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Paleopathology In Ancient Eygpt: Evidence From The Sites Of Dayr Al-barsha And Sheikh Said

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PALEOPATHOLOGY IN ANCIENT EGYPT:
EVIDENCE FROM THE SITES OF DAYR AL-BARSHĀ AND SHEIKH SAID

by

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ABSTRACT

For centuries, people have been fascinated with how the ancient Egyptians lived, and particularly how they died. Although Egyptologists in the past had a greater interest in the treasures that accompanied the dead, there has now been a shift in focus on the actual ancient Egyptians themselves and their ways of life. Recognizing the health and disease status of ancient Egyptians has become particularly important. The aim of this research project is to document the paleopathology of the individuals from the sites of Dayr al-Barshā and Sheikh Said encompassing the Old Kingdom (2686 – 2160 BC), the First Intermediate Period (2160 – 2055 BC), and the Middle Kingdom (2055-1650 BC) periods. The site of Dayr al-Barshā was most importantly the necropolis, or burial site, used by the inhabitants of the ancient city of *Hermopolis Magna*, and it was also a very prominent quarry site. Today, Dayr al-Barshā is a large scale archaeological site that has been divided into eleven zones. The results of this research reveal a documented list of paleopathologies that include traumatic conditions, congenital anomalies, joint diseases, infectious diseases, hematological disorders, dental pathology, neoplastic conditions, and various other conditions that ailed the people in their daily lives. Fractures and dental diseases are the paleopathologies that occurred most frequently. These pathologies provide important knowledge about the living conditions and occupations during the span of the Old Kingdom through the Middle Kingdom.

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Dedicated to Sebastian

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CHAPTER ONE: INTRODUCTION

Paleopathology can be defined as the study of disease in ancient populations through the examination of human remains (Aufderheide and Rodriguez-Martin, 1998). The analysis of paleopathology is an essential tool in investigating diseases that occurred in ancient populations. Additionally, information about the overall health, nutrition, stature, and possible stress periods of individuals can be assessed. The quality of living of the members of past societies can be assessed by analyzing their remains (Larsen, 1997). Paleopathologists have the direct advantage of being able to study the remains of the diseased, where other disciplines have to rely on conclusions made based on written records and artifacts found in graves and archaeological sites. The principle disadvantage may be that only diseases that affect the skeleton can be analyzed (Waldron, 2009), whereas working in Egypt provides the advantage that not only skeletonized human remains can be analyzed, but also mummified remains with preserved soft tissue.

Due to the environmental conditions in Europe, Asia, and North America, only skeletonized human remains survive and they are commonly found in a highly deteriorated condition. Preservation conditions in Egypt on the other hand, are different in many ways. First, due to the desert, the climate is arid throughout the entire year. In addition, the ancient Egyptians mummified their dead. Even if the deceased was not wealthy enough to afford the costly mummification process, the dry desert sand preserved the bodies in many cases. The sand in Egypt is also alkaline, and sand draws the moisture out of those buried in direct contact with the sand. The bones, as well as soft tissue and inner organs, are preserved in excellent condition and allow a thorough analysis. Most of the current knowledge on the daily life and the living condition of the ancient Egyptian people usually derives from archaeological findings and occasionally from written sources and mostly neglecting biological finds such as human remains (Nerlich et al., 2000a; Buzon, 2006). Today, the focus shifts more towards paleopathological analyses in order to gain insight on how individuals in ancient Egypt lived and how they died.

Several paleopathological studies have been conducted in different parts of Egypt, such as Tell el-Amarna (Rose, 2006), in the Dakhleh Oasis (Browne, 1985; Fairgrieve and Molto, 2000; Molto, 2000), in Thebes-West (Nerlich et al., 2000a; Nerlich et al., 2002), in Abusir (Strouhal et al., 2003), Saqqara (Strouhal, 1986), Abydos (Keita and Boyce, 2006), Mendes (Lovell and Whyte, 1999), and in Nubia (Buzon, 2006; Hummert, 1983). This thesis presents a paleopathological study of the human remains from the site of Dayr al-Barshā and Sheikh Said, and compares them with other sites in Egypt. From very early, the ancient Egyptians had a high interest in disease and tried to learn as much as possible about different medical conditions and treatments. Medical papyri, such as the Papyrus Ebers, the Papyrus Edwin Smith, or the Kahun Papyrus give an insight to their medical knowledge (Carpenter et al., 1998; Pahl, 1986; Sandison and Tapp, 1998).

Comparisons of the paleopathological conditions between the ancient Egyptian population and populations of the Mediterranean region, such as Italy in particular where there is a comparable amount of findings (Bonfiglioli et al., 2003; Canci et al., 2005; Cucina et al., 2006), is considered to put the paleopathologies in a broader context.

The human remains that will be analyzed for this thesis were excavated by a Belgian team under the direction of Harco Willems at Dayr al-Barshā and Sheikh Said in Middle Egypt. The site of Dayr al-Barshā is remarkable due to the archaeological presence of all time periods of ancient Egyptian history which allows a holistic examination.

The large archaeological sites of Dayr al-Barshā and Sheikh Said were divided into different archaeological zones, of which only zones 2, 4, 7, and 9 in Dayr al-Barshā and zone A in Sheikh Said are analyzed in this thesis.

The objectives of this research are diverse and multifaceted. Although the archaeological zones at Dayr al-Barshā and Sheikh Said date to different time periods, human remains from the Old Kingdom and the Middle Kingdom will be the focus of this thesis. This focus will give important insight into the health status of the population during these particular time periods. The first objective is to determine if the same paleopathologies are present in the different time periods. The second objective is to determine how the paleopathologies reflect the arduous work in the quarries of Dayr al-Barshā. The third objective is to interpret how the documented paleopathologies affected these individuals and their ways of life. The last objective is to compare the paleopathologies in Dayr al-Barshā and Sheikh Said to other sites in Egypt.

The organization of the thesis will consist of the following chapters: Chapter two introduces the different paleopathologies that are found in Dayr al-Barshā and Sheikh Said from a clinical point of view. Chapter three contains the materials and methods sections: Dayr al-Barshā and Sheikh Said are discussed as well as the sample and the exact methods that were used. Chapter four presents the results of the Old Kingdom (zones 4 and 7) from Dayr al-Barshā. Chapter five covers the results of the Middle Kingdom (zones 2, 9A and 9B in Dayr al-Barshā and zone A in Sheikh Said). Chapter six will discuss the occurrence of the different paleopathologies in the different time periods and chapter seven will present the conclusion.

CHAPTER TWO: PALEOPATHOLOGY

This chapter presents information on the paleopathologies that are present on the skeletal material from Dayr al-Barshā and Sheikh Said.

Traumatic Conditions

Traumatic conditions comprise conditions such as various types of fractures, spondylolysis, amputations, and pseudoarthrosis. Traumatic conditions, especially fractures, can tell a lot about the life style of an individual and how they may have died. On a timeline, fractures can be classified as antemortem, perimortem, and postmortem kinds of fractures.

Healing

The healing process starts as soon as a fracture occurred and takes place in several phases (Table 1). The blood flows from the blood vessels into the surrounding soft tissue where it forms instantly a hematoma, also known as a clot. At the same time, inflammatory cells penetrate the soft parts at the fracture site. Different kinds of cells begin working in and around the periosteum. The ends of the fractured bone are not involved in the healing process (McKibbin, 1978). During the next few days, a vascular bridge is formed through the clot and the ends of the bone are pulled back together and allow the nutrients and cells to pass the fracture site. The osteoclasts start to resorb the fragments of the dead bone (Galloway, 1999). During the third phase, which occurs weeks after the injury, callus is formed due to the activity of osteoblasts, the bone forming cells. The callus consists of an organic matrix where minerals can be laid down to reinforce the fracture area. In the time period of one to two months, bony callus is completely formed. Cartilage may be formed at the periphery of the callus, which later will be formed to bone. Osteoblasts continue with the deposit of minerals until the callus is calcified by endochondral ossification. The area of new formed bone is called woven bone and performs the task of keeping the damaged site reinforced (Galloway, 1999). Bone remodeling is the final phase and occurs years after the initial fracture. After the callus is stabilized, the osteoclasts and osteoblasts start remodeling the bone and convert the callus into lamellar bone and Haversian systems. The surface of the bony callus becomes smoother and rounder. The bone heals completely in younger children, but in adults the fracture line will remain (Galloway, 1999). The remodeling of cancellous bone is far simpler than the remodeling of compact bone. The cells are never far away, so the process of remodeling occurs on the surface of the trabeculae, the “honey comb structure”. The remodeling of compact bone is far more complicated due to the existence of the Haversian systems, or osteons, that are vital in cortical bone (McKibbin, 1978). The complexity of the healing process requires good health and nutrition.

Table 1: The different phases in the healing process (after Galloway, 1999).

Phase	Process	Duration after fracture
Hematoma/clot formation	Instantly after the fracture, blood flow forms a hematoma/clot.	Hours
Vascular bridge formation	The ends of the broken bone are pulled together and allow the nutrients to pass.	Days
Soft callus formation	Osteoblasts get active and form soft callus that stabilizes the fracture site. In addition, minerals are laid down.	Weeks
Bony callus formation	More minerals are laid down by osteoblasts until the fracture area is calcified. The new bone is called woven bone.	1-2 months
Bone remodeling	Osteoblasts and osteoclasts remodel the bone into lamellar bone and Haversian systems.	Years

Congenital Anomalies

Craniosynostosis

Craniosynostosis is characterized as the premature fusion of the cranial sutures (Shillito and Matson, 1968; Aufderheide and Rodriguez-Martin, 1998; Hehr and Muenke, 1999; Ortner, 2003; Kabbani and Raghuveer, 2004; Duncan and Stojanowski, 2008). The major problem with craniosynostosis is that the infant's brain undergoes extensive growth and therefore needs to expand. In cases of craniosynostosis, this expansion is no longer possible due to the restriction of the premature cranial suture closure (Shillito and Matson, 1968; Kabbani and Raghuveer, 2004).The anomaly can occur on every cranial suture. All of the major sutures on the skull may be affected alone or in different variations, however the sagittal suture is the most frequently affected with 40-55% of all cases (Hunter and Rudd, 1976; Hunter and Rudd, 1977; Morriss-Kay and Wilkie, 2005; Duncan and Stojanowski, 2008). In sagittal synostosis, the head cannot expand in a lateral direction due to the fusion of the two parietal bones. As the brain grows, the head can expand just above the ears and anteriorly and posteriorly, causing an elongated shape of the head (for a list of further variants of craniosynostosis see Table 2; Shillito and Matson, 1968). According to Virchow's law, premature fusion results in the termination of growth perpendicular to the affected suture, but compensatory growth occurs at other sites (Duncan and Stojanowski, 2008). Today, surgical procedures are conducted commonly during the first three years of life and include surgeries such as frontocranial remodeling that has two aims: 1) to restore normal anatomy of the forehead and the cranial vault and 2) to allow the brain to expand naturally (Marchac and Renier, 1989). Kabbani and Raghuveer (2004) discuss the possible risk factors of craniosynostosis and list factors such as Caucasian maternal ancestry, advanced maternal age, male infant sex, maternal smoking, maternal residence at high altitude, use of nitrosatable drugs, certain paternal occupations (e.g., agriculture and forestry, mechanics, repairmen), and fertility treatments.

Table 2: Varieties of craniosynostosis (after Marchac and Renier, 1989; Aufderheide and Rodriguez-Martin, 1998; Huang et al., 1998).

Craniosynostosis	Characteristics
Trigonocephaly	- Synostosis of the midline metopic suture producing a triangular shape of the forehead - The orbits are closer than normal with parallel inner walls
Scaphocephaly	- Synostosis of the sagittal suture producing a lowering and narrowing at the parietal level - Compensatory projection of the frontal and occipital areas - Head seems to be narrow and elongated - Most common type of craniosynostosis
Plagiocephaly	- Unilateral synostosis of the coronal suture producing a flattening of the forehead on the affected side - The orbits are elevated and triangular shaped - The root of the nose is distorted - The sagittal sutures are also deviated
Brachycephaly	- Synostosis of both coronal sutures - The forehead is recessed and bulging - The orbits are triangular shaped
Oxycephaly	- Late-appearing synostosis of the coronal sutures - The supraorbital rim is recessed and the forehead is tilted backward with no frontonasal angle - The top of the head is elevated - This synostosis is frequently observed in North Africa
Triphyllocephaly	- This type of synostosis is caused by multiple sutural fusion and affects mostly the parietotemporal sutures - A constriction ring develops in the lambdoid-squamosal region and causes a marked bulging in the frontal and temporal bones - This type is also known as “Cloverleaf skull” - This form is usually associated with hydrocephalus - Mental retardation is common

Spina Bifida

Spina bifida is the most frequent neural tube defect (Aufderheide and Rodriguez-Martin, 1998; Botto et al., 1999). The cause may not be completely known in many cases but the main causes of this condition are heterogeneous and may include chromosome abnormalities (Mitchell et al., 2004). The malformations can be various, but they affect mostly the spinal cord, vertebrae, and skin. The vertebral canal is open due to a disruption in the formation of the vertebral arches and as a result, the laminae do not fuse (Mathews, 2008). Mitchell et al. (2004) explain that the neural tube, which is the embryonic structure that develops further into the spinal cord and the brain, is formed by different sequences of development that is known as neurulation. The primary neurulation shapes the brain and the spinal cord. Spina bifida is a defect that occurs during the primary neurulation that results from failure of fusion of the caudal neural tube. If the defect occurs in the cranial region of the neural tube, the result is a defect known as anencephaly. At birth, spina bifida occurs more frequently in girls than in boys (Mitchell et al., 2004). The main factor for an increased risk for neural tube defects is if relatives were already suffering from the disorder. Aufderheide and Rodriguez-Martin (1998) argue that the anomalies can occur at birth or later in life and that they can be hereditary or acquired between fertilization and birth. There is an increased risk for both spina bifida and anencephaly if natural folate, or its synthetic form folic acid, was taken during the early stages of the pregnancy (Mitchell et al., 2004). Not only folate may affect the development of the neural tube in fetuses, but also other nutrients such as vitamin B12. Another increased risk for a child born with spina bifida is if the mother has diabetes. In these cases, the risk is two-fold to tenfold higher than in the general population (Mitchell et al., 2004). Furthermore, obese women also bear an increased risk of giving birth to a child with spina bifida or other neural tube defects (Botto et al., 1999; Mitchell et al., 2004). Today, surgery to close the spinal lesion is commonly done within 48 hours after birth. Mitchell et al. (2004) suggest that the surgery could also be proceeded in-utero but in many of these cases, lower limb paralysis may be the result.

Spina bifida is divided into three categories: spina bifida occulta, spina bifida cystica, and meningocele. Spina bifida occulta (Latin: *concealed*, *hidden*, *secret*) is the mildest form and is characterized by the non-fusion of the vertebral arch of one vertebra. The underlying neural tube develops normally. This defect is usually covered with skin and remains undetected in many cases (Boone et al., 1985; Aufderheide and Rodriguez-Martin, 1998; Mathews, 2008). Spina bifida cystica is the more severe form. This defect can occur at any single vertebra, but it is most common in the lower lumbar or sacral region. The spinal cord is unprotected, protrudes through the unfused bone, and results in an exposure outside of the body. The spinal cord may be in a sac filled with cerebrospinal fluid (Wynne-Davies, 1975; Aufderheide and Rodriguez-Martin, 1998; Ortner, 2003; Mathews, 2008). Meningocele is the most severe form of spina bifida and commonly results in the death of the newborn. Mathews (2008) describes that the spinal cord develops normally in this condition and remains in the vertebral canal. The life threatening defect results from the meninges which are pushed through the unfused vertebrae, resulting in a sac filled with cerebrospinal fluid which can be forced outside of the body or into the retroperitoneum.

Joint Diseases

Osteoarthritis (Degenerative Joint Disease)

Ortner (2003) provides the three major components of skeletal involvement in osteoarthritis: 1) the collapse of articular cartilage that results in bone on bone contact and in abnormal abrasion of the subchondral bone, 2) reactive bone formation (sclerosis) in the subchondral compact bone (eburnation) and in the trabeculae underlying the affected subchondral compact bone and possibly associated with cyst formation, and 3) new growth of cartilage and bone at the joint margins (osteophytes). Inflammation is very uncommon in osteoarthritis, although it can occur if it is the destructive form. Weiss and Jurmain (2007) argue that the term osteoarthritis should be changed into osteoarthrosis because osteoarthritis implies an inflammatory condition. Generally, two types of osteoarthritis can be distinguished: primary osteoarthritis that tends to affect individuals in their later years as a result of multiple factors, such as biomechanical stress due to repetitive workload, traumatic conditions, or a high body mass index, and secondary osteoarthritis that develops earlier in life in joints that are affected by other pathological conditions, such as slipped femoral epiphysis and Legg-Perthes disease (osteonecrosis of the hip and the femoral head which is only found in children; Salter, 1984) or metabolic disorders (Jurmain, 1977; Ortner, 2003; Weiss, 2006; Weiss and Jurmain, 2007). The frequency of appearance of osteoarthritis in the different skeletal elements can be summarized as follow: 1) knee, 2) first metatarsophalangeal joint, 3) hip, 4) shoulder, 5) elbow, 6) acromioclavicular joint, and 7) sternoclavicular joint (Aufderheide and Rodriguez-Martin, 1998; Ortner, 2003). Partial or complete loss of cartilage results in bone on bone contact which causes either deep grooves or eburnation (polished areas). Ortner (2003) points out that in ball-and-socket joints, such as the hip and the elbow, osteoarthritis results in enlargement, altered curvature, and deformation, especially on the convex joint surface.

Another frequently occurring type of osteoarthritis is spinal osteoarthritis which occurs in almost everyone over the age of forty (Ortner, 2003). The changes on the vertebrae are similar to joint changes on elements of the appendicular skeleton: subchondral bone involvement includes eburnation, and osteophyte formation at the margins that can result in marginal lipping (Ortner, 2003). Commonly observed in spinal osteoarthritis are so called Schmorl's nodes, extrusions of nucleus pulposus material of the cartilage intervertebral disk into the adjacent vertebral bodies, causing round or lobulated nodules up to 1 cm in diameter (Aufderheide and Rodriguez-Martin, 1998; Ortner, 2003). Faccia and Williams (2008) describe the formation process of Schmorl's nodes as fluid that travels through a fissure in the cartilaginous endplate and erodes into the vertebral body where degeneration of local trabeculae results, causing a small dent in the surface of the vertebral body. Schmorl's nodes may be the result from 1) congenital spinal defects, 2) traumatic conditions, and 3) ageing processes (Faccia and Williams, 2008). Spinal osteoarthritis most commonly occurs on the lower thoracic or lumbar vertebrae (Ortner, 2003). Males are in most cases more frequently affected by osteoarthritis than females (Jurmain, 1977; Larsen, 1997; Aufderheide and Rodriguez-Martin, 1998; Hussien, 2009).

Rheumatoid Arthritis

Rheumatoid arthritis is an inflammatory and chronic condition that affects the synovial joints and the connective tissue (Aufderheide and Rodriguez-Martin, 1998). The disease commonly affects multiple joints (Ortner, 2003). The initial cause of rheumatoid arthritis may be environmental due to the invasion of an infectious microorganism that creates an autoimmune response causing the destruction of the soft tissues (Aufderheide and Rodriguez-Martin, 1998; Ortner, 2003). The joints of the hands and feet are the first skeletal elements to show signs of the condition (Aufderheide and Rodriguez-Martin, 1998; Ortner, 2003). Ankylosing and osteoporosis occur frequently together with rheumatoid arthritis (Ortner, 2003). The condition never affects the joint surfaces themselves, but the lesions are located very close to the joint surfaces (Ortner, 2003).

Aufderheide and Rodriguez-Martin (1998) list the different systemic effects of rheumatoid arthritis including rheumatoid nodules on the skin, vasculitis, enlarged lymph nodes, eye inflammations, visceral involvement, inflammations of nerves, hepatitis, and amyloidosis.

Ortner (2003) points out that about 1% of the general population is affected by the disease. Rheumatoid arthritis has a higher frequency in females, so are in Europe approximately 4% of the males affected, while the frequency in females is as high as 16% (Ortner, 2003).

The differential diagnosis of rheumatoid arthritis includes osteoarthritis (degenerative joint disease), ankylosing spondylitis, psoriatic arthritis, and gout.

Diffuse Idiopathic Skeletal Hyperostosis (DISH)

Diffuse Idiopathic Skeletal Hyperostosis, or DISH (in the earlier clinical literature: ankylosing hyperostosis or Forestier's disease), is a condition that causes the production of excessive amounts of bone at joint margins and the entheses (Resnick and Niwayama, 1976; Crubézy, 1990; Aufderheide and Rodriguez-Martin, 1998; Ortner, 2003). Aufderheide and Rodriguez-Martin (1998) list the diagnostic criteria for DISH:

1) At least four vertebrae need to be fused by bony bridges arising from the anterolateral aspects of the vertebral bodies, involving the anterior and right aspects. The bony bridges have a flowing appearance that reminds of dripping candle wax. This process commonly starts in the midthoracic spine.
2) The intervertebral disk space and the vertebral end plates are not affected.
3) The anterior longitudinal spinal ligament is ossified.
4) The extraspinal ligamentous and muscular attachments are calcified (enthesopathies). These include the ischial tuberosities, the iliac crests, the pubic symphysis, the trochanters, the patellae, the femoral linea aspera, the Achilles tendon attachment, and the calcaneus.
5) The sacroiliac joint may present a fixation by bony bridges, but not by intra-articular bony ankylosis.

Utsinger (1985) used the same criteria to diagnose DISH and classified them into three categories: definite, probable, and possible.

DISH can take place on many different locations in the skeleton, but the spine is the skeletal element that is most often affected. In the spine the abnormal bony growth takes place under the anterior longitudinal ligament, whereas in the thoracic region the bony growth associated with DISH is only limited to the right side (Ortner, 2003). One hypothesis concerning this limitation to only one side is the presence of the descending aorta. If the disease reaches the cervical spine, dysphagia may be occurring due to a compression of the esophagus caused by the formation of cervical osteophytes (Utsinger, 1985; Sarzi-Puttini and Atzeni, 2004; Bremke et al., 2006). The etiology of DISH is still unknown. Sahin et al. (2002) and Mader and Lavi (2009) suggest metabolic, genetic, and constitutional factors, such as obesity, a high waist circumference ratio, hypertension, diabetes mellitus, hyperinsulinemia, dyslipidemia, elevated growth hormone levels, and elevated insulin.

Ortner (2003) reports that the disease is about twice as common in males than in females and it increases with age, so that DISH is common in individuals over the age of 65 years in about 10% of the population. Aufderheide and Rodriguez-Martin (1998) report that the ratio of affected females to affected males in DISH is 2:3, that is hardly ever detected in individuals younger than 40 years of age, and that it is present in more than half of all conducted autopsies. Rogers and Waldron (2001) report that the prevalence is higher in whites than it is in blacks and that it is low in Asians and in Native Americans.

Ankylosing Spondylitis

Ankylosing spondylitis, also known as Bechterew's disease or Bamboo spine, is a systemic, progressive, noninfectious, inflammatory disease of connective tissue calcification that affects the spine, and the sacroiliac and peripheral major joints (Aufderheide and Rodriguez-Martin, 1998). Ortner (2003) describes it as a progressive inflammatory condition of unknown etiology in which the enthesis is the primary pathology site. The hip and the shoulder are the most commonly affected appendicular skeletal elements (Ortner, 2003). The typical spinal lesion is the syndesmophyte, a bony outgrowth at the margin of the joint with a vertical orientation (in contrast to the osteophytes in osteoarthritis that have a more horizontal orientation; Ortner, 2003). One typical feature of ankylosing spondylitis is the change from the normal concave shape of a vertebra to a square shape. The remodeling process results in smooth fusions of the vertebrae and produces the typical bamboo-like structure of the spine. Three diagnoses are possible in the ossification of the anterior longitudinal ligament or the syndesmophytes, or both: 1) ankylosing spondylitis, 2) spondylosis deformans, or 3) DISH (Chhem et al., 2004). The presence of a fusion of the sacroiliac joints is an excluding criterion for spondylosis deformans and DISH (Chhem et al., 2004). Ortner (2003) points out that the main difference between ankylosing spondylitis and DISH is the distinctive osteoporosis of the vertebral bodies in ankylosing spondylitis. Aufderheide and Rodriguez-Martin (1998) and Ortner (2003) discusses that ankylosing spondylitis affects more frequently males and the disease commonly begins in the second or third decade of life. Another difference is that ankylosing spondylitis starts at a young age, usually in late adolescence and early adulthood, and DISH begins at a much older age (Olivieri et al., 2007). DISH usually begins in the sacroiliac joints and lumbar vertebrae and progressively ascends to the thoracic spine and their costovertebral joints (Ortner, 2003).

Infectious Diseases

In antiquity, infectious diseases were the single greatest threat to life and caused many individuals to die before they reached sexual maturity (Ortner, 2003). Infectious diseases that can be traced directly on the skeleton are either of subacute or chronic nature, and diseases that kill individuals after a short incubation period may not be present on skeletal elements. The most common infectious diseases that can be traceable on bones are osteitis (an inflammation within the compact bone; Ortner, 2003), osteomyelitis, and periostitis. The two latter ones are present in the skeletal sample of Dayr al-Barshā and Sheikh Said and will be discussed in detail. Osteitis on the other hand is not present at the above mentioned sites and is therefore not discussed in this thesis. Other infectious diseases that can affect the skeleton are those such as tuberculosis and leprosy. Larsen (1997) documented a synergy between infectious diseases and malnutrition. Malnourished individuals are less resistant to infectious pathogens which make them more susceptible to infectious diseases. If an individual was exposed to a pathogen and got infected it does not mean that the disease will express itself. The progression of the infection depends on pathogenicity, the transmission route from the agent to the host, and the physical strength and the nature of the response of the host (Larsen, 1997).

Osteomyelitis

The term osteomyelitis describes an infection of the bone and the bone marrow (Larsen, 1997; Aufderheide and Rodriguez-Martin, 1998). The disease is either caused by the pus-producing microorganism *Staphylococcus aureus* (occurs in 80-90% of cases in modern populations) or by the bacterium *Streptococcus* (Larsen, 1997; Ortner, 2003). Ortner (2003) points out that other infectious agents, such as viruses, fungi, and multicelled parasites can also affect the bone marrow. The skeletal changes consist of bone destruction along with new bone formation (involucrum) and necrotic bone (sequestrum) (Aufderheide and Rodriguez-Martin, 1998). The affected bones are enlarged, highly deformed, and show an irregular surface covered with pits, cavities, and plaques of new bone (Aufderheide and Rodriguez-Martin, 1998). Another typical manifestation of osteomyelitis is the formation of cloacae (drainage canals) that may be present in many cases. If the blood flow in the affected bone is restricted, the entire diaphyses may become necrotic (Aufderheide and Rodriguez-Martin, 1998). Osteomyelitis does not only occur in an acute form, but also in a subacute and a chronic form that can reappear over a period of many years and according to Larsen (1997) it can be the response to systemic or localized stress. Death can occur if the infection spreads from the bone to the circulatory system and finally affects vital organs. If osteomyelitis heals, the bone becomes dense and becomes part of the normal cortical tissue and sclerotic scarring may occur (Larsen, 1997; Ortner, 2003). Aufderheide and Rodriguez-Martin (1998) argue that healed osteomyelitis leaves irregularities with sclerosis and cavities on the infected bone along with a general thickening and growth of the bone of about 1 cm. Osteomyelitis occurs worldwide and can affect all age groups, however mostly children between 3 and 12 years of age are affected because skeletal growth is most active during this age period, and peaks of the disease occur in children under 2 years and between 8 and 12 years (Aufderheide and Rodriguez-Martin, 1998). Aufderheide and Rodriguez-Martin (1998) discuss that the long and large cylindrical bones of the extremities are the skeletal elements that are most affected by osteomyelitis. The epiphyses, the location where the most rapid growth occurs, are most susceptible to the disease, especially in subadults. Another explanation would be that the ends of bones have the richest blood supply. In adults, the diaphyses are affected at the same rate as the metaphyses (Aufderheide and Rodriguez-Martin, 1998). Osteomyelitis mostly affects the femur, the tibia, the humerus, and the radius. Aufderheide and Rodriguez-Martin (1998) discussed that acute osteomyelitis caused by infections due to compound fractures, injuries, or surgery, occurs most frequently in adults over 40 years of age.

Periostitis

Periostitis is an inflammation of the periosteum and is caused by bacteria that enter the bone either due to a traumatic incident or due to infection (Larsen, 1997; Ortner, 2003). The surface of the bone may be irregular and appear elevated due to different degrees of thickness, nodulation, and pitting secondary to hypervascularity (Aufderheide and Rodriguez-Martin, 1998). Ortner (2003) states that periosteal bone will not develop cloacae, involucrum, or show changes in the marrow cavity. In periostitis, the formation of woven bone is usually activated which causes the incorporation of the latter into the underlying cortex and the remodeling into lamellar bone (Ortner, 2003). The skeletal elements affected by periostitis usually show the porous surface that is characteristic for woven bone. Although periostitis is an isolated disease, it is most commonly associated with a specific disease process, such as syphilis (Ortner, 2003).

Tuberculosis

Tuberculosis is sometimes referred to as “disease of poverty” and it is a chronic infectious disease caused by one of the microorganisms of the group *Mycobacterium*. There is a direct human-human transmission caused by *Mycobacterium tuberculosis*, and there is transmission to humans from the consumption of bovine products caused by *Mycobacterium bovis*, and the latter transmission occurs relatively rarely (Aufderheide and Rodriguez-Martin, 1998; Roberts and Buikstra, 2003; Ortner, 2003). Today, approximately 5000 individuals die every day from tuberculosis (Roberts and Buikstra, 2003). Aufderheide and Rodriguez-Martin (1998) describe the two phases of the disease: 1) the primary infection phase and 2) the re-infection or reactivation phase. Roberts and Buikstra (2003) describe that primary tuberculosis occurs during the first five years after the initial infection, while the secondary tuberculosis occurs after 5 years. The route of infection usually begins in the respiratory tract, leading to the formation of a primary focus in the lung and additionally to single or multiple foci in the regional hilar lymph nodes (Ortner, 2003). The tuberculosis pathogen may be inactive for many years and if activated, the immune system quickly initiates a very aggressive immune response which attacks the pathogen itself, but in many cases also the surrounding organ tissues which may cause a serious dysfunction of the affected organ (Ortner, 2003). If tubercle bacilli circulate in the bloodstream, they can particularly be found in the red marrow because those areas have a high circulatory and metabolic rate (Ortner, 2003). Osseous changes start to occur approximately 3 years after the infection (Roberts and Buikstra, 2003). Typical for tuberculosis is both bone formation and bone destruction (Roberts and Buikstra, 2003). Tuberculosis of the spine, especially of the lower spine, is highly frequent in all age groups; this can be explained by the red marrow content of vertebrae, ribs, and sternum (Ortner, 2003). Brothwell and Sandison (1967) describe that tuberculosis only affects the vertebral bodies, and never the neural arches. Buikstra and Roberts (2003) mention that the vertebrae, the ribs, and the sternum are most frequently affected by tuberculosis. Tuberculosis of the spine is called Pott's disease in which the spine curves heavily after the vertebral bodies collapsed. The number of vertebrae involved in tuberculosis is highly varying with 1 to 6. Aufderheide and Rodriguez-Martin (1998) suggest that tuberculosis occurs between the thoracic vertebra 8 and the lumbar vertebra 4.

According to Roberts and Buikstra (2003), following factors are essential for the emergence of tuberculosis: population growth, immunosuppression, age, HIV, malnutrition, pregnancy, trauma, and malignancy. Males have a higher frequency of tuberculosis than females (Roberts and Buikstra, 2003).

Roberts and Buikstra (2003) list the possible differential diagnosis including brucellosis, congenital wedging of the spine, fractures, fungal infection, osteomyelitis, osteoporosis, Paget's disease, sarcoidosis, Scheuermann's disease, Schmorl's nodes, septic arthritis, tumors, and typhoid.

Diseases of the Viscera

Mastoiditis

Mastoiditis is a severe middle ear infection that is the result of otitis media and is the most common disease in children in general (McKenzie and Brothwell, 1967; Loveland et al., 1990; Berman, 1995; Leskinen and Jero, 2005; Benito and Gorricho, 2007; Anderson and Adam, 2009; Flohr and Schultz, 2009a; Flohr and Schultz, 2009b; Thorne et al., 2009). For a better understanding of mastoiditis, otitis media will be described first.

Otitis media is categorized into acute otitis media and recurrent otitis media, whereas the correlated conditions of the latter may include male sex, sibling history of recurrent otitis media, not being breastfed, primary clinical treatment failure, bilateral acute otitis media, allergy, upper airway infection, gastroesophagial reflux, craniofacial abnormalities, passive smoking, day-care-attendance, season, and previous history of recurrent otitis media (Leibovitz, 2008; Flohr and Schultz, 2009a). Otitis media may be caused by a variety of bacteria, but infections caused by *Streptococcus pneumoniae*, and *Haemophilus influenza* are the most common (Aufderheide, 2003; Lewis, 2007). In chronic otitis media, the Eustachian tube may swell and pus build-up can drain through the tympanic membrane, resulting in periostitis, lytic lesions, and even otosclerosis, or hearing loss (Lewis, 2007; Anderson and Adam, 2009). The complicated acute otitis media affects approximately 20% of children during their first few years of life, however more than 60% of children suffer at least from one episode of acute otitis media during their first year of life (Leibovitz, 2008). Untreated otitis media may subside spontaneously or spread from the middle ear region into the surrounding temporal bone . If this happens osteomyelitis may lead to complications and even death, as a resulting abscess that may penetrates the lateral cortex (Loveland et al., 1990; Ortner, 2003). Otitis media may affect mastoid development, especially between birth and the first two to four years of life, and delay pneumatization (Loveland et al., 1990; Anderson and Adam, 2009). The process of pneumatization forms air cells or cavities in tissues, especially in the temporal bone, the ethmoid, and the mastoid (Flohr and Schultz, 2009a).

Mastoiditis in children is caused by *Streptococcus pneumoniae*, *Streptococcus pyogenes*, *Staphylococcus aureus*, or *Haemophilus influenza* and can be classified into acute and chronic mastoiditis (Anderson and Adam, 2009). The clinical symptoms of acute mastoiditis include postauricular pain, erythema, tenderness of the soft tissue overlying the mastoid, outwardly displaced pinna, fever, ear pain, headache, rhinorrhea, hearing loss, and a perforation of the tympanic membrane (Anderson and Adam, 2009; Flohr and Schultz, 2009b). Acute mastoiditis may develop into necrosis and demineralization of the normal mastoid air cells, osteitis of the mastoid bone, and general damage of the mastoid air cells (Anderson and Adam, 2009). Chronic or subacute mastoiditis possibly evolves into a long lasting middle ear disease with chronic purulent drainage and hearing loss (Anderson and Adam, 2009). Berman (1995) lists the complications of mastoiditis that can result in death, including sepsis, meningitis, brain abscess, subdural emphysema, lateral sinus vein thrombosis, and disabilities of the central nervous system, such as spasticity, paralysis, mental retardation, cortical blindness, seizures, labyrinthitis, and facial nerve paralysis. Flohr and Schultz (2009a) describe the osseous changes in mastoiditis as characterized by related proliferation and resorption which result in enlarged cells and in spicular bone formation (remnants of former septa between the pneumatized cells). The osseous proliferations can be plate-like and spicular, with thickened or even bases, rough or smooth surfaces, and fine net-like bone formations that are very brittle and fragile (Flohr and Schultz, 2009a and 2009b). The formation of new bone indicates chronic mastoiditis (Flohr and Schultz, 2009b).

Today, the treatment of otitis media and mastoiditis with antibiotics is successful and in most cases no complications remain (Anderson and Adam, 2009; Flohr and Schultz, 2009a). In developing countries, the health situation is completely different, mostly people have no access to antibiotics, and children especially have poor immune systems due to malnutrition, vitamin deficiencies, HIV, and chronic and parasitic infections. Therefore, the prevalence of both otitis media and mastoiditis is much higher in developing countries (Berman, 1995; Leskinen and Jero, 2005; Flohr and Schultz, 2009a). The major problem with the antibiotic treatment is the increasing resistance of the microorganisms. Therefore, mastoidectomy, the surgical removal of the infected portion of the mastoid bone, increases in frequency with approximately 25% of cases of acute mastoiditis (Benito and Gorricho, 2007). Homøe et al. (1996) report that today, otitis media and mastoiditis still are the major health issue in Greenlandic Inuit.

Metabolic Disorders

Osteoporosis

Osteoporosis is defined as a reduction of total bone mass per unit volume while retaining a normal ratio of bone mineral to bone matrix (Aufderheide and Rodriguez-Martin, 1998; Brickley, 2002; Ortner, 2003). Losing bone mass is a normal phenomenon in the ageing process (Dequeker et al., 1997; Aufderheide and Rodriguez-Martin, 1998). Aufderheide and Rodriguez-Martin (1998) classify idiopathic osteoporosis into two types. Type I usually affects menopausal women who are between the ages of 51 to 75 years. This type is characterized by trabecular bone loss with fractures of the distal radius and vertebrae. Type II occurs in males and females older than 60 years and it is characterized by bone loss in trabecular and cortical bones, causing fractures of the hip and vertebrae. Most frequently, hip fractures in older individuals are associated with osteoporosis and it accounts for the largest percentage of the mortality, morbidity, and public health costs in modern Western societies. The incidence of hip fractures has drastically increased over the past 30 years (Dequeker et al., 1997).

Dequeker et al. (1983) conducted a study to determine the relationship of age, weight, and stature with osteoporosis and osteoarthritis in women. The study determined that osteoporosis usually occurs in slender women, and osteoarthritis in women with an excess of body weight.

Osteoporosis is more frequently encountered in females, but also males can be affected by the condition. Eastell et al. (1998) suggest that approximately 30% of hip fractures happen in men. The causes of male osteoporosis include low body mass index, smoking, high levels of alcohol, lack in physical activity, vitamin D deficiency, increased thyroid hormone levels, and low testosterone levels (Eastell et al., 1998; Bilezikian, 1999; Kamel, 2005).

Most commonly fractures of the femur occur in individuals suffering from osteoporosis. An estimated number of 60,000 hip fractures occurred in Great Britain in 1994 (Brickley, 2002). One of the consequences of hip fractures is the shortening of the affected leg due to muscle action. Brickley (2002) states that the mortality in past populations was undoubtedly higher.

Diabetes Mellitus

Diabetes mellitus is a metabolic condition caused by insufficient levels of insulin (Aufderheide and Rodriguez-Martin, 1998; Dupras et al., 2009). Two types of abnormalities can be characterized. Type 1, the insulin-dependent diabetes mellitus, occurs in juveniles and adolescents, and caused the body to burn fat instead of sugar. Type 2, the noninsulin-dependent diabetes mellitus, occurs in adults and commonly the elderly, and is caused by the beta cell's subnormal response and the resistance of the peripheral tissues to the insulin's action (Aufderheide and Rodriguez-Martin, 1998). The blood sugar level is increased in both types of diabetes mellitus. The surplus of sugar appears in the urine and is associated with polyuria and extensive thirst. Other symptoms of diabetes mellitus include, increased fluid intake, blurred vision, blindness, lethargy, weight loss, possibly osteopenia, and there is possibly an association with DISH (Aufderheide and Rodriguez-Martin, 1998; Dupras et al., 2009). Diabetes mellitus causes a destruction of the peripheral nerves with consequent anesthesia that most commonly affects the feet and the legs. The anesthesia results in foot and leg injuries that can cause soft tissue ulcerations that get infected and may involve the metatarsals (Aufderheide and Rodriguez-Martin, 1998). Deposits in the small vessels of the foot may additionally cause osteolysis, an active resorption of bone, resulting in remodeling the metatarsals and phalanges to a distinct, distally tapered shape (Aufderheide and Rodriguez-Martin, 1998). Furthermore, Plagemann et al. (1992) determined that diabetes mellitus type 2 is associated with obesity.

Hematological Disorders

Anemia is the general term for a variety of abnormalities of red blood cells that are vital for the circulatory system to exchange oxygen (Ortner, 2003). In other words, anemia can briefly be defined as a reduction below normal in concentration of hemoglobin or red blood cells (Stuart-MacAdam, 1997). Iron is essential for many different functions of the body. The efficiency of dietary absorption of iron is dependent on the foods that are consumed, either heme or nonheme (Larson, 1997). Heme sources such as meat are efficiently absorbed, and they do not require further processing in the stomach. Nonheme sources are variable, therefore plant sources are poorly absorbed, and many substances in plants even inhibit iron absorption, such as phytates in many nuts (almonds, walnuts), cereals (maize, rice, whole wheat flour), legumes, plant proteins (soybeans, nuts, lupines), and tannates (tea, coffee) (Larsen, 1997). Larsen (1997) lists the nondietary factors for iron deficiency anemia, such as children with low birth weight, blood loss, hemorrhage, chronic diarrhea, parasitic infection (schistosmiasis, hookworm), and genetic diseases (thalassemia, sickle cell anemia, nonsperocytic hemolytic anemia, spherocytosis, and hereditary elliptocytosis).

Hematological disorders can easily affect skeletal elements because the red bone marrow is the production site of blood (Aufderheide and Rodriguez-Martin, 1998; Larsen, 1997). Ortner (2003) points out that anemia is commonly caused by defects in the production or retention of abnormal hemoglobin or by iron deficiencies. The skeletal changes include perpendicular orientation of the trabeculae in the cranial diploë ("hair-on-end"), expansion of the diploë (hyperostosis), thinning of the compact cranial bones, orbital roof thickening, and postcranial changes that occur most frequently in the metaphyses of long bones (Larsen, 1997). In societies relying on agriculture, iron deficiency can be caused by the lack of iron in the soil itself (Schutkowski and Grupe, 1997).

Porotic Hyperostosis and Cribra Orbitalia

Porotic hyperostosis and cribra orbitalia are both hematological conditions most likely caused by iron deficiency (Larsen, 1997; Aufderheide and Rodriguez-Martin, 1998; Fairgrieve and Molto, 2000; Facchini et al., 2004; Walker et al., 2009)

Porotic hyperostosis is a descriptive expression for any porous enlargement of bone tissue that finally results in a porotic external surface of the skull vault that is usually also thickened (Lallo et al., 1977; Ness et al., 1978; Stuart-MacAdam, 1997; Aufderheide and Rodriguez-Martin, 1998; Ortner, 2003). Ortner (2003) points out that in the earlier literature, the term porotic hyperostosis was only used to describe bony changes that occur in anemia, but in his opinion this was an unfortunate usage that should be abandoned and the above mentioned description should be used instead. Stuart-MacAdam (1985) and Aufderheide and Rodriguez-Martin (1998) show that the condition usually only affects the frontal and the parietal bones, and less frequently the occipital bone. Porotic hyperostosis can be caused by different conditions such as anemia, scurvy, rickets, osteomyelitis, periostitis, inflammatory processes of the scalp (Larsen, 1997; Ortner, 2003). Many researchers suggest iron deficiency anemia as the main cause for porotic hyperostosis (Lallo et al., 1977; Ness et al., 1978; Stuart-MacAdam, 1997; Aufderheide and Rodriguez-Martin, 1998; Fairgrieve and Molto, 2000; Rothschild, 2000). Other researchers suggest parasitic invasion as the major cause that affects the bone due to the blood loss (Holland and O'Brien, 1997). Facchini et al. (2004) suggest changes in alimentary habits, poor diet and/or gastrointestinal infections, and parasite infections as the main causes for acquired anemia.

