	1	1				1							
143	PF	25-35													
144	M	30-50	5	2	3	1	1	1	1		1				
151	M	27-38													
154	F	25-35	3	2	1	1	1	1							
158	F	25-35	2		2				1		1				
164	M	25-40													
166	F	18-24	1	1				1							
175	PF	40-50													
176	F	18-24	2	2				1				1			
178	F	25-35													
179	I	A	1	1										1	
190	M	35-45	4	3	1	1	1			1		1			
191	M	25-35	1	-	-					-	-				
193	F	25-35													

This table lists any individual who has a Schmorl's node on the thoracic or lumbar vertebrae. Female and male are indicated by "F" and "M". Indeterminate indicated by an "I" is an adult skeleton lacking bones permitting the determination of sex. "U" stands for unknown and indicates bones permitting determination of sex are present, but ambiguous. "PM" indicates probable male whereas "PF" indicates probable female. "N/A" indicates infant or juvenile skeletons too young to show or have preserved bones determining sexual characteristics. Ages are in years unless noted otherwise. "The age estimate "adult" and "older adult" were the words utilized by the Amarna osteology team instead of a numerical estimate or a term used in Buikstra and Ubelaker (1994) and thus not matching the life stages determined for this analysis. "S" and "I" indicate superior and inferior surfaces for the location of the Schmorl's nodes. A "-" indicates the possible presence of a Schmorl's node in which the total are known, but the exact

position could not be determined. A "*" indicates a discrepancy in the burial forms so the number or position of the Schmorl's node on the vertebra is an estimate.

Appendix Table XIII – Expression of Spondylolysis by Individual

Individual	Sex	Age	Vertebra	Bilateral or Unilateral	Without Fusion	With Fusion
002	Probable Male	15-23	L5		X	
05.1	Female	30-39	L5		X	
009	Male	18-24	L5		X	
023	Male	25-33	L5		X	
024	Male	15-20	L5		X	
033	Male	20-24	L4			
039	Male	35+	L5	Bilateral	X	
042	Male	20-25	L5	Unilateral Right	X	
051	N/A	10-15.5	L5	Unilateral Right	X	
056	Male	40+	L5	Bilateral	X	
058	Male	40-49	L5		X	
062A	Male	20-29	L5		X	
062B	Female	40-50	L5	Unilateral		X
110	Female	25-35	L5		X	
130	Probable Male	18-24	L5		X	
143	Probable Female	25-35	L5		X	
150	Female	20-29	L5		X	
158	Female	25-35	L5		X	
194	Male	35-50	L5	Unilateral Right	X	

This table includes all individuals with spondylolysis. "N/A" indicates infant or juvenile skeletons too young to show or have preserved bones determining sexual characteristics. The blanks left in the table indicate the lack of recorded information in the burial forms and burial narrative.

Appendix Table XIV – Degenerative Joint Disease by Individual for the Vertebrae

Individual	Sex	Age	Cervical Vertebrae	Thoracic Vertebrae	Lumbar Vertebrae
C11375	Female	Adult		X	X
C11643A	Probable Male	Adult			
C12705A	Female	20-30	X	X	
C12705B	Female	35-45		X	X
C12803A	Male	40-45		X	X
005	Indeterminate	18-24			X
014	Indeterminate	Adult			X
015	Probable Female	40-50	X	X	X
017	Female	35-40			X
018	Indeterminate	Adult	X		
019	Female	Adult	X		
021A	Male	20-35			
023	Male	25-33		X	X
024	Male	15-20			
026A	Indeterminate	35-50+	-	-	-
027A	Indeterminate	35-50	X	X	X
028	Female	40-50	X		X
029	Female	30-39			X
033	Male	20-24			
034	Female	35-45		X	X
036	Male	20-25		X	X
039	Male	35+		X	X
040	Female	35-45	X		X
043	Female	40+	X	X	X
048	Female	35-39	X	X	X
049	Female	35-45			X
052	Female	Young Adult (Early-Mid 20s)			
055	Female	35-50			X
056	Male	40+	X	X	X
057	Probable Male	16-20			X

058	Male	40-49		X	X
059	Male	35-59		X	X
062A	Male	20-29			
062B	Female	40-50	X	X	X
066	Male	20-29			
067D	Male	Older Adult		X	-
069A	Female	40-49	X	X	X
070	Indeterminate	Adult		X	X
071	Male	35-45	X	X	X
072	Female	30-39	X	X	X
074	Female	40-50	X	X	X
075	Female	30-40			X
079	Female	25-35			X
083	Female	30-39	X	X	X
084	Male	25-35			
085	Female	Adult		X	X
089	Female	35-45		X	X
090	Female	25-35			
092	Male	25-35			
093	Female	35-50			
096	Probable Male	Adult			X
099	Male	25-30			
102	Male	35-45		X	X
106	Male	35-45	X	X	X
107	Male	25-35		X	X
108	Female	25-35			
110	Female	25-35		X	X
113	Female	20-25			
114	Female	35-45	X	X	X
117	Male	30-50			
120	Female	20-29	X	X	X
121	Male	18-24			
125	Male	25-29		X	
127	Female	40-45	X	X	X
128	Female	Adult		X	
131	Probable Male	20-35	X	X	X

134	Female	50+	X	X	X
136	Female	25-35			X
137	Male	25-35	X	X	X
141	Male	18-24		X	
142	Male	30-50	X	X	
143	Probable Female	25-35			X
144	Male	30-50	X	X	X
150	Female	20-29			
151	Male	27-38	X	X	X
153	Probable Male	25-40	X	X	
154	Female	25-35			
158	Female	25-35			X
164	Male	25-40		X	X
175	Probable Female	40-50	X	X	X
176	Female	18-24			
178	Female	25-35		X	
182	Female	Adult			
188A	Female	35-45		X	X
189	Male	25-35			
190	Male	35-45		X	X
191	Male	25-35	X	X	X
193	Female	25-35	X		X
194	Male	35-50	X	X	X

This table includes every individual who has some form of degenerative joint disease. Indeterminate indicates an adult skeleton lacking bones permitting the determination of sex. Unknown indicates bones permitting determination of sex are present, but ambiguous. Ages are in years unless noted otherwise. An "X" indicates presence of degenerative joint disease and a blank indicates absence of the pathology. Any of the cells marked with a "-" indicate the burial forms listed degenerative joint disease in the joints selected, but did not indicate side.