BIOARCHAEOLOGICAL ANALYSIS OF A BRONZE AGE SKELETAL SAMPLE FROM THE QIJIA CULTURE CEMETERY MOGOU (1750-1100 BCE) IN GANSU PROVINCE, CHINA

by

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ABSTRACT

ELIZABETH D. JOHNSON. Bioarchaeological Analysis of a Bronze Age Skeletal Sample from the Qijia Culture Cemetery Mogou (1750-1100 BCE) in Gansu Province, China. (Under the direction of DR. SARA JUENGST)

Bronze Age China has consistently been an area of research foci for both domestic and international researchers. However, paleopathological analysis of certain cultures within the "Northern Zone" is relatively new and demands scholarly exploration. Located along the northern borders of modern-day China, this area was a critical arena for interregional contact which aided technological and cultural diffusion. The following research analyzes skeletal stress markers to make inferences about the health and lifestyles of Qijia (2200-1400 BCE) individuals, paying particular attention to trends that would indicate sex-based social inequality. To do this, a small sub-sample (n=44) from the Qijia culture cemetery Mogou (1750-1100 BCE) was analyzed for nonspecific indicators of stress, including osteomyelitis, periosteal reaction, porotic hyperostosis, cribra orbitalia, dental pathologies, and trauma. Results indicate that the population at Mogou was in relatively "good" health, displaying majority healed skeletal lesions. Additionally, there are no significant differences in pathology or trauma between the sexes, suggesting that individuals at Mogou were not subjected to sex-based inequality to a degree that resulted in differences in skeletal lesions.

DEDICATION

I would like to dedicate this work to my parents, Frances and Paul Johnson, who have worked so hard to encourage and support my educational endeavors. I cannot thank you enough for making me into the woman I am today.

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CO	Cribra Orbitalia
PH	Porotic Hyperostosis
LEH	Linear Enamel Hypoplasia

CHAPTER I: INTRODUCTION

The human body does not exist in a vacuum. Rather, it is an embodied product of human action (Grauer 2016; Sofaer 2006). As individuals participate in life, variation in the roles they may hold throughout their lifetime, or aspects of identity such as age, gender, status, or ethnicity, can result in differential access to resources, treatment in society, or exposure and susceptibility to disease. Bioarchaeology is an interdisciplinary field that can investigate skeletal indicators of stress, patterns of trauma and diseases, skeletal morphology, etc., to understand how both the physical and social landscapes a person participates in impacts their health and mortality. Therefore, this research seeks to contribute to the larger anthropological questions concerning the embodiment of status differences and the institutionalization of gender hierarchies, or the concept that individuals of one gender have "disproportionately greater access to status, power, wealth, and/or resources" (Neitzel 2000: 138) (See also Ortner 1996).

Prior to the twentieth century, traditional biological anthropological research in China primarily focused on craniometry and population history with regards to migration debates and race/ethnicity studies (Pechenkina 2012). However, in recent decades there has been an increasing interest in paleopathological analysis (Pechenkina 2012). As this interest grows, bioarchaeological analysis of populations from Prehistoric China are being conducted in order to explore and understand the lived experience of peoples from various regions and time periods. This avenue of research is instrumental to understanding how different variables, such as climate and geography, subsistence strategies, emerging social hierarchies, etc. affect individuals and populations. In order to contribute to this newly developing interest in pathological inquiry in China, I performed a bioarchaeological analysis on a small sample (n=44) of Bronze Age individuals from the Qijia culture (2200-1400 BCE) excavated from the Qijia culture cemetery Mogou (1750-1100 BCE). I was particularly interested in investigating possible sex-based differences in health and life experience using paleopathology and trauma analysis. The research I present here examines skeletal indicators of nonspecific stress to investigate the health and lifestyle of Qijia individuals, paying particular attention to trends that would indicate embodiment of sex based social inequalities.

CHAPTER 2: BACKGROUND AND LITERATURE REVIEW

2.1: Bronze Age China

Bronze Age China is a particularly interesting period for anthropologists because of the increasing complexity of societies and cultures during this time. The "Northern Zone," a transitional region between China and the steppe, is one such area that has been considered important for interregional interactions. During the transition from the Neolithic to Bronze Age, this area "emerged as a crucial arena for interactions among sedentary, semi-sedentary, and nomadic people during a decisive period in which the region's unique economic adaptations, socio-political systems, local cultures and identities took shape" (Shelach 2009: 1). Within the Northern Zone, Northwest China in particular served as an important area of contact that enabled trade and communications between people (Di Cosmo 2002; Flad *et al.* 2010; Jia *et al.* 2013; Shelach 2009; Shelach-Lavi 2015; Womack and Underhill 2017), and includes the Hexi Corridor, the Tibet-Qinghai Plateau, and portions of the Loess Plateau and Inner Mongolia (Berger 2017).

Such a transitional period and complex area offers many topics for bioarchaeologists to analyze. As such, research over the past few decades has become increasingly involved in documenting the complexity of this transitional phase and region (Berger 2017, Shelach 2009). These studies have focused on topics such as subsistence strategies in relation to health (Eng 2016; Liu *et al.* 2010), adaptation to climate change (Berger 2017), diets and inequality (Dong *et al.* 2017), chronology and diffusion of ancient cultures (Dong *et al.* 2014; Jia *et al.* 2012), and stable isotope analysis within the area (Ma *et al.* 2014; Ma *et al.* 2015; Ma *et al.* 2016; Zhang *et al.* 2016). Increasingly, bioarchaeologists have begun to analyze health patterns during this period. However, since this is a relatively new and rapidly expanding avenue of research in China, scholarly literature surrounding specific cultures, sites, and time periods is severely needed.

Archaeological analysis of the Chinese Northern Zone has consistently demonstrated complex social, cultural, and economic exchange and growth during the Bronze