There are two types of porotic hyperostosis: 1) porotic hyperostosis of the skull vault, known as cribra crania externa and 2) porotic hyperostosis of the orbital roofs, known as cribra orbitalia (see next section). The development of porotic hyperostosis is characterized by four stages (see Table 3).

Table 3: The four stages in the development of porotic hyperostosis (after Ortner, 2003).

Phase	Characteristics
Phase 1	The surface of the cranial vault displays small, porotic areas that consist of fine, regular pitting. These changes are commonly found on the parietals or the frontal. The external lamina in the affected areas is very thin, reduced, and disintegrated.
Phase 2	The area of the porotic skull surface is massively enlarged and the pitting displays a more irregular pattern. The middle region of the squama and some other areas of the skull can be affected as well. The external lamina is highly disintegrated in larger areas. The so called "hair-on-end" phenomenon starts to develop: the skull vault becomes slightly thickened.
Phase 3	The affected area on the skull has distinctly thickened. The trabeculae of the diploë take on a parallel orientation, therefore the hair-on-end phenomenon has fully developed.
Phase 4	The skull vault shows an advanced thickening of the affected areas. The large holes in the center of the thickened areas are confluent, and form space and labyrinth-like structures.

Most individuals affected by porotic hyperostosis are juveniles younger than 5 years of age, because in young children the marrow spaces are filled with red marrow and therefore, the expansion caused by an increase in marrow cells can result in increased stress on the bone (Larsen, 1997).

Cribra orbitalia is a type of porotic hyperostosis that solely affects the orbital roofs (Webb, 1982; Larsen, 1997; Schutkowski and Grupe, 1997; Aufderheide and Rodriguez-Martin, 1998; Fairgrieve and Molto, 2000; Wapler et al., 2004). The condition can be categorized into different grades (see Table 4; Hengen, 1971). Webb (1982) classifies cribra orbitalia into three categories (see Table 5).

Table 4: Different grades in cribra orbitalia (after Hengen, 1971).

Grade	Characteristics
Grade 1	- Net of shallow furrows on the orbital roof with a number of tiny holes in the tabula externa
Grade 2	- Several deeper grooves are added - The holes have a diameter of up to 1 mm - Holes are more numerous than in grade 1
Grade 3	- Still deeper grooves or furrows - Some holes have a diameter of 1-2 mm
Grade 4	- Even bigger holes in the tabula externa - Not more than 2-3 mm wide
Grade 5	- Bigger and smaller holes - Beginning of osteophyte formation
Grade 6	- Well developed osteophytes which form a wrinkled net of trabeculae
Grade 7	- Presence of very prominent, several millimeter long osteophytes

Table 5: The different categories of cribra orbitalia (after Webb, 1982; Fairgrieve and Molto, 2000).

Category	Name	Characteristics
Category 1	Porotic	- Mildest form - Consists of a number of small and fine foramina forming a round or elongated cluster
Category 2	Cribrotic	- The foramina become larger in diameter - The area involved may be larger
Category 3	Trabecular	- Most extreme form - The large foramina become confluent and channeling produces deeply etched furrows and/or a completely eroded outer table consisting of a trabeculated network of islets and strands of bone - The trabeculae vary in size

Wapler et al. (2004) discuss that the main reasons for an anemic status is blood loss due to likelihood of accidents, menstruation, childbirth, vitamin C deficiency, and gastrointestinal ulcers. Hotz (2004) points out that there is a direct connection between qualitative nutrition and a good overall health and that a starving body is much more susceptible to diseases, infectious diseases in particular. The protein insufficiency during the fall and winter seasons added to the mortality of past populations (Hotz, 2004).

Porotic hyperostosis and cribra orbitalia are more prevalent in juveniles and that females are more frequently affected by the condition (Fairgrieve and Molto, 2000; Wapler et al., 2004). Children are usually born with an extra supply of iron to compensate for the eventual low iron content of the mother's breast milk. Under normal conditions, this supply lasts for about six months to ensure the vital level of iron necessary for normal development (Carlson et al., 1974).

Neoplastic Conditions

Osteoma

An osteoma, or also known as button osteoma, is a benign, slow-growing tumor which occurs almost exclusively in the skull (Brothwell and Sandison, 1967; Aufderheide and Rodriguez-Martin, 1998; Eshed et al., 2002; Ortner, 2003; Sewell et al., 2008). It consists mostly of dense lamellar bone with vascular channels but with minimal marrow space (Aufderheide and Rodriguez-Martin, 1998; Ortner, 2003). It is most frequently located on the outer table and is presented as a smooth bump that is usually not bigger than 2 cm in diameter, sharply demarcated, and usually solitary (Aufderheide and Rodriguez-Martin, 1998; Ortner, 2003). Osteomas most commonly occur on the frontal and the parietal bones in approximately 35% of the population (Ortner, 2003; Sewell et al., 2008). The different authors do not share a common opinion about the prevalence in sex. Aufderheide and Rodriguez-Martin (1998) report that button osteoma occur more in males, Eshed et al. (2002) account that females are more frequently affected, and Sewell et al. (2008) only mention that the sex distribution is controversial. The condition appears during the fourth and fifth decades of life (Aufderheide and Rodriguez-Martin, 1998; Eshed et al., 2002).

Miscellaneous Conditions

Parietal Thinning

Parietal thinning is a condition that affects the parietal bones and results in unilateral or bilateral depressions. This thinning involves the outer table that disappears first and the diploë that get absorbed (Phillips, 2007). Since the first mention in the 1800's, many terms were used to describe the condition, such as biparietal thinning, malum senile biparietale, senile biparietal atrophy, symmetrical thinness, unilateral or symmetrical thinning, developmental thinness, biparietal osteodystrophy, osteoporosis calvarii symmetrica, morbus Rokitansky, depressio biparietalis circumscripta, and carpet bag skull (Greig, 1926; Jackson, 1957; Mikic, 1976; Wilms et al., 1983; Phillips, 2007). Parietal thinning can be found on every continent and in a time period spanning at least 9500 years. CT and MRI offer the most reliable means of frequency determination (Wilms et al., 1983; Phillips, 2007)

Phillips (2007) points out that even today, the etiology of parietal thinning is still unknown and the different researchers cannot reach a consensus. He lists all the etiologies that have been proposed for the past 150 years, including pathology, senile atrophy, constant pressure, muscle movement, developmental dysplasia, growth defect, post-menopausal osteoporosis, gonadal insufficiency, or hormonal changes (Phillips, 2007). Another possible etiology is heredity due to a few cases where a positive blood relationship could be determined (Strouhal, 2003; Phillips, 2007). The known issues for parietal thinning include predominance in females and old adult individuals (older than 50 years), and for its relatively uncommon occurrence (Phillips, 2007). In rare cases, parietal thinning may occur in younger adults (Brothwell and Sandison, 1967).

G. Elliott Smith (c.f. Phillips, 2007) stated that thinned parietal bones were very common in ancient Egypt within the elite classes between the 4th and the 20th dynasties (Old Kingdom to New Kingdom). Elliott Smith hypothesized that parietal thinning resulted from bone loss due to senile aging and pressure atrophy due to the wearing of the heavy ancient Egyptian elite wigs (Brothwell and Sandison, 1967; Phillips, 2007).

Diseases of the Dentition

Dental Abscesses

Abscesses of a tooth lead frequently to its exfoliation and cause a remodeling process that usually destroys the alveolus and reduces the size of the alveolar process at the site of the tooth loss (Ortner, 2003). The etiology of abscesses is still obscure. Some researchers state that abscesses are caused by *Fusobacterium nucleatum*, *Streptococcus milleri*, or *Streptococcus mitis* (Oguntebi et al., 1982; Williams et al. 1983; Lewis et al., 1986). Herrera et al. (2000a) report that abscesses can be caused by various sources, such as pulp necrosis, periodontal infection, trauma (may be caused by uncommon things, such as a piece of a toothpick, a popcorn kernel, or a piece of dental floss), or surgery. Abscesses originate at the apex of the root canal, commonly of a non-vital tooth, and are associated with the destruction of the alveolar bone (Williams et al., 1983; Herrera et al., 2000a; Herrera et al., 2000b). Symptoms for a dental abscess include pain, edema, redness, swelling, bleeding after probing, and suppuration (Herrera et al., 2000b). Periapical abscesses can be fatal if the resulting infection spreads into the sinuses (Williams et al., 1983). Although periapical abscesses can occur on the roots of every tooth, Herrera et al. (2000b) conclude that molars are most frequently affected with an occurrence of 69%. Most abscesses happen in patients that already suffer from periodontal disease (Herrera et al., 2000b).

In many cases, penicillin is used to treat an abscess, but a study conducted by Fouad et al. (1996) showed that there is no significant difference between antibiotics and other medication such as ibuprofen. In some patients, the treatment with antibiotics even accelerated the abscess formation (Herrera et al., 2000a).

Dental Caries

Dental caries, or also known as cavities, is an infectious disease that destroys the tooth structure, the root and the crown (Brothwell and Sandison, 1967; Aufderheide and Rodriguez-Martin, 1998). Ortner (2003) mentions that caries are caused by acid-producing bacteria in dental plaque that initiate the destructive process. Larsen (1997) argues that caries do not refer to lesions in teeth resulting from the invasion of microorganisms, but that the disease is characterized by the focal demineralization of dental hard tissues by organic acids produced by bacterial fermentation of dietary carbohydrates, especially sugars. The disease is manifested in different stages from small enamel opacity to extensive cavity formation on crowns and roots that may result in tooth loss. A high risk for infection occurs if the pulp chamber of the tooth is exposed and untreated caries can result in the destruction of the entire crown and/or significant portions of the root (Ortner, 2003).

According to Larsen (1997), there are several modifying factors for the development of dental caries: crown size and morphology, enamel defects, occlusal surface attrition, food texture, oral and plaque pH, speed of food consumption, some systemic diseases, age, child abuse, heredity, salivary composition and flow, nutrition, periodontal disease, enamel elemental composition, and the presence of fluoride and other geochemical factors.

Duyar and Erdal (2003) show that caries rates are important for the reconstruction of the dietary habits and the life styles of past populations due to the relationship of caries and sugars that had been introduced to the diet.

Periodontal Disease

Periodontal disease, or periodontitis, is an inflammation of the periodontium (gingival, periodontal ligament, alveolar bone, and cementum) that often results in minor to severe resorption of the alveolar process which creates an unusually large distance between the bone and the cementoenamel junction of the tooth (Lavigne and Molto, 1995). Periodontal disease is caused by several irritants such as bacterial plaque that becomes calculus due to calcification of plaque, and living or dead microorganisms (Clarke, 1990; Aufderheide and Rodriguez-Martin, 1998; Ortner, 2003). Another cause of periodontal disease can be gingivitis, an inflammation of the teeth surrounding soft tissues, if it remains untreated (Ortner, 2003). Gingivitis can be caused by penetrating foreign bodies, major local trauma, or most frequently the loss of interproximal contact (Aufderheide and Rodriguez-Martin, 1998).

In a progressive phase of periodontal disease, the roots of the teeth may be exposed and tooth loss may occur. Aufderheide and Rodriguez-Martin (1998) classify periodontal disease as generalized or localized. Generalized periodontal disease means that all teeth are affected and the reduction of the alveolar bone occurs horizontally. Localized periodontal disease occurred more frequently in past populations than in modern societies. It occurs interdentally and creates vertical defects between the root of the tooth and the alveolar bone. Most commonly, the posterior teeth, the second and the third molars, are affected (Clarke, 1990; Aufderheide and Rodriguez-Martin, 1998). Clarke (1990) and Larsen (1997) point out that if periodontal disease is unchecked and untreated, the skeletal support for the teeth diminishes and exfoliation may occur. Once a tooth is lost, the alveolus will be remodeled. Furthermore, Larsen (1997) lists the influencing factors, such as bacteria, poor oral hygiene, malocclusion, nutritional status, pregnancy, puberty, and psychological stress.

Dental Enamel Hypoplasia

Dental enamel hypoplasia, or linear enamel hypoplasia, is a defect in the structure of the enamel of the tooth that is represented as defined, linear, horizontal grooves of reduced enamel thickness (Brothwell and Sandison, 1967; Goodman and Armelagos, 1988; Hillson and Bond, 1997; Aufderheide and Rodriguez-Martin, 1998; Guatelli-Steinberg, 2003; Guatelli-Steinberg et al., 2004; Halcrow and Tayles, 2008; Martin et al., 2008; Ritzman et al., 2008). Aufderheide and Rodriguez-Martin (1998) call the defect a *biological window* that gives the opportunity to detect long-term consequences of biological stress that was not fatal to the individual. However, the stress must be severe and life-threatening, so that the growth of the tooth stops (Aufderheide and Rodriguez-Martin, 1998). The enamel is structured in layers (perikymata) that represent the sequence of the development of the tooth crowns (Hillson, 1992; Hillson and Bond, 1997). The defect can be characterized as horizontal furrows, pits, or planes. Furrows are the most frequent type of hypoplastic enamel defect that can be divided into three elements: its occlusal wall, its floor, and its cervical wall. Pits or point form defects usually line up in a row around the circumference of the crown. Exposed-plane-form defects consist of brown striae (Hillson and Bond, 1997). The teeth the most affected are the maxillary central incisors and the mandibular canines (Lewis, 1997; Aufderheide and Rodriguez-Martin, 1998). Dental enamel is a unique material because it does not remodel (Goodman and Armelagos, 1988).

The dental enamel hypoplasia defect is primarily caused by growth disruptions to the cells that are responsible for the enamel matrix formation (amelogenesis) in growing teeth (Hillson and Bond, 1997). The factors causing dental enamel hypoplasia include malnutrition, hemolytic disease of the newborn, premature birth, dietary deficiencies of vitamins A, C, and D, childhood fevers, tuberculosis, congenital syphilis, and newborn hypoxia (Hillson and Bond, 1997; Aufderheide and Rodriguez-Martin, 1998; Guatelli-Steinberg, 2003). Ortner (2003) argues that the stimulating cause must occur before the age of 6 years to affect the permanent dentition. Aufderheide and Rodriguez-Martin (1998) state that the disturbance occurs most frequently during the first year of life and only in 2% in children between the ages of 3 to 7 years. In most societies, the weaning process takes place between the ages of 2 to 4 years (Lewis, 1997). The change from breast milk to other food seems like a realistic stress factor in the early life of a child.

An important question in the analysis of dental enamel hypoplasia is when in the life of the individual the disorder occurred and how long it lasted. Several studies have been conducted and have established that the measurement from the occlusal and cervical margins of each defect to the cementoenamel junction of the crown allows for the establishment of when the insult occurred (Hillson and Bond, 1997). For example, in a furrow causing defect, a chronic disruption may involve 20 or more pkg (pkg = perikyma groove), a short disruption may only involve 5 pkg. Defects on different teeth of one individual can be matched, because the teeth were developing at the same time (Hillson, 1992). A study conducted by Goodman and Armelagos (1988) on a sample from Dickson Mounds, Illinois, revealed the relationship between dental enamel hypoplasia and longevity of a society. Individuals with no hypoplasia lived 35.8 years, individuals with one hypoplasia stress period lived 31.6 years, and individuals with two or even more stress periods lived for only 25.6 years.

CHAPTER THREE: MATERIALS AND METHODS

Dayr al-Barshā and Sheikh Said

Dayr al-Barshā is located on the east side of the Nile, approximately 260 km in the south of Cairo in the province of Minia (Figure 1). It is situated almost opposite of al-Mallawi and al-Ashmunayn. In the ancient periods this area was known as *Khemenu,* and in the Late Period (Greco-Roman Period) *Hermopolis Magna.* Al-Ashmunayn was the religious place of Thoth, the ibis headed god of wisdom and writing, and the location of the main temple of this god in ancient Egypt. Immediately in the south of Dayr al-Barshā is Tell el-Amarna, the capital of the ancient Egyptian empire for a short period of time during the New Kingdom, was founded by the pharaoh Akhenaton in honor of the god Aten.

Ancient Egypt was divided into 42 nomes (Greek "nomos" = district or province), 20 nomes in Lower Egypt and 22 nomes in Upper Egypt; Bard, 2008). Al Ashmunayn was the capital of the 15th nome of Upper Egypt, the Hare Nome (De Meyer, 2008). The nomarchs of the Old Kingdom until the 6th dynasty were buried in the cemetery of Sheikh Said which is located about 4 km in the south of al-Barshā (Brunner, 1936; De Meyer, 2008).

Dayr al-Barshā was the main necropolis of al-Ashmunayn/Hermopolis from the 6th dynasty on and therefore the burial place of the nomarchs of the Hare Nome (De Meyer, 2008).

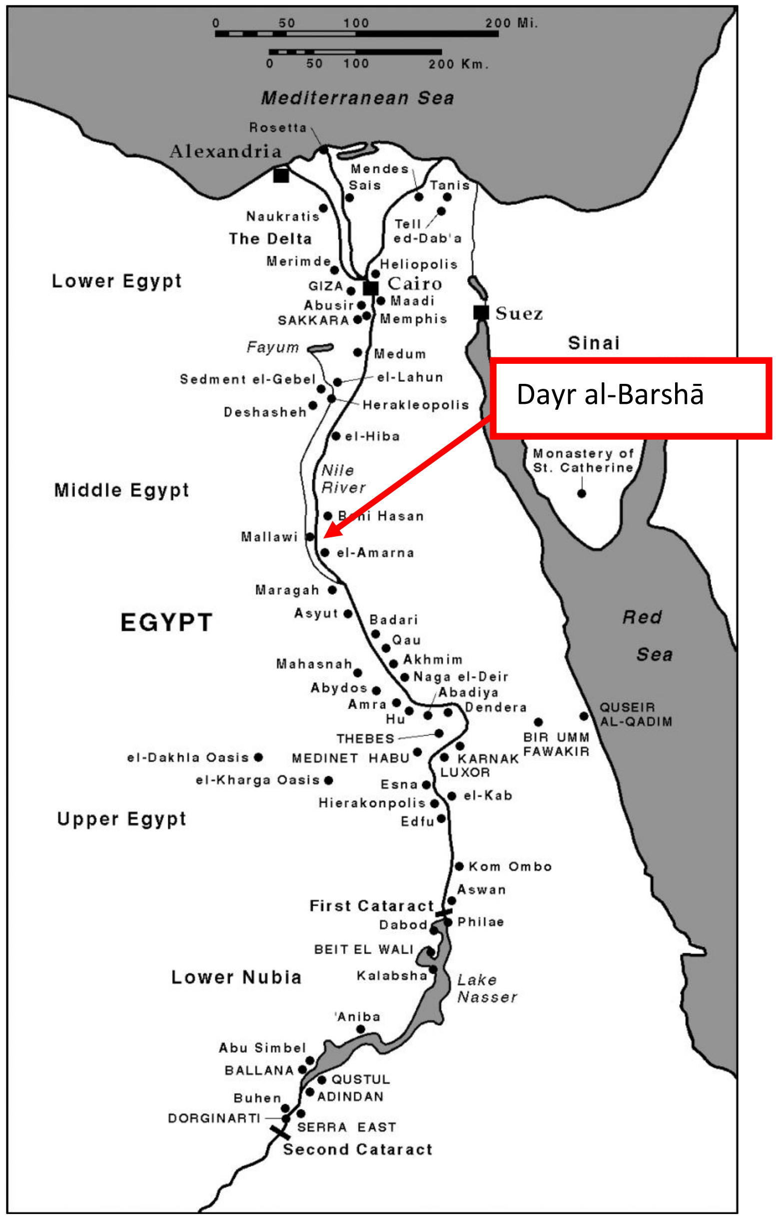


Figure 1: Map of Egypt. The arrow points to the location of Dayr al-Barshā which is situated in the east of Mallawi and 15 km in the north of Tell el-Amarna.

(Map after http://oi.uchicago.edu/research/lab/map/maps/egypt.html)

The site of Dayr al-Barshā consists of the desert plain, the mountainous area and the Wadi Nakhla, a valley which is located directly in the east of the modern village of Barshā. The Wadi Nakhla is a large system of different quarries which were used from the Old Kingdom to the Coptic Period. Dayr al-Barshā is not only interesting due to the fact that nomarchs were buried at this site, but also because all the time periods of ancient Egypt (see Table 6) are present (Willems, 2002).

Table 6: The different time periods in the history of ancient Egypt (after Shaw, 2000).

Period	**Duration**
Old Kingdom	2686 – 2160 BC
First Intermediate Period	2160 – 2055 BC
Middle Kingdom	2055 – 1650 BC
Second Intermediate Period	1650 – 1550 BC
New Kingdom	1550 – 1069 BC
Third Intermediate Period	1069 – 664 BC
Late Period	664 – 332 BC
Ptolemaic Period	332 – 30 BC
Roman Period	30 BC – AD 395
Coptic Period	AD 395 – present (Christian era)

De Meyer (2008) reports on all past excavations, surveys, and epigraphical work at Dayr al-Barshā. Sayce was the first who conducted an epigraphic survey in 1885, followed by Petrie and Griffith in 1886, Major and Brown in 1889, and Newberry and Griffith between 1891 and 1893. The first excavation was conducted in 1894 by the Service des Antiquités who never published their findings. The first well documented excavation was conducted by Daressy in

1897. He excavated mainly the area in front of the tomb of Djehutihotep and the shaft tombs of Sepi I, Sepi II, Sepi III, Nefri, and Gua. In 1990 the University of Leiden, the Boston Museum of Fine Arts and the Philadelphia Museum of Art conducted a joint excavation at Dayr al-Barshā. The two American institutions left the project and in 1992 and at this time Harco Willems launched a collaboration with the Katholieke Universiteit Leuven, and started a new Barshā project which is still ongoing (De Meyer, 2008). At this time, the large area of Dayr al-Barshā was divided into 11 archaeological zones (see Table 7, Figure 2).

Table 7: The different archaeological zones at Dayr al-Barshā (after De Meyer, 2008).

Zone 1	Top of the hill north of the Wadi Nakhla
Zone 2	The level below zone 1. Plateau with nomarchal tombs of the Middle Kingdom
Zone 3	Northward continuation of zone 2: limestone quarries, inhabited since early 5th century AD by Coptic monks
Zone 4	Old Kingdom and First Intermediate Period tombs at the mouth of the Wadi Nakhla, below zone 2
Zone 5	The Wadi Nakhla itself with its extensive pharaonic quarries
Zone 6	Top of the hill south of the Wadi Nakhla
Zone 7	The rock tombs on the southern slope of the Wadi Nakhla
Zone 8	Northern area of the desert plain
Zone 9	Southern area of the desert plain
Zone 10	Antiquities area in the center of the village
Zone 11	Antiquities area on the southern border of Dayr al-Barshā, called el-Tod

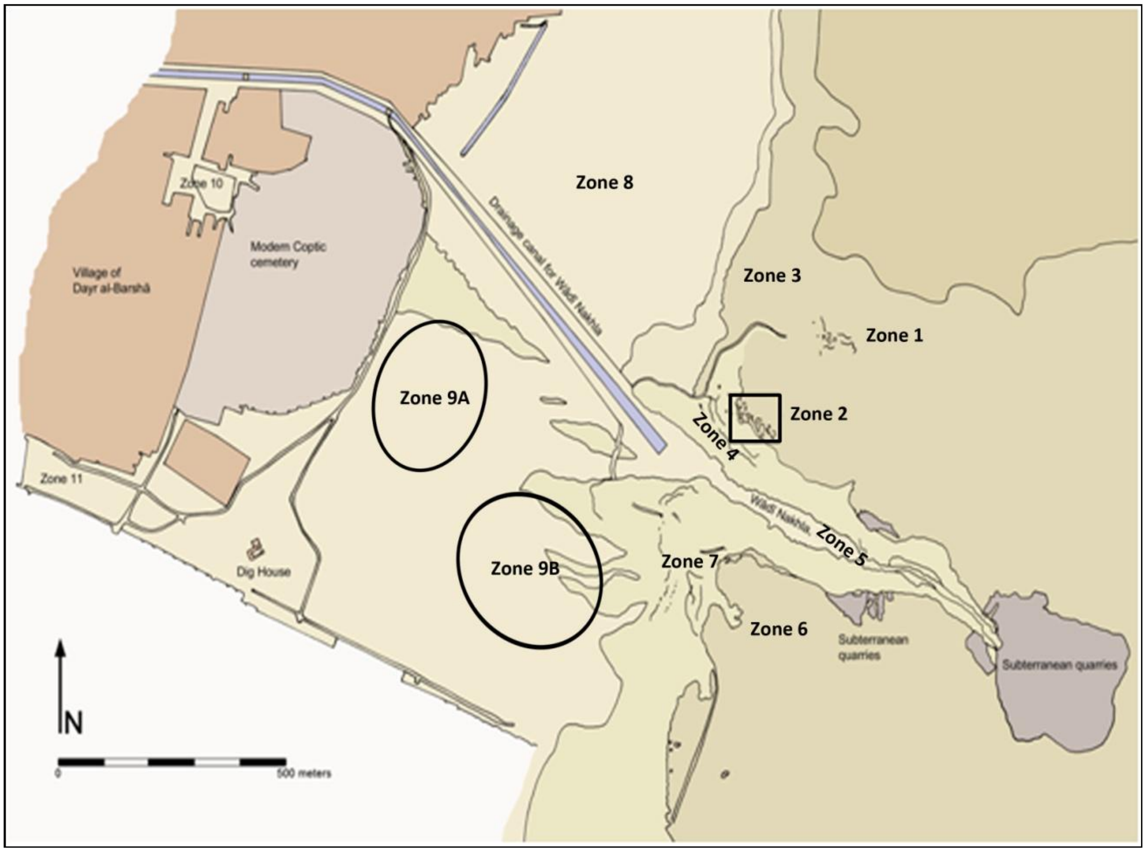


Figure 2: General plan showing all the different archaeological zones in Dayr al-Barshā (after Willems, 2007).

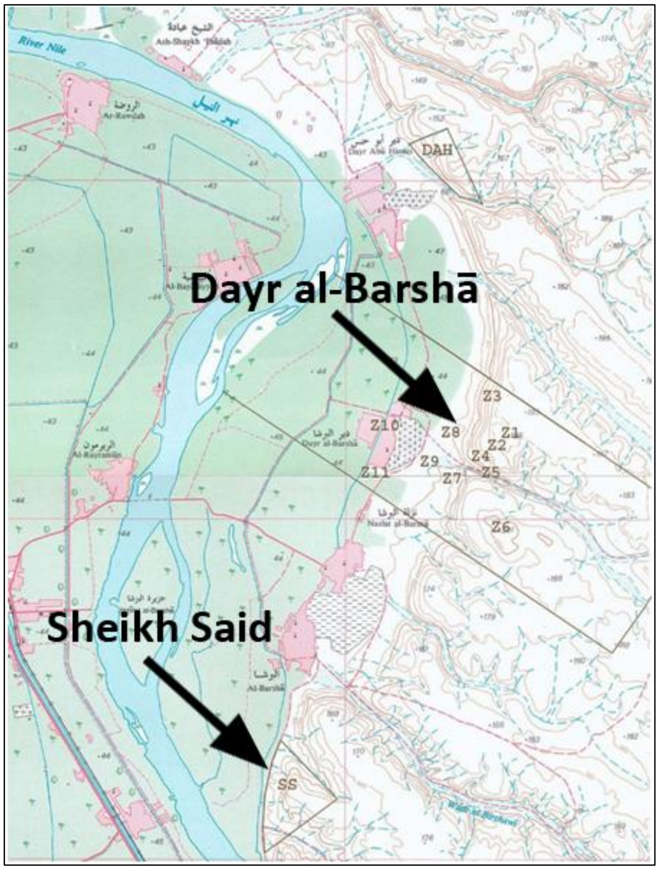


Figure 3: Map showing the locations of Dayr al-Barshā and Sheikh Said (after Willems, 2008).

Zone 2 consists of a plateau in the north of the Wadi Nakhla. This plateau was used by the nomarchs and elite of the Hare Nome as the location of their eternal resting place (Figure 4,Figure 5, and Figure 6). The tombs date to the Middle Kingdom (De Meyer, 2008).

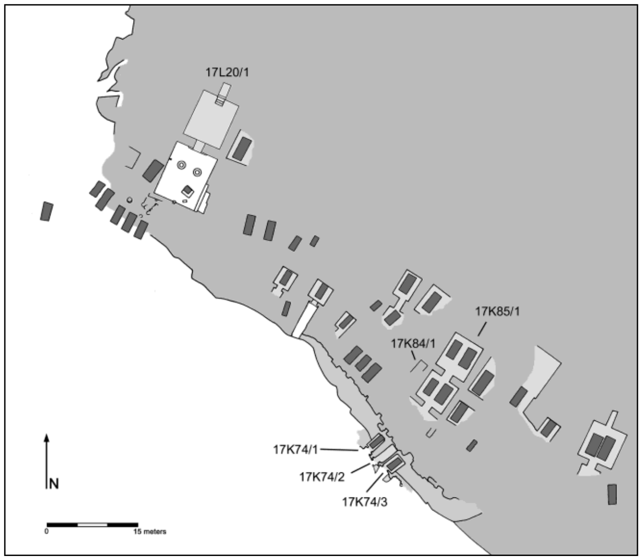


Figure 4: Zone 2, in the north of the Wadi Nakhla, the area in which the nomarchs of the Hare Nome were buried (after Willems, 2006).

Figure 5**:** Area in front of the tomb of Djehutihotep in zone 2.

(http://www.arts.kuleuven.be/bersha/2002%20mission/Deir%20al-Barsha%202002.htm)

Zone 4 is located right below zone 2 at the mouth of the Wadi Nakhla and holds the tombs of the Old Kingdom and First Intermediate Period (Figure 6 and Figure 7). Many tombs in Dayr al-Barshā originate in the Old Kingdom, but were reused later as tombs, quarries, or housing for Coptic monks (De Meyer, 2008). Three shaft types occur in the Old Kingdom rock tombs in zone 4: square vertical shafts, rectangular shafts, and sloping shafts (De Meyer, 2008). The earliest tombs date to the 3rd dynasty and are found on the foothills of the northern and southern hills. Those tombs are surrounded by a superstructure consisting of boulders laid out in circles (De Meyer, 2008). In the excavation season of 2007, the University of Leuven discovered the intact burial of Henu, consisting of the typical rectangular coffin of the First Intermediate Period and Middle Kingdom, several wooden models, such as a boat, women in the process of brewing beer, bread making, and a statue of the tomb owner himself (De Meyer, 2008).

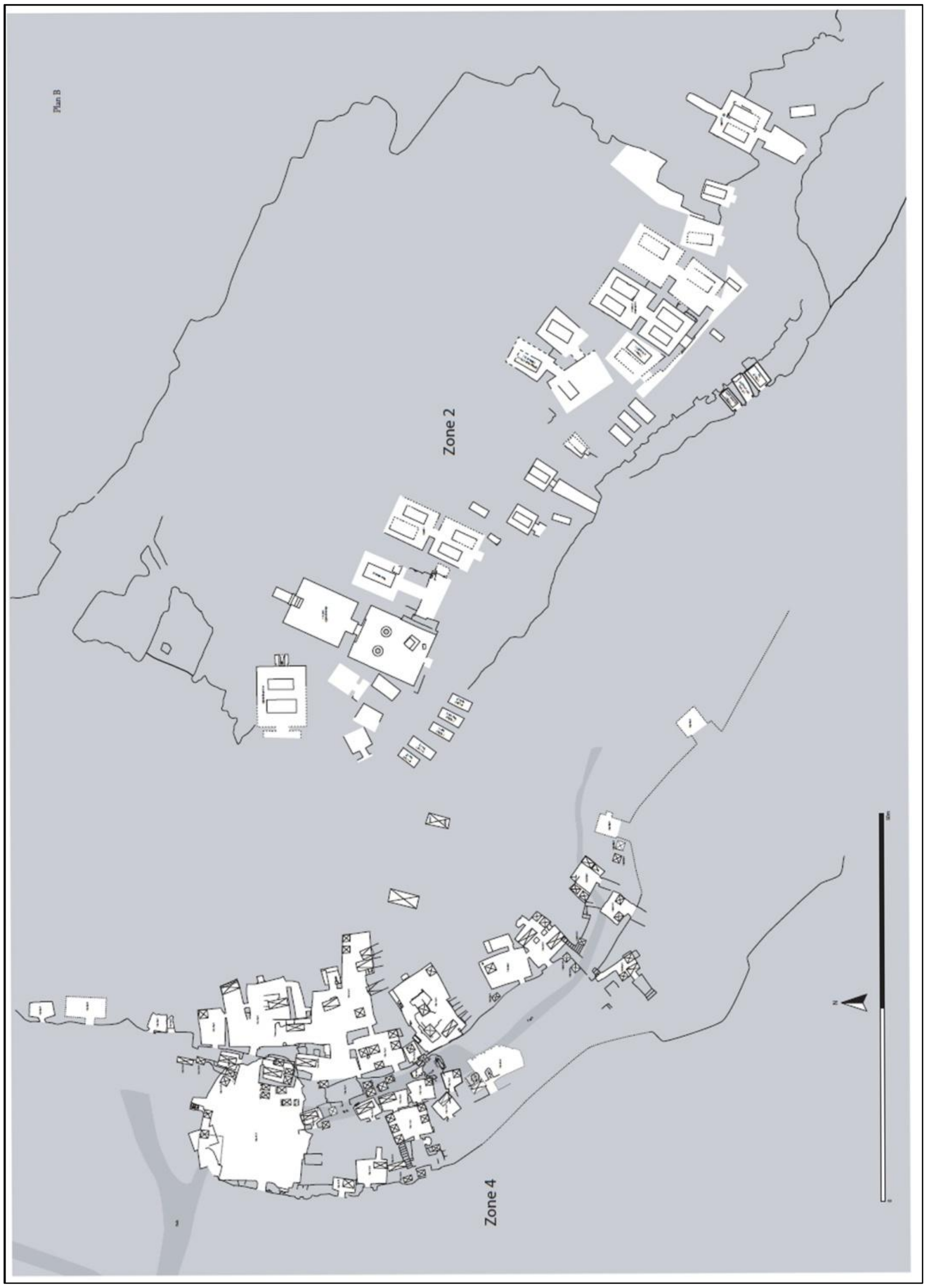


Figure 6: Map showing the proximity between zones 4 and 2, dating to the Old Kingdom and the Middle Kingdom (after De Meyer, 2008).

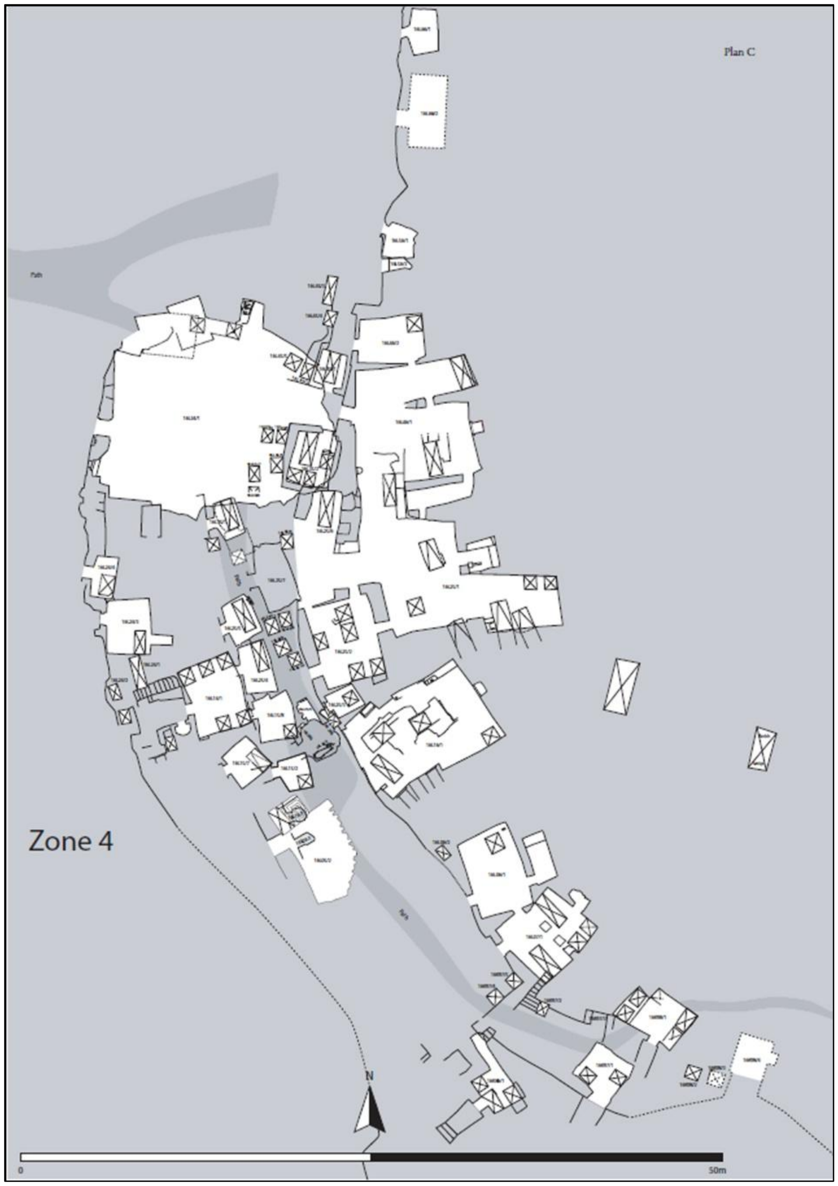


Figure 7: Map of zone 4 dating to the Old Kingdom (after De Meyer, 2008).

Zone 7 consists of Old Kingdom rock tombs (Figure 8) located on the southern slope of the Wadi Nakhla (Willems, 2004).

Figure 8: Examples of tomb entrances in zone 7 dating to the Old Kingdom (after Willems, 2008).

Zone 9 is located in the southern area of the desert plain and was further divided into zones 9A (Figure 9) and 9B (Figure 10). The burials in zone 9A date to the Middle Kingdom while those in zone 9B date to different time periods, such as the first half of the Middle Kingdom, the New Kingdom, and the Roman Period, reflecting the intensive reuse of the tombs (Willems, 2006).

Figure 9: Map of zone 9A. The areas shaded light grey were excavated between 2002 and 2005, the dark grey areas were excavated during the campaign in 2006 (after Willems, 2006).

Figure 10: One example of a burial in zone 9B (individual 2; Sector 122, Feature 7238, Tomb 13J41/1) with a stone enclosure.

Sheikh Said is located about 7 km away from Dayr al-Barshā (Figure 3) approximately midway between Dayr al-Barshā and Tell el-Amarna. The only zone analyzed in Sheikh Said is zone A. Only four burials were discovered and no funerary equipment was found (Willems, 2008). This zone dates to the Middle Kingdom. Sheikh Said was the burial place for the nomarchs of the 15th Upper Egyptian nome until the 6th dynasty.

The excavation season of 2009 shed light on the beginning phase of the use of Dayr al-Barshā as a necropolis. The team unearthed in zone 8 on the slope of the north hill burials that can be dated to the 1st dynasty in the Early Dynastic Period, starting with the unification of Upper and Lower Egypt at around 3100 BC (Shaw, 2000). The burials consist of round pits in which the dead were buried in a round coffin in a fetal position. The superstructures of those tombs consist of large boulders (personal communication, T. Dupras).

Sample

There are a total of 18,904 bones and bone fragments (16,850 adult and 2,054 juvenile) in Dayr al-Barshā and a total of 959 bones and bone fragments (918 adult and 41 juvenile) in Sheikh Said. Additionally, there are not only skeletal remains present, but mummified remains as well. Most skeletal material was excavated in zone 4, with a total of 13,139 bone fragments (Figure 11).

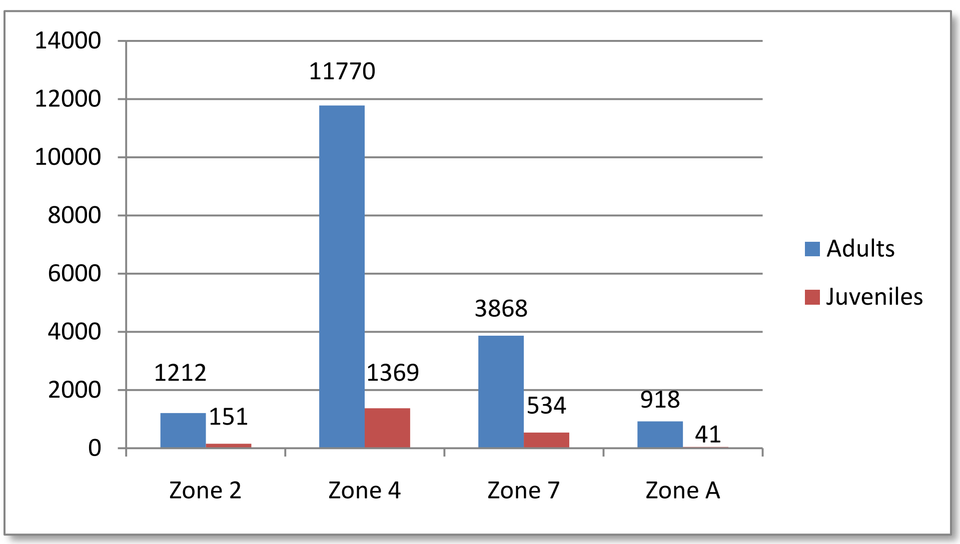


Figure 11**:** A histogram representing the breakdown of the number of bones and bone fragments by the different zones of Dayr al-Barshā (Zones 2, 4, and 7) and Sheikh Said (Zone A). Zone 9 is not present on this graph.

Two different types of burials, multiple and individual, can be observed in Dayr al-Barshā and Sheikh Said. Zones 2, 4, and 7 consist of multiple burials with intermixed skeletal elements which were counted by T. Dupras and L. Williams and listed in Excel spreadsheets. Zones 9A and 9B consist of individual burials that are not present on the graph in Figure 11 due to the completeness of the individuals buried in these areas. Twenty nine complete burials were excavated in zone 9A and seven burials in zone 9B. Those complete burials were counted as individuals and not as loose skeletal elements.

A total MNI of 198 individuals (145 adults and 53 juveniles) was recovered from the sites of Dayr al-Barshā and Sheikh Said. 91 adults and 43 juveniles date to the Old Kingdom, and 47 adults and 10 juveniles date to the Middle Kingdom (Figure 12). Seven individuals were discovered in zone 9B which is not represented in the graph in Figure 12 due to the intermixture of time periods.

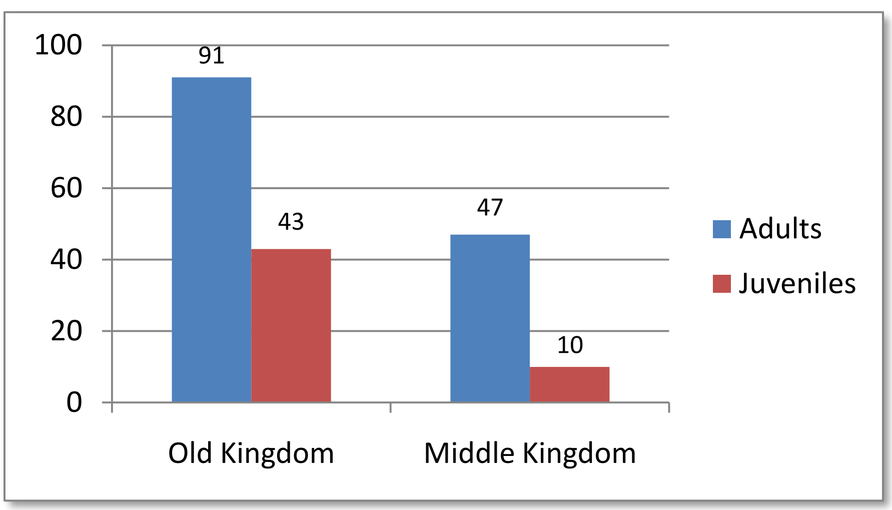


Figure 12: Graph showing the distribution of adult and juvenile individuals found in zones 2, 4, 7, and 9A in Dayr al-Barshā and zone A in Sheikh Said.

Methods Used

The study material of this thesis consists of human remains that were originally examined by Drs. Tosha L. Dupras and Lana Williams, and listed in 36 Microsoft Excel worksheets that were divided into columns labeled *zones*, *sectors*, *features*, *date*, *excavator*, *element*, *side*, *number*, *adult/juvenile*, *complete*, and *comment*. Furthermore, osteological and archaeological reports of each zone provided further information about the zones and burials.

As a guideline for the classification of the different paleopathologies in this thesis, the following categorizations made by Aufderheide and Rodriguez-Martin (1998) were adopted: traumatic conditions, joint diseases, infectious diseases, neoplastic conditions, diseases of the dentition, hematological disorders, diseases of the viscera, congenital conditions, and miscellaneous conditions.

The sites of Dayr al-Barshā and adjacent Sheikh Said provide two different types of burials: multiple burials/ossuaries (zones 2, 4 and 7 in Dayr al-Barshā and zone A in Sheikh Said) and individual/single burials (zones 9A and 9B in Dayr al-Barshā). The remains recovered from the multiple burial zones are highly disturbed and mixed and the skeletal elements cannot be assigned to particular individuals. In most cases, only the minimum number of individuals (MNI) can be determined by analysis of duplicated skeletal elements. Individual burials on the other hand reveal much more about the individual due to the completeness of the remains. While in multiple burials single paleopathologies only can be marked as present, so can they be assigned to the individual in single burials.

The pictures of the human remains were provided by Tosha Dupras and had been taken during the different field seasons. After choosing the appropriate picture for the individuals, respectively the paleopathologies, they have been processed in Photoshop CS4 to give them a uniform black background and to insert descriptive features, such as arrows and circles.

On the graphs used to display the data the term “occurrences” means that, if not otherwise mentioned, every single observed case of a paleopathology was noted in an Excel worksheet and subsequently the collected data was formatted into a graph.

The approach taken in this thesis is interdisciplinary due to a background not only in physical anthropology but also in Egyptology.

CHAPTER FOUR: THE OLD KINGDOM – RESULTS OF ZONES 4 AND 7 IN DAYR AL-BARSHĀ

Chapter four discusses zones 4 and 7 that can be dated to the Old Kingdom.

Description and Results of Zone 4

Zone 4 is situated at the entrance to the Wadi Nakhla, below the nomarchal plateau of zone 2, and holds Old Kingdom tombs that consist of deep shafts cut into the bed rock of Dayr al-Barshā. This zone was subdivided into 22 sectors. The data derive from T. Dupras and L. Williams who analyzed the burials.

Sector 2, Features 2002-2004, 2006, 2008, 2010, 2013-2016, 2018, 2020-2027 & 2031

A total of 1935 bones and bone fragments (1731 adult and 204 juvenile) were recovered in sector 2. Based on eight adult right temporal, three juvenile right humeri, and three juvenile C2 vertebrae, a MNI of eight adults and three juveniles was determined. The analysis of the excavated pubic bones determined that at least three females and three males were buried in sector 2. By examining the pubic symphyses, the ages of five individuals could be assessed as approximately 35 years for two of the males, 40-45 years for the other male, and 25 years and 30-35 years for the second female (see Table 8). The age of the three juveniles could be determined by measuring three humeri, two radii, and one femur (Table 9). The paleopathologies noted include biparietal thinning on a female cranium, osteoarthritis on a lumbar vertebra, amputated right and left feet, internal lesions on a cranium, cribra orbitalia on an adult and on a juvenile frontal, antemortem tooth loss of all incisors on a mandible (Figure

13). Furthermore mentioned in the data is a fractured right femoral head. The picture (Figure 13) does not reveal if it is a fracture or if it is a case of rheumatoid arthritis.

Individual traits such as septal apertures on both the right and the left humeri were present.

Table 8: List of the age assessments of the three adult males and three adult females in sector 2. The age of the third female individual could not be assessed.

Sex	**Phase**	**Age**	**Range**	**Approximate age**
Male	IVb	35.2 +/- 9.4	23-57	35
Male	IV	35.2 +/- 9.4	23-57	35
Male	V	45.6 +/- 10.4	27-66	40-45
Female	II	25 +/- 4.9	19-41	25
Female	IVb	38.2 +/- 10.9	26-70	40-45
Female	-	-	-	-

Table 9: Summary of the three juveniles found in this sector (after De Meyer, 2008).

Bone	**Side**	**Measurement in mm**	**Estimated Age**
Humerus	Right	92.5	6 months
Humerus	Right	226.0	9 years
Humerus	Right	271.0	12 years
Radius	Left	68.7	6 months
Radius	Right	179.0	9 years
Femur	Right	392.0	12 years

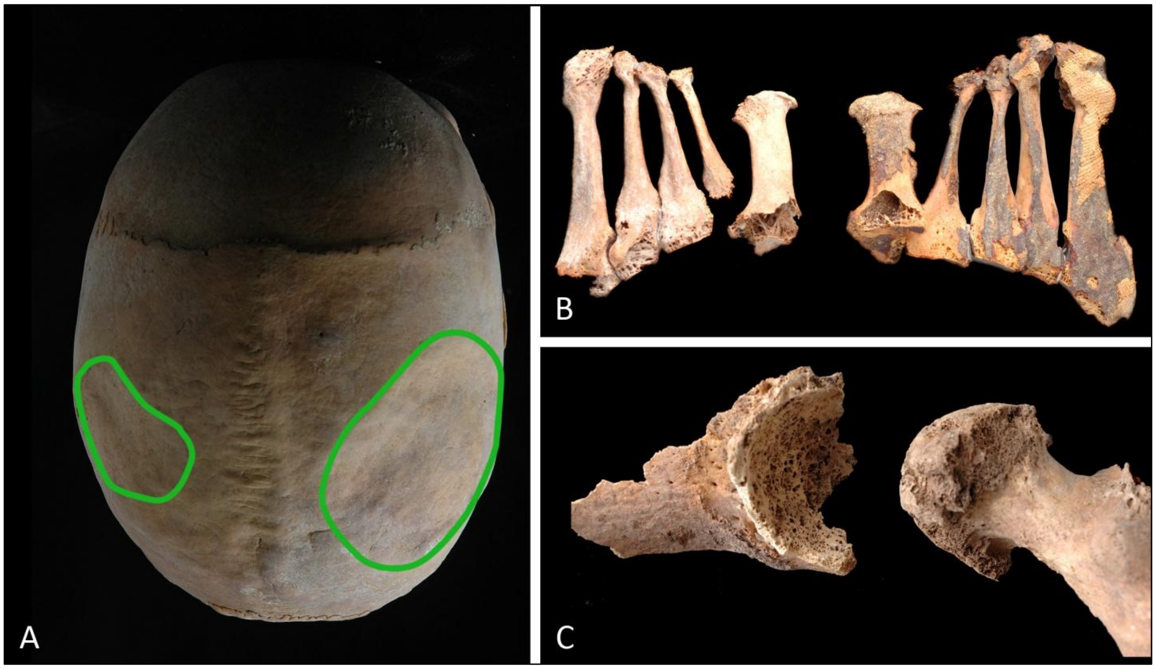


Figure 13: Paleopathologies from sector 2: (A) biparietal thinning on a female cranium, (B) amputations through both feet, and (C) healed fractured right femoral head with the corresponding acetabulum displaying heavy wear (or possibly rheumatoid arthritis).

Sector 3, Features 2051 & 2052

A total of 145 adult bones and bone fragments were excavated. All the skeletal elements needed for an age and sex determination were missing. The MNI was determined to be one adult based on the fact that no skeletal elements were duplicated. The only paleopathologies noted are a healed fracture on a radial shaft and osteoarthritis on a lumbar vertebra.

Sector 4, Features 2100, 2101, 2103, 2109, 2111, 2113, 2118 & 2121

A total of 136 bones and bone fragments (124 adult and 12 juvenile) were recovered. No skeletal elements were duplicated which determined a MNI of one adult and one juvenile. The only paleopathology observed is heavy dental wear on a mandibular molar.

Sector 5, Features 2125, 2150 & 2152-2156

A total of 112 bones and bone fragments (111 adult and 1 juvenile) were excavated. Based on two adult left 1st cuneiform, two adult right calcanei, and no duplicated juvenile skeletal elements, the MNI of two adults and one juvenile was determined. At least one of the adult is a male individual of approximately 35 years of age at death. The analysis of a pubic symphysis determined a phase IV that results in 35.2 +/- 9.4 years with a range of 23 to 57 years. No paleopathologies were noted.

Sector 6, Features 2200 & 2202

A total of 225 bones and bone fragments (192 adult and 33 juvenile) were excavated. Based on three right adult clavicles and three right adult tali, the MNI of three adults and one juvenile was determined. The only paleopathology noted were osteophytes on a thoracic vertebra.

Sector 7, Features 2207, 2209, 2211, 2213 & 2214

The excavation in sector 7 recovered a total of 648 bones and bone fragments (614 adult and 34 juvenile). Based on six right adult metatarsals #4 and two different juvenile stages, a MNI of six adults and two juveniles was determined. The paleopathologies observed include severe compression fractures on three lumbar and one thoracic vertebrae, a fracture on a right humerus (Figure 14), severe dental wear, and an osteoma on a cranial fragment.

Figure 14: Fracture on a right humerus of an individual in sector 7.

Sector 8, Features 2215, 2250-2254, 2258 & 2351

A total of 153 bones and bone fragments (122 adult and 31 juvenile) were excavated. Based on four C2 vertebrae, a MNI of four adults and one juvenile was determined. The only paleopathology noted is heavy dental wear.

Sector 9, Features 2300, 2302, 2304, 2306, 2308 & 2403

During the excavation, a total of 161 bones and bone fragments (151 adult and 10 juvenile) were recovered. Based on two right adult calcanei, two right adult MC1, two right adult MC3, two left adult MT4, and two left adult patellae, a MNI of two adults and one juvenile was determined. The pathologies noted include a fracture of a right MC3, heavy dental wear, and caries on the occlusal surface. A C2 vertebra shows a very unique morphology: the dens is not present on the vertebra (Figure 15).

Figure 15: Some paleopathologies of sector 9: (A) posterior view of the C2 that does not have a dens, (B) anterior view of the C2, and (C) fracture on a right MC3.

Sector 10, Features 2350, 2352, 2353 & 2354

A total of 202 bones and bone fragments (188 adult and 14 juvenile) were excavated in sector 10. Based on two right adult 1st cuneiforms, two left adult calcanei, two right adult MT3, two right adult MT5, and two different juvenile stages, a MNI of two adults and two juveniles was determined. Paleopathologies observed include fractures and heavy dental wear. The L5 vertebra might show sacralization.

Sector 11, Features 2400-2407, 2409-2412 & 2450

During the excavation in sector 11, a total of 4548 bones and bone fragments (4153 adult and 395 juvenile) were recovered. Based on twelve right adult clavicles, seven right juvenile maxillae, and seven left juvenile temporal bones, a MNI of twelve adults and seven juveniles was determined. The paleopathologies noted include three healed fractures, a fusion of a calcaneus and a talus, heavy dental wear, and two cribra orbitalia on one adult frontal and on one juvenile frontal.

Sector 12, Features 2450, 2455, 2456, 2460 & 2462-2464

A total of 1735 bones and bone fragments (1644 adult and 91 juvenile) were recovered. Based on nine right adult tali and five right juvenile iliae, a MNI of nine adults and five juveniles was determined. The list of paleopathologies noted includes heavy dental wear, apical abscesses, periodontal disease, posterior spondylolysis, healed fractures, fractures with callus, healed ulna fracture exhibiting osteomyelitis, osteoarthritis, mastoiditis, porotic hyperostosis, cribra orbitalia on an adult frontal, and on two juveniles (Figure 16 and Figure 17). Furthermore, there is retention of a metopic suture.

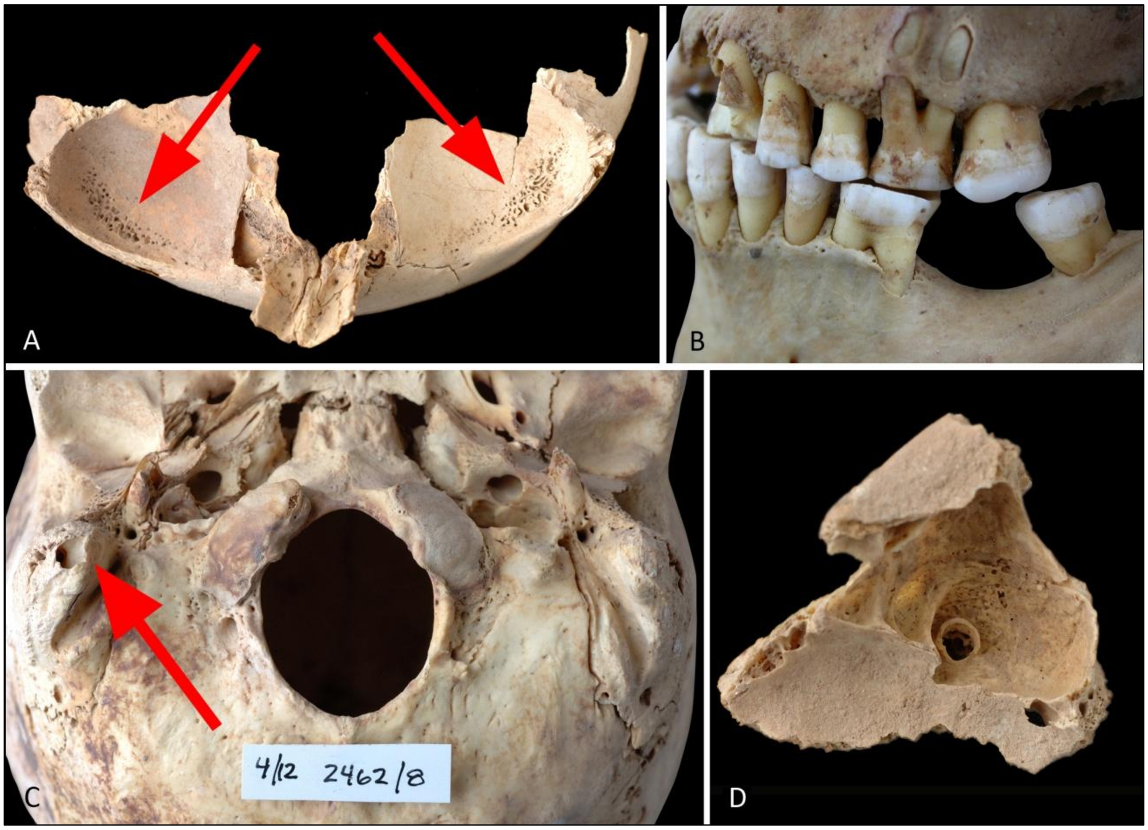


Figure 16: Paleopathologies of sector 12: (A) cribra orbitalia (arrows), (B) periodontal disease and antemortem tooth loss, (C) possible case of mastoiditis (arrow), and (D) abscess in a maxillary sinus.

Figure 17: Paleopathologies of sector 12: (A) posterior spondylolysis on a C1, (B) healed rib fracture, and (C) healed fracture on an ulnar shaft affected by osteomyelitis.

Sector 14, Features 2551-2553 & 2557

A total of 65 bones and bone fragments were excavated (59 adult and 6 juvenile). Based on two right adult scaphoid, a MNI of two adults and one juvenile was determined. No paleopathologies were noted.

Sector 15, Feature 2406

Five adult bones and bone fragments were recovered in this sector and determined a MNI of one adult. No paleopathologies were noted.

Sector 16, Features 2651-2655, 2660-2663 & 2670

During the excavation of this sector, a total of 1305 bones and bone fragments (884 adult and 421 juvenile) were recovered. Based on five right adult 1st cuneiform, five right adult patellae, and five right juvenile malar, a MNI of five adults and five juveniles was determined. The paleopathologies noted on the skeletal elements include biparietal thinning, a healed fracture, a secondary joint surface on a radial fossa, heavy dental wear, dental enamel hypoplasia, caries, apical abscesses, fusion of several thoracic vertebrae caused by DISH (Figure 18 and Figure 19), and two cribra orbitalia (two in orbits with active plaque in one of them) (Figure 20).

Figure 18: Fusion of two thoracic vertebrae of an individual in sector 16.

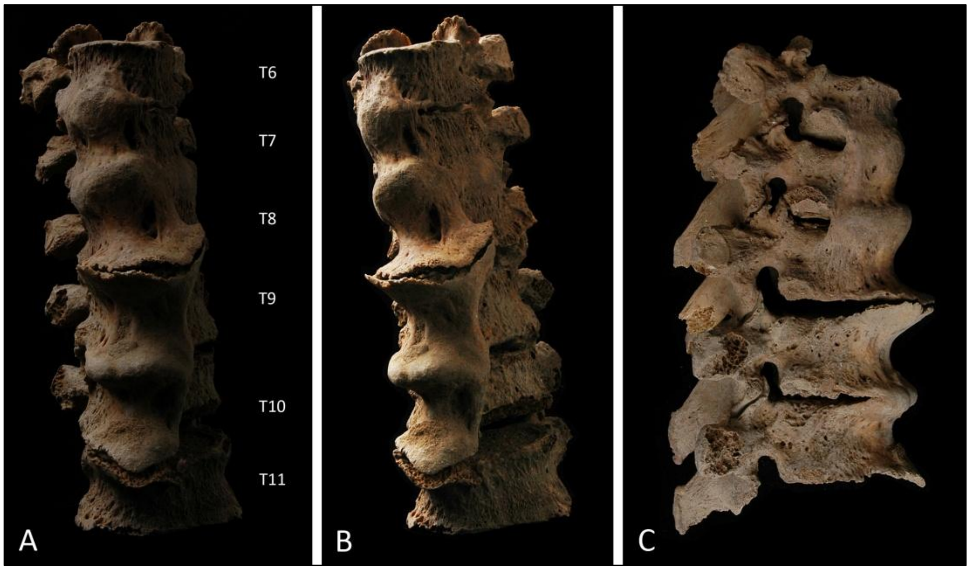


Figure 19: Spine affected by DISH from sector 16: (A) anterior view, (B) anterolateral view, and (C) lateral view.

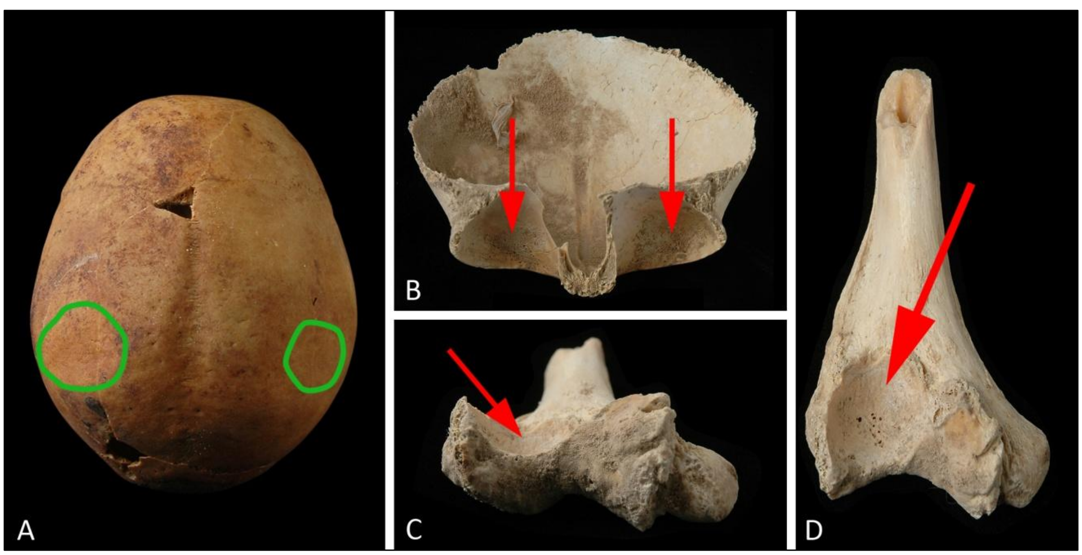


Figure 20: Paleopathologies of sector 16: (A) biparietal thinning, (B) cribra orbitalia in both orbits, (C) close-up of a pseudoarthrosis on a humerus, and (D) a secondary joint surface on a humerus.

Sector 17, Features 2700, 2703-2705, 2710-2712, 2714, 2715, 2720, 2730-2732 & 2735

A total of 1466 bones and bone fragments (1360 adult and 106 juvenile) were excavated. Based on eight right adult calcanei, three left juvenile calcanei, three left juvenile clavicles, and three right juvenile mandibles, a MNI of eight adults and three juveniles was determined. The paleopathologies observed include osteoarthritis, a healed fracture with periostitis, and jaw resorption.

Sector 18, Features 2750 & 2751

A total of only three adult bones and bone fragments were recovered and determined a MNI of one adult individual. No paleopathologies were noted.

Sector 19, Feature 2800

During the excavation, a total of 97 bones and bone fragments (96 adult and 1 juvenile) were discovered. Based on no duplication of skeletal elements, a MNI of one adult and one juvenile individual was determined. The only paleopathology noted was heavy dental wear.

Sector 20, Features 2810 & 2811

A total of 90 bones and bone fragments (88 adult and 2 juvenile) were excavated. Based on two left adult MC2, a MNI of two adult individuals and one juvenile was determined. No paleopathologies were noted.

Sector 21, Features 2850, & 2852-2854

A total of 78 bones and bone fragments (70 adult and 8 juvenile) were excavated. Based on no duplication of skeletal elements, a MNI of one adult and one juvenile was determined. No paleopathologies were noted.

The analysis of the human remains recovered in zone 4 determined a total MNI of 107 individuals, 71 adults and 36 juveniles. The paleopathologies observed are very diverse. For a summary of all the paleopathologies present in zone 4, see Figure 21.

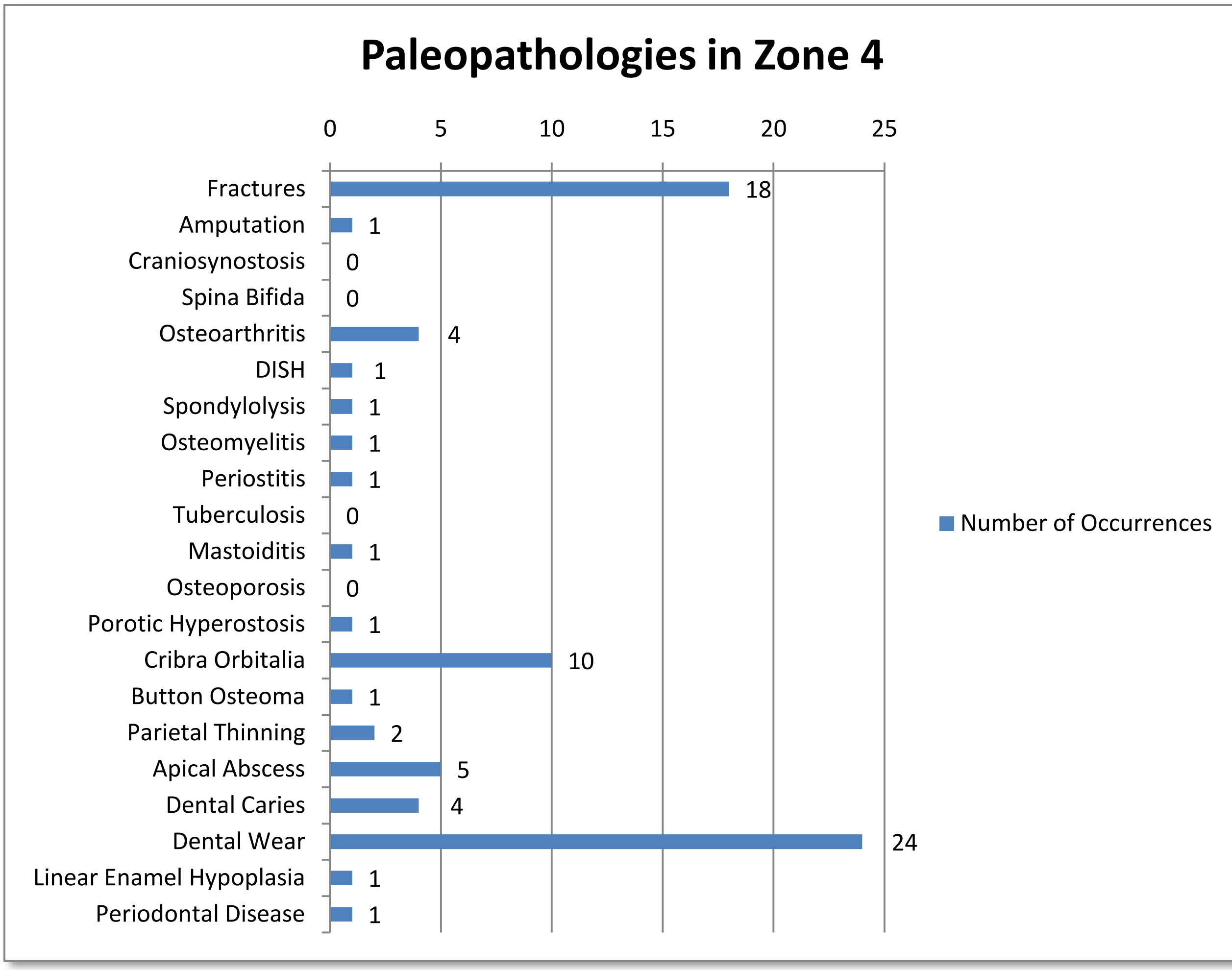


Figure 21: Summary of the different paleopathologies occurring in zone 4.

Description and Results of Zone 7

Zone 7 in Dayr al-Barshā is located on the southern slope of the Wadi Nakhla. The rock cut tombs in this part of the necropolis dates to the Old Kingdom (Willems, 2004). Zone 7 was subdivided into 7 sectors. The data derive from T. Dupras and L. Williams who analyzed the burials.

Sector 1, Features 3050-3058

During the excavation, a total of 288 bones and bone fragments (181 adult and 107 juvenile) were recovered. Based on two left adult tali, a MNI of two adult individuals and one juvenile was determined. The paleopathologies noted include osteoarthritis, lesions in orbits, apical abscesses and heavy dental wear (Figure 22).

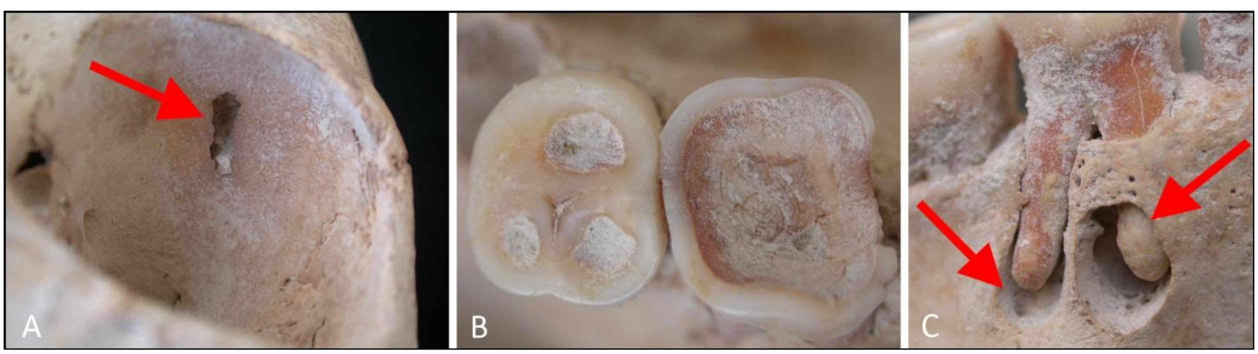


Figure 22: The paleopathologies found in zone 7, sector 1: (A) lesion in orbit, (B) extensive dental wear, and (C) apical abscesses.

Sector 2, Features 3100-3103, 3105 & 3107-3114

A total of 1209 bones and bone fragments (1047 adult and 162 juvenile) were excavated. Based on four adult C2 vertebrae, four right adult calcanei, four right adult clavicles, two right juvenile clavicles, two left juvenile humeri, two left juvenile iliae, two right juvenile ischiae, and two juvenile S2 elements, the MNI of four adults and two juveniles was determined. The paleopathologies noted include parietal thinning and a lesion on a proximal anterior humerus shaft.

Sector 3, Features 3100, 3150-3158, 3160, 3161, 3170-3173, 3180 & 3181

A total of 1955 bones and bone fragments (1896 adult and 59 juvenile) were recovered during the excavation. Based on eight adult temporal bones, the MNI of eight adult and one juvenile was determined. The paleopathologies noted include biparietal thinning on a male cranium (Figure 23), osteoarthritis, heavy dental wear, and apical abscesses.

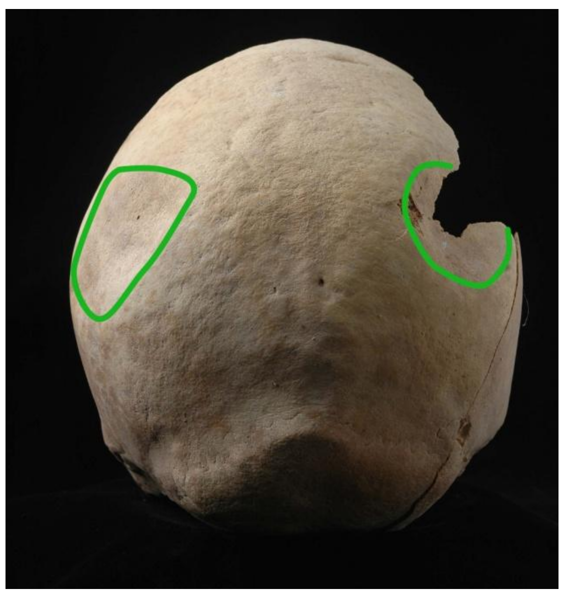


Figure 23: The cranium with biparietal thinning from sector 3.

Sector 4, Feature 3220

A total of 80 adult bones and bone fragments were excavated and determined a MNI of one adult. No paleopathologies were observed.

Sector 5, Features 3251 & 3252

In this sector, a total of 121 bones and bone fragments (117 adult and 4 juvenile) were recovered. The MNI was determined to be one adult and one juvenile because no skeletal element was duplicated. No paleopathologies were noted.

Sector 6, Features 3280-3283, 3285, 3287, 3288, 3290 & 3293

A total of 636 bones and bone fragments (434 adult and 202 juvenile) were excavated. Based on three right adult ribs #3-10 and two right and left juvenile scapulae, the MNI of three adults and two juveniles was determined. The paleopathologies observed include heavy dental wear, osteoarthritis, cribra orbitalia on an adult frontal (Figure 24), fractures, such as on the 1st left rib (Figure 26), and an amputation of a lower arm, leaving only the proximal ulnar head (Figure 25).

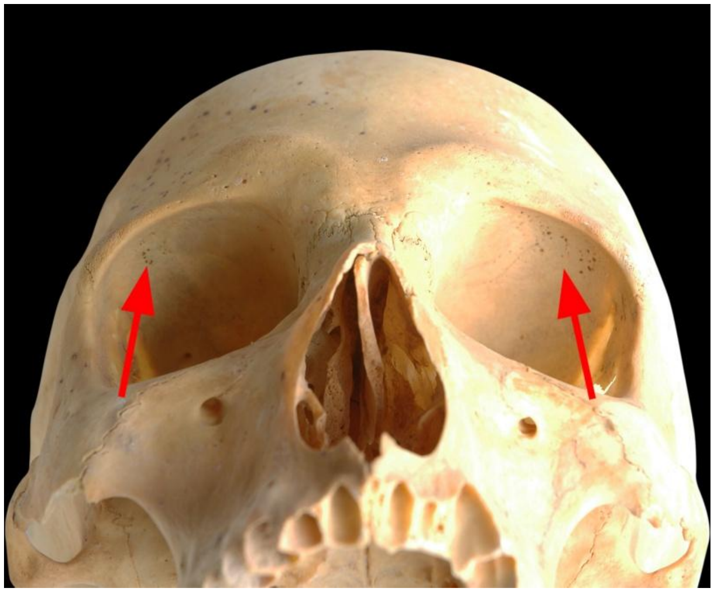


Figure 24: Cribra orbitalia (arrows) in both orbits of an individual from zone 7, sector 6.

Figure 25: The amputation of a lower arm, leaving only the proximal ulnar head: (A) medial view and (B) anterior view.

Figure 26: Fracture on the 1st left rib.

Sector 7, Features 3301, 3305, 3306 & 3308

A total of 113 adult bones and bone fragments were recovered and determined a MNI of one adult. No paleopathologies were noted on the skeletal elements.

The analysis of the human remains recovered in zone 7 determined a total MNI of 27 individuals, 20 adults and 7 juveniles. For a summary of all paleopathologies present in zone 7, see Figure 27.

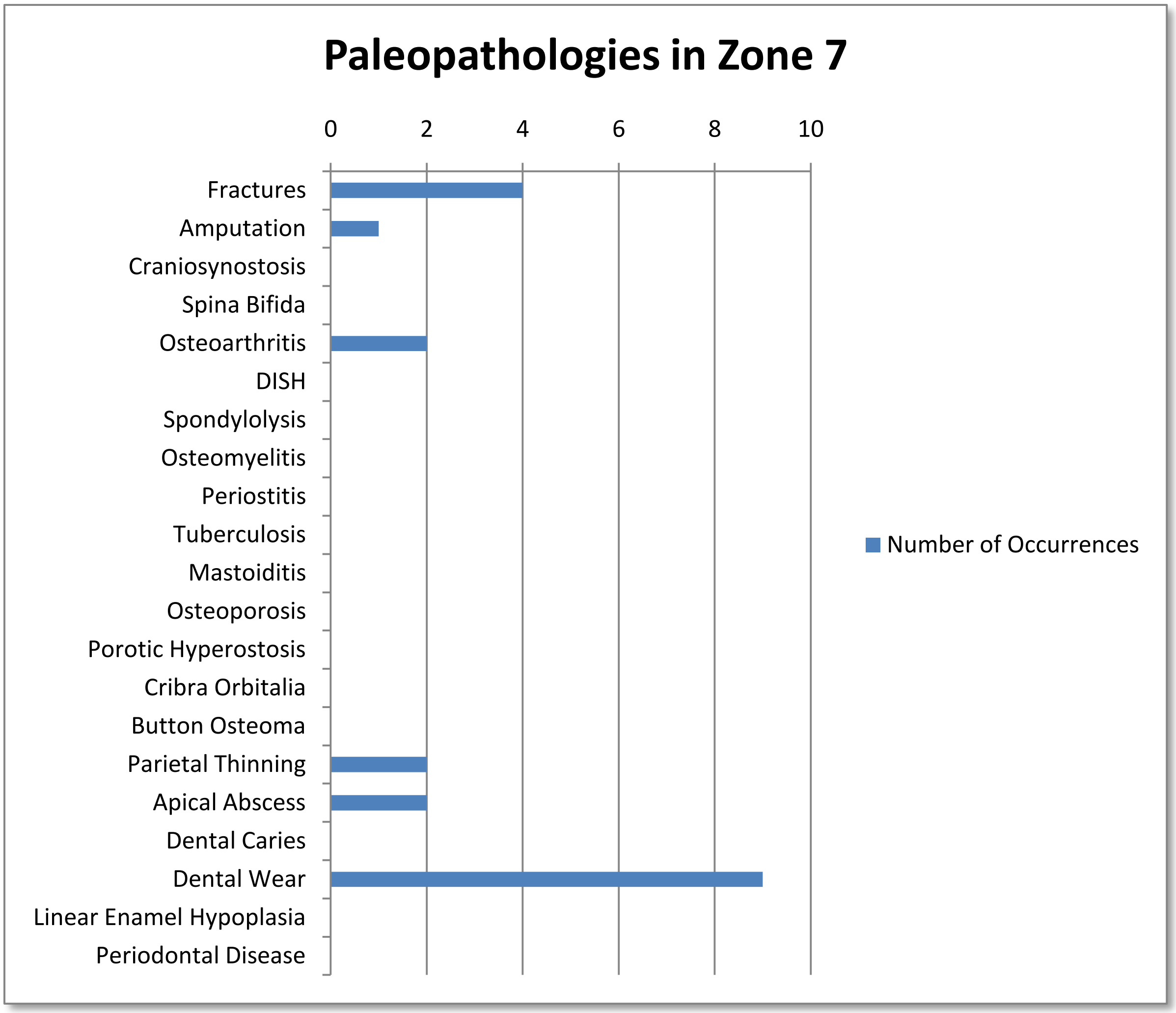


Figure 27: Summary of the different paleopathologies occurring in zone 7.

CHAPTER FIVE: THE MIDDLE KINGDOM – RESULTS OF ZONES 2, 9A, AND 9B IN DAYR AL-BARSHĀ AND ZONE A IN SHEIKH SAID

Description and Results of Zone 2

Zone 2 is located in the north of the Wadi Nakhla, consisting of a plateau that was used by the nomarchs and the elite, dates to the Middle Kingdom. The archaeological zone is divided into different sectors of which only sectors 1, 2, 3, 4, 14, and 19 will be discussed.

Sector 1, Features 1000 – 1009

A total of 454 bones and bone fragments (310 adult and 144 juvenile) were excavated from sector 1. Based on two adult right distal radial portions, two adult left MT5, two juvenile first ribs, and two juvenile distal femoral epiphyses, a MNI of two adults and two juveniles was determined. One of the adults was male of approximately 23 years of age. The pubic symphysis determined a phase IIb with a mean of 23.4 +/- 3.6 and a range of 19 to 24 years. One of the juveniles is very young based on an unfused basiocciput and unfused sternebrae which indicate an age of less than eight years at death. The paleopathologies include osteoarthritis on two cervical vertebrae, two healed Boxer's fractures on a right MC4 and on a right MC5, and a healed fracture of the distal end of a MC1 that was dislocated and caused therefore the formation of a secondary joint surface (Figure 28).

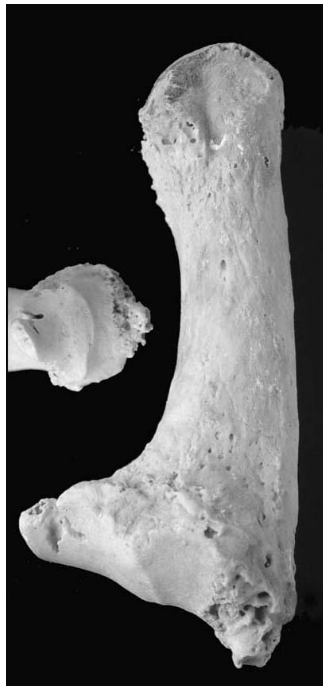


Figure 28: Healed fracture on the distal end of a MC1 and formation of a secondary joint surface.

Sector 2, Features 1052 & 1056

In this sector, a total of twelve bones and bone fragments (11 adult and 1 juvenile) were recovered. A MNI of one adult and one juvenile was determined. No paleopathologies were noted.

Sector 3, Features 1100 – 1102

A total of 161 adult bones and bone fragments were excavated. A MNI of one adult was determined. The only noted paleopathology is osteoarthritis, manifested as osteophytes on a lumbar vertebra.

Sector 4, Features 1150-1152, 1154, 1159-1163, 1166-1168, 1170-1174

A total of 617 bones and bone fragments (611 adult and 6 juvenile) were excavated. Almost all the adult skeletal elements are represented twofold, although three adult right calcanei were recovered. Nevertheless, the MNI was determined to be two adults and one juvenile. The third calcaneus seems to be from a neighboring burial. One of the adults was male determined from morphological traits on a cranium and a male pubic symphysis that determined the age at death of approximately 23 years with a range of 19 to 34 (phase II). The other adult was female determined from dorsal pits on a pelvic bone and the shape of the pubic bone. The measurements of two femora conclude that the two adults had statures of 147.5 cm and 166.6 cm. The paleopathologies noted on the skeletal elements include osteoarthritis, a compressed fracture of a head of a MC2, and a healed fracture on a right tibia.

Sector 14, Features 1270, 1271, 1290-1293

A total of 102 adult bones and bone fragments were excavated in this sector. The human remains belong to an adult male of approximately 30 years of age. The pubic symphysis determined a phase IIIa: 28.7 +/- 6.5 years with a range of 21 to 46 years. A few cranial elements represent another person. The paleopathologies include healed porotic hyperostosis and biparietal thinning (Figure 29).

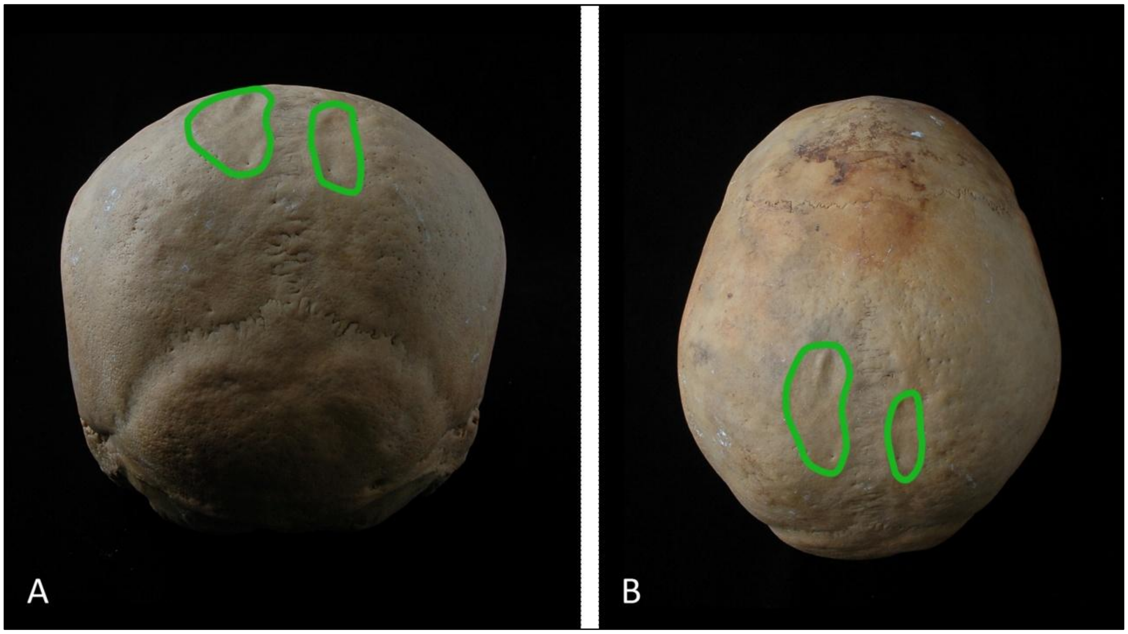


Figure 29: The biparietal thinning of the individual discovered in sector 14, (A) posterior view and (B) superior view.

Sector 19, Features 1330, 1333 & 1334

A total of 17 adult bones and bone fragments were recovered. Based on no duplication of any skeletal elements, a MNI of one adult was determined. The analysis concluded that the individual was female determined from a female pubic bone.

The analysis of the human remains recovered in zone 2 determined a total MNI of 12 individuals, 8 adults and 4 juveniles. For a summary of all paleopathologies present in zone 2, see Figure 30.

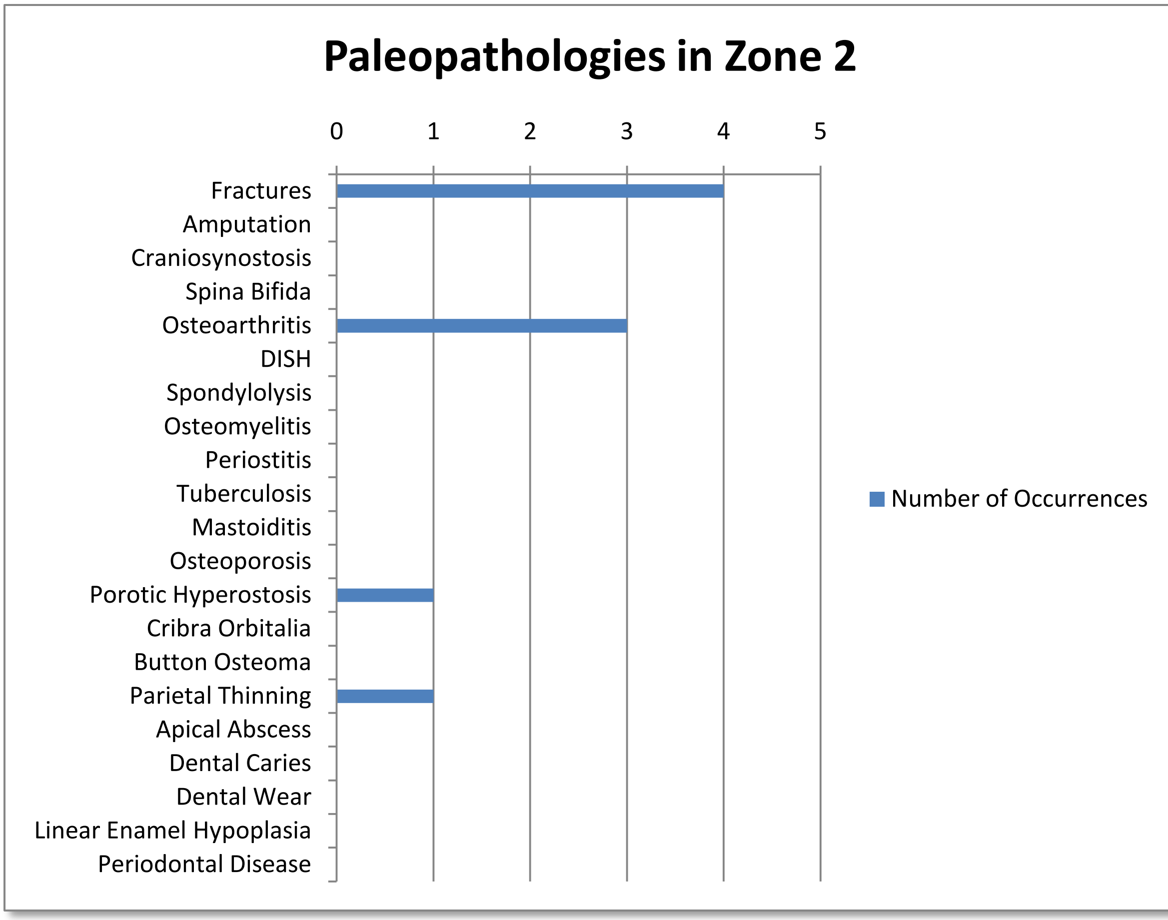


Figure 30: Summary of the different paleopathologies occurring in zone 2.

<u>**Description of Individuals from Zone 9A**</u>

The following descriptions of individuals from Zone 9A are derived from field reports produced by T. Dupras during the 2004 and 2006 field seasons. The burials date to the Middle Kingdom.

Individual 1 (Sector 98, Feature 6103, Tomb 10O61/1)

The human remains found in this tomb belong to an adult female of about 38 years of age at death (the age at death was determined by analyzing the pubic symphysis which resulted in a phase IVb: 38.2 +/- 10.9, range: 26-70 years). The individual had a stature of 158 cm. The skull shows extensive termite damage. No paleopathologies were noted.

Individual 2 (Sector 100, Feature 6013, Tomb 10O02/2, South Burial Chamber)

Tomb 10O02/2 contains two burial chambers, the South and the North burial chamber. In the South burial chamber, the remains of an adult female were discovered together with a fetus/perinate (see Individual 3 below). The female individual was approximately 25 years of age at death. The analysis of the pubic symphysis determined the phase IIb: 25 +/- 4.9, range: 19-24 years, and the medial ends of the clavicles show an epiphyseal fusion line which indicates an age of around 25 years. The individual had a stature of 153 cm. There were no signs of paleopathology.

Individual 3 (Sector 100, Feature 6013, Tomb 10O02/2, South Burial Chamber)

The fetal/perinate skeleton which was discovered in the same burial with individual 2 is well preserved and is aged at 37 to 38 weeks gestation at death. The age was determined by the measurement of the long bones and the dental development. No signs of paleopathology were noted.

Individual 4 (Sector 100, Feature 6014, Tomb 10O02/2, North Burial Chamber)

The North burial chamber of tomb 10O02/2 contains the human remains of two individuals; an adult male and an adult female (see Individual 5 below). The adult male was about 29 years of age at death. The pubic symphysis showed a phase IIIb, which determines an age of 28.7 +/- 6.5 and therefore a range of 21-46 years. He had a stature of 178 cm and no signs of paleopathology were noted.

Individual 5 (Sector 100, Feature 6014, Tomb 10O02/2, North Burial Chamber)

Individual 5 is an adult female of approximately 48 years at death with a stature of 163 cm. The analysis of the pubic symphysis determined a phase Vb which translates to 48.1 +/- 14.6 and a range of 25-83 years. The paleopathologies noted include biparietal thinning (Figure 31) and heavy dental wear and periodontal disease.

Figure 31: The lateral views of the biparietal thinning of individual 5, (A) right side and (B) left side.

Individual 6 (Sector 22, Features 372, 373, 375, Tomb 10O22/1)

The remains from this tomb were severely disturbed and the analysis of the skeletal elements revealed an MNI of 2, based on several intrusive replicate elements (e.g. two manubria, two right and left temporal bones, and an extra fourth metatarsal). Sex and age could not be determined because of the incompleteness of the remains. The stature of the more complete individual was approximately 165 cm. No paleopathologies were noted.

Individual 7 (Sector 73/78, Tomb 10N55/1A)

Tomb 10N55 consists of three shafts that contain the disturbed burials of three individuals (individuals 8 and 9 below). Individual 7 is a young adult female, approximately 18 to

20 years of age. The age was determined based on the epiphyseal fusion of the vertebrae. Her stature was 176 cm. No signs of paleopathology were noted.

Individual 8 (Sector 78, Tomb 10N55/1B)

Individual 8 was discovered in the same tomb as individuals 7 and 9 . The human remains belong to 7-8 year old juvenile of indeterminable sex. Age was determined based on the long bone length and the development of the dentition. The only notable paleopathology is cribra orbitalia in both orbits.

Individual 9 (Sector 73 and 78, Tomb 10N55/1C)

Individual 9 was found in the same tomb as individuals 7 and 8. Although the remains of all three individuals were dispersed in all three shafts, individual 9 was mostly found in shaft 1C. The skeletal remains belong to an adult male of approximately 35 to 45 years of age at death with a stature of 175 cm. The age assessment is based on the dental wear and the appearance of an apical abscess on the maxillary right M^1. This male had suffered from many antemortem pathologies. Following trauma were observed on the bones: a healed Boxer's fracture on the left fifth metacarpal, a healed fracture of the left nasal bone and the perpendicular plate of the ethmoid bone which caused a deviation of the nose to the right side. Furthermore, there are a healed misplaced fracture of the left temporal arch at the malar suture, a healed fracture of the left temporal arch where it meets the squamous of the temporal, a chronic displacement of the left temporal mandibular joint that resulted in the formation of a secondary joint surface, and a unilateral parietal thinning on the left parietal bone (Figure 32). Additional paleopathologies on the skeletal remains are the fusion of ten thoracic and lumbar vertebrae caused by DISH (Figure 33). Dental pathology includes the antemortem loss of the left mandibular M_2 and M_3.

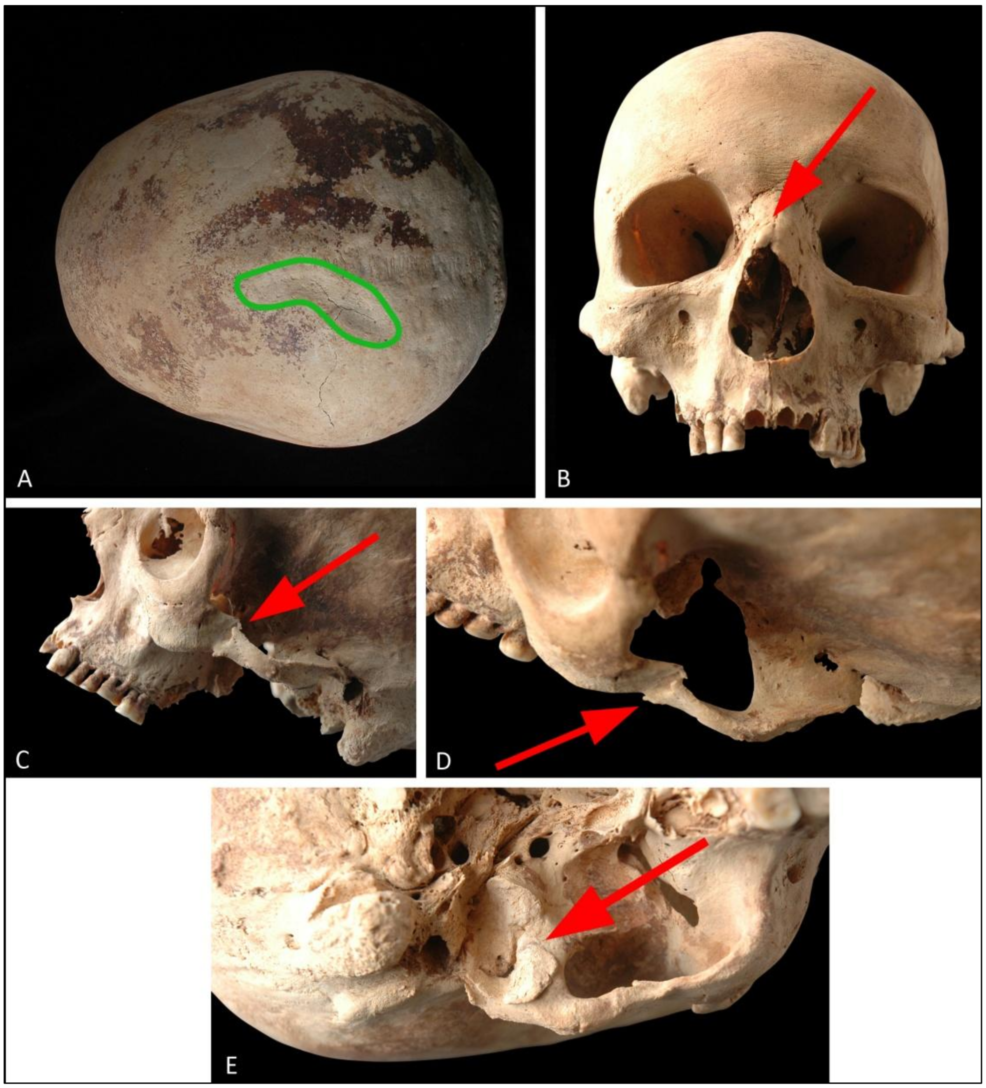


Figure 32: Paleopathologies on individual 9: (A) parietal thinning, (B) nasal fracture (arrow) leaving the nose deviated to the right side, (C) lateral view of the fractured left temporal arch (arrow), (D) top view of the fractured left temporal arch (arrow), and (E) a secondary joint surface on the right temporomandibular joint (arrow).

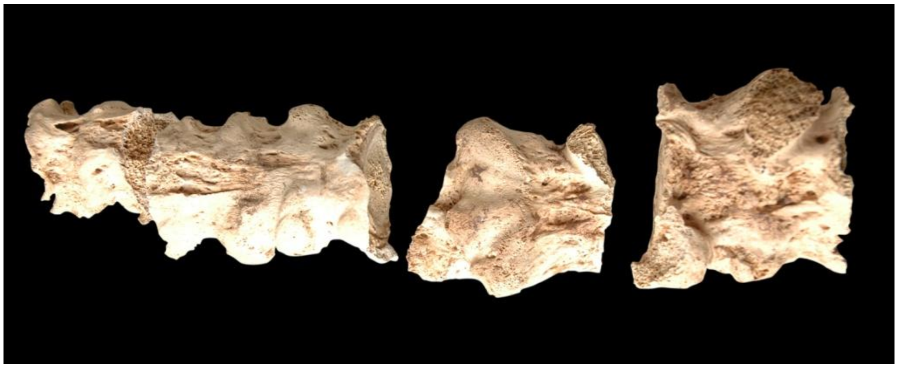


Figure 33: Fusion of several vertebrae caused by DISH or ankylosing spondylitis.

Individual 10 (Sector 63, Feature 6021, Tomb 10O25/2)

Tomb 10O25/2 contained the human remains of three individuals (the MNI of 3 was determined due to three right naviculi). The majority of the remains appear to belong to an adult female, and an adult male (see Individual 22). Due to the lack of bones analyzable for age, no age determination could be assessed. Her stature was 161 cm and no signs of paleopathologies were observed.

Individual 11 (Sector 47, Features 573, 575, 576, Tomb 10O12/1)

Individual 11 is an adult female of approximately 35 to 40 years at death. Her stature was 150 cm. The remains showed no signs of paleopathologies.

Individual 12 (Sector 52, Feature 648, Tomb 10O02/1)

The skeletal remains discovered in tomb 10O02/1 belonged to a young adult female of approximately 17-18 years at death with a stature of 163 cm. There are no visible signs of paleopathologies.

Individual 13 (Sector 60, Features 725 and 726, Tomb 10O25/1)

This tomb contains the human remains of a juvenile of undetermined sex who was approximately 8 years of age. The archaeologists attribute sex as female due to a small hair ornament in form of a fish. No paleopathologies were observed.

Individual 14 (Sector 54, Feature 761, Tomb 10O11/2)

The complete skeleton of an adult female was discovered in tomb 10O11/2. Her age was determined to be older than 60 years at death. The pubic symphysis showed a phase VI which means 60 +/- 12.4 years and a range of 42-87 years. Her stature was calculated to 154 cm. The skull showed extensive termite damage on the left side. Several of the skeletal elements are osteoporotic. The right frontal bone displays a button osteoma (Figure 34). There are many dental pathologies noted on this individual. The individual had lost many teeth antemortem: from the maxilla the right I^1 and PM^1, left PM^1, M^2, and M^3; and from the mandible the right PM_2, M_1, M_2, and M_3, left I_1, M_1, and M_3. All remaining teeth were worn to the dentine and the mandibular right PM_2 and M_1, and the left canine, PM_2, and M_2, as well as the maxillary right PM^2 and M^1 were worn down to the root. Furthermore, apical abscesses are present on maxillary right I^1, PM^2 and M^1, and on mandibular right I_1 and left I_2 and M_2, as well as periodontal disease.

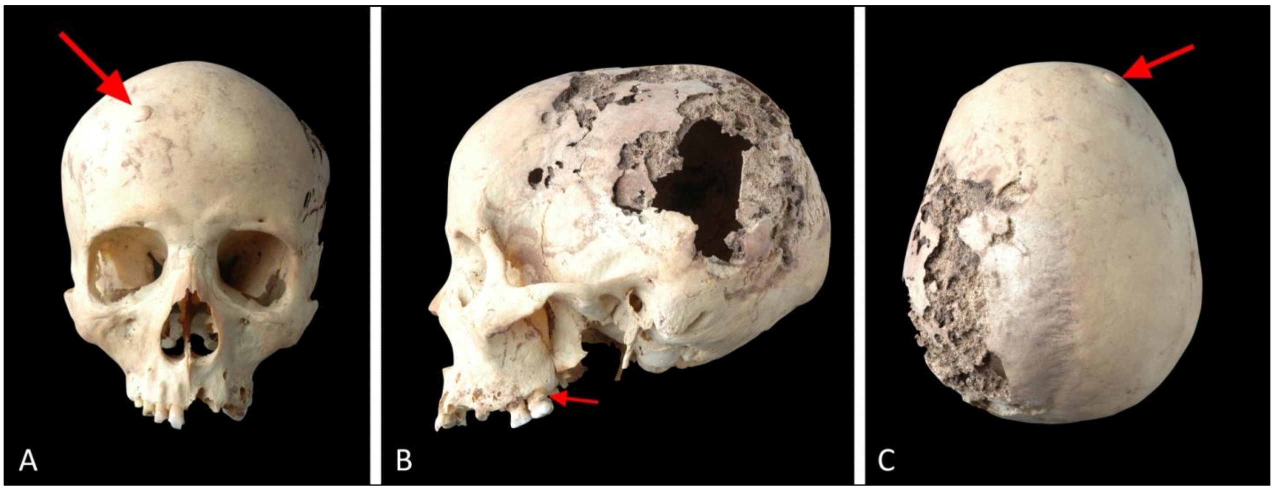


Figure 34: Different views of the cranium of individual 14: (A) front view showing the button osteoma on the left frontal, (B) lateral view showing the extensive termite damage to the left side of the cranium and the presence of periodontal disease (arrow), (C) top view of the cranium.

Individual 15 (Sector 10, Feature 274, Tomb 10O22/1)

Individual 13 is an adult female of 45-50 years of age with a stature of 155 cm. She exhibits severe osteoarthritis on the spine, the body of the second lumbar vertebra shows some compression, and a fusion of the C7 and T1. The dental paleopathology includes heavy dental wear (most teeth are worn down to the dentin and the root; Figure 35) and dental abscesses in both maxilla and mandible (the mandible shows a large healed abscess at the central incisor and an active abscess on the left canine).

Figure 35: Extensive dental wear in individual 15.

Individual 16 (Sector 46, Feature 559, Tomb 10O03/1)

The human remains from this tomb belong to an adult female of 60-70 years at death with a stature of 146 cm. The paleopathologies noted include an active dental abscess on the maxillary left PM^1, calculus on all teeth, heavy dental wear, periodontal disease with exposed roots, osteoarthritis (osteophytic lipping on L1 through L5), compression fractures on the fifth lumbar vertebra and on the right ankle which caused the talus and the calcaneus to fuse together, and healed fractures on both distal tibia and fibula. The first observation suggested a healed depressed fracture on the right parietal bone. After further analysis, the depressed area may be parietal thinning. Furthermore, there is a definite unilateral parietal thinning on the left parietal bone (Figure 36).

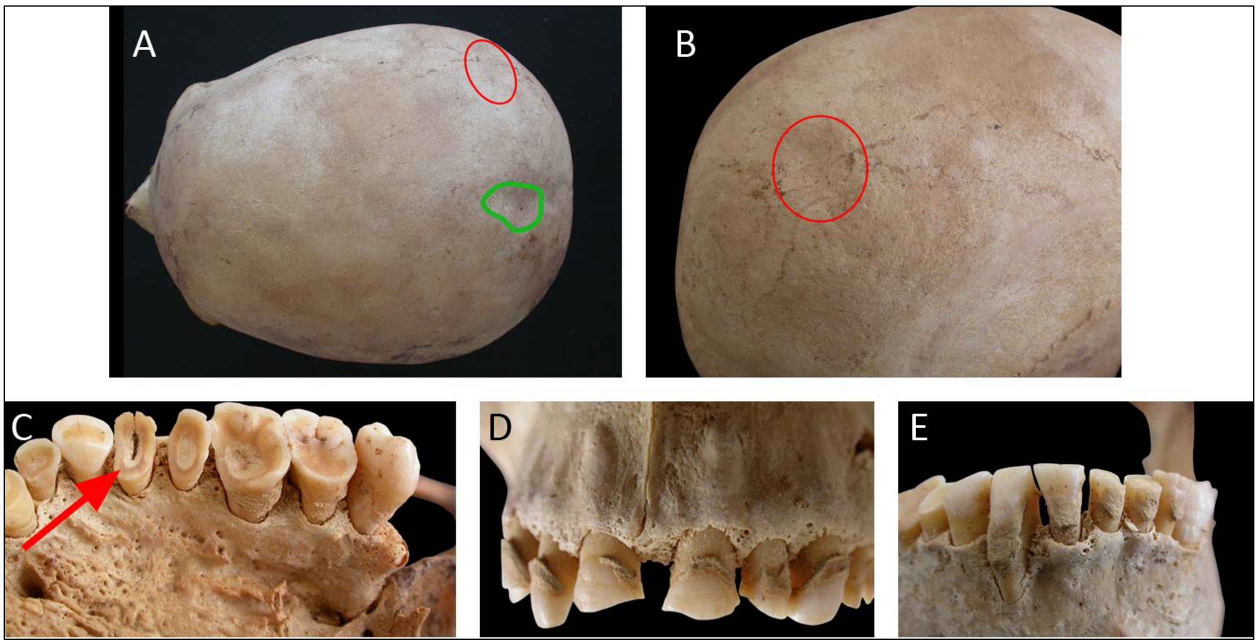


Figure 36: The paleopathologies on individual 16: (A) cranium showing the healed depressed fracture on the right parietal (red circle) and the unilateral parietal thinning on the left parietal (green), (B) close up view of the healed depressed fracture on the right parietal, (C) heavy dental wear on the maxillary dentition, (D) maxillary dentition showing substantial calculus, and (E) mandibular dentition exhibiting periodontal disease and calculus.

Individual 17 (Sector 15, Feature 650, Tomb 10O13/1A)

Individual 17 is an adult female of approximately 40 years at death with a stature of 156 cm. The paleopathologies observed include healed fractures of the right distal radius and the left tibia and fibula. The skeletal remains exhibit osteoporosis. The bones of the cranial vault are thickened. Healed fractures are visible on the distal left radius and on the right ankle which caused the ligaments on the distal right tibia and fibula to ossify (Figure 37). Furthermore, the dentition shows caries on the molars, calculus, tooth wear, antemortem tooth loss, and periodontal disease. The skeletal elements display the formation of salt crystals which indicates a long-term exposure to water.

Figure 37: The healed fracture on the right distal fibula of individual 17.

Individual 18 (Sector 53, Feature 764, Tomb 10O11/1)

Tomb 10O11/1 contained the human remains of an adult male of about 29 years of age with a stature of 169 cm. The analysis of the pubic symphysis determined a phase IIIb: 28.7 +/- 6.5, range 21-46 years. The skull and some postcranial elements exhibit extensive termite damage. The paleopathology includes a healed Boxer's fracture on the right fifth metacarpal (Figure 38). The dental pathologies include heavy wear on all teeth down to the dentin, active cavities between mandibular right M_2 and M_3, and left M_2 and M_3 (Figure 38). The left maxillary M^1 was lost perimortem. Furthermore, the first cervical vertebra exhibits an extra foramen.

Figure 38: Paleopathologies of individual 18: (A) extensive dental wear on the maxillary dentition, (B) severe dental wear on the mandibular dentition, and (C) the healed Boxer's fracture on the right MC5.

Individual 19 (Sector 58, Feature 773, Tomb 10O11/4)

Individual 18 was an adult male of approximately 28-29 years of age at death with a stature of 172 cm. The pubic symphysis determined a phase IIIa which means 28.7 +/- 6.5 years with a range of 21-46 years. Lytic lesions on both the metacarpals and the metatarsal and on some phalanges were the only paleopathology noted (Figure 39). Such lesions are caused by rheumatoid arthritis that affects the areas close to the joint surfaces but never the joint surfaces themselves.

Figure 39: Lesions occurring on metacarpals, metatarsals, and phalanges of individual 19 caused by rheumatoid arthritis.

Individual 20 (Sector 104 and 105, Feature 6073, Tomb 10O00/1)

The human remains discovered in tomb 10O00/1 belong to an adult male of approximately 28-29 years of age with a stature of 163 cm. The skeleton was almost complete; only five distal foot phalanges were missing. The age was determined by analyzing the pelvic symphysis which resulted in a phase IIIa: 28.7 +/- 6.5 years, range 21-46 years. During the examination of the skeletal remains, following paleopathologies were observed: osteophytes are present on the lumbar vertebrae, the tooth wear is not severe (the only teeth that were worn down to the dentin are the first molars), and linear enamel hypoplasia is present on all mandibular and maxillary incisors, premolars, and molars.

Individual 21 (Sector 58, Feature 772, Tomb 10O11/5)

Tomb 10O11/5 contained the disturbed remains of an adult male of approximately 35 years of age with a stature of 165 cm. The examination of the pelvic symphysis determined a phase IV: 35.2 +/- 9.4 years, range 23-57 years. Based on the tooth wear down to the dentin and the presence of apical abscesses, the individual seems to on the older side of the range. The paleopathologies encountered include extreme arthritic changes on all left carpals and the left patella. Two cervical vertebrae show compression fractures and arthritic changes, and the fifth lumbar vertebra has a compression fracture and lytic lesions on the superior surface of the body. Furthermore, the cranium shows biparietal thinning and a small active lytic lesion on the left parietal bone. Both first ribs exhibit major costal cartilage ossification (Figure 40). A healed fracture was noted on one of the proximal foot phalanges. The individual lost the left maxillary PM^1 and M^1, and the right PM^1, PM^2, M^1, and M^2 antemortem.

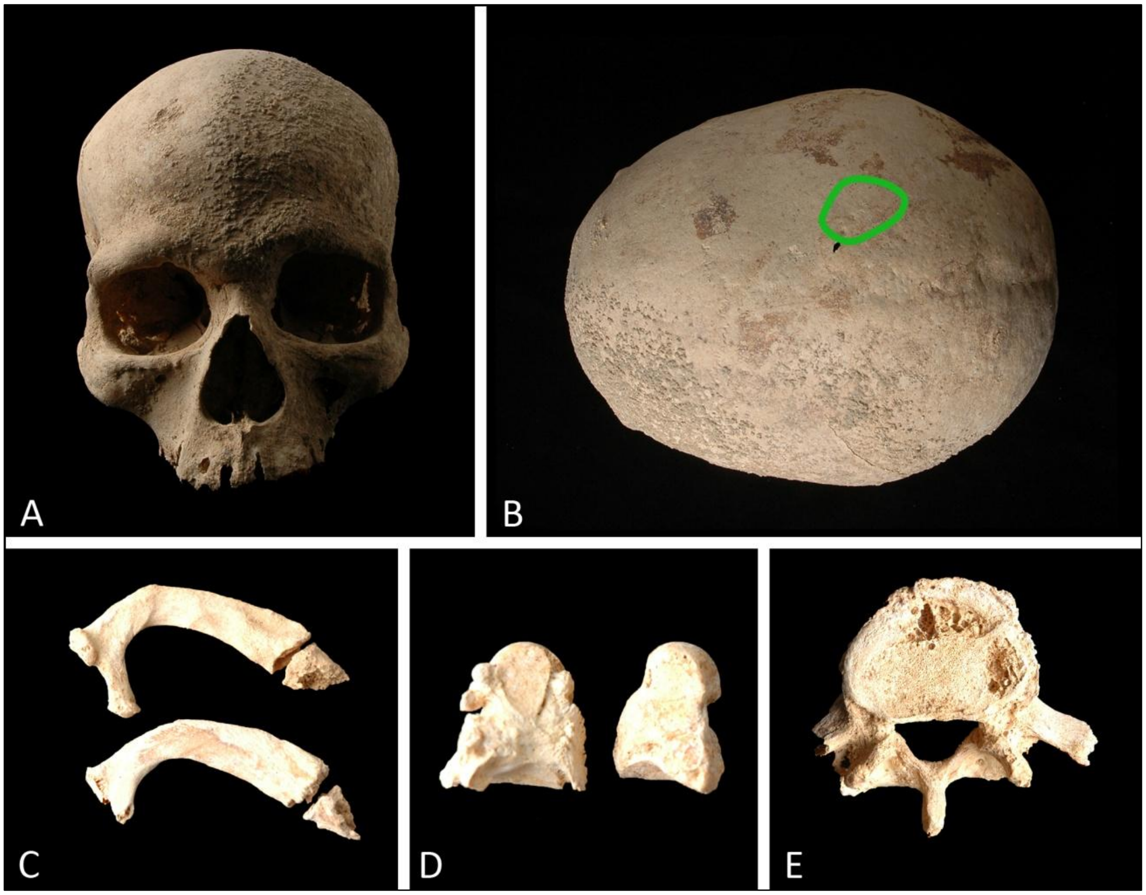


Figure 40: Paleopathologies on individual 21: (A) front view of the cranium displaying salt crystals that occur after bones were exposed to water for a long period of time , (B) top view of the cranium showing the parietal thinning, (C) ossified costal cartilage on the 1st ribs, (D) arthritic changes on a capitate, and (E) 5th lumbar vertebra displaying lytic lesions on the superior surface of the body.

Individual 22 (Sector 63, Feature 6021, Tomb 10O11/3)

Individual 22 was found together with individual 10 in tomb 10O11/3 and belongs to an adult male of approximately 35 years of age with a stature of 177 cm. The pubic symphysis determined a phase IVb which results in 35.2 +/- 9.4 years and a range of 23-57 years. The only paleopathology noted are apical abscesses on the right mandibular I_2 and the canine.

Individual 23 (Sector 54 and 57, Features 766, 767, 769 and 770, Tomb 10O11/3

The disturbed remains from this tomb belong to an adult male of approximately 29 years at death with a stature of 167 cm. The analysis of the pubic symphysis showed a phase IIIb: 28.7 +/- 6.5 years, range 21-46 years. Based on the dental wear, the individual seems to be on the mid part of the age range. All mandibular teeth are worn down to the dentin, but no abscesses are present. Healed fractures were observed on two right ribs and on the second lumbar vertebra where the left transverse process was fractured and healed in two separate pieces (Figure 41). Other paleopathologies observed include spondylolysis of the arches of the fourth and fifth lumbar vertebrae (Figure 41) and a Schmorl's node on the third thoracic vertebra.

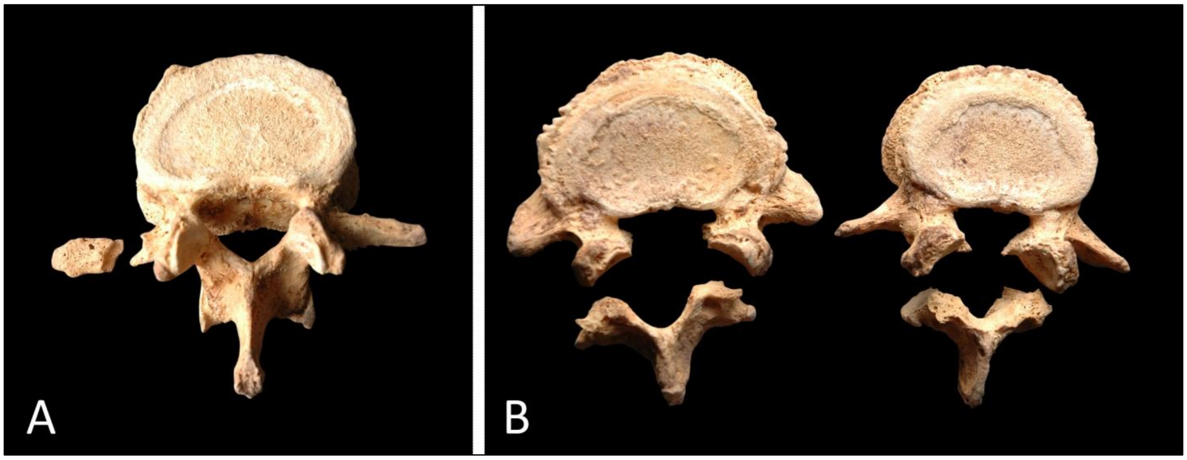


Figure 41: Paleopathologies of individual 23: (A) healed fracture of the transverse process of the L2 vertebra that left the transverse process in two pieces, (B) spondylolysis on the L4 and L5 vertebrae.

Individual 24 (Sector 102, Feature 6019, Tomb 10O01/1)

Tomb 10O01/1 contained the disturbed skeletal remains of an adult male of approximately 35 years at death. Since the cranium was missing in the tomb, the sex is based on the pelvic morphology. Although the pubic symphysis is damaged, the phase was determined to be IVb: 35.2 +/- 9.4 years with a range of 23-57 years. Based on the severe dental wear on the loose teeth, his age is most likely in the latter part of the calculated range. He was a rather short individual with a stature of 151 cm. He had severe healed fractures of the right humerus and the right ulna which did not heal together but formed a secondary joint surface. Furthermore, there is a healed fracture on the distal end of the right fibula (Figure 42). Additionally, spondylolysis of the fifth lumbar vertebra was noted. The individual exhibits individual characteristics such as an elongated left transverse process of the second lumbar vertebra and an extra lateral projection on the right fifth metatarsal for the articulation of a sixth toe Figure 42).

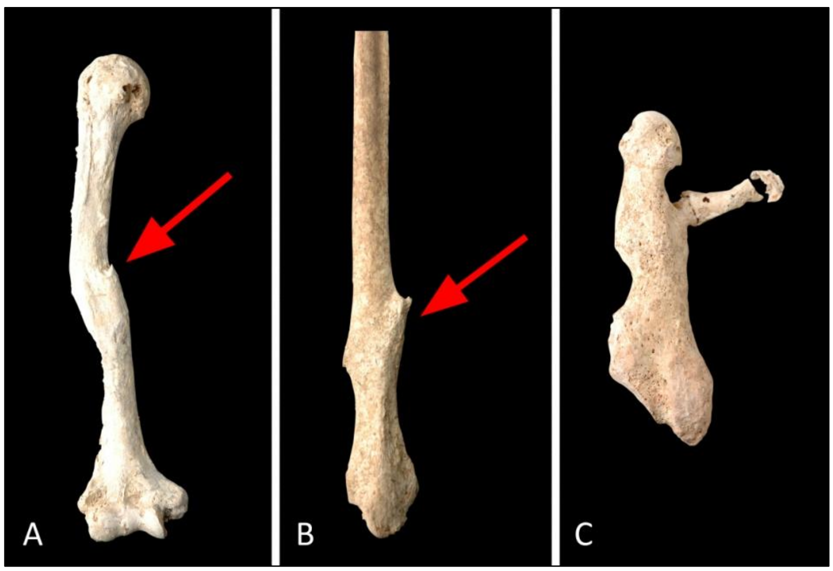


Figure 42: The paleopathologies and individual traits of individual 24: (A) fracture of the right humerus, (B) fracture on the distal end of the right fibula, (C) the extra lateral projection on the right MT5 for the articulation of a sixth toe.

Individual 25 (Sector 15, Feature 169, Tomb 10O13/1B)

Individual 25 is an adult male of approximately 30-40 years at death who had a stature of 168 cm. The only noted paleopathology is an impacted M3 (Figure 43) and minor worn teeth with no dental caries. The remains display individual characteristics such as a manubrium that is fused to the sternal body and a sternal foramen in the sternal body. The bones are covered by salt crystals that indicate a long-term exposure to water.

Figure 43: Dental wear and impacted M3 of individual 25.

Individual 26 (Sector 47, Feature 630, Tomb 10O12/3)

The individual discovered in tomb 10O12/3 was an adult male of approximately 20-24 years of age at death with a stature of 175 cm. The coccyx elements 2 through 4 are fused and bent which can be the healed result of a fracture (Figure 44). The thoracic (T6 through T12) and lumbar vertebrae (L1 and L2) exhibit infectious lesions that may be caused by tuberculosis (Figure 45). To give a definite answer if the individual was indeed infected by tuberculosis, other skeletal elements commonly affected by the disease (ribs, sternum, hips, and knees) should be further examined.

Figure 44: The fused and bent coccyx elements 2 through 4 of individual 26.

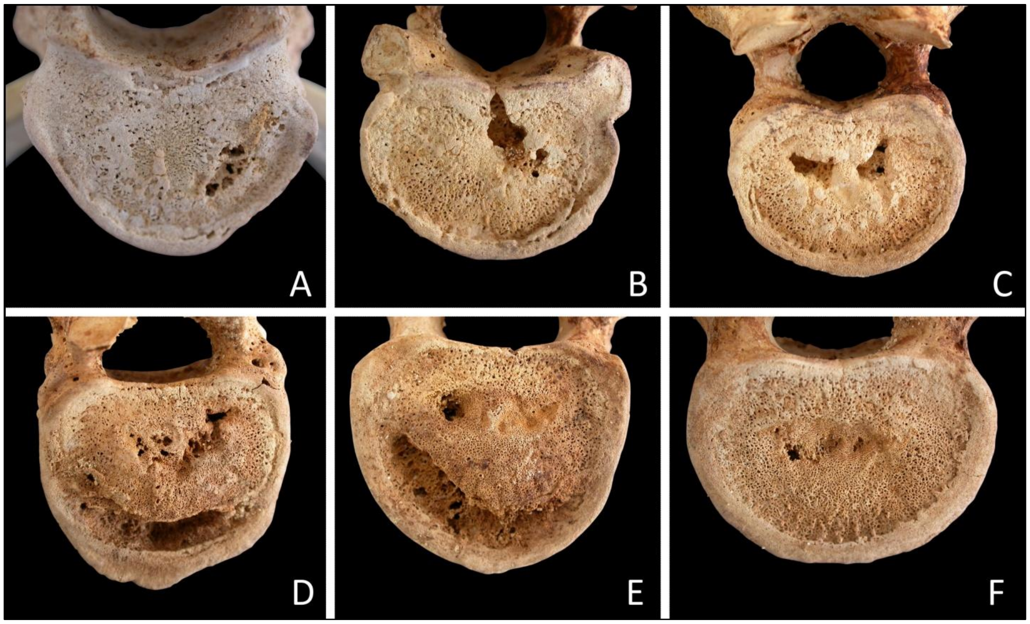


Figure 45: The lesions on the thoracic and lumbar vertebrae of individual 26: (A) superior body of T6, (B) inferior body of T8, (C) inferior body of T10, (D) superior body of T12, (E) inferior body of L1, (F) superior body of L2.

Individual 27 (Sector 16, Feature 186, Tomb 10O13/1C)

Shaft 1C in tomb 10O13 contained the remains of an adult male of approximately 50 years at death with a stature was 171 cm. The dentition shows heavy dental wear (down to the dentin on all teeth), periodontal disease, small amounts of calculus, and active apical abscesses on the roots of the mandibular right and left first molars and on the maxillary left I^1, PM^2, and M^1, and right PM^1 (Figure 46). Furthermore, the roots of the mandibular teeth are of a purple color. All lumbar vertebrae exhibit severe osteophytic lipping which is evidence for osteoarthritis. Furthermore, the skull is very peculiar in its shape: it is very narrow and long (Figure 46), indicative of craniosynostosis or premature fusion of the sagittal suture.

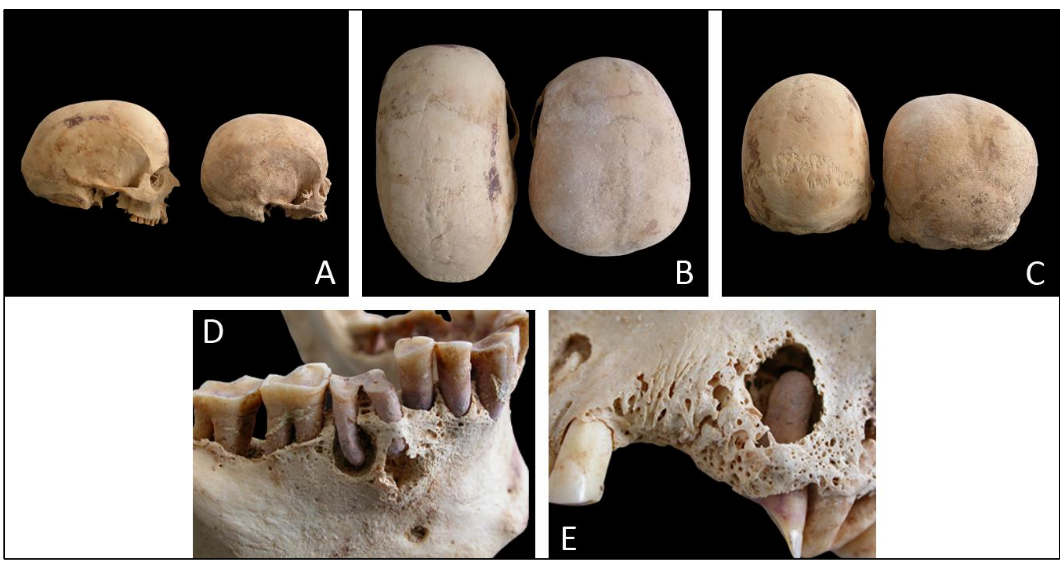


Figure 46: Paleopathologies on Individual 27: (A) narrow and elongated cranium, lateral view, (B) narrow and elongated cranium, top view, (C) narrow and elongated cranium, back view, (D) abscess on mandibular right M1, (E) apical abscess on right maxillary PM2 and antemortem tooth loss.

Individual 28 (Sector 10, Feature 277, Tomb 10O22/1)

Tomb 10O22/1 contained the skeletal remains of an adult male of 40-45 years of age with a stature of 171 cm. Both feet show a healed antemortem amputation through the metatarsals (Figure 47). The spine shows fusions of the first to the third lumbar vertebra and from the sixth thoracic to the eleventh thoracic vertebra (Figure 47). The fusions of vertebrae lead to the diagnosis DISH. The individual was diagnosed with diabetes due to the amputations of both feet and DISH which is commonly associated with diabetes. The upper thoracic and cervical vertebrae show osteoarthritic changes. Furthermore, the individual exhibits a healed fracture of a left rib and a healed round depressed fracture on the right frontal bone. The dentition shows several cavities (Figure 47), dental wear that is heavier on the maxillary than on the mandibular teeth, periodontal disease, calculus, and antemortem tooth loss.

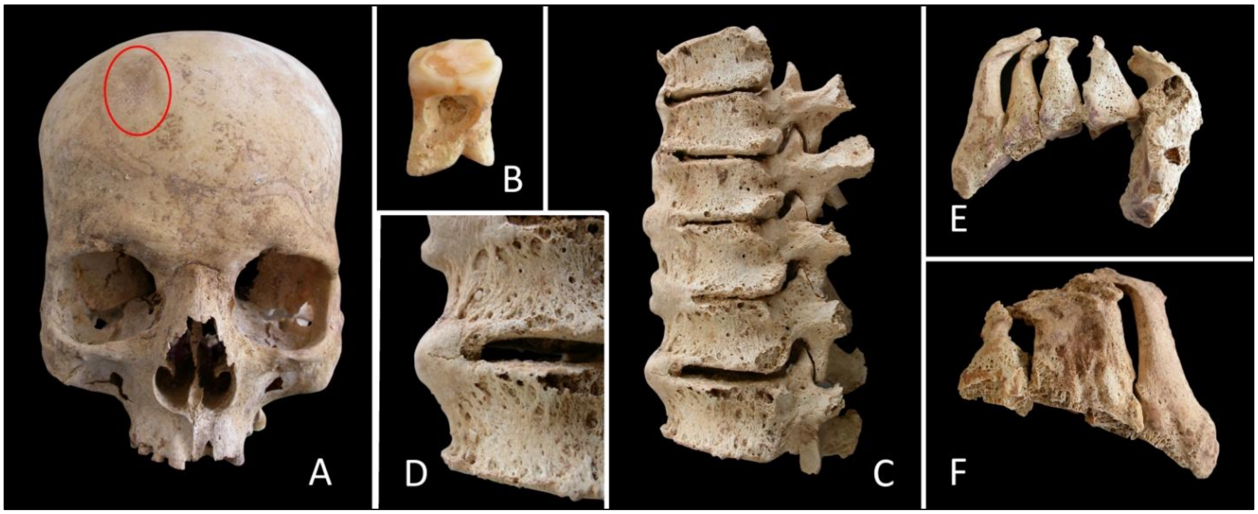


Figure 47: Paleopathologies on individual 28: (A) healed round depressed fracture on the right frontal; (B) severe interproximal cavity on the roof of the left M1, (C) fusion of T6, T7, T8, T9, T10, and T11; (D) close-up on the fusion of T10 and T11; (E) healed amputation through left metatarsals; and (F) healed amputation through right metatarsals.

Individual 29 (Sector 47, Feature 626, Tomb 10O12/2)

Individual 29 is an adult male of approximately 40-50 years at death with a stature of 167 cm. The only noted paleopathology is dental disease that includes periodontal disease, apical abscesses on all mandibular incisors and on the right maxillary PM^1, and antemortem tooth loss.

The analysis of the human remains recovered in zone 9A determined a total MNI of 27 adults and 3 juveniles. For a summary of all paleopathologies present in zone 9A, see Figure 48.

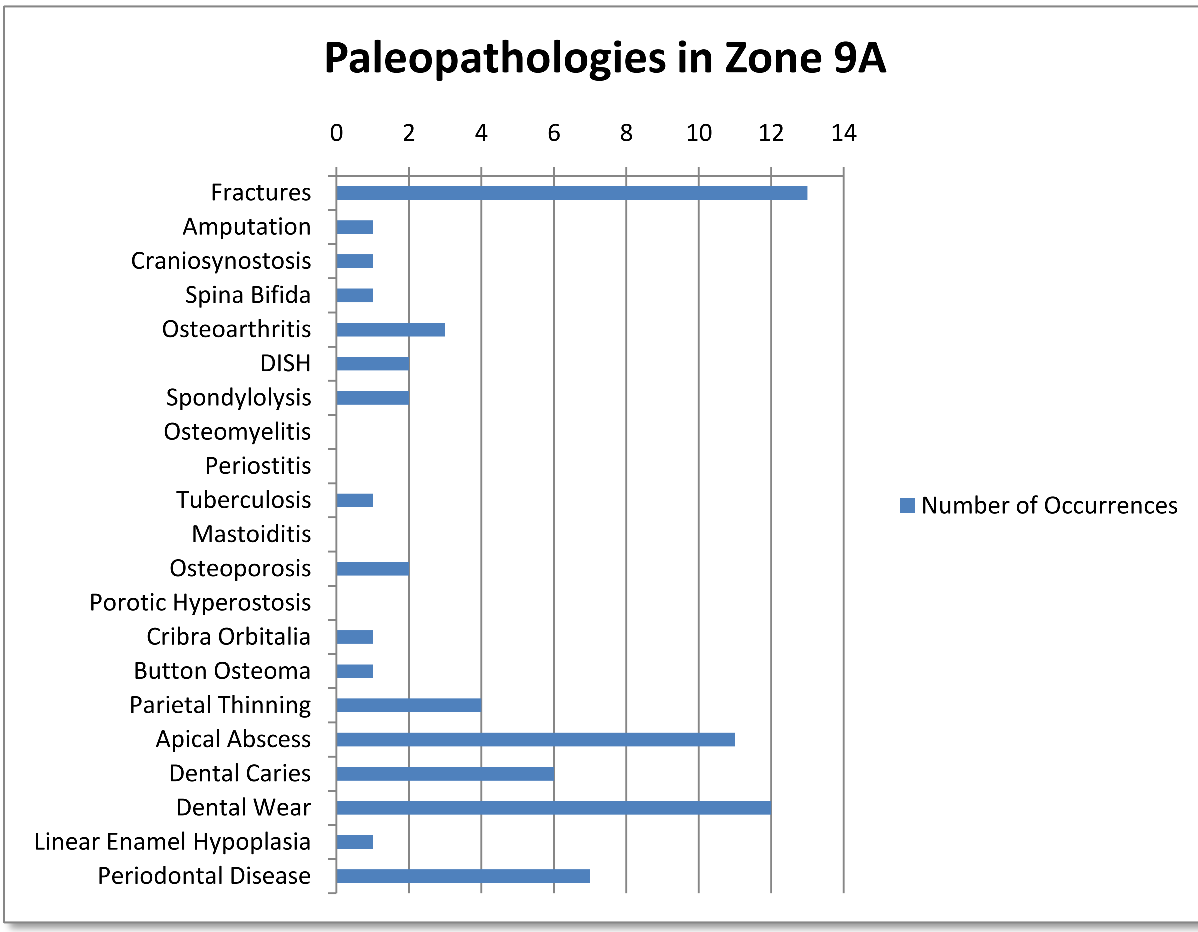


Figure 48: Summary of the different paleopathologies occurring in zone 9A.

Description of Individuals from Zone 9B

The following descriptions of individuals from Zone 9B are derived from the field report produced by T. Dupras during the 2007 field season.

Individual 1 (Sector 120, Feature 7039, Tomb 12J46/2)

The undisturbed human remains were discovered with a complete pot sitting on the cranium. The individual is an adult male of approximately 29 years of age with a stature of 164 cm. The pubic symphysis determined a phase IIIb which results in 28.7 +/- 6.5 years and a range of 21-46 years. Little dental wear and the absence of abscesses suggest that the individual is most likely in his early 30s. Spondylolysis is present on the fourth lumbar vertebra (Figure 49). The dentition shows linear enamel hypoplasia on the incisors. The lateral side of the right patella shows an antemortem non-commuted fracture that caused the formation of a secondary joint surface (Figure 49). Furthermore, the remains exhibit individual characteristics including the sacralization of the fifth lumbar vertebra and a non-fusion of the acromial epiphysis on the right scapula (Figure 49). The cranium displays a large postmortem concentric fracture of the right parietal, squamous portion and the temporal arch of the temporal bone, which was caused by the weight of the pot which was placed on the cranium at the burial. This burial dates to the New Kingdom.

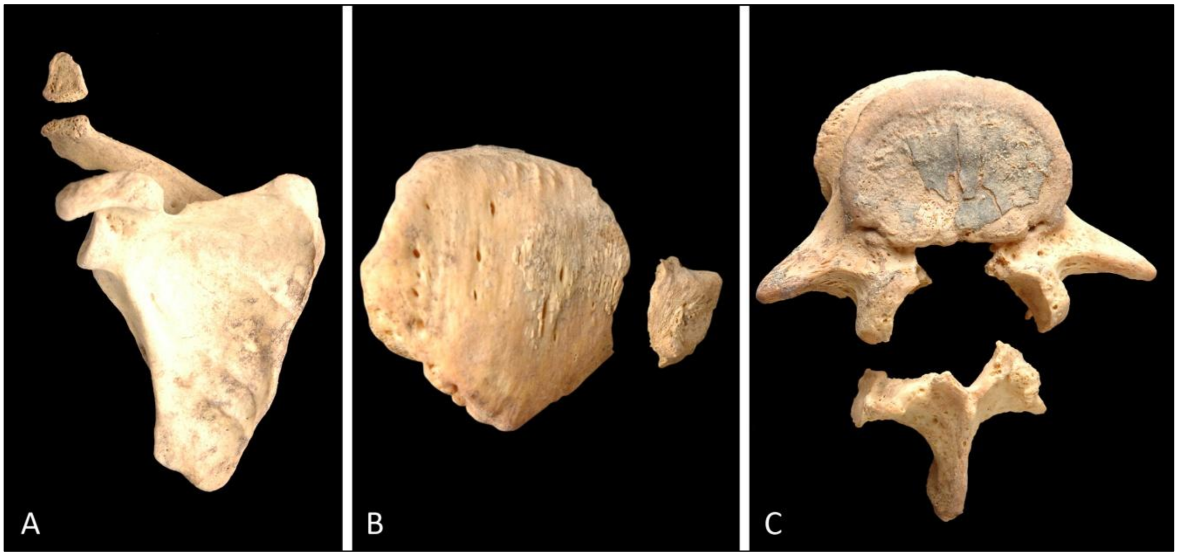


Figure 49: Paleopathologies and individual traits of individual 1: (A) non-fusion of the acromial epiphysis on the right scapula, (B) non-commuted fracture on the right patella resulting in a secondary joint surface, and (C) spondylolysis on the L4 vertebra.

Individual 2 (Sector 122, Feature 7238, Tomb 13J41/1)

This tomb consists of an almost complete burial of an adult male of approximately 35 years of age with a stature of 178 cm (Figure 50). The age was determined analyzing the pubic symphysis which resulted in a phase IVa: 35.2 +/- 9.4 years, range 23-57 years. The teeth show only minimal dental wear, but nevertheless, dental paleopathology was present. Linear enamel hypoplasia is visible on all maxillary and mandibular anterior teeth. The pulp cavities are exposed on the mandibular right and left I_1 and on the maxillary right I^1, resulting in an apical abscess. Furthermore, the individual suffered from periodontal disease, calculus, and antemortem tooth loss of the maxillary right M^1. The only antemortem traumatic condition that was observed was a healed fracture on a distal pedal phalanx #1. The vertebrae L3, L4, C3, and C4 show the beginning of osteoarthritic changes that present themselves as small osteophytes and minor lipping. Additionally, extra bone formation was observed on the distal ends of the right and left tibiae and fibulae. The skeleton exhibits individual traits such as a well-developed cervical rib on the left side of C7. The individual suffered extensive perimortem trauma, such as a complete fracture of the right clavicle at the medial end, two fractures on the sternal body, and both sides of the rib cage show severe trauma (see Table 10). Furthermore, the right arm also shows severe perimortem trauma. The right finger phalanges, the carpals, and the lower radius and ulna are missing. The right humerus shaft shows a butterfly fracture and approximately 16 cut marks on the anterior side, directly on top of the fracture (Figure 51). In addition, there are two cut marks on the right radius near the proximal end, and one cut mark on the right ulna also near the proximal end. Those cut marks seem to be evidence for an attempt to save the individual's life by amputating the right lower arm. There is a puncture mark on the radial tuberosity of the right radius which may have been part of the method that was used to stabilize the arm during the amputation process. It seems that the amputation was successful due to the location between the legs where the radius, the ulna, and the distal humerus were found (Figure 50). A possible cause for the trauma might be a crushing event such as a big rock falling down and crushing the individual. This scenario may be possible since Dayr al-Barshā was also an important quarry site. The bones of the right arm show no signs of healing which indicates that the individual did not live long after this incident.

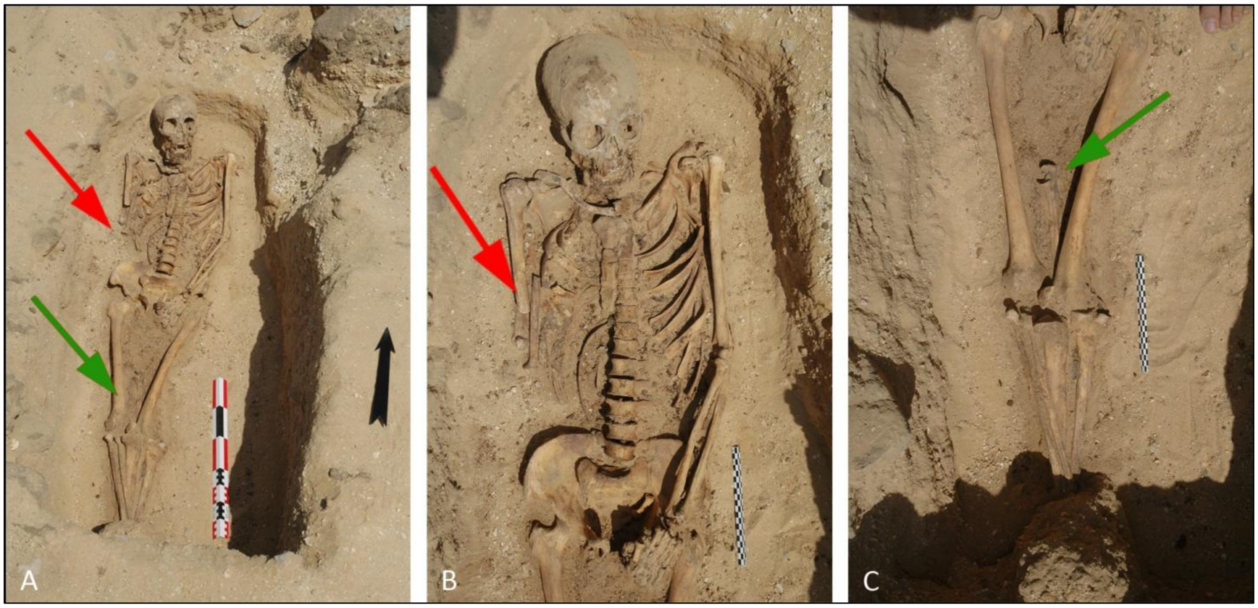
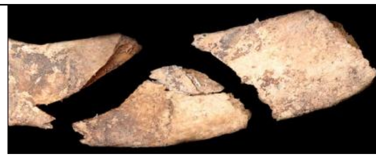
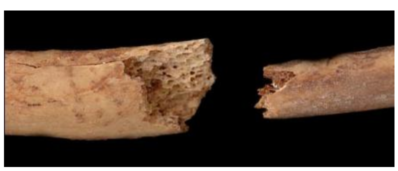
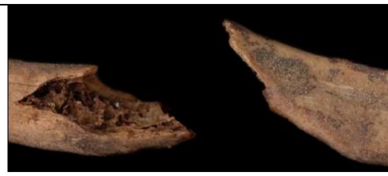
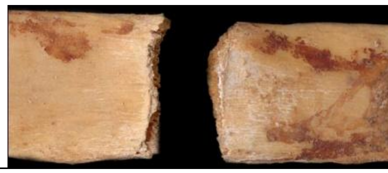
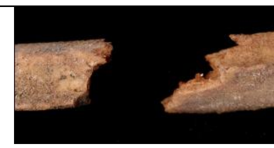
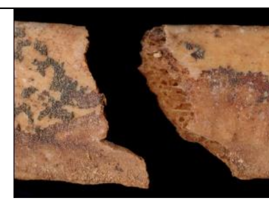


Figure 50: Individual 2 in situ in tomb 13J41/1: (A) general view with arrows indicating the missing lower arm bones (red arrow) and the location of the ulna between the legs (green arrow), (B) close-up view of the thorax with only the proximal part of the right humerus present (red arrow), (C) close-up view of the lower body with the missing right ulna between the legs (green arrow).

Figure 51: Perimortem fracture of the right humerus of individual 2 in zone 9B: (A), (B) butterfly fracture in the lower half of the shaft, (C) close-up view of the cut marks, and (D) cut marks highlighted in white (after Dupras et al., 2009).

Table 10: Table listing all the rib fractures of individual 2 (after Dupras et al., 2009).

Rib #	Right	Right photo	Left	Left Photo
1	Butterfly fracture with one part free – force from superior		No fractures	None
2	One complete fracture near sternal end		No fractures	None
3	Two complete fractures – one midshaft and one at the sternal end with plastic deformation		Two fractures – one complete midshaft, and one incomplete near sternal end	Not available
4	Three complete fractures – one at sternal end, one near sternal end and one near vertebral end		One fracture midshaft with piece missing	
5	Three complete fractures – one at sternal end, two at vertebral end creating butterfly fracture with triangular piece created		Two complete fractures, one midshaft and one at sternal end	

Rib #	Right	Right photo	Left	Left Photo
6	Two complete fractures – one at sternal end, the other midshaft with chip disengaged	 	Two fractures – one complete midshaft, and one incomplete with plastic deformation on the ventral side near the sternal end	
7	Two complete fractures – one at sternal end, the other midshaft with chip disengaged		One complete fracture midshaft	
8	Two complete fractures – one at sternal end and the other at the vertebral end		One complete fracture midshaft	
9	Two complete fractures – one at sternal end and the other at the vertebral end		One fracture with severe plastic deformation at sternal end – deformation has caused rib to bend ventrally and inferiorly	
10	One complete fracture at sternal end	Not available	No fractures	None
11	No fractures	None	No fractures	None
12	No fractures	None	No fractures	None

Individual 3 (Sector 122, Feature 7242, Tomb 13J41/2)

Individual 3 was discovered below the burial of individual 2 (Figure 52). The skeletal remains belong to an adult female of approximately 30 years of age at death with a stature of 161 cm. The pubic symphysis determined a phase IIIb, with a mean of 30.7 +/- 8.1 years and a range of 21-53 years. The analysis of the cranium suggests African ancestry due to the morphological traits such as a wide nasal aperture, a rounded forehead, a prognathic face, a flat superior nasal/frontal suture area, and short coarse curly hair (Figure 53). Additionally, her incisors are shovel-shaped, a trait that does appear in approximately 5% of the African population. The legs of the female exhibit individual traits due to a shorter left leg (right tibia = 370 mm, left tibia = 352 mm; right fibula = 341 mm, and left fibula = 335 mm). Because of this, she must have had a notable limp when she walked. Furthermore, the right tibia and fibula, and the right radius and ulna are noticeably bowed. The teeth exhibit only minimal dental wear, but there is notable calculus build up on the labial side of the anterior teeth, as well as the presence of periodontal disease. The right ethmoid is expanded and suggests a chronic sinus infection. The perimortem trauma consists of seven cut marks across the anterior bodies of the cervical vertebrae C4, C5, and C6 (Figure 53). The location and depth suggest that the individual's throat was cut violently and caused her death.

Figure 52: Individual 3 in situ in tomb 13J41/2.

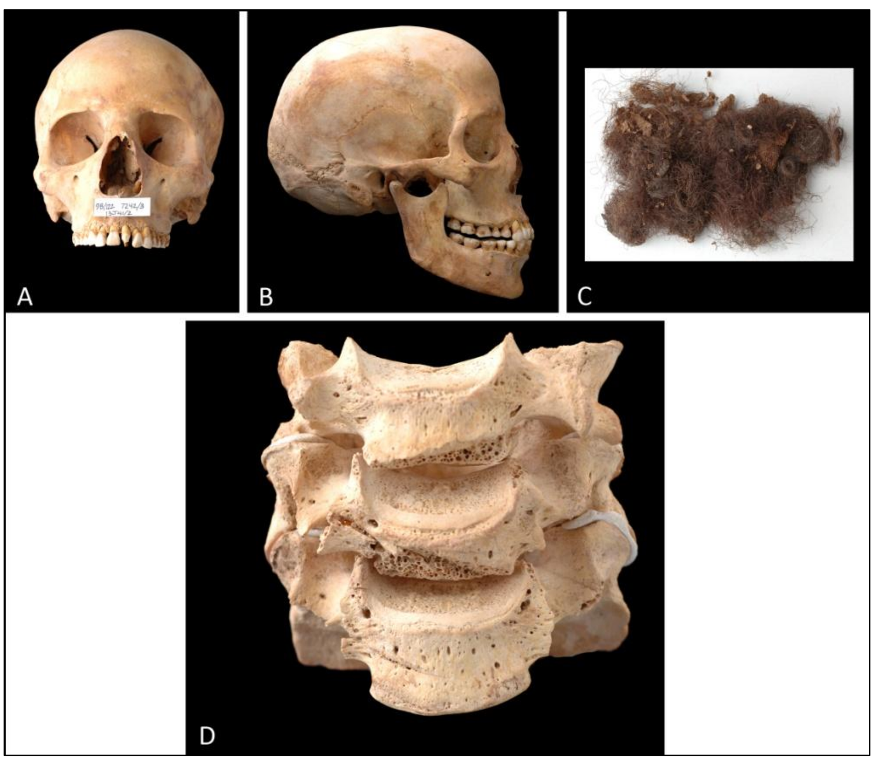


Figure 53: Individual 3: (A) front view of the cranium, (B) lateral view of the skull, (C) coarse curly hair, typical for African ancestry, and (D) cervical vertebrae C4-C6 displaying cut marks.

Individual 4 (Sector 120, Feature 7054, Tomb 12J46/1)

The individual is an adult female of approximately 38 years at death with a stature of 151 cm. The pubic symphysis determined a phase IVb: 38.2 +/- 10.9 with a range of 26-70 years. The teeth show heavy dental wear with an unusual wear pattern in which the lingual sides of the maxillary incisors are worn as well as the lingual sides of the left PM^1, PM^2, and M^1. The mandibular left PM_1 and M_1 are worn in a similar way, but on the buccal side. The individual suffered antemortem paleopathology, such as two healed fractures on the left rib #4, a single healed fracture on the right rib #12, two healed fractures on the right ribs #3, #4, #5, and #8, and three healed fractures on right rib #7 (Figure 54). Additionally, the female suffered from beginning stages of osteoarthritis caused by some lipping and the development of osteophytes on vertebral bodies. The remains also show individual traits such as sacralization and a compression of the fifth lumbar vertebra.

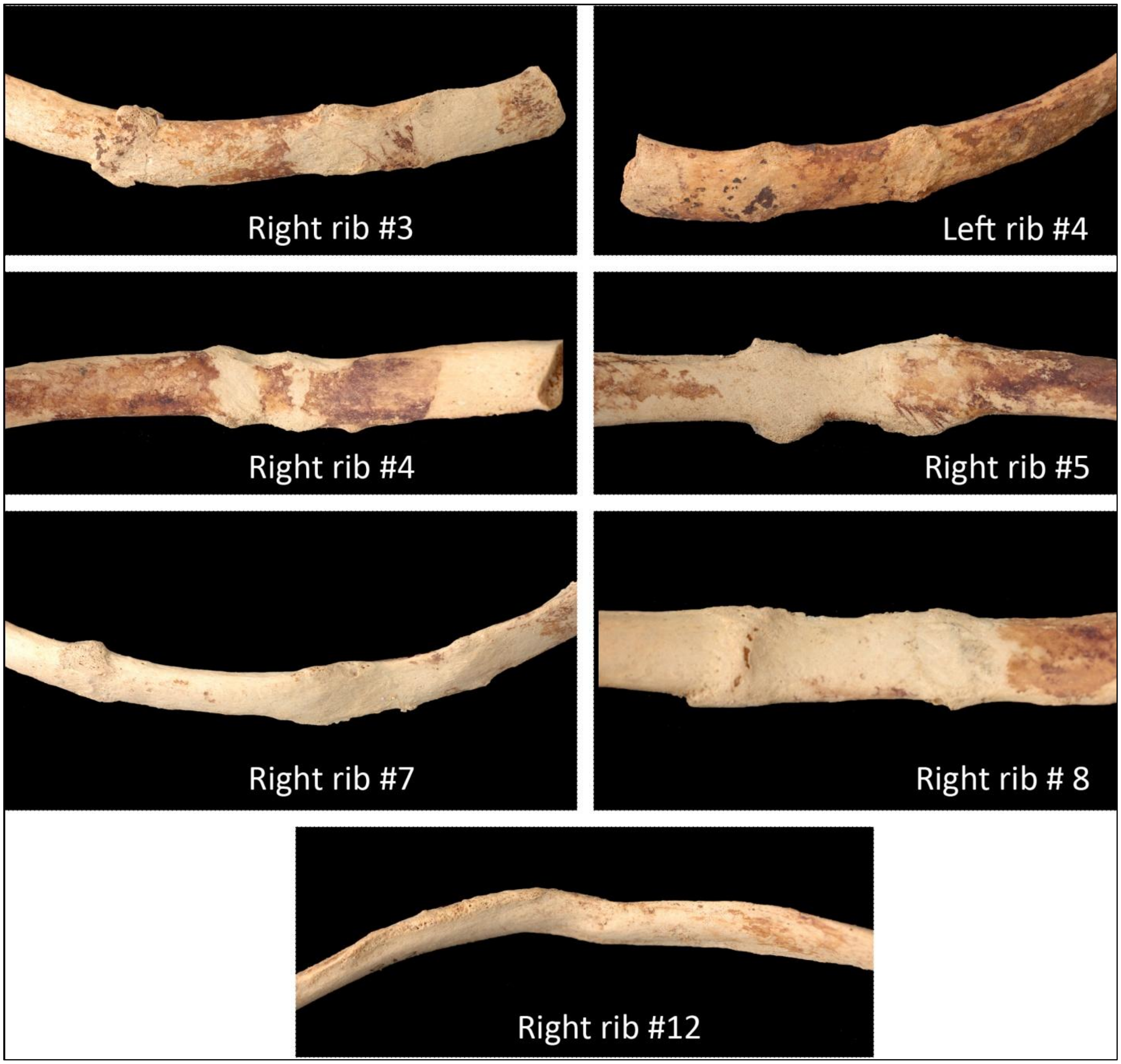


Figure 54: The different antemortem healed rib fractures of individual 4.

Individual 5 (Sector 120, Feature 7060, Tomb 12J47/1)

The human remains belong to an adult male of approximately 35 years of age with a stature of 169 cm. The analysis of the pubic symphysis determined a phase IVb with a mean of 35.2 +/- 9.4 years and a range of 23-57 years. The mandible has an unusual, skewed appearance. The individual suffered antemortem tooth loss of the mandibular right I_1 and I_2. The dental wear is only minimal.

Individual 6 (Sector 723N, Feature 7040, Tomb 12J46/3)

The skeletal remains were discovered in a Roman Period coffin and belonged to a late teenage/early adult female with a stature of 155 cm. The pubic symphysis determined a phase Ib, mean 19.4 +/- 2.6 years with a range of 15-24 years. The only antemortem paleopathology observed is an apical abscess on the maxillary right I^1.

Individual 7 (Sector 120, Features 7053 & 7065, "Cow Pit")

The incomplete and fragmentary human remains from this feature were found in a pit together with 15 cows (Figure 55). No skull was recovered, and only a few pelvic and long bone fragments were found. One fragment of a pubic bone could be analyzed and determined that the individual was an adult female of approximately 38 years of age at death. The pubic symphysis determined a phase IVa with a mean of 38.2 +/- 10.9 years and a range of 26-70 years. No paleopathologies were noted. The pottery in the shaft dates to the Middle Kingdom.

Figure 55: Burial shaft containing the human remains of individual 7 and 15 cows (after Willems, 2007).

The analysis of the human remains recovered in zone 9B determined a MNI of 7 adults. For a summary of all paleopathologies present in zone 9B, see Figure 56.

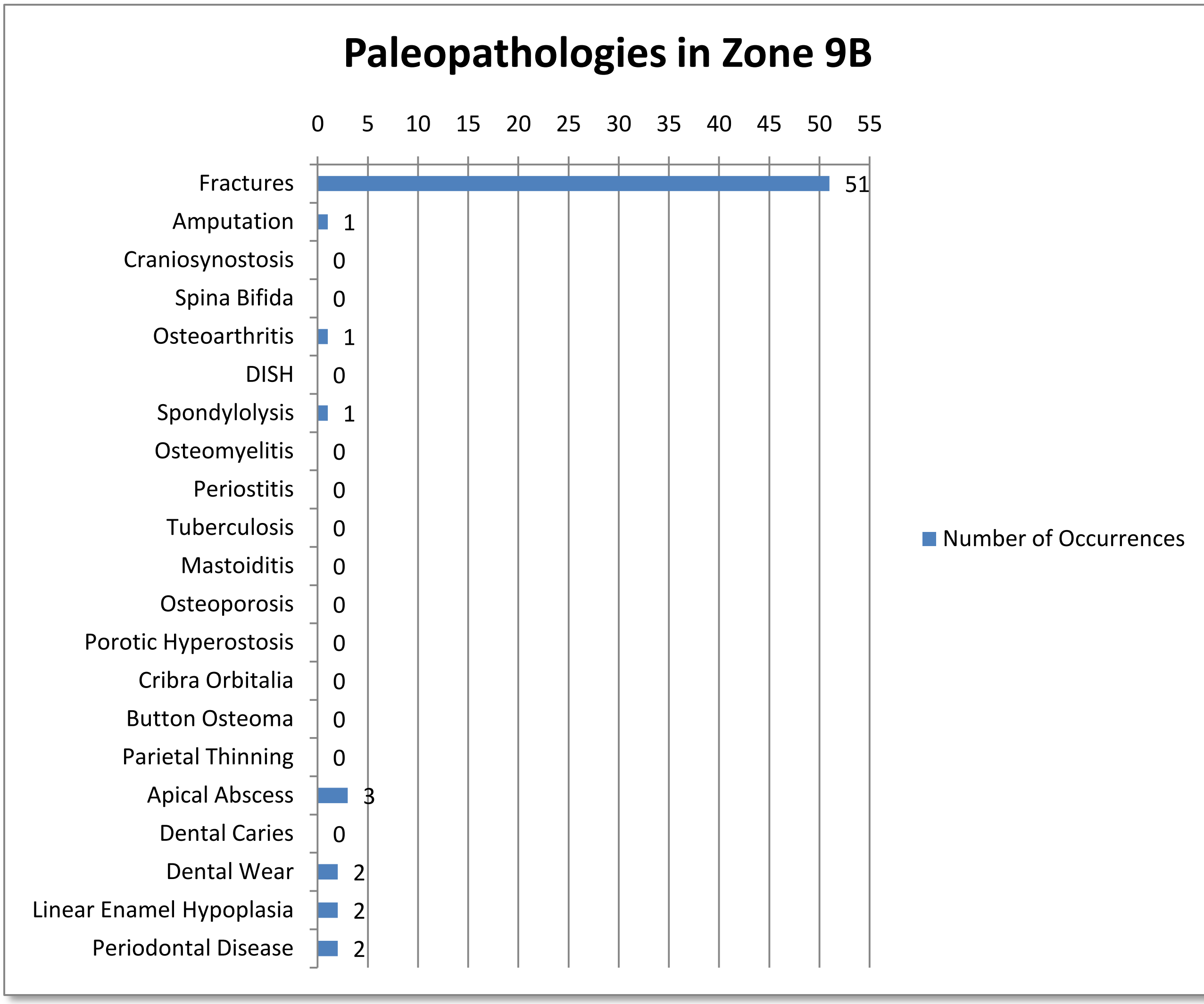


Figure 56: Summary of the different paleopathologies occurring in zone 9B.

Description and Results of Zone A in Sheikh Said

The following descriptions of individuals from Zone A in Sheikh Said are derived from field reports produced by T. Dupras and L. Williams during the 2008 and 2009 field seasons. Zone A dates to the Middle Kingdom.

Sector 1, Features S1, S4, S7, and S9

A total of 334 bones and bone fragments (313 adult and 21 juvenile) of one adult and one juvenile were recovered in this sector during excavation. Based on the dental development, the age of the juvenile was determined to be 3-5 years of age. No pathologies were noted on the juvenile remains. Age, sex, and stature of the adult individual could not be determined due to the incompleteness of the skeleton. The only paleopathology noted are two large apical abscesses on a maxillary fragment.

Sector 2, Features S100-S104 & S107

This sector had a total of 422 bones and bone fragments (402 adult and 20 juvenile) that were discovered. The juvenile skeletal elements indicate an MNI of one juvenile individual. Unfortunately, there are no elements that can help determine the age of this individual. The duplication of the adult bones and bone fragments indicate an MNI of five adult individuals based on the presence of five C2 vertebrae. No skeletal elements are complete enough to assess age, sex, or stature of any of the individuals. Observed paleopathologies include osteoarthritis (osteophytic lipping on cervical vertebrae), healed fracture of a distal left ulna, periostitis on a distal left fibula, two healed rib fractures, a healed fracture on a left 2^{nd}

metacarpal, and a healing fracture of the midshaft of a clavicle. Furthermore, there is a fusion of a C2 vertebra with a C3 (Figure 57).

Figure 57: Fusion of the C2 and the C3 vertebrae.

Sector 3, Features S110-S112, S117 & S119A

A total of 25 bones and bone fragments were recovered during the excavation. The MNI is consistent with one adult individual. Unfortunately, all skeletal elements needed to determine age, sex, and stature are not present. No paleopathologies were noted.

Sector 3, Feature S116

This feature contained the poorly preserved skeletal remains of a female with a stature of 160 cm. She was buried on her left side in an extended position in a wooden coffin. The individual is approximately 19 years old, based on the fusion state of the iliac crest epiphysis and the presence of an epiphyseal line on the vertebral bodies. The female has some unusual dental development. The mandibular right canine did never erupt but is still in the crypt, the mandibular right M_2 and the left M_1 and M_3 exhibit occlusal caries, the right M_3 was lost antemortem (Figure 58). The maxillary left and right canines still belong to the deciduous dentition and show extensive dental wear. The maxillary left M3 presents a large occlusal/medial cavity (Figure 58). The human remains also show individual traits such as a very small and narrow cranium and a femoral torsion of the distal ends to the medial side, most likely causing the individual to walk “knock-kneed”.

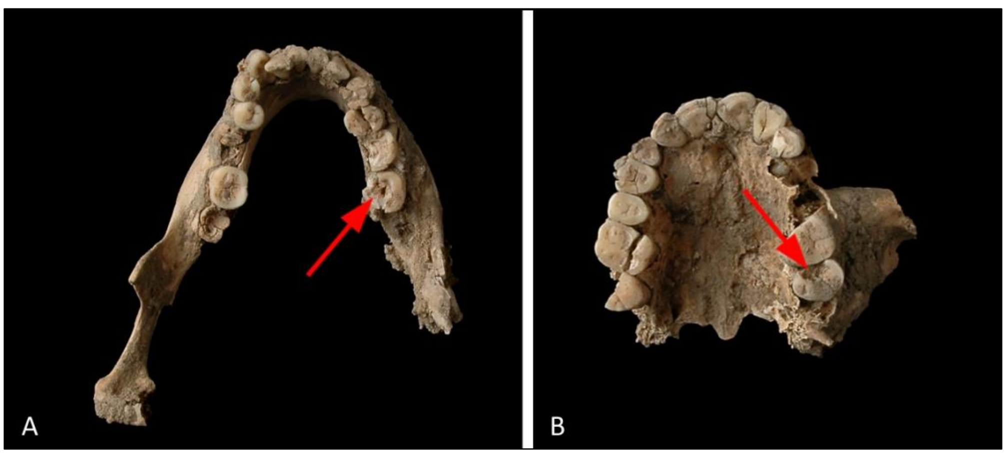


Figure 58: The dentition of the individual discovered in sector 3, feature S116: (A) the mandibular M_2 displays large caries, and (B) the maxillary M^3 exhibits a large cavity.

Sector 3, Feature S118

This burial contains the skeletal remains of an adult male with a stature of 170 cm (Figure 59). His age was determined to be older than 40 years of age. Paleopathologies noted include osteoporosis, osteoarthritis, and biparietal thinning (Figure 60). The dental pathologies comprise dental calculus built up, periodontal disease, heavy dental wear, and an abscess.

Figure 59: The individual excavated in sector 3, feature S118.

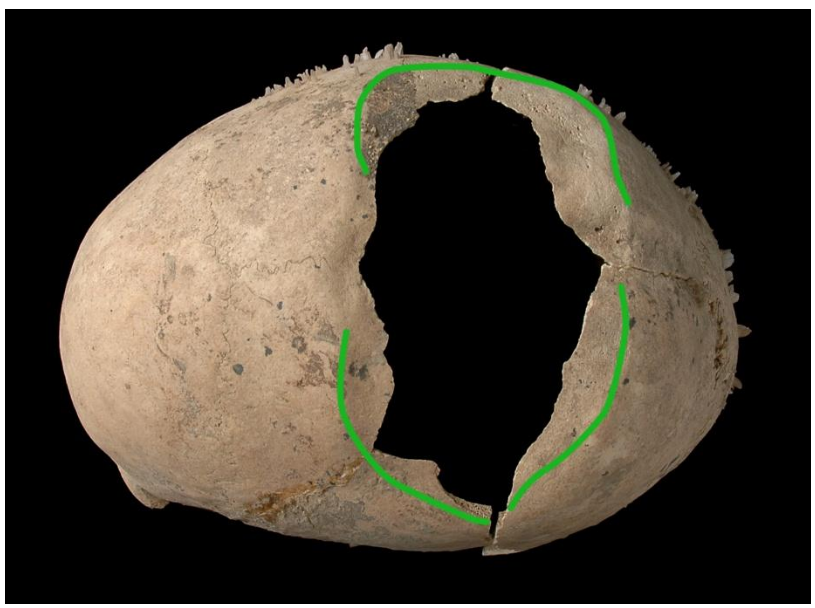


Figure 60: Cranium of individual of sector 3, feature S118, displaying biparietal thinning.

Sector 53, Features 20 & 21

The individual in this burial is only represented by a partially mummified right and left foot. Sex and stature cannot be determined. The morphology of the bones indicates that the individual was adult. No paleopathologies were noted.

Sector 55, Features 1-21

The human remains from this burial represent an adult female of 30-35 years with a stature of 152 cm was recovered from this burial. The paleopathologies noted include healed rib fractures, a healed nasal fracture, and healed blowout fractures to the right and left orbits. The dentition exhibits dental calculus, periodontal disease, dental wear, and linear enamel hypoplasia.

Sector 7, Feature 13

The burial contains the remains of an adult female of approximately 40 years of age with a stature of 158 cm. The paleopathologies noted include spina bifida, healed rib fractures, dental calculus, periodontal disease, caries, and abscesses. The female also had individual traits such as six sacral elements, consisting of 5 sacral elements and a sacralized lumbar vertebra.

The analysis of the human remains recovered in zone A determined a total MNI of 14 individuals, 12 adults and 2 juveniles. For a summary of all paleopathologies present in zone A, see Figure 61.

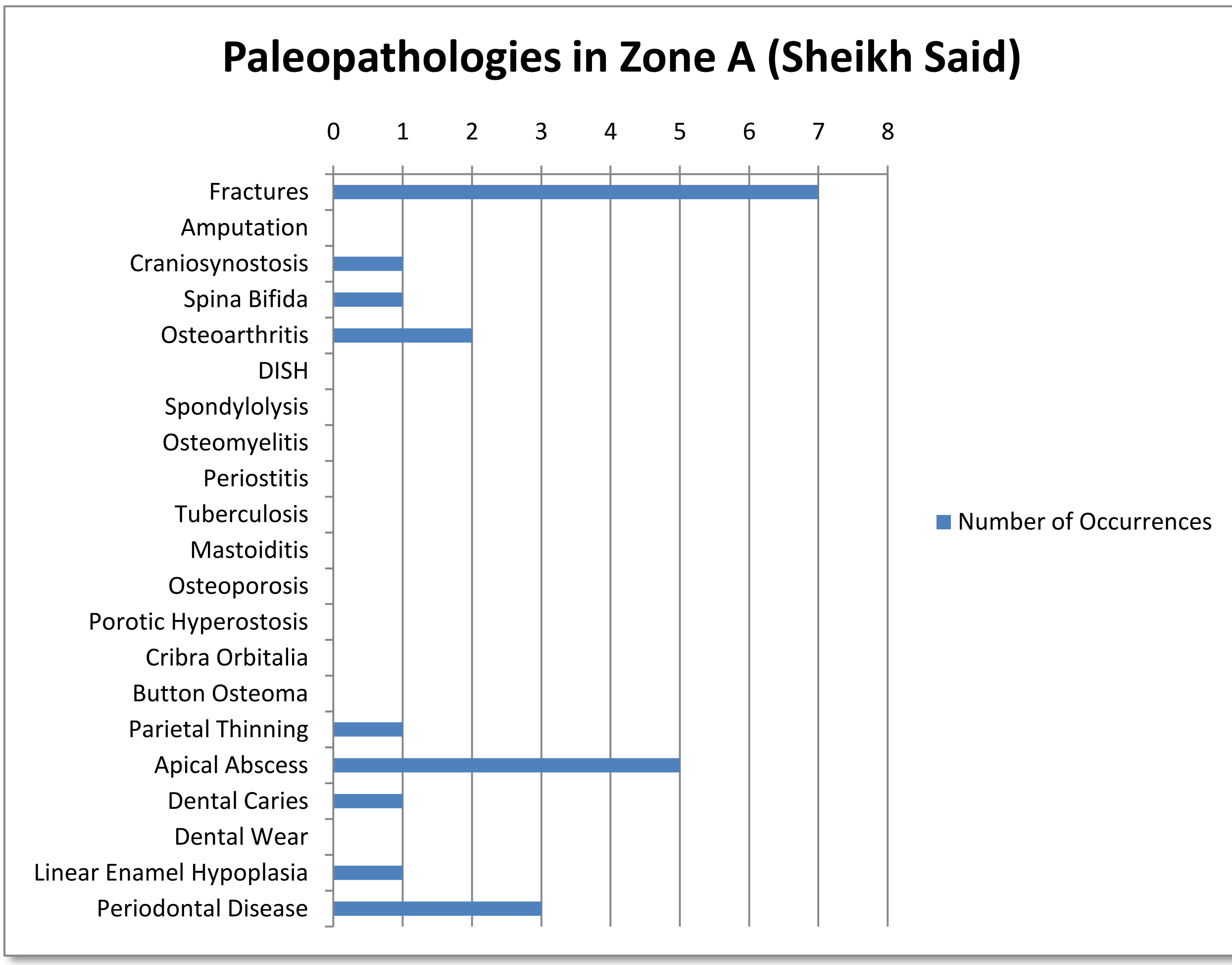


Figure 61: Summary of the different paleopathologies occurring in zone A (Sheikh Said).

CHAPTER SIX: DISCUSSION OF THE PALEOPATHOLOGIES OCCURRING IN THE OLD KINGDOM AND THE MIDDLE KINGDOM

This chapter discusses the paleopathologies occurring in the Old Kingdom and in the Middle Kingdom at the sites of Dayr al-Barshā and Sheikh Said. The two time periods will briefly be described historically to provide insight of what happened in Egypt during that time. The findings of the two time periods will be compared to findings at other sites in Egypt. Because zone 9B cannot be dated accurately (the burials come from at least four different time periods - Old Kingdom, Middle Kingdom, New Kingdom, and Roman Periods), it cannot be treated with the other zones dating to the Middle Kingdom. Therefore, zone 9B will not be included in the graphs showing the distribution by time periods, and it will be discussed separately.

The Old Kingdom – The Age of the Pyramids

The Old Kingdom marks the first cultural peak in the ancient Egyptian civilization and lasted from 2686 – 2160 BC (Dynasties 3 to 6; Shaw, 2000). Commonly this period is also known as "Age of the Pyramids" due to the intensive pyramid building of that time. The largest pyramids originate in the Old Kingdom, starting in the 3rd dynasty with the step pyramid of Djoser in Saqqara built by the well-known architect Imhotep, continuing in the 4th dynasty with the three pyramid attempts of pharaoh Sneferu in Meidum and Dashur, and the three most famous pyramids at Giza built by Khufu, Khafra, and Menkaura, representing the highly effective organization of the Egyptian state (Bard, 2008). The population density was the highest at the beginning of the Old Kingdom (Allen, 1997). During the Old Kingdom urbanization began with the founding of several cities, for example the first capital of Egypt which was located at Memphis. The pharaoh's court was located in Memphis, as well as the centralized government headed by the vizier, the second person in power after the king (Bard, 2008). The role of the king emerged as well in the Old Kingdom after the unification of Upper and Lower Egypt around the year 3100 BC (Bard, 2008). Egypt was already divided into 42 nomes, or provinces, that were ruled by a governor, or nomarch. *Hermopolis Magna*, or al-Ashmunayn was already inhabited during the Old Kingdom but beside a temple dating to this period and lying underwater beneath a Middle Kingdom temple, no other structures could be located (De Meyer, 2008). *Hermopolis Magna* was the sacred city of Thoth, the ibis headed god of wisdom and writing.

At the end of the Old Kingdom, in the 6th dynasty, Egypt faced different problems and conflicts that lead to the downfall of the era. These problems can be categorized into environmental and sociopolitical problems. The environmental problems include lower Nile inundation, that led to poor harvest and finally to famine (Bard, 2000). The sociopolitical problems are in a way tied to the environmental troubles. The intensive pyramid building during the Old Kingdom left Egypt bankrupt. The irrigation of agricultural fields failed and no surplus of food was available. The last king of the 6th dynasty, Pepi II, died after a long reign, left no heir to the throne, but left Egypt in corruption and uprising. The centralized government had given more and more control to the nomarchs, the local governors. Some nomarchs dealt better than others with the problematic times and arose to greater power. Especially two regions came to power: rulers of the 9th and 10th dynasties emerged at Herakleopolis in the north and rulers of the 11th dynasty at Thebes in the south (Bard, 2000). The First Intermediate Period (2160 – 2055 BC) was a time of intensive rivalry and alliance making (Bard, 2000; Shaw, 2000).

The Middle Kingdom – Renaissance of the Egyptian State

After the collapse of the Old Kingdom and the turbulent time of the First Intermediate Period, the ancient Egyptian empire arose to new glory during the Middle Kingdom (2055 – 1650 BC, dynasties 12-14, Shaw, 2000). The king of Thebes, Mentuhotep II, became more powerful and led his troops into Lower Egypt which cleared the way to the second unification of Upper and Lower Egypt under Amenemhat I. This king founded a new capital known as *Itjtawy*, a location that still remains unknown, but presumably was found in the Faiyum region in Lisht. Founding the new capital was politically wise because it signaled a new beginning after the chaotic time of the First Intermediate Period (Shaw, 2000). The Rhind Mathematical papyrus, the Edwin Smith surgical papyrus, and the Ebers medical papyrus, three of the most famous papyruses, were written during the Middle Kingdom (Breasted, 1930; Shaw, 2000). During the Middle Kingdom Egypt engaged in many fights with Asiatic groups that led their troops onto Egyptian grounds. The end of the Middle Kingdom was marked by political unrest that resulted in the collapse and finally in the conquest of Egypt by the Asiatic Hyksos who ruled Egypt during the following Second Intermediate Period (Shaw, 2000).

During the Middle Kingdom, the nomarchs strengthened their power, and the governors of the Hare nome of *Hermopolis Magna* played a significant role. Nehry, for instance, dated inscriptions to his own reign, a practice that was uncommon in ancient Egypt where everything has been dated to the reign of the ruling king. Nehry's statements at the Hatnub quarry suggest that he challenged the pharaoh (Shaw, 2000).

The Quarries of Dayr al-Barshā

The limestone quarries of Dayr al-Barshā played an essential role in the lives of the ancient population around Dayr al-Barshā and may be directly related to some paleopathologies visible on the skeletal remains. The quarries are located in the Wadi Nakhla which has been assigned zone 5 on the large-scale archaeological site (Figure 2). The large stones were mainly used on behalf of the temple of the god Thoth in *Hermopolis Magna* on the opposite bank of the Nile (Willems, 2002). Over 400 graffiti were left on the walls in the different chambers of the quarries, most of them in Demotic. The earliest use of the quarries is still debated. The earliest royal name mentioned in the area of the quarries is Thutmosis III, a ruler of the 18th dynasty (Brovarski et al., 1992). Nevertheless, some decorations can be dated to the Old Kingdom giving strong evidence that the quarries were already used during that time period (De Meyer, 2008). Together with the quarries in Dayr Abu Hinnis (approximately 5 km in the north), the quarries of Dayr al-Barshā were in extensive use during the New Kingdom when a new chamber was opened during the reign of Amenhotep III (Willems, 2002; Willems, 2004).

It is interesting that some stones from this quarry are unusual small with sizes of only 55-60 cm x 25-30 cm. This is exactly the size of so called talatats, stones used for the construction of Akhenaton's new capital in Tell el-Amarna (Willems, 2002). Later on in the 30^{th} dynasty, the quarries have been extensively used during the reigns of Nectanebo I and Nectanebo II.

Discussion of the Paleopathologies from Dayr al-Barshā and Sheikh Said

The paleopathologies in the skeletal material from Dayr al-Barshā and Sheikh Said are very diverse (Table 11 and Figure 62).

Table 11: Summary of all the paleopathologies in the skeletal material from Dayr al-Barshā and Sheikh Said.

Paleopathology	Old Kingdom	Middle Kingdom	Zone 9B
Fracture	22	26	51
Amputation	2	1	1
Spondylolysis	1	2	1
Craniosynostosis		1	
Spina Bifida		1	
Osteoarthritis	6	8	1
DISH	1	2	
Osteomyelitis	1		
Periostitis	1	1	
Tuberculosis		1 (?)	
Mastoiditis	1		
Osteoporosis		2	
Cribra Orbitalia	12	1	
Porotic Hyperostosis	1	1	
Osteoma	1	1	
Parietal Thinning	4	6	
Dental Wear	31	12	2
Dental Caries	4	7	
Dental Abscesses	7	16	3
Periodontal Disease	1	10	2
Dental Enamel Hypoplasias	1	2	2

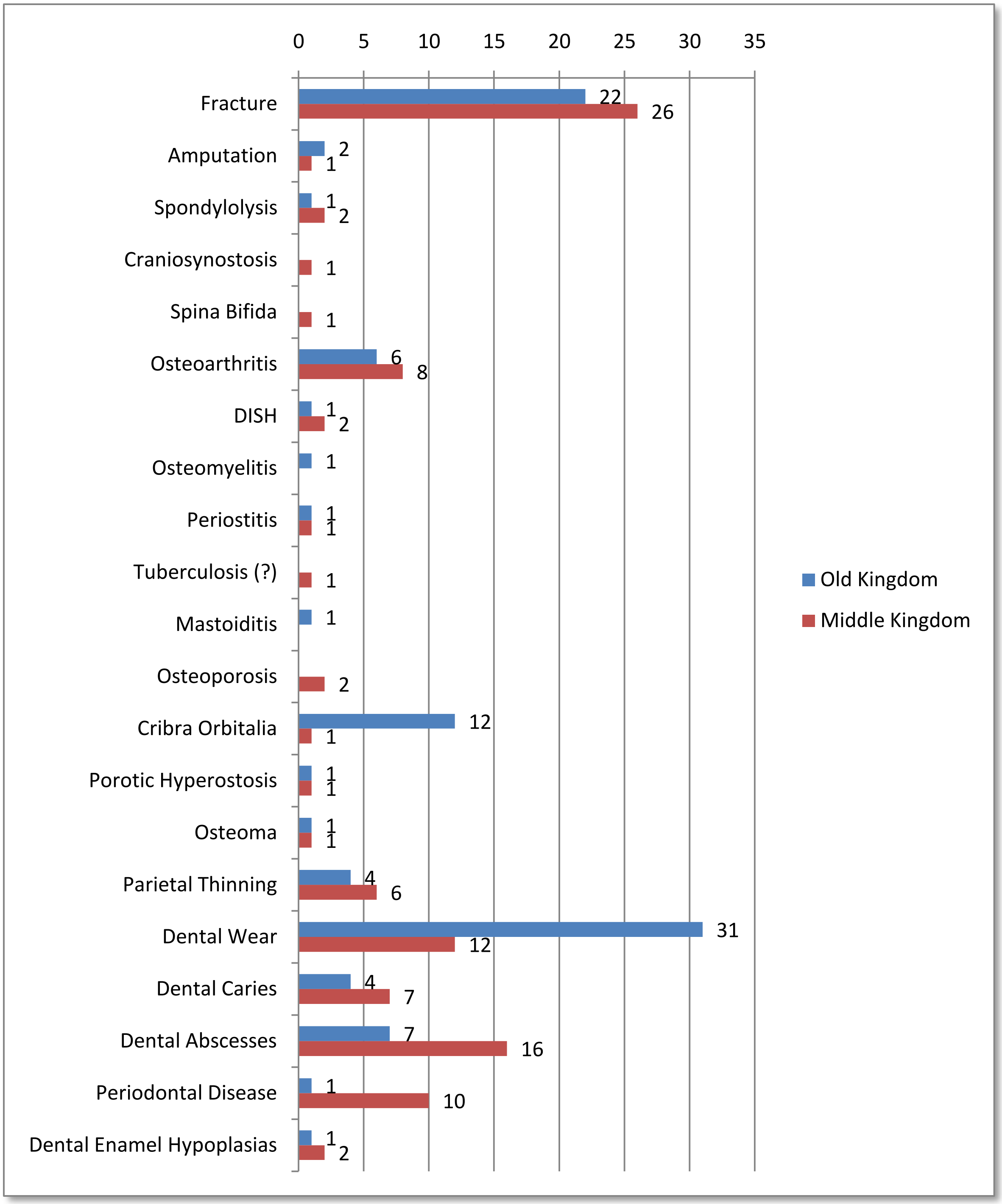


Figure 62: Graph showing all the paleopathologies occurring in the skeletal material from Dayr al-Barshā and Sheikh Said in the Old Kingdom and Middle Kingdom periods.

Fractures

Fractures are a very common condition in human remains and tell a lot about how the particular individual lived and in many cases how they died. The prevalence and distribution patterns of fractures may help shed light on the risks that past societies had to deal with on a daily basis (Judd, 2007; Erfan et al., 2009). There are two causes of trauma that causes fractures, accidents and violent origins. Both are very important to reconstruct the life not only of a past individual, but also of an entire society.

To determine the number of fractures, each single fracture was counted. The total number of fractures encountered in the skeletal material from the Old Kingdom and the Middle Kingdom was 48 (Table 12; Figure 64,Figure 65, and Figure 66). The distribution of fractures in the skeletal material from Dayr al-Barshā and Sheikh Said is almost the same with 22 fractures in the Old Kingdom and 26 incidents of fractures in the Middle Kingdom (Figure 63).

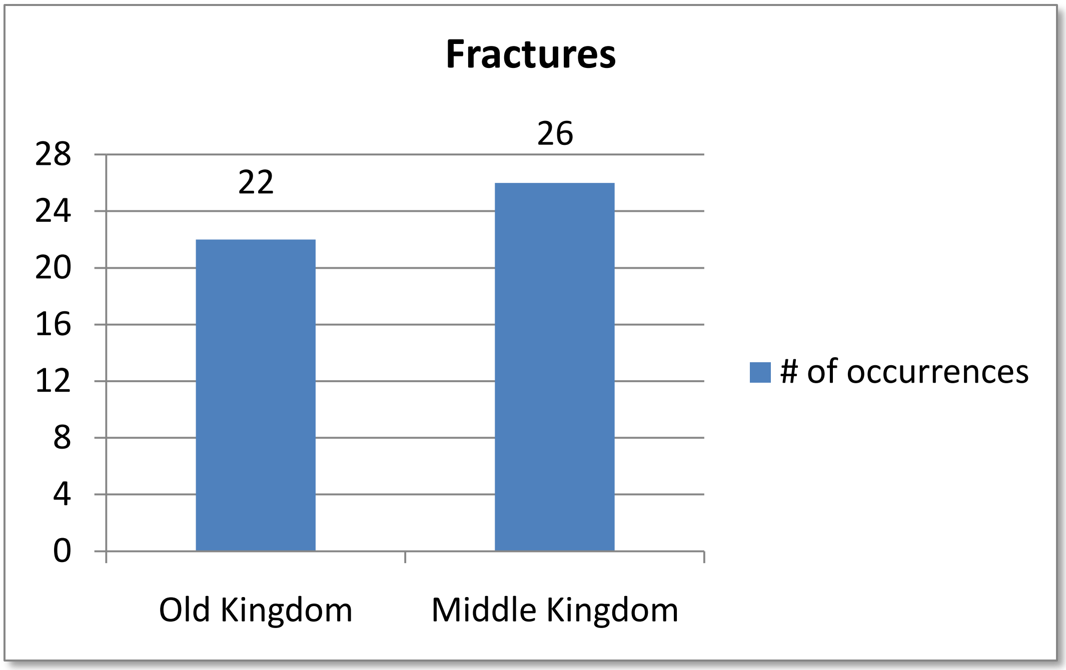


Figure 63: Graph showing the overall distribution of fractures in the Old Kingdom and the Middle Kingdom.

The distribution by skeletal elements and by zones/time periods shows that the ribs are the most frequently affected element in both time periods (Table 12, Figure 64). The human remains from zones 4 and 7 that represent the Old Kingdom exhibit a total of 7 rib fractures, and the remains from zones 2, 9A, and zone A in Sheikh Said only showed 4 fractured ribs. Zone 9B, which consists of burials from multiple time periods, shows a high peak in the rib fracture distribution. A total of 40 rib fractures were counted on just two individuals. Individual 4 has 14 fractured ribs and individual 2 has 29. While the fractures on the ribs of individual 4 are healed and occurred antemortem, individual 2 exhibits perimortem fractures that occurred around his death and possibly led to his death.

Multiple rib fractures can occur through extensive blunt force trauma to the thorax. Today, this may happen most frequently through road traffic accidents (Sirmali et al., 2003). In ancient times and especially with the focus on Dayr al-Barshā and the quarries, the blunt force trauma pathologies may have been caused by a large rock that slipped and crushed the workman. Sirmali et al. (2003) state that the greater the number of fractured ribs, the higher the morbidity and mortality is. Flagel et al. (2005) analyzed rib fracture data of the National Trauma Data Bank and concluded that today the overall mortality rate for patients with rib fractures is 10%. This rate increased for every further fractured rib (Flagel et al., 2005).

The rib fractures may be overinflated in the skeletal material, simply because of the amount of ribs an individual has.

Table 12: Summary of the number of fractures categorized by skeletal elements and archaeological zones, encountered in the skeletal material from Dayr al-Barshā and Sheikh Said.

	Old Kingdom		Middle Kingdom				
Skeletal element	**Zone 4**	**Zone 7**	**Zone 2**	**Zone 9A**	**Zone A**	**Zone 9B**	**Total**
Skull				2	1		3
Clavicle		1			1	1	3
Sternum						2	2
Ribs	4	3		1	3	43	54
Thoracic vertebrae	1						1
Lumbar vertebrae	3						3
Humerus	1			1		1	3
Ulna	3				1	1	5
Radius	1			1		1	3
MC1			1				1
MC2	2		1		1		4
MC4			1	1			2
MC5			1	2			3
Femur	1						1
Patella						1	1
Tibia			1	2			3
Fibula	1			2	1		4
Talus				1			1
Toe phalanx						1	1
Long bone diaphysis	1						1
Total	**18**	**4**	**5**	**13**	**8**	**51**	**99**

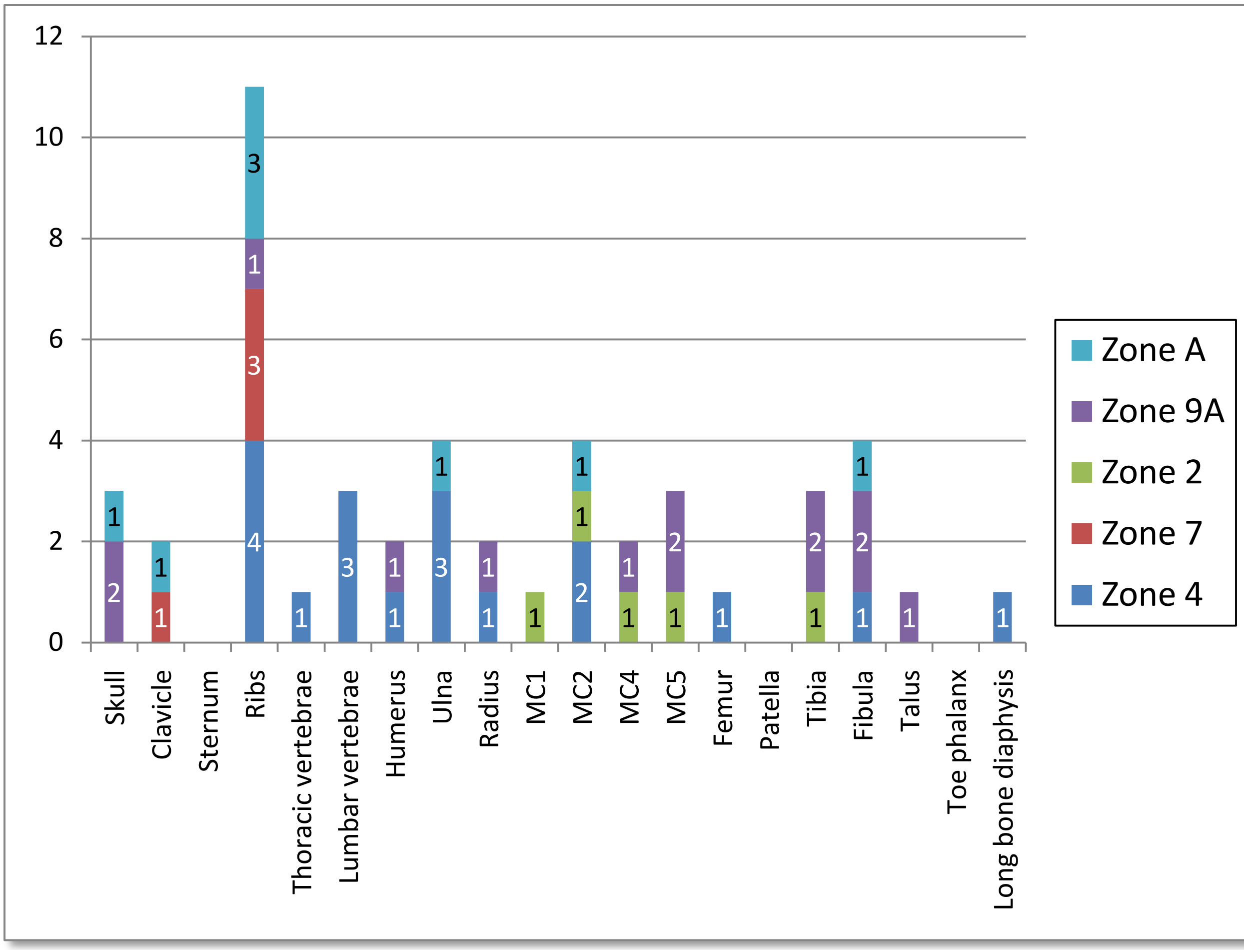


Figure 64: Graph showing the distribution of fractures by zones and skeletal elements. Zone 9B is not represented in this graph.

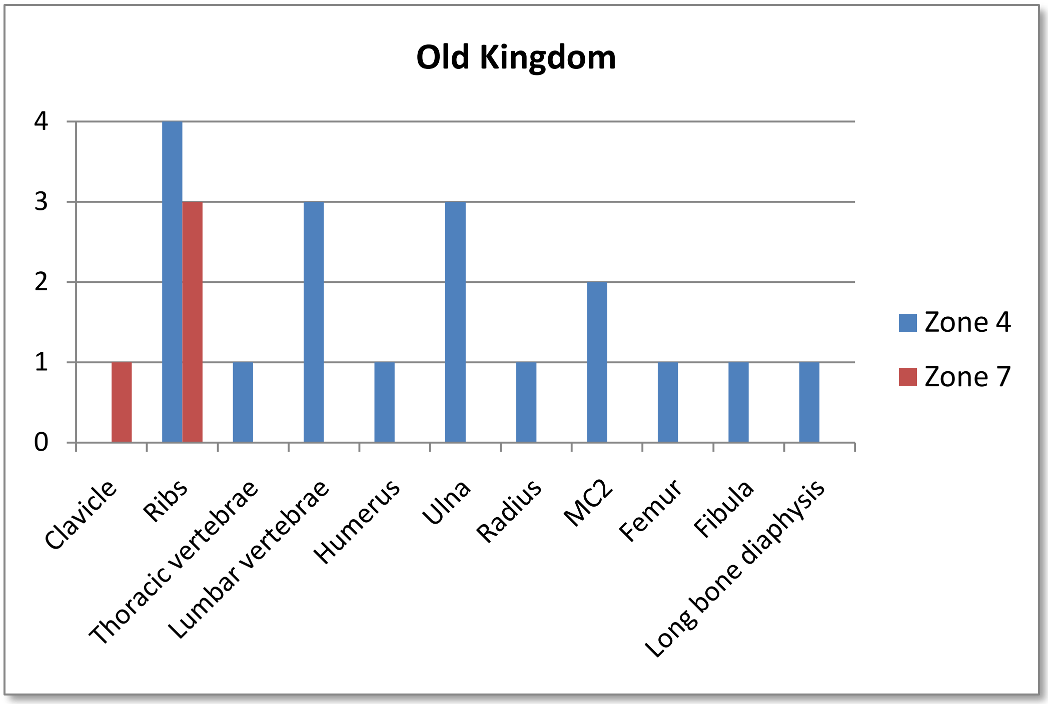


Figure 65: Graphs showing the number of fractures by skeletal elements and zones in the Old Kingdom.

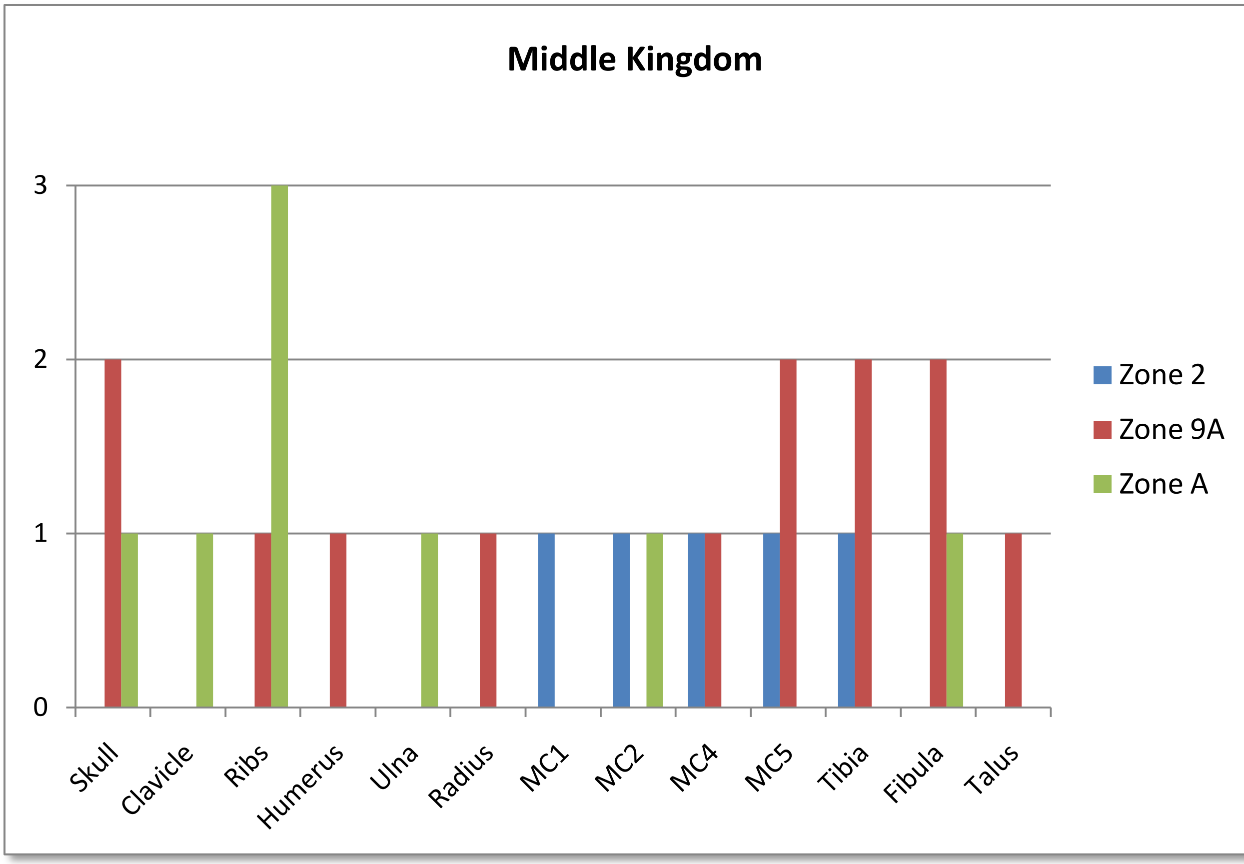


Figure 66: Graphs showing the number of fractures by skeletal elements and zones in the Middle Kingdom. Zone 9B is not included in this graph due to the mix in time periods in this zone.

Brothwell and Sandison (1967) analyzed over 6000 skeletal human remains from Egypt and determined following frequency of fractures: 1. forearm (31%), 2. clavicle (14%), 3. femur (12%), 4. lower leg (10%), 5. humerus (7%), 6. ribs (6%), and 7. pelvis (4%). The overall distribution in both time periods in Dayr al-Barshā and Sheikh Said (Table 13 and Table 14) show that rib fractures represent 23.0% of the fractures, a much higher distribution than noted by Brothwell and Sandison (1967).

Table 13: Overall summary of the distribution of fractures by skeletal elements in Dayr al-Barshā and Sheikh Said during the Old Kingdom and Middle Kingdom periods (N=48).

Skeletal Element	**%**
Rib	23.0
Lower leg	14.6
Forearm	12.4
Boxer's fracture (MC4 and MC5)	10.4
MC2	8.3
Lumbar vertebra	6.3
Skull	6.3
Clavicle	4.1
Humerus	4.1
MC1	2.1
Femur	2.1
Talus	2.1
Thoracic vertebra	2.1
Undetermined long bone diaphysis	2.1

Previously rib fractures were rarely included in studies investigating fractures in past populations (Brickley, 2006). Fractured ribs can tell a lot about past societies because these skeletal elements play an essential role in protecting the vital organs and providing attachments for muscles (Brickley, 2006). Morbidity and mortality increase in individuals older than 45 years of age after trauma to the ribs (Brickley, 2006). In modern populations, an average of 70 days healing is needed after a rib fracture (Kerr-Valentic et al., 2003).

Table 14: Comparison of the results from Dayr al-Barshā and Sheikh Said with the results from Brothwell and Sandison (1967).

Skeletal element	Dayr al-Barshā	Brothwell and Sandison (1967)
Rib	23.0%	6%
Lower leg	14.6%	10%
Forearm	12.4%	31%
Clavicle	4.1%	14%
Humerus	4.1%	7%
Femur	2.1	12%

The Boxer's fracture occurs at a relatively high frequency, 10.4% of all fractures, in the skeletal material from Dayr al-Barshā and Sheikh Said. In the skeletal material from both necropoli, a total of 10 hand fractures (1 MC1, 4 MC2, 2 MC4, and 3 MC5) were counted. 5 fractures, or 50%, were fractures of the 4^{th} or 5^{th} metacarpal and therefore Boxer's fractures.

The Boxer's fracture is a special traumatic condition because it can provide direct insight into the life style or the occupation of an individual. A boxer's fracture occurs at the neck or shaft of the 4^{th} or 5^{th} metacarpals. The term Boxer's fracture gives reason to think that this type of fracture usually occurs in boxers but more frequently it occurs in brawlers and in frustrated individuals who strike a hard surface of immobile objects at an angle with a clenched fist (Siegel, 1995; Ali et al., 1999). Siegel (1995) describes the forces that cause this fracture. If the fist is clenched, the metacarpal flexes at the hamate-metacarpal joint, and the impact of the punch is directed onto the dorsal surface of the metacarpal head. This leads to an immediate flexion deformity as the dorsal surface of the bone fails in tension and the palmar surface of the bone fails in compression. Gudmundsen and Borgen (2009) conducted a study in a hospital in Norway where 1475 hand fractures were analyzed, and 271 or 18.4% of those fractures were located on the fifth metacarpal bone. The researchers determined that 130 out of the 271 had occurred through aggression, such as punching a hard surface (N=104) or a fistfight (N=26), while 141 fractures of the fifth metacarpal occurred by accident (N=114 falling, 10 sports injuries, 6 squeeze, 5 injuries at work, and 6 other causes).

The Middle Kingdom burials from the site of Semna South in Nubia exhibit a large number of fractures, with almost 21% of the individuals buried suffering at least one healed fracture during life , with fractures occurring more frequently in older adults and males (Alvrus, 1999).

Fractures of the skull occur at a very low rate in the skeletal material from Dayr al-Barshā at only 6.3%. This rate may be even lower considering that one of the healed depressed fractures of a right parietal bone from individual 16 in zone 9A may be parietal thinning. Alvrus (1999) reports that 17.9% of the crania in Semna South exhibited a depressed, round non-lethal fracture occurring most frequently on the frontal bone, possibly caused by some sort of sling weapon. Erfan et al. (2009) state that in the Bahariyah Oasis more females suffered from trauma than males, and the most frequently fractured bone on the cranium is the parietal bone (65.9%), followed by the frontal (27.3%), and the occipital (6.8%). The depressed cranial fractures were mainly caused by blunt force trauma (88.63%), while blade injuries from edged weapons only account for 11.4% of all incidents (Erfan et al., 2009). Erfan and colleagues (2009) also comment that the frequency of fractures is much higher in the Greco-Roman Period than it is in the Old Kingdom. This statement is true for Dayr al-Barshā where only two crania display fractures; one cranium shows a depressed round fracture on the frontal bone, the other cranium displays a depressed fracture on the parietal bone. Nerlich et al. (2002) determined in their sample from Thebes that trauma had a frequency of 21.8% during the Middle Kingdom and 12.3-22.6% in the New Kingdom and in later time periods.

The ancient Egyptians had effective treatments for all kinds of fractures. The Edwin Smith surgical papyrus is a testimony of the medical knowledge of ancient Egyptian doctors, called *swnw*. Although only the first half of the papyrus survived, it gives significant insight on the medical practices in ancient Egypt. The papyrus was discovered in 1862 and dates to around 1600 BC. This papyrus is a copy of a much older text that was written around 2500 BC and is attributed to Imhotep, the famous vizier, architect, physician, and astronomer to pharaoh Djoser of the 3rd dynasty (Sullivan, 1995). The Edwin Smith papyrus consists of 377 lines in 17 columns that discuss 48 cases of treatments for different fractures. The cases are grouped by skeletal region; cases 1-27 discuss fractures occurring on the head, cases 28-33 the throat and the neck, cases 34-35 the clavicle, cases 36-38 the humerus, cases 39-46 the sternum, the overlying soft tissue, and the true ribs, case 47 the shoulders, and case 48 (incomplete) the spinal column (Breasted, 1930). Each case is divided into; 1. title of the case; 2. examination of the patient; 3. Diagnosis; 4. treatment (unless a fatal case that was considered untreatable); and 5. glosses (Breasted, 1930). Only a few selected cases and their treatments will be presented at this place to give an idea about the ancient Egyptian treatment of fractures (translation after Breasted, 1930):

<u>Case 1: “A wound in the head penetrating to the bone”</u>

Examination: *If thou examines a man having a wound in his head, penetrating to the bone of his skull, but not having a gash, thou shouldst palpate his wound (or lay hand upon it); shouldst thou find his skull uninjured, not having a perforation, a split or a smash in it* (conclusion in diagnosis).

Diagnosis: *Thou shouldst say regarding him: “One having a wound in his head, while his wound does not have to lips, nor a gash, although (it penetrates to the bone of) his head. An ailment which I will treat.”*

Treatment: *Thou shouldst bind it with fresh meat the first day and treat afterward with grease, honey and lint every day until he recovers.*

<u>Case 6: “A gaping wound in the head with compound comminuted fracture of the skull and rupture of the meningeal membranes”</u>

Examination: *If thou examines a man having a gaping wound in his head penetrating to the bone smashing his skull and rending open the brain of the skull, thou shouldst palpate his wound. Shouldst thou find that smash which is in his skull like those corrugations which form in molten copper, and something therein throbbing and fluttering under thy fingers, like the weak place on an infant’s crown before it becomes whole – when it has happened there is no* *throbbing and fluttering under thy fingers until the brain of his skull is rent open – and he discharges blood from both his nostrils, and he suffers with stiffness in his neck* (conclusion in diagnosis).

Diagnosis: *Thou shouldst say regarding him: "One having a gaping wound in his head penetrating to the bone and rending open the brain of the skull, while he discharges blood from his nostrils and suffers with stiffness in his neck. An ailment not to be treated."*

<u>Case 11: "A broken nose"</u>

Examination: *If thou examines a man having a break in the column of his nose, his nose being disfigured, and a depression being in it, while the swelling that is on it protrudes, and he has discharged blood from his nostrils* (conclusion in diagnosis).

Diagnosis: *Thou shouldst say concerning him: "One having a break in the column of his nose. An ailment which I will treat."*

Treatment: *Thou shouldst cleanse it for him with two plugs of linen. Thou shouldst place two other plugs of linen saturated with grease in the inside of his two nostrils. Thou shouldst put him at his mooring stakes until the swelling is reduced. Thou shouldst apply for him stiff rolls of linen by which his nose is held fast. Thou shouldst treat him afterward with grease, honey, and lint every day until he recovers.*

Case 36: "Fracture of the upper arm"

Examination: *If thou examinest a man having a break in his upper arm and thou findest his upper arm hanging down, separated from its fellow* (conclusion in diagnosis).

Diagnosis: Thou shouldst say regarding him: "One having a fracture in his upper arm with his arm hanging down. An ailment which I will treat."

Treatment: *Thou shouldst place him prostrate on his back, with something folded between his two shoulder blades, thou shouldst spread out with his two shoulders in order to stretch apart his upper arm until that break falls into its place. Thou shouldst make for him two splints of linen and thou shouldst apply one of them both on the inside of his arm and the other on the underside of his arm. Thou shouldst bind it with ymrw and treat it afterward with honey every day until he recovers.*

Case 44: "Fractures of ribs with inflicted wound"

Examination*: If thou examinest a man having a break in the ribs of his breast, over which a wound has been inflicted; and thou findest that the ribs of his breast crepitate under thy fingers* (conclusion in diagnosis).

Diagnosis: *Thou shouldst say concerning him: "one having a break in the ribs of his breast, over which a wound has been inflicted. An ailment not to be treated."*

Brothwell and Sandison (1967) mention the splint treatment as early as the 5th dynasty consisting of either the mid-rib of the date-palm leaf, the spongy strips of wood, the bark of the Acacia tree, or bundles of straw from coarse grass. The great majority of the fractures in the skeletal material form Dayr al-Barshā and Sheikh Said are healed fractures and only two fractures exhibit osteomyelitis and another fracture periostitis. This situation shows that most ancient Egyptian patients received the right fracture treatment, or they were left to heal on their own. Nevertheless, there are a few cases where fractures without the proper treatment caused the formation of secondary joint surfaces.

The Case of a Violent Death – Sharp Force Trauma

An individual that should be discussed at this point is individual 3 from zone 9B in Dayr al-Barshā (Figure 52 and Figure 53). Because this zone consists of mixed/multiple burials that were objects of reuse, the burial cannot be dated clearly. However, the suggestion is that the burial is dated at least to the early Middle Kingdom. The individual is an adult female of approximately 30 years of age. The morphology of her cranium and her short, curly hair suggest African ancestry. Her left leg was noticeably shorter than the right leg and may have caused her to limp. The skeletal remains did not exhibit any fractures or other pathologies, but evidence of sharp force trauma was noted on the anterior surfaces of cervical vertebrae C4 through C6. Seven deep cut marks were counted, testifying to the violent death of this individual, as her throat was cut while somebody was standing behind her.

Amputations

Four cases of amputations were found at the site of Dayr al-Barshā (Dupras et al., 2009; Table 15). Individual 2 from zone 9B died shortly after the injuries and the amputation occurred (see section below, A Deadly Accident in the Quarries?). The individuals from zones 4, 7, and 9A show healed pathological changes to the amputation sites, indicating that the individuals lived for a longer period of time after the amputation process (Dupras et al., 2009). The two individuals discovered in zones 4 and 9A show that the amputations through the metatarsals were not necessary due to trauma, but more likely due to a medical condition such as diabetes mellitus or leprosy. The Ebers medical papyrus, dating to the Middle Kingdom, is the first written source that discusses diabetes mellitus and makes clear that it was a condition relatively common in ancient Egypt (Aufderheide and Rodriguez-Martin, 1998; Dupras et al., 2009).

Table 15: Summary of the amputations found in the human remains from Dayr al-Barshā (after Dupras et al., 2009).

Time Period	Zone	Individual/Sector	Skeletal Element
Old Kingdom	Zone 4	Sector 2	Right and left feet
Old Kingdom	Zone 7	Sector 7	Left ulna
Middle Kingdom	Zone 9A	Individual 28	Right and left feet
Middle Kingdom?	Zone 9B	Individual 2	Right arm

Amputations occurring in past societies are very rarely discussed in the literature. Brothwell and Moller-Christensen (1963) discuss a possible case of an amputated lower arm dating to the 9th dynasty that displays considerable healing with well rounded ends. They also mention possible situations that may have caused an amputation; 1. as a result of injury during battle; 2. as a punishment for theft; 3. as part of the process of recording the numbers of prisoners or killed enemy soldiers; and 4. through infection or injury, with subsequent intentional surgical amputation. Nerlich et al. (2000b) describe the case of an amputation found on a mummy discovered by a German excavation team in TT95 in Sheikh Abd el-Qurna on the west bank of the Nile in Thebes. The tomb was originally built in the 18th dynasty in the New Kingdom, but just as in Dayr al-Barshā, the Theban tombs were extensively reused over time. The individual exhibiting the amputation, dated to the 21st or 22nd dynasty of the 3rd Intermediate Period, was female of approximately 50-60 years of age at death. The right big toe had been amputated during her life and the missing body part had been replaced by a wooden prosthesis consisting of three parts, a longitudinal toe-shaped wooden corpus and two small wooden plates that were attached by leather strings. Traces on the bottom side of the prosthesis showed clear marks of use, revealing that the prosthesis was fully functional during the life time of the individual and allowed her to walk upright (Nerlich et al., 2000b).

A Deadly Accident in the Quarries?

Individual 2 from zone 9B most likely dates to the Middle Kingdom period. The human remains belong to an adult male of approximately 35 years of age with a stature of about 178 cm. The right ulna and radius were not in situ in the burial. The right radius was recovered next to the humerus, but was not articulated. The right ulna was discovered between the legs (Figure 50). The individual displays severe trauma, including a complete fracture of the upper portion of the sternal body, an incomplete and a complete fracture of the right clavicle, extensive rib fractures, and a fracture of the right humerus. Dupras et al. (2009) determined that the trauma all occurred perimortem and that the individual died shortly after the event. The rib fractures display the direction of the force, anterior with a superior-to-inferior motion. The humerus fracture most likely occurred while the individual had lifted his arm to protect himself. The attempted amputation took place either to free the individual's arm after it was trapped by a crushing accident, or to save the individual's life in a medical attempt (Dupras et al., 2009).

Dayr al-Barshā was not only a necropolis, but also an important quarry site that may have resulted in many accidents where victims were crushed by the large rocks. The grave of this individual is located just beneath of one of the most important quarries of the New Kingdom, directly beneath what is believed to be a quarrymen's village (Dupras et al., 2009).

Spondylolysis

Spondylolysis is a condition in which the neural arch of a vertebra is separated from the vertebral body (Waldron, 1993; Arriaza, 1997; Aufderheide and Rodriguez-Martin, 1998; Merbs, 2002; Ortner, 2003, Fibiger and Knüsel, 2005). The separation occurs through the pedicle, the lamina, or the pars interarticularis, whereas the latter is the most common and it most frequently takes place on the L4 and L5 lumbar vertebrae (Waldron, 1993; Arriaza, 1997). Spondylolysis can be complete or partial, unilateral or bilateral (Porter and Park, 1982; Arriaza, 1997). The separation may cause a forward slipping of the vertebral body, a phenomenon known as spondylolisthesis (Bridges, 1989; Ortner, 2003).

The etiology of spondylolysis is still very little known and the researchers are still debating. Arriaza (1997) suggests five possible etiologies for the condition: 1) a congenital anomaly, 2) a genetic anomaly, 3) a pathological condition, for example a byproduct of a disease such as tuberculosis, 4) the result of severe spinal trauma, and 5) a stress fracture. Merbs (1989) and Bridges (1989) argue that lumbar spondylolysis is an exclusive condition in humans and it may be related to erect posture and the presence of the lumbar curve. Fibiger and Knüsel (2005) also relate spondylolysis to the upright human posture and add that it only occurs after an individual has started to walk. According to Arriaza (1997) and Cavallier et al. (2006), spondylolysis is typical of the youth; however it occurs most frequently in individuals who carry out intense physical activities, including workers lifting and carrying heavy objects and athletes, such as gymnasts, football players, and divers. Bridges (1989) argues that spondylolysis is associated with higher levels of osteoarthritis and is not found in females until after 40 years of age. Most cases of spondylolysis do not seem to be the result of acute trauma, and it seems more probable that they are fatigue fractures caused by repetitive stress (Troup, 1976; Bridges, 1989; Fibiger and Knüsel, 2005). Individuals with greater lordosis curves (convex anteriorly and concave posteriorly) develop a higher risk for spondylolysis if they engage in stressful activities that require a hyperextension of the lower back (Arriaza, 1997). Waldron (1993) discusses a possible relationship between spondylolysis and spina bifida occulta. Studies performed on patients with lower back pain determined that both diseases where present in the majority of all conducted cases.

Several researchers studied the frequencies of spondylolysis in different populations. An average of 5-6% of Europeans and white Americans, 2-3% of African Americans, 7-10% of Asians, and 54% of Inuit suffer from the condition (Bridges, 1989; Ortner, 2003; Fibiger and Knüsel, 2005). Several studies concluded that males suffer more frequently from spondylolysis than females (Bridges, 1989; Larsen, 1997).

Spondylolysis occurred in four cases in the skeletal material from Dayr al-Barshā and it was not present in Sheikh Said. One case dates to the Old Kingdom and two cases date to the Middle Kingdom (Figure 67). The fourth case was found in zone 9B that cannot be dated accurately.

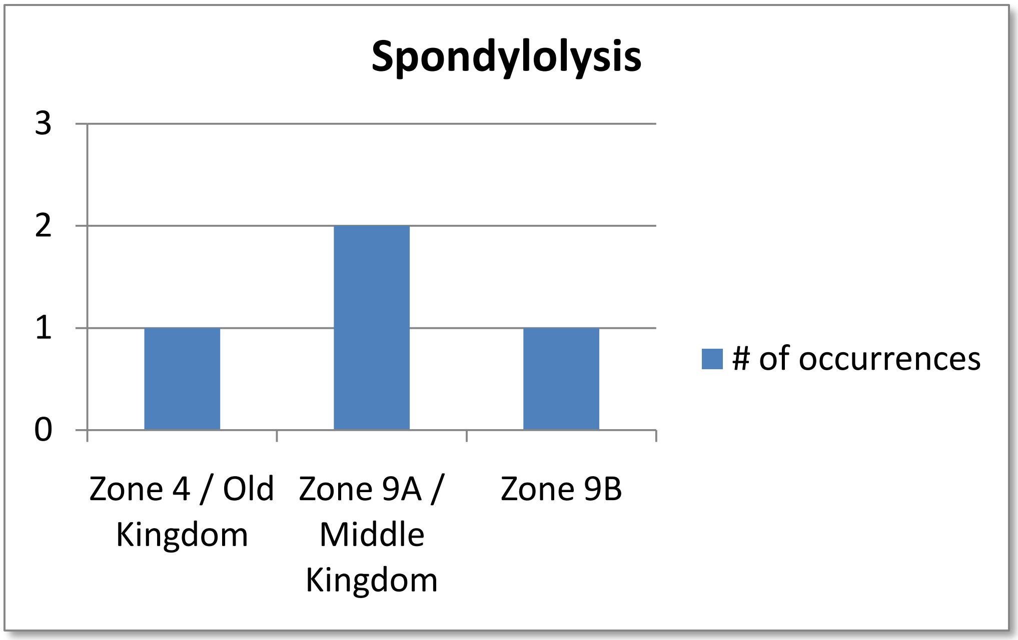


Figure 67: Graph showing the distribution of spondylolysis by zones and time periods.

Arriaza (1997) and Cavallier et al. (2006) concluded that the stress fracture in spondylolysis occurs mainly in individuals with a high level of physical activity, for example individuals who lift and carry heavy objects. Lifting heavy objects would apply exactly to the occupation of many inhabitants of Dayr al-Barshā in ancient times who worked in the underground quarries. No cases of spondylolysis were encountered in zone 2, the burial place of the elite of the Hare nome. This may be directly related to the different life ways of the elite and nobility who did not have to engage in the arduous work in the quarries.

Craniosynostosis

Only one individual in the osteological sample of Dayr al-Barshā and Sheikh Said exhibits craniosynostosis (Figure 46). Individual 27 from zone 9A has a very long and narrow skull. This form of craniosynostosis is called scaphocephaly and is caused by the premature fusion of the sagittal suture which results in the compensatory projection of the frontal and occipital areas (Aufderheide and Rodriguez-Martin, 1998). Scaphocephalic skulls can be found all over the world and in different time periods.

Due to the close geographic relation between Dayr al-Barshā and Tell el-Amarna, also known as *Akhetaten*, the capital founded by the pharaoh Akhenaten, the unusual cranium shape of the royal family should be addressed briefly. Depictions of the king, his queen Nefertiti, and their six daughters show them with very long and narrow crania that became typical for the Amarna Period of the 18th dynasty. Additionally, the cranium of his alleged son Tutankhamun also displays a slightly longer shape that nevertheless is still in the normal standard variation. To the present day, it is not entirely clear if it was the beauty standard of the time or if these are examples of craniosynostosis. The results of the DNA examination of Tutankhamun published by Hawass et al. (2010) did not mention any possible conditions that would explain the shape of the cranium. Furthermore, previous examinations of the mummy did not report any signs for craniosynostosis on the mummy of Tutankhamun.

Spina Bifida

Spina bifida was encountered only once in the skeletal remains studied in this thesis. The individual is an adult female of approximately 40 years of age with a stature of 158 cm, discovered in zone A, sector 7 in Sheikh Said, dating to the Middle Kingdom. Aufderheide and Rodriguez-Martin (1998) mention that spina bifida occulta is commonly seen in the archaeological record, but spina bifida aperta or cystica are rarely documented. Charon (2005) mentions that one case of spina bifida was found on an individual in the Bahariya Oasis, dating to the Second Intermediate Period. Nerlich et al. (2002) describe a case of spina bifida in a sample of human remains from the necropolis of Sheikh Abd el-Qurna in Thebes. Zimmerman (1977) mentions three cases of spina bifida in a sample consisting of 30 individuals (25 adults and 5 juveniles) from the necropolis of Dra Abu el-Naga in Thebes. The archaeological literature only reports a few cases of spina bifida encountered in skeletal material from Egypt. This stands in contrast to reports of Aufderheide and Rodriguez-Martin (1998) and Botto et al. (1999) who mention that spina bifida is very common in past and modern populations. Mitchell et al. (2004) show that spina bifida may be related to the natural folate intake during pregnancy. The ancient Egyptian population may not have been at a high risk of being affected by spina bifida due to their diet poor in natural folate.

Osteoarthritis (Degenerative Joint Disease)

The occurrence of osteoarthritis in a society gives direct insight in the daily life and occupancies of the population, and it is a defining characteristic of human adaptive activity (Larsen, 1997).

Osteoarthritis was recognized in a total of 15 cases in the skeletal material studied in this thesis. The results show that osteoarthritis was encountered in 6 cases dating to the Old Kingdom, in 8 cases dating to the Middle Kingdom, and in one case from zone 9B (Figure 68 and Figure 69). Zone 2 holds burials that can be attributed to the nomarchs of the Hare nome and dated to the Middle Kingdom. A total of 3 cases were encountered in this zone which accounts for 21.4% of all cases. The overall frequency of osteoarthritis in the skeletal material is 7.3% (14 cases in 191 individuals in the Old Kingdom and Middle Kingdom periods).

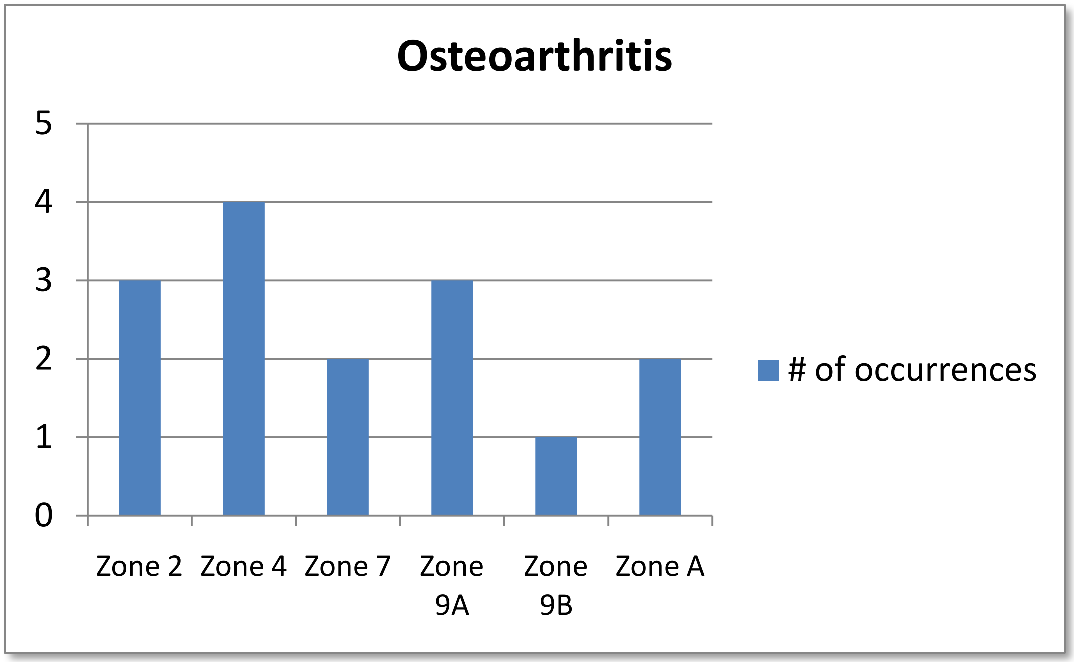


Figure 68: Graph showing the number of cases of osteoarthritis in the different zones.

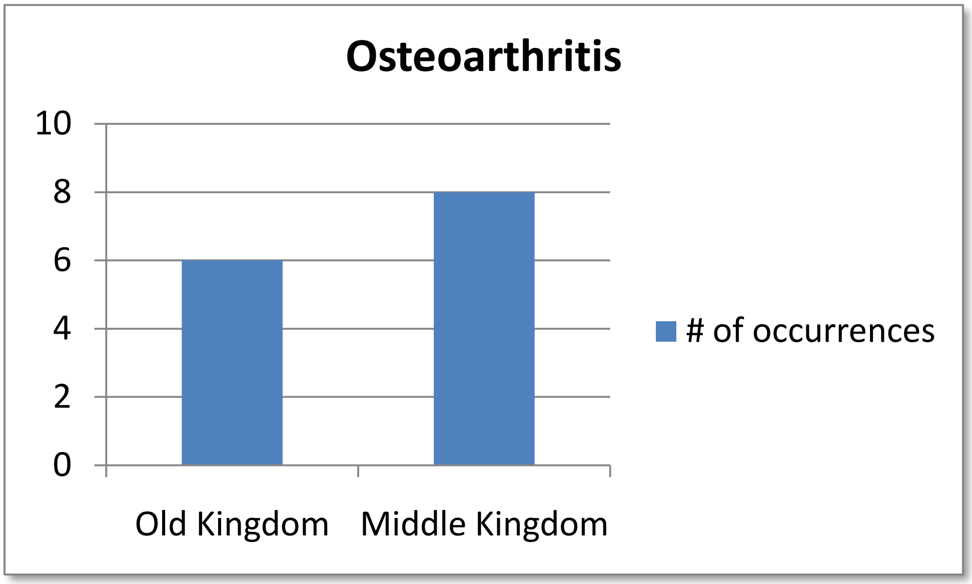


Figure 69: Graph showing the distribution of osteoarthritis in the Old Kingdom and the Middle Kingdom. Zone 9B is not represented on this graph due to the mixed and disturbed burials.

Osteoarthritis can be found in every time period and Waldron (1995) describes it as the oldest disease ever recognized in skeletal material. Arthritic changes are a very common condition in human remains from ancient Egypt. Larsen (1997) explains that the identification of heavy workload may provide important understanding of the fertility and birth rates of a society, because demanding physical activity causes decreased fertility and therefore lower birth rates.

Wenz et al. (1975) describe osteoarthritis in the mummy of a female dating to the 22nd dynasty, that was probably discovered in Thebes and is today in a museum in Freiburg, Germany. Mulhern (2005) provided evidence of osteoarthritis in remains of a young adult in Giza dating to the 5th dynasty. Hussien et al. (2009) compare the prevalence of degenerative joint disease among the population of the Greco-Roman Period with those from the Old Kingdom. Nerlich et al. (2000a) describe human remains from three tombs in Thebes-West dating from the 18th to the 22nd dynasty, where the frequency of osteoarthritis was low in the New Kingdom and higher in later periods. Rose (2006) studied burials from commoners in Tell el-Amarna and attributes the occurrence of individuals with degenerative joint diseases to the heavy workload that was needed to build the new capital for the pharaoh Akhenaten. Strouhal et al. (2000) describe degenerative joint disease in the individuals recovered in Abusir (26th dynasty). Waldron (1995) compared the order of skeletal elements affected by osteoarthritis in pre-medieval times, medieval times, and post-medieval times. Interestingly, the spine was the most frequently affected skeletal region in that study, a fact that was also visible in the present material of Dayr al-Barshā and Sheikh Said.

The proximity of Dayr al-Barshā to the quarries would suggest that more individuals would display signs of osteoarthritic changes. Most inhabitants of the ancient site are believed to have worked in the underground quarries, so physical activity must have been very high and therefore the level of osteoarthritis should be increased throughout the burials. Although osteoarthritis has been linked to climate, it is believed that degenerative joint disease symptoms are less severe in warm climates (Larsen, 1997). Therefore, the lifting of heavy objects, or working in the quarries most likely caused primarily arthritic changes in the hips, knees, and spine. For example, carpal bones in the sample of Dayr al-Barshā show arthritic changes what proves that manual labor was a daily occurrence.

Diffuse Idiopathic Skeletal Hyperostosis (DISH)

DISH was encountered in two, possibly three, cases in the skeletal material from Dayr al-Barshā and Sheikh Said. One case was discovered in zone 4, dating to the Old Kingdom, and two cases in zone 9A, dating to the Middle Kingdom (Figure 70). The overall frequency of DISH is as low as 1.6% (3 cases out of 191 individuals). At least two of the three individuals affected by DISH were males between the ages of 35-45 years. The clinical literature (Aufderheide and Rodriguez-Martin, 1998) revealed that the ratio between males and females is 3:2 which is true for the skeletal material from Dayr al-Barshā (Table 16).

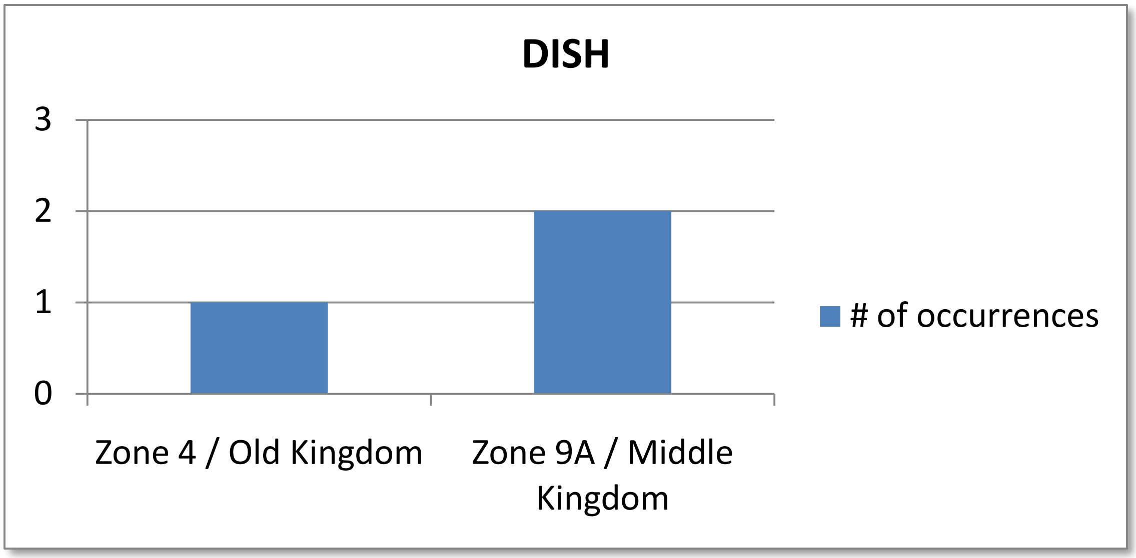


Figure 70: Graph showing the distribution of DISH in the Old Kingdom and the Middle Kingdom.

Table 16: Summary of the individuals with DISH.

Time Period	Zone	Individual/Sector	Sex	Age
Old Kingdom	Zone 4	Sector 16	n/a	n/a
Middle Kingdom	Zone 9A	Individual 9	Male	35-45
Middle Kingdom	Zone 9A	Individual 28	Male	40-45

Hussien et al. (2009) describe one single case of DISH in the Bahariya Oasis. Arriaza et al. (1993) studied a Nubian sample from Semna and determined that 13.4% of the inhabitants had DISH. Nerlich et al. (2002) mention that DISH was present in three tombs in the Valley of the Nobles in Thebes.

It is possible that there is a connection between DISH and parietal thinning. Individual 9 positively exhibits both conditions, while the individual with DISH from zone 4 may have also eventually displayed parietal thinning. The second case is a little bit difficult to decide because a MNI of 5 adults was determined in sector 16. There is a chance that the adult with DISH is the same individual that shows parietal thinning. Both conditions, parietal thinning and DISH, are more prevalent in older adults, but individual 9 is relatively young with 35-45 years of age and the individual of zone 4 would be in his 30's if the spine really belongs to the cranium exhibiting parietal thinning. So, there might be a relation between the occurrence of both conditions and the younger age. Researchers analyzing parietal thinning usually only examine crania and researchers analyzing DISH commonly only study the particular affected skeletal elements. It is important for future studies to examine both skeletal regions to finally determine the etiology of parietal thinning.

Osteomyelitis and Periostitis

Osteomyelitis, the infection of the bone and the bone marrow, occurs once in zone 4, sector 12 on an ulnar shaft (Table 17). Periostitis, the infection of the periosteum, occurs twice on fibular shafts; in zone 4 sector 17 and in zone A, sector 2 (Table 17).

Table 17: Summary of the three cases of osteomyelitis and periostitis in Dayr al-Barshā and Sheikh Said.

Time Period	Zone	Sector	Osteomyelitis	Periostitis
Old Kingdom	4	17	1	
Old Kingdom	4	17		1
Middle Kingdom	A	2		1

Populations shifting from being hunter-gatherers to agriculturalists display more cases of periostitis (Larsen, 1997). Infectious diseases occur to a much higher frequency in malnourished individuals (Larsen, 1997). Larsen (1997) concludes that osteomyelitis is far less prevalent in archaeological samples than is periostitis.

Larsen (1997) states that the tibia is most frequently affected by osteomyelitis in past populations. Bouzon (2006) reports that 45% of the population at Tombos in Nubia exhibits periostitis. Nerlich et al. (2000a) discovered cases of osteomyelitis in 14 individuals from tombs on the west bank of the Nile in Thebes. The shift from foraging to farming in the Nubian Nile valley did not cause an increase in the frequency of infectious bone diseases, due to the presence of tetracycline in the bones. Tetracycline has the same characteristics as antibiotics (Larsen, 1997). Al-Waili (2004) and Al-Jabri (2005) state that natural honey occurring in Egypt and Nubia has the same effects than antibiotics. Honey does not only act as antibiotics, but also as disinfectant (McKenna, 1998). As stated above in the section on fractures and their treatment in ancient Egypt, honey was applied on open wounds, a process that helped prevent infectious bone diseases. The high number of fractures and the low number of cases of infectious bone diseases in the sample from Dayr al-Barshā and Sheikh Said proves that honey acts as antibiotics.

Tuberculosis

The skeletal material from Dayr al-Barshā and Sheikh Said presents only one case of tuberculosis in zone 9A (Middle Kingdom). Zink et al. (2007) point out that skeletal lesions are not necessary in tuberculosis, and many cases in their study did not display bone lesions, but tested positive in molecular tests. The actual number of cases of the osteological material presented in this thesis could be higher, but cannot be determined without molecular tests.

Tuberculosis can be traced back 5000 years in the Old World (Larsen, 1997). One of the earliest cases of tuberculosis dates back to first half of the 4th millennium BC, found in a spine from the cave of Arena Candide in Italy (Zink et al., 2007). Sandison and Tapp (1998) mention that tuberculosis has been documented in multiple sites throughout Egypt. One of the first documentations of tuberculosis in Egypt was made by Sir Marc Armand Ruffer in 1910 on the mummy of Nesperhan, a priest of the god Amun (Zink et al., 2007). Zink et al. (2001) conducted a study examining 41 mummies and skeletons discovered in Thebes and Abydos dating to the Middle Kingdom and the New Kingdom periods. Of the 41 human remains, three individuals displayed the typical morphological bone alterations of tuberculosis. In further 17 cases, non-specific bone changes were discovered that could not be clearly assigned to tuberculosis. Zink et al. (2007) documented tuberculosis in mummies and skeletons from the Pre-dynastic Period, the Early Dynastic Period, the Middle Kingdom, the Second Intermediate Period, the New Kingdom, and the Late Period. The study revealed following frequencies for tuberculosis in the different time periods: Pre-/Early Dynastic Period = 28%, Middle Kingdom = 22%, and New Kingdom until Late Period = 23%. (Zink et al., 2007). Brothwell and Sandison (1967) published the exact same percentages in an earlier study. Zimmerman (1977) describes the case of an approximately 5 year old child from Dra Abu el-Naga in Thebes who was diagnosed with tuberculosis because the lungs were adhered to the inner chest wall, and scoliosis was present. The studies conducted in Egypt could not determine any cases of a infection with *Mycobacterium bovis* (Zink et al., 2007). Scheidel (2001) points out that high rates of tuberculosis have an increased impact on death rates and especially causes a high mortality amongst young adults.

Mastoiditis

Only one possible case of mastoiditis was found in the osteological material from Dayr al-Barshā in zone 4 dating to the Old Kingdom. The opinions diverged on this case because a high level of remodeling occurs in mastoiditis which is not necessarily the case in this individual (private communication, Dr. Schultz). This situation reflects the osteological paradox described by Wood et al. (1992) that states that all the individuals of a population will never be present in skeletal material. This individual with mastoiditis in the present material must have lived long enough after the onset of the disease to develop osteological changes. There must have been others with the disease, the only problem is that they died from the acute variant of mastoiditis and were not able to live long enough to exhibit traces on the bones. In pre-antibiotic societies otitis media and the resulting mastoiditis were and still are the most frequently occurring disease in children. According to Brothwell and Sandison (1967), middle ear infections were a common disease in Egypt and Nubia, and they occurred in every time period. Rowling (1961) mentions that he encountered otitis media and mastoiditis very frequently in his studies of ancient Egyptian mummies.

Osteoporosis

Osteoporosis, the reduction of total bone mass per unit volume occurs only in two individuals in the present skeletal material. Individual 14 from zone 9A is an adult female of approximately 40 years of age. The second case of osteoporosis is a male adult older than 40 years of age from zone A in Sheikh Said. Both individuals date to the Middle Kingdom. Zaki et al. (2009) analyzed 74 skeletons from Giza (Old Kingdom) and determined that osteoporosis in females was predominantly due to the marked reduction in secretion of the sex hormones that occurs 10-15 years earlier in females. Strouhal et al. (2003) diagnosed osteoporosis in the 25-30 year old lecture priest Iufaa in Abusir and determined that the bones showed even less dense trabecular pattern as much older individuals found at the same site.

Osteoporosis is divided into two types that both occur in older individuals; type I usually affects menopausal women who are between the ages of 51 to 75 years, while type II occurs in males and females older than 60 years of age (Aufderheide and Rodriguez-Martin, 1998). Both individuals in the present material are younger than the common age of individuals affected by osteoporosis. Possibly this has to do with the fact that ancient Egyptians had much shorter lives than we have today. The average life expectancy of an ancient Egyptian was around 35-45 years, so it is possible that osteoporosis began earlier in past populations. Brickley (2002) determined that the mortality in past societies must have been very high because proper treatment could not be given. The case of the male affected by osteoporosis is very unique because of the sex and the age of the individual. The factors that caused osteoporosis in this relatively young male cannot be determined at this point.

Porotic Hyperostosis and Cribra Orbitalia

The skeletal material from Dayr al-Barshā and Sheikh Said displays a total of 13 cases of cribra orbitalia, 12 dating to the Old Kingdom and 1 dating to the Middle Kingdom (Figure 71 and Figure 72). Porotic hyperostosis was only seen in two cases, one in zone 4 dating to the Old Kingdom and one in zone 2 dating to the Middle Kingdom. The distribution by adults and juveniles shows that in the Old Kingdom, 6 adults and 6 juveniles were affected by cribra orbitalia, while in the Middle Kingdom only one juvenile was affected (Table 18 and Figure 73). The 6 adults in the sample of Dayr al-Barshā display healed cribra orbitalia. The overall frequencies of cribra orbitalia and porotic hyperostosis in the Old Kingdom and the Middle Kingdom periods are 6.8% (cribra orbitalia) and 1.5% (porotic hyperostosis).

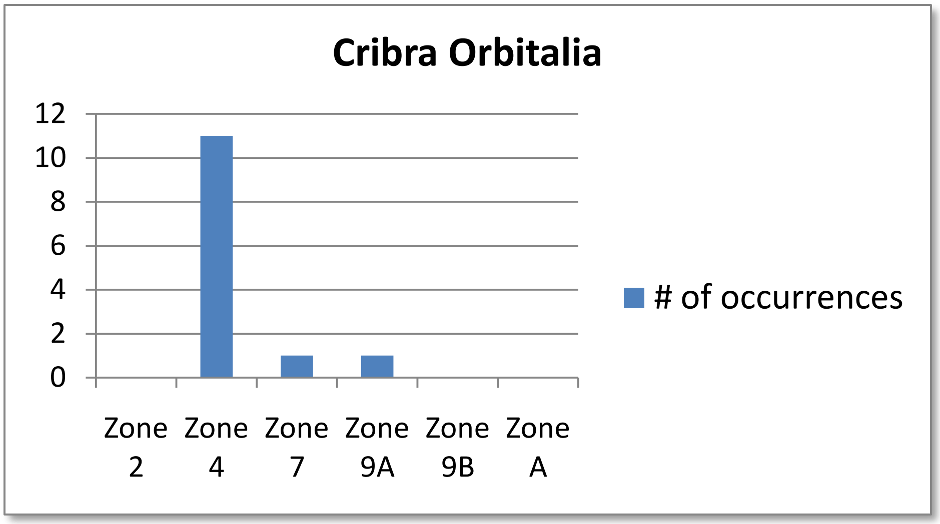


Figure 71: Graph showing the distribution of cribra orbitalia in the different zones.

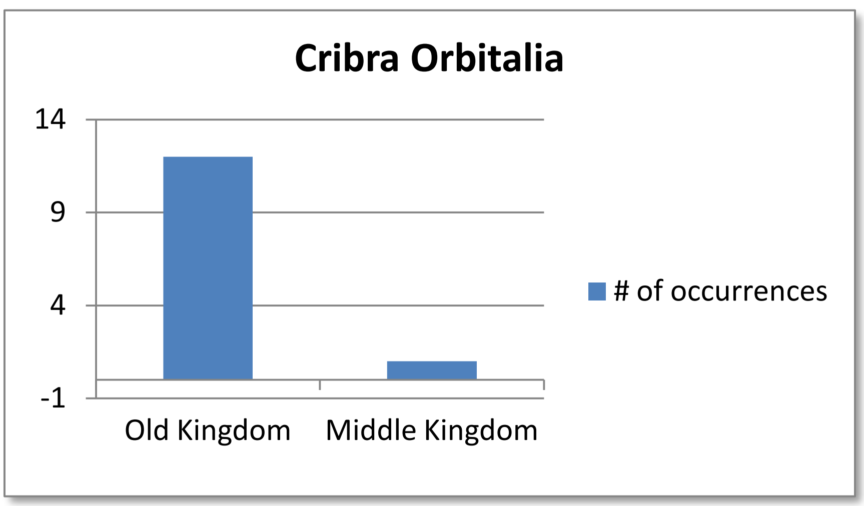


Figure 72: Graph showing the distribution of cribra orbitalia in the Old Kingdom and the Middle Kingdom.

Table 18: The distribution of cribra orbitalia by time period and by adults and juveniles.

Time Period	Adult	Juvenile
Old Kingdom	6	6
Middle Kingdom		1

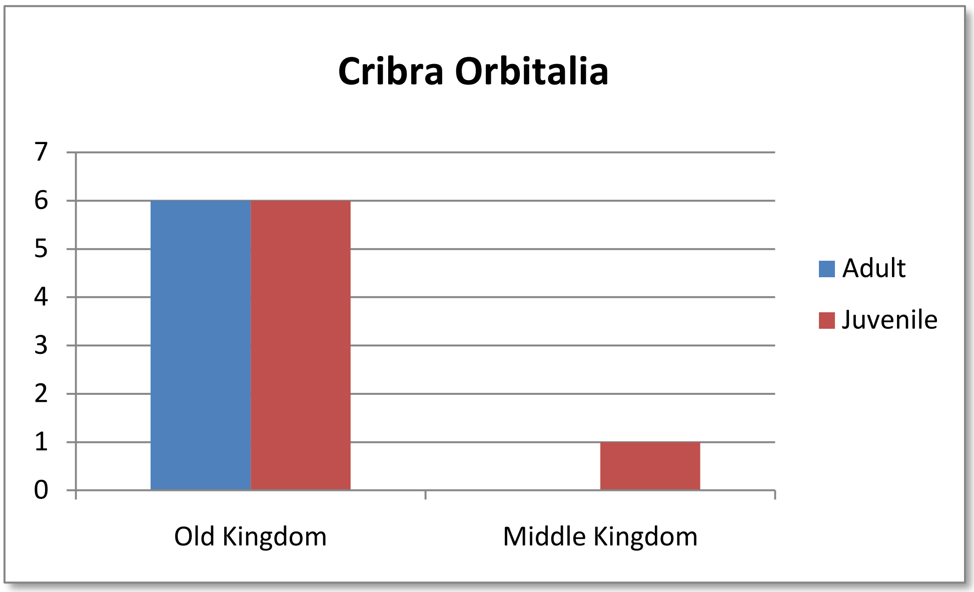


Figure 73: Graph showing the distribution of cribra orbitalia by time period and by adults and juveniles.

Porotic hyperostosis and cribra orbitalia, both caused by iron deficiency anemia, are very frequently encountered in human skeletal remains from past societies. The presence of porotic hyperostosis and especially cribra orbitalia is a great indicator to determine the health and nutritional status of past populations (Facchini et al., 2004). Fairgrieve and Molto (2000) describe a sample from the Dakhleh oasis in Egypt where 100% of all individuals exhibit an active lesion during their first year of life. During the ages of 1-3 years, still 59% of the juveniles are affected. The condition can be detected in 60% of all individuals from the Dakhleh oasis (Fairgrieve and Molto, 2000). Nerlich et al. (2000a) report that in the Theban necropolis of Sheikh Abd el-Qurna 29.2% of individuals exhibit cribra orbitalia and 15.4% of cases display porotic hyperostosis. Rose (2006) describes that cribra orbitalia is present in about 23% of the burials in Tell el-Amarna. Carlson et al. (1974) report that in Meroitic Nubia (350 BC – AD1400), cribra orbitalia occurred with an average of 21.4%, and the 0-10 age group displays cribra orbitalia at a rate of 32%. The Nubian diet, consisting mainly of millet and wheat, remained consistent for the last 3000 years with relatively little iron intake. In modern Egypt, 75-80% of the population does not have an adequate nutritional intake, and therefore iron deficiency anemia occurs very frequently among infants and females (Carlson et al., 1974). Bouzon (2006) describes the study of 100 individuals from Tombos in Nubia, dating to the Middle Kingdom to the Third Intermediate Period (1069 – 664 BC; Shaw, 2000) and in her study, 100% of the subadults at the site of Tombos display active lesions of cribra orbitalia (Bouzon, 2006). Due to a diet consisting of milled cereal grains and cow milk, individuals from Tombos were susceptible to illnesses. Furthermore, they were exposed to infectious agents such as periosteal lesions, infections caused by parasites (hookworm and schistosomiasis), and possibly malaria (Bouzon, 2006). Scheidel (2001) presents findings from Kulubnarti in Upper Nubia and indicates that the presence of cribra orbitalia greatly reduced the chances of survival to maturity. The overall frequency of cribra orbitalia and porotic hyperostosis in the skeletal material studied in this thesis with 6.8% and 1.5% is very low in an ancient sample. Nevertheless, cribra orbitalia in the Old Kingdom accounts to 92.3% of all the cases in the sample of Dayr al-Barshā and Sheikh Said.

This might be related to the environmental stress period at the end of the Old Kingdom that led to the collapse of the state when the Nile was not enough inundated (Bard, 2000).

The period of stress may be induced by the weaning process that began in ancient Egypt at around 3 years of age (Lewis, 1997; Lovell and White, 1999; Wheeler, 2009). A weaning diet rich in carbohydrates, such as barley, wheat, and cereal does not only provide low amounts of iron, but it also includes phosphorus and phytates that inhibit the intestinal absorption of iron (Facchini et al., 2004). Additionally, children can be affected by diarrheal infections when they stop feeding on sterile breast milk and begin ingesting food and water that may be contaminated by microorganisms (Facchini et al., 2004).

Cribra orbitalia may be also associated with dental enamel hypoplasia which also indicates stress periods in life.

Osteoma

Only two button osteomas were found in the skeletal material from Dayr al-Barshā and Sheikh Said - one individual is from zone 4 dating to the Old Kingdom, and the other is individual 14 from zone 9A dating to the Middle Kingdom. Osteomas are very rarely described in the archaeological literature. Nerlich et al. (2002) describes benign neoplastic conditions in the skeletal material from Thebes without giving further details. Rose (2006) reports on osteomas from the necropolis of the commoners in Tell el-Amarna. Aufderheide and Rodriguez-Martin (1998) mention that osteomas appear in individuals older than 50 years of age and predominantly in females. Individual 14 from zone 9A is female and she is older than 60 years of age. Sex and age of the individual from zone 4 cannot be determined. Due to the small number of osteomas in the skeletal material, nothing more can be determined.

Parietal Thinning

Parietal thinning occurs on ten crania in the skeletal material from Dayr al-Barshā and Sheikh, four in the Old Kingdom and six in the Middle Kingdom (Table 19; Figure 74, Figure 75, and Figure 76). The overall frequency of parietal thinning in the skeletal material is 5.2%.

The opinions diverged on individual 16 from zone 9A. The possible parietal thinning occurs very close to the sagittal suture which may indicate an abnormal suture development instead of parietal thinning. The cranium needs to be further examined to give a definite answer.

Table 19: Summary of the parietal thinning cases in Dayr al-Barshā and Sheikh Said.

Time Period	Zone	Individual/Sector	Sex	Approx. Age
Old Kingdom	Zone 4	Sector 2	Female	45
Old Kingdom	Zone 4	Sector 16	Male	n/a
Old Kingdom	Zone 7	Sector 2	Male	older adult
Old Kingdom	Zone 7	Sector 3	n/a	n/a
Middle Kingdom	Zone 2	Sector 14	Male	30
Middle Kingdom	Zone 9A	Individual 5	Female	48
Middle Kingdom	Zone 9A	Individual 9	Male	35-45
Middle Kingdom	Zone 9A	Individual 16	Female	60-70
Middle Kingdom	Zone 9A	Individual 21	Male	35
Middle Kingdom	Zone A (Sheikh Said)	Sector 3	Male	+40

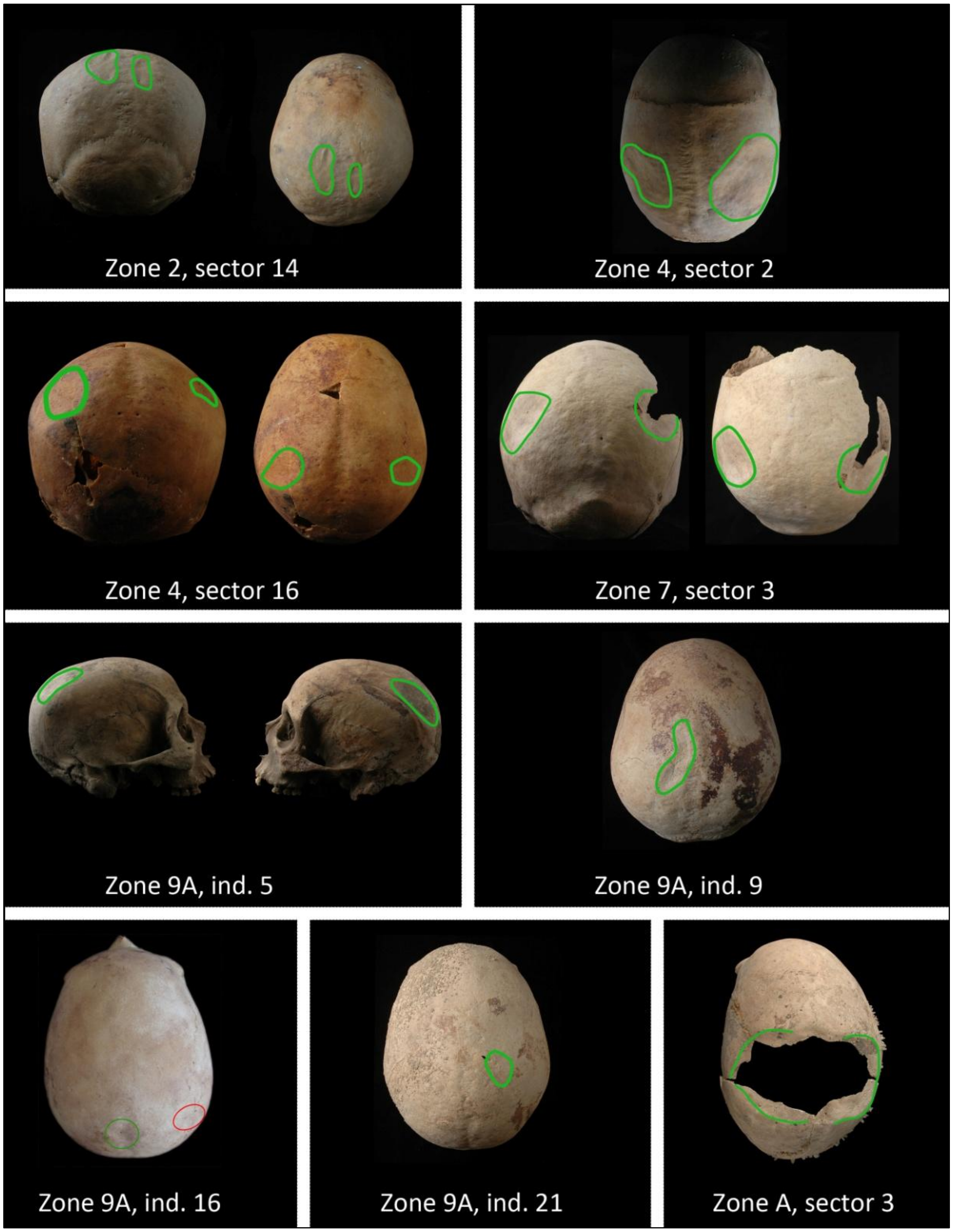


Figure 74: Composition of all the parietal thinnings in the skeletal material. No picture of the parietal thinning from zone 7, sector 2 was available.

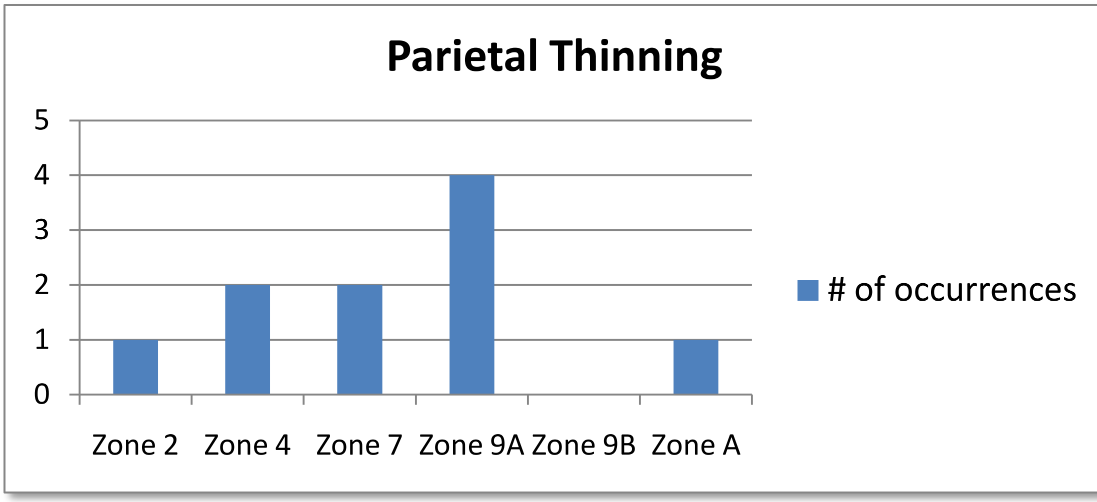


Figure 75: Graph showing the occurrences of parietal thinning by zones.

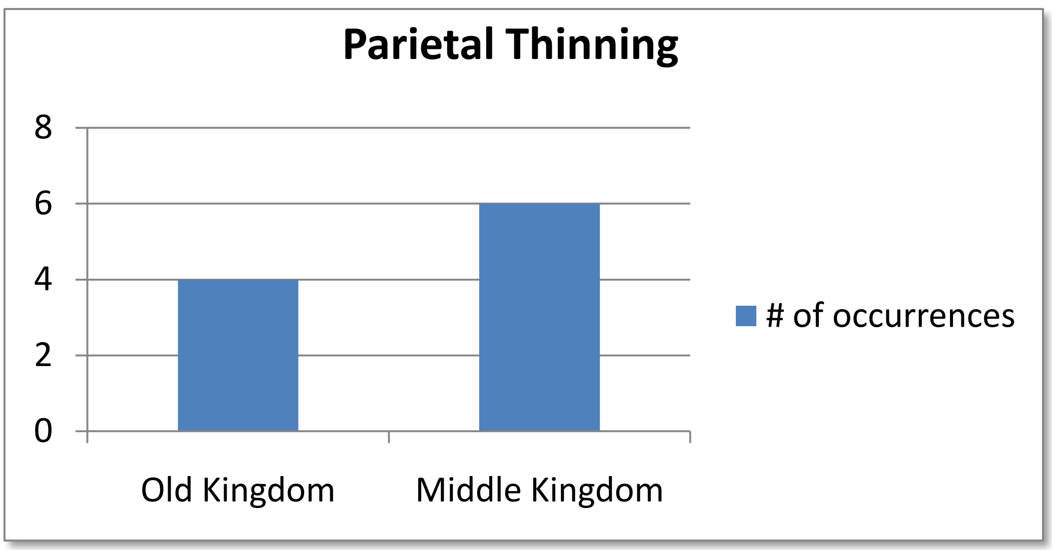


Figure 76: Graph showing the cases of parietal thinning by time periods.

Table 20: The distribution of parietal thinning by sex.

Male	Female	Indeterminate
6	3	1

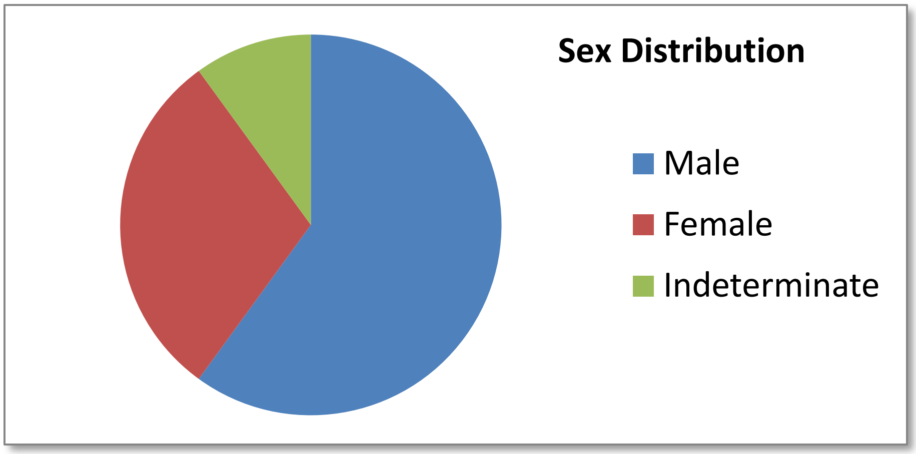


Figure 77: The distribution of parietal thinning by sex.

Table 21: The distribution of parietal thinning by age.

Younger than 45 years	Older than 45 years	Indeterminate
4	4	2

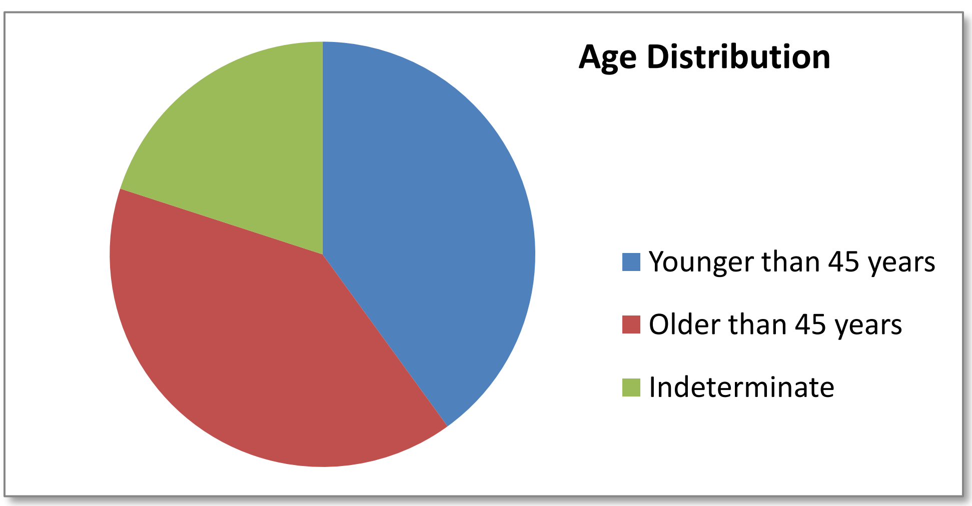


Figure 78: The distribution of parietal thinning by age.

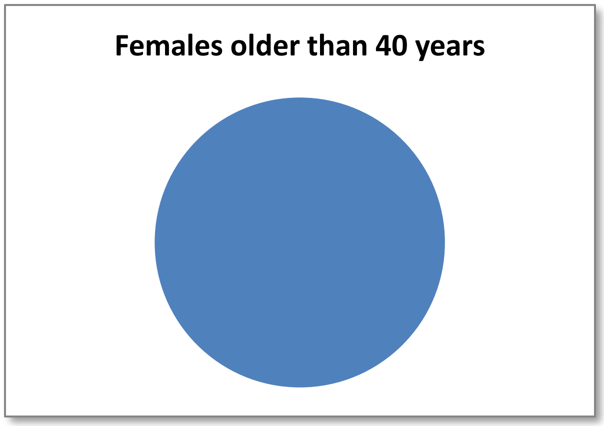


Figure 79: The distribution of parietal thinning in females older than 40 years (3/3 = 100%).

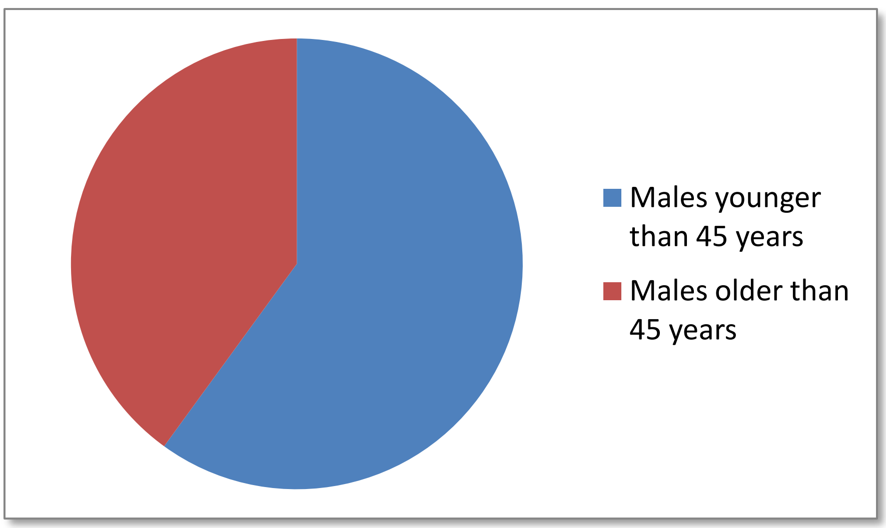


Figure 80: The distribution of parietal thinning in males by age.

Breitinger (1982) describes a large number of cases of parietal thinning from all over the world and from different time periods. In most populations he analyzed, the frequency of the condition was between 0.4% and 1.1%. The mummies of the pharaoh Thutmosis III (18th dynasty, New Kingdom) and the princess Meritamon (12th or 13th dynasty, Middle Kingdom) exhibit parietal thinning. Furthermore, Brothwell and Sandison (1967), Dutta (1969) and Breitinger (1982) describe the mummy of Khety (a 50-60 year old male who lived during the Middle Kingdom) a cranium that was found in the Kharga Oasis, and remains that have been excavated from Assiut and Gebelein. Strouhal et al. (2003) describe parietal thinning in the human remains of the lecture priest Iufaa and his father Nekawer from Abusir (26th dynasty). Mulhern (2005) mentions the 5th dynasty skeleton of an adult male in his early 20's to 30's from Giza who exhibits parietal thinning. Phillips (2007) analyzed 1,041 crania in Egypt: 172 from Lower Egypt, 485 from Middle Egypt, 366 from Upper Egypt, and 15 crania of indeterminate provenance, and of these 11 crania were affected by parietal thinning in Lower Egypt, 15 crania in Middle Egypt, and 25 crania in Upper Egypt.

Phillips (2007) describes that the most affected crania date to the Middle Kingdom. The same can be seen in the skeletal material from Dayr al-Barshā and Sheikh Said where six crania with parietal thinning date to the Middle Kingdom (Figure 76).

Phillips (2007) summarizes the known issues of parietal thinning, including predominance in females, predominance in old adult individuals (older than 50 years), and a relatively uncommon occurrence. In the skeletal material presented in this thesis, 3 parietal thinnings were found on female crania, 6 on males, and the sex of one cranium could not be determined (Table 20, Figure 77). The age distribution of the human remains analyzed by Breitinger (1982) determined one case of parietal thinning in 20-40 year old adults, 13 cases of parietal thinning in 40-60 year old adults, and twelve cases of parietal thinnings in individuals older than 60 years. Phillips (2007) reports that 94% of the parietal thinning cases occur in older adults. Brothwell and Sandison (1967) state that although parietal thinning is a condition that affects mainly older adults, it may also occur in younger adults. At least four of the individuals from Dayr al-Barshā and Sheikh Said diagnosed with parietal thinning are of an age younger than 45 years (Table 21, Figure 78). The results of this thesis suggest that parietal thinning occurs more frequently in younger males and in older females (Figure 79 and Figure 80). One assumption was originally that older individuals must exhibit stronger parietal depressions than younger individuals. Strouhal et al. (2003) describe that the parietal thinning is stronger expressed in the younger Iufaa (25-30 years) than in his father Nekawer (55-65 years).

One of the younger individuals, individual 9 from zone 9A, additionally has DISH. There might be a relation between parietal thinning and DISH (see section on DISH).

Dental Wear

Dentition can give important insight in the nutritional status of the group and the health status of the individual. Ancient Egyptian medical papyri such as the Ebers papyrus contain sections about “loose tooth”, “pain in the tooth”, or “a tooth that gnaws into an opening in the flesh" (Leek, 1969), so it is apparent that the ancient Egyptians were concerned about their dental health.

The human remains from Dayr al-Barshā and Sheikh Said display extensive dental wear that was almost twice as high in the Old Kingdom than in the Middle Kingdom (Figure 81 and Figure 82). The severe dental wear is the result of the bread baking for which the grain needed to be grinded, a process in which sand was incorporated into finished bread molds. The sand caused extensive dental abrasion (Filer, 1995; Larsen, 1997; Aufderheide and Rodriguez-Martin, 1998; Nerlich et al., 2000a; Nerlich et al., 2002).

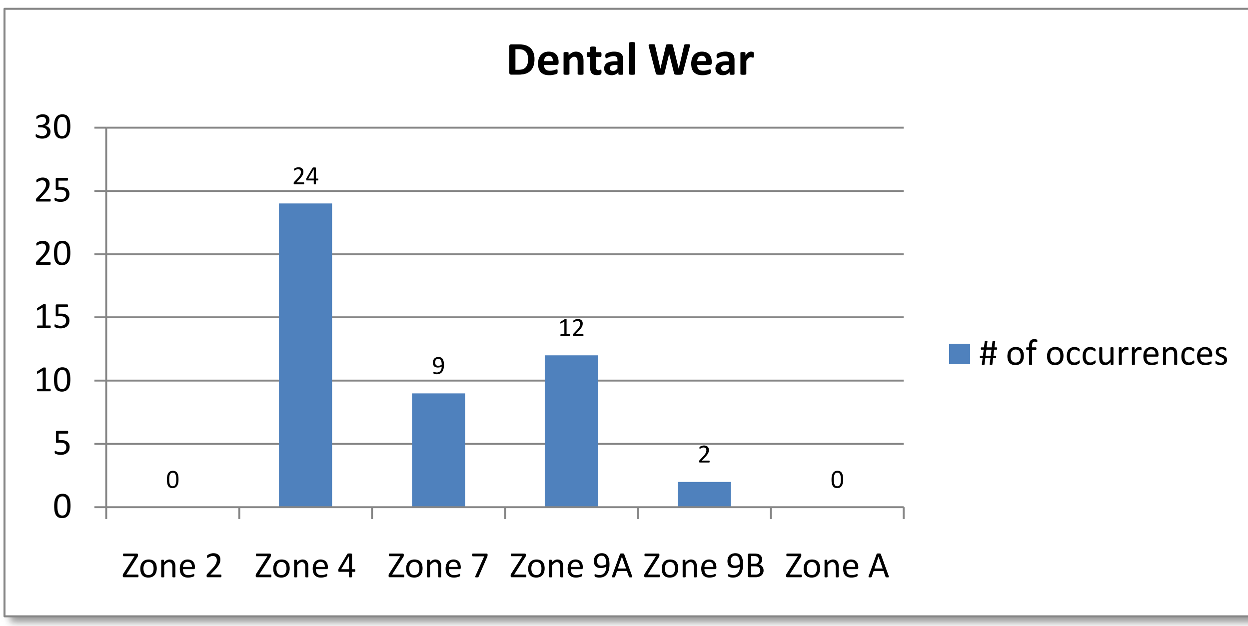


Figure 81: Graph showing the distribution of dental wear in the different zones.

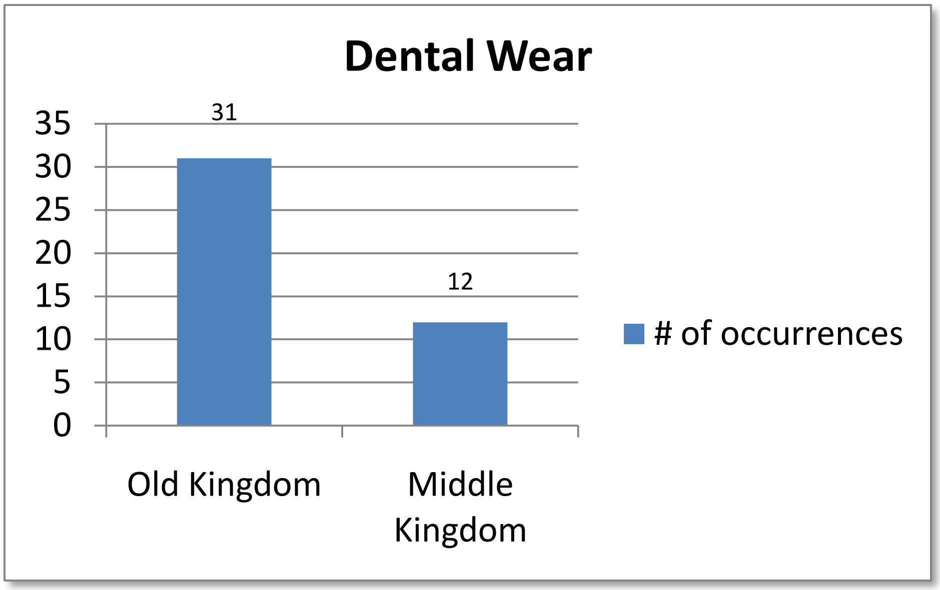


Figure 82: Graph showing the distribution of dental wear in the Old Kingdom and the Middle Kingdom.

Nerlich et al. (2000a) describe the heavy dental wear that individuals in three Theban tombs display. Furthermore, the high frequency of apical abscesses (12.8% - 31%) and antemortem tooth loss suggests that periodontal disease was present. Parsche (1991) mentions that the inhabitants of Minshat Abu Omar, dating to the Early Dynastic Period, exhibited severe dental wear.

Dental Abscesses

Dental abscesses occurred frequently in the osteological material of Dayr al-Barshā and Sheikh Said. Seven dental abscesses were counted in the Old Kingdom and 16 abscesses in the Middle Kingdom (Figure 83 and Figure 84). Bouzon and Bombak (2009) conducted a study on dental diseases in different ancient groups from Nubia and Egypt. In their study 1084 individuals were examined for caries, abscesses, and antemortem tooth loss. The study concludes that the rate of abscesses was higher in every group. The same result can be seen in Dayr al-Barshā and Sheikh Said.

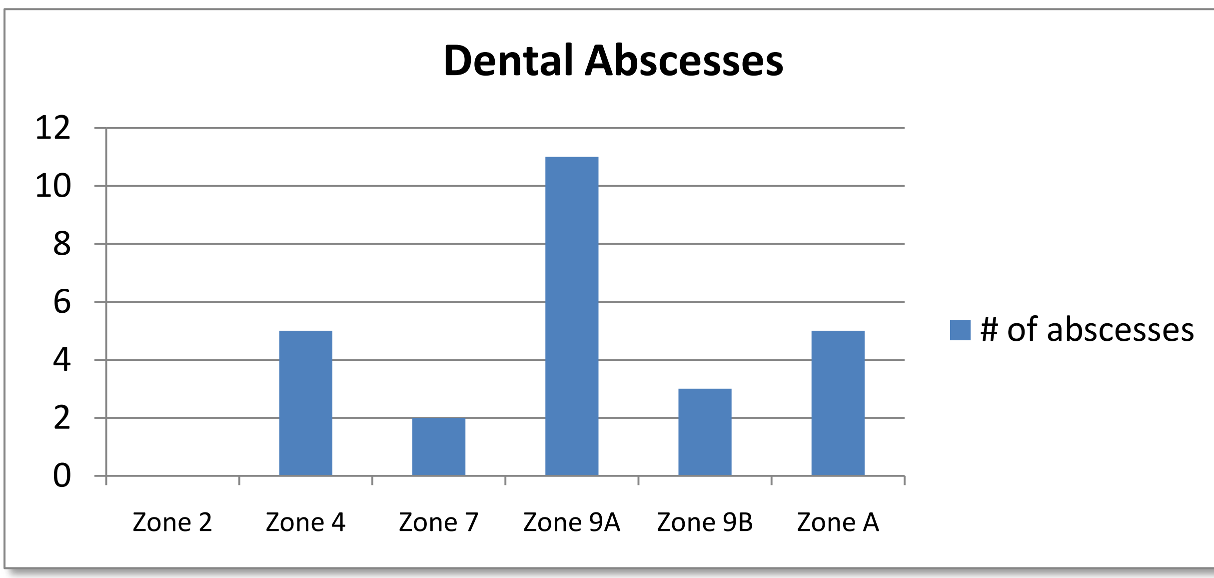


Figure 83: Graph showing the distribution of dental abscesses in the different zones.

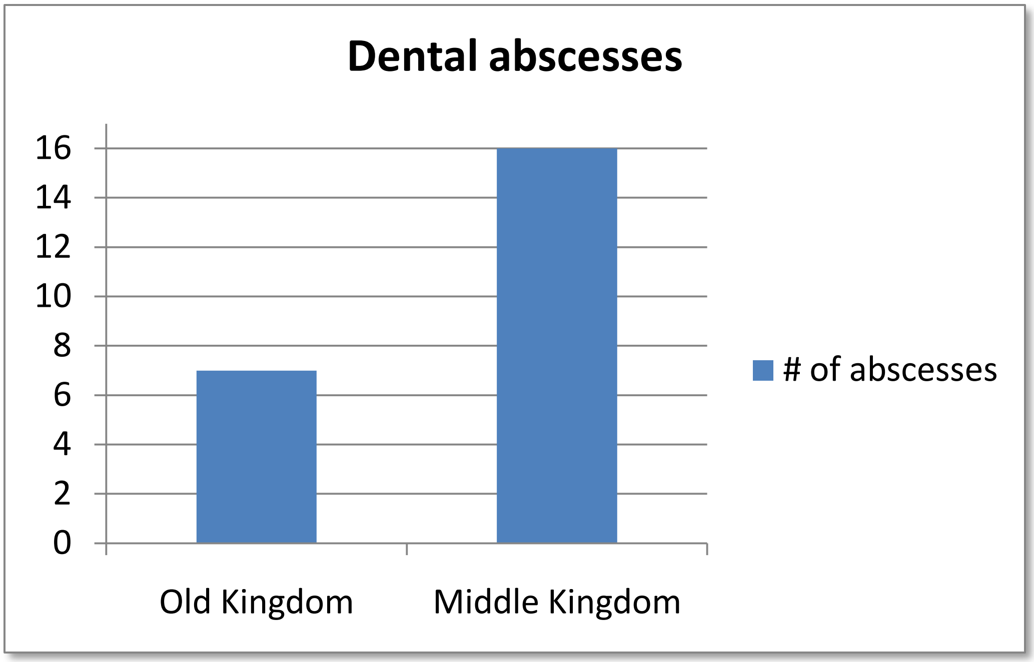


Figure 84: Graph showing the distribution of dental abscesses in the Old Kingdom and the Middle Kingdom. Zone 9B is not represented in the Middle Kingdom data.

While high levels of caries are usually associated with high levels of abscesses, the overall low frequency of caries may be explained by the higher frequency of dental wear that causes the crowns to be worn down and therefore sticky food could not attach to the teeth anymore (Buzon and Bombak, 2009). Another possible cause for the high levels of abscesses may be the abrasive elements in the food. Small grains of sand may slip under the gum and cause the body to produce sacks of pus that result in an abscesses.

Dental Caries

The skeletal material from Dayr al-Barshā and Sheikh Said shows higher frequencies of dental caries in the Middle Kingdom (Figure 86). With a total of only 11 cases, caries is highly underrepresented in the sample (Figure 85). This might have to do with the reuse of the tombs and therefore the disturbing of the burials.

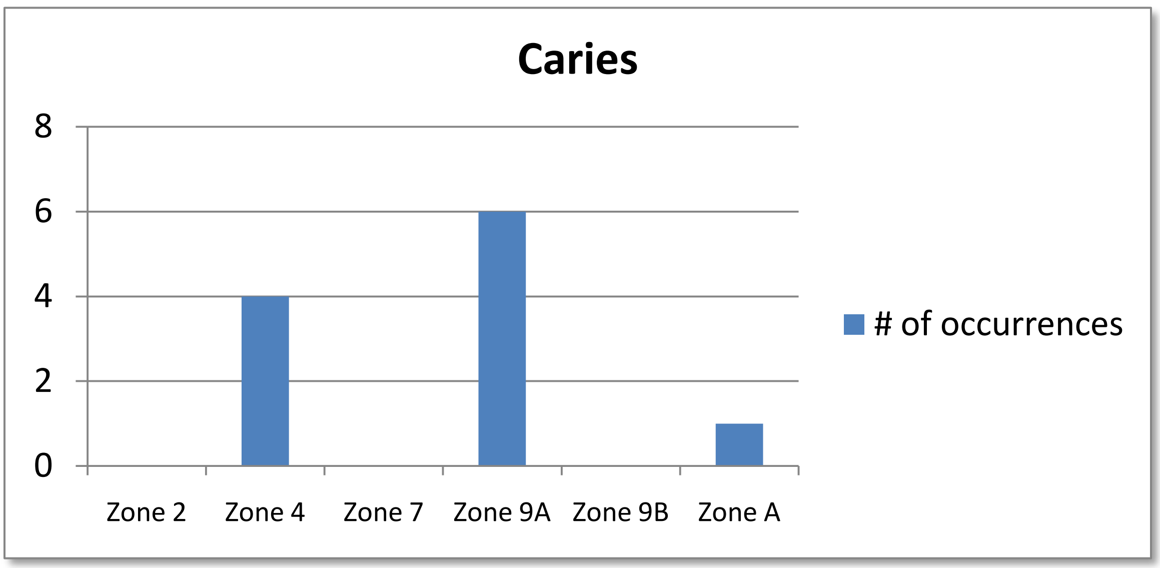


Figure 85: Graph showing the distribution of caries in the different zones.

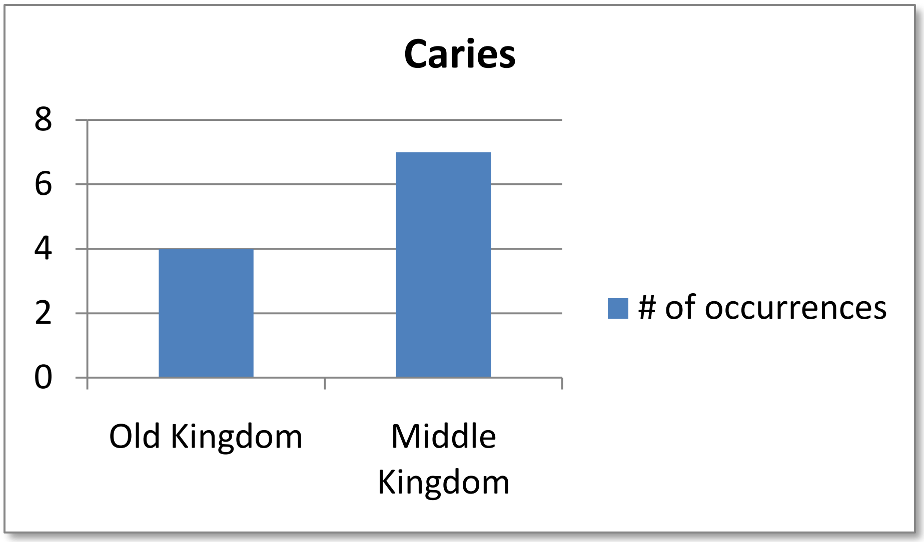


Figure 86: Graph showing the distribution of caries in the Old Kingdom and the Middle Kingdom.

Caries occurs in higher frequencies in agricultural societies than in hunter-gatherer communities because the dietary stress is more prevalent in agriculturists than it is in hunter gatherers (Larsen, 1997). Agriculture introduced people to carbohydrates, or sugars, which affect the teeth and cause dental caries. Griletto (1977) describes the three factors for caries, as being the tooth structure itself, buccal action and microorganisms, and the food. The staple diet of ancient Egyptians consisted of beer, bread, vegetables, and fruits (David, 2003). All the staple foods are high in carbohydrates and caused dental caries. Zones 4 and 9A seem to be burial grounds of commoners and due to their social status, only staple foods were available. In contrast, no dental caries was found in zone 2, the nomarchal plateau. This suggests that the elite had different better foods to eat than the commoners.

Periodontal Disease

Periodontal disease occurred in a total of 11 cases in the osteological material from Dayr al-Barshā and Sheikh Said (Figure 87 and Figure 88). The frequency of periodontal disease might be slightly higher in the present material since antemortem tooth loss is also an indication for the condition. The osteological material from Dayr al-Barshā and Sheikh Said comprises many cases of antemortem tooth loss. Those teeth lost during life were not counted as periodontal disease because other incidences can also cause tooth loss, such as for example accidents or interpersonal violence. Since the exact cause of antemortem tooth loss cannot be determined, the lost teeth are not counted as periodontal disease.

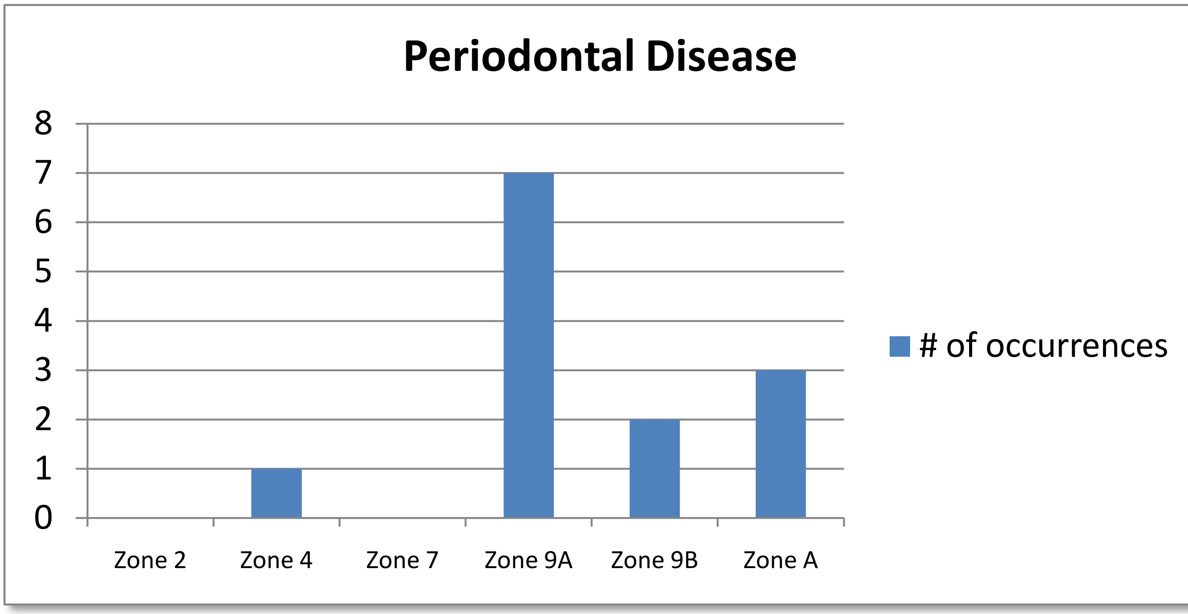


Figure 87: Graph showing the distribution of periodontal disease in the different zones.

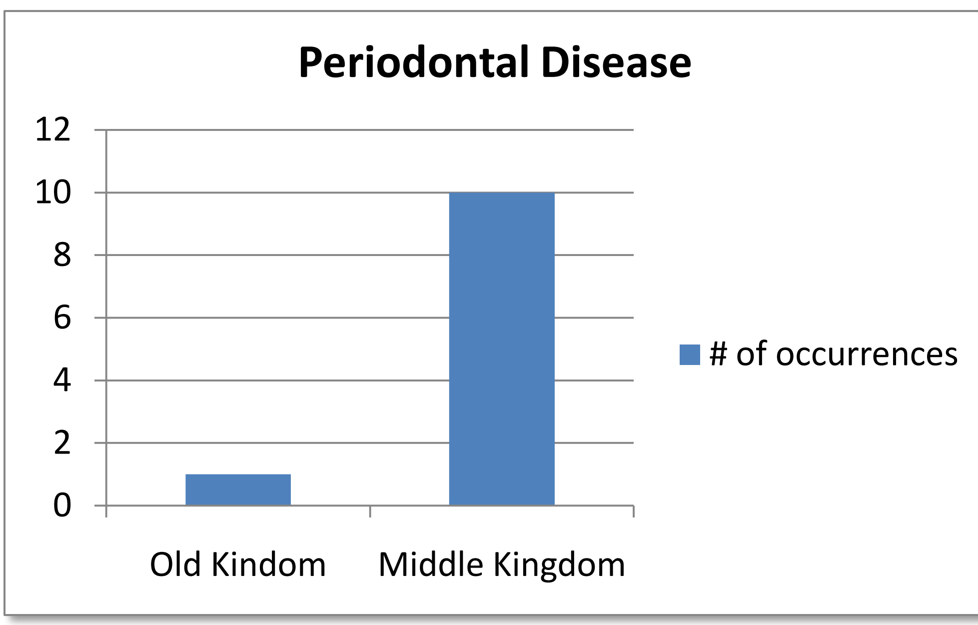


Figure 88: Graph showing the distribution of periodontal disease in the Old Kingdom and the Middle Kingdom.

Dental Enamel Hypoplasias

Dental enamel hypoplasias occur in a total of 5 cases (Figure 89 and Figure 90). One case was seen on dentition dating to the Old Kingdom and two cases date to the Middle Kingdom. Two cases were discovered in zone 9B that consists of mixed time periods that are hard to date. However, one of those cases from zone 9B occurs on individual 1 that has been dated to the New Kingdom.

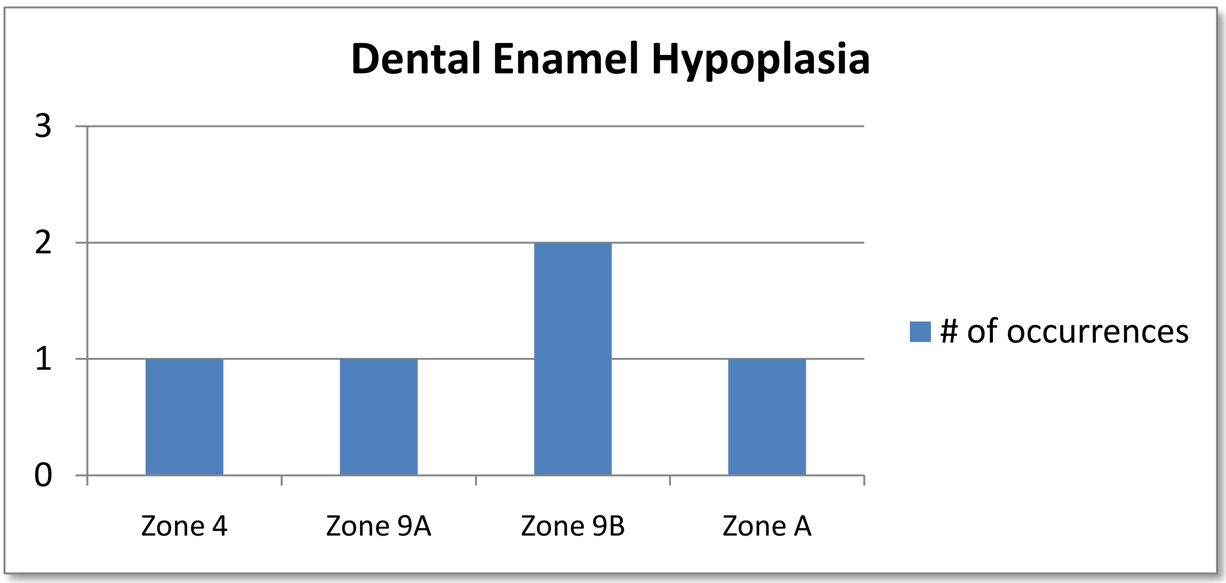


Figure 89: Graph showing the distribution of dental enamel hypoplasia in the different zones.

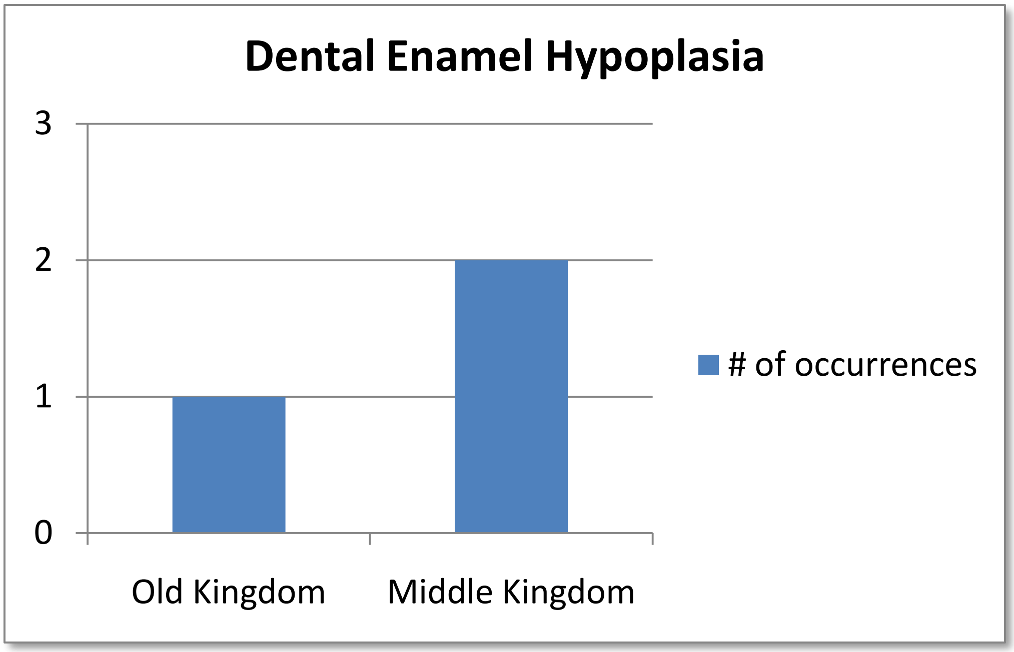


Figure 90: Graph showing the distribution of dental enamel hypoplasia in the Old Kingdom and the Middle Kingdom.

Dental enamel hypoplasias are very important indicators of population health and serve as permanent markers for stress since teeth do not remodel (Halcrow and Tayles, 2008). The possible causes for dental enamel hypoplasia are listed as hereditary, trauma, malnutrition, infection and systemic metabolic stresses (Larsen, 1997; Lovell and White, 1999; Starling and Stock, 2007).

Lovell and White (1999) conducted research on 88 dental remains from the ancient city of Mendes in Egypt. Mendes was occupied during the Old Kingdom, the First Intermediate Period, and the Greco-Roman Period. Of all the individuals excavated, 48% had one or more teeth affected by dental enamel hypoplasia. 17% affected permanent teeth and 8% deciduous teeth. Lovell and White (1999) point out that the presence of dental enamel hypoplasia reflects the individual’s ability to adapt biologically to physiological stress and therefore should be seen as reflecting fitness rather than frailty. Lovell and White (1999) conclude that dental enamel hypoplasia have higher frequencies in males in Mendes. Starling and Stock (2007) examined 242 dentitions from ancient Egyptian and Nubian populations dating from 13,000 – 1,500 BC. The earliest agriculturalists display a decline in health due to the risk of failing crops, and 42.1% of all individuals showed dental enamel hypoplasia in one or more teeth. Individuals from the Badari culture display the highest frequency with 69.9% (Starling and Stock, 2007).

Limitations

The skeletal material discussed in this thesis has its own limitations. In ancient Egypt, it was a common practice to reuse earlier tombs as secondary burials, or in the case of Dayr al-Barshā, also as quarries or housing for Coptic monks. De Meyer (2008) describes that the tombs on the south hill (zone 7) are much less intensely reused than the tombs on the north hill (zones 2 and 4). The tombs in zone 4 on the north hill were heavily reused during later periods of Egyptian history, often leaving little trace of the original tomb structures (De Meyer, 2008). Due to those reuses, many burials cannot clearly be assigned to a particular individual or time period. But nevertheless, the burial goods that were placed beside the deceased can help date the burial. In addition, because of the mixture of burials (due to tomb looting and earlier excavations), the human remains are disturbed and mixed. Therefore, it is difficult to assign a paleopathology to a particular individual if more than one individual was present in a burial shaft. Over the millennia since the tombs were cut into the bedrock of Dayr al-Barshā, many burials were looted and robbed of all the valuable items meant for the survival of the dead in the afterlife. Even today, tomb lootings are a daily business for poor Egyptians who try to find a way out to better themselves financially. The site began to attract archaeologists and geologists since the late 1800's, and particularly the mission of the Boston Museum of Fine Arts under the direction of George A. Reisner excavated intensely and transported many burial goods away from Dayr al-Barshā. Another limitation is the fact that not all diseases can be seen on bones, some diseases are only soft tissue related. Additionally, some paleopathologies are idiopathic.

Wood et al. (1992) discuss the so called osteological paradox which illustrates the problems that may occur with inferring prehistoric health from skeletal samples. Three main problems arise during the examination of skeletal material: demographic non-stationarity, selective mortality, and individual heterogeneity in the risks of deaths and pathologies (Wood et al., 1992). The heterogeneity in risks may have different causes, such as genetic, socioeconomic, micro-environmental, or even temporal trends. Wood et al. (1992) argue that it is not possible to assess direct demographic or epidemiological rates from examining archaeological skeletal samples. Another point is that the results of single skeletons cannot tell how the health status of the overall ancient population looked like. Heterogeneity and selectivity cause difficulties in interpreting morbidity and mortality of past populations. Wood et al. (1992) further discuss how skeletal samples are composed of multiple individuals who were exposed to diseases and the risk of death at different ages. The paleopathology may be either the primary cause of death or the contributor to death (Wood et al., 1992).

Another important point is the ongoing excavation. There are many more burials to be excavated from the two sites. The percentages of paleopathologies in the necropolis may change drastically over the next field seasons.

A total MNI of 191 individuals was counted in the material of Dayr al-Barshā and Sheikh Said for the scope of this thesis, however this is a small sample for a time period that encompasses 526 years in the Old Kingdom (2686-2160 BC) and 405 years in the Middle

Kingdom (2055-1650 BC). It is very difficult to conclude from this relatively small sample to the entire population of the Old Kingdom respectively the Middle Kingdom.

CHAPTER SEVEN: CONCLUSION

Dayr al-Barshā is a very important necropolis in Egypt due to the occupation from the Early Dynastic Period to the modern day. Until the 6th dynasty, Sheikh Said was the burial site of the nomarchs of the Hare nome. From the 6th dynasty on, the necropolis shifted to Dayr al-Barshā and it was from then on the burial ground of the ancient city of *Hermopolis Magna* and the capital of the Hare nome. It was not only a necropolis, but also an important quarry site with large underground chambers.

The large scale archaeological sites of Dayr al-Barshā and Sheikh Said were divided into different zones. Relevant for this thesis are zones 4 and 7 dating to the Old Kingdom, and zones 2, 9A, and zone A in Sheikh Said, dating to the Middle Kingdom. Furthermore, there is zone 9B that is unique due to the mix in time periods consisting of burials dating to the Middle Kingdom, New Kingdom, and the Roman Period. Just recently, in the field season of 2010, burials of the Old Kingdom were discovered (personal communications, T. Dupras).

The research objectives were diverse and included (1) to determine what paleopathologies were present in the osteological material, (2) to interpret the effect that these paleopathologies had on the life ways of the population, (3) to determine if the hard work in the quarries is reflected in the human remains, (4) and to compare the results with other sites in Egypt.

The examination of the human remains determined that the paleopathologies encountered include fractures, spondylolysis, amputations, craniosynostosis, spina bifida, osteoarthritis, DISH, osteomyelitis, periostitis, tuberculosis, mastoiditis, osteoporosis, diabetes mellitus, porotic hyperostosis, cribra orbitalia, osteoma, parietal thinning, and dental diseases, such as dental abscesses, caries, periodontal disease, and dental enamel hypoplasia. Every condition, beside dental wear and cribra orbitalia, has a greater prevalence in the Middle Kingdom. Cribra orbitalia is a good indicator to determine the health and nutritional status of individuals. The higher prevalence in the Old Kingdom may be associated with the collapse of the kingdom due to socio-economic and environmental problems that occurred to that time and had a great impact on the daily lives of the population. The results of the study show that traumatic conditions have a very high frequency in the skeletal material and accidents or interpersonal violence was a common daily occurrence. Usually in skeletal samples of past societies, fractures and infectious bone diseases occur both at a high frequency. Not so in Dayr al-Barshā and Sheikh Said where traumatic conditions have a high prevalence, but infectious bone diseases, such as osteomyelitis and periostitis, occur in very low frequencies. This is related to the advanced medical knowledge of ancient Egyptian doctors and their use of honey as a natural antibiotic and disinfectant that prevented infections. Another high prevalence in the sample had the ten cases of parietal thinning that may eventually be related to diffuse idiopathic hyperostosis (DISH). Parietal thinning is a condition that usually occurs more prevalent in older individuals and females. The sample from Dayr al-Barshā and Sheikh Said concludes that eventually the condition occurs more frequently in older females but if males are affected, then their age is generally younger than 45 years.

The hard and dangerous work in the quarries is definitely reflected in the paleopathologies. Individual 2 from zone 9B especially stands out, presumably having died in an accident in the quarries.

Future research will consist of further excavations in both Dayr al-Barshā and Sheikh Said to not only draw the final picture of the paleopathologies, but also of the occupation of the necropolis itself. Further research on parietal thinning should be conducted to determine if there is a connection to diffuse idiopathic skeletal hyperostosis. Furthermore, it would be interesting to examine the skeletal material of Dayr al-Barshā and Sheikh Said for the presence of tetracycline which is a natural antibiotics to determine why fractures occur at a high frequency while infectious bone diseased occur at a very low frequency.

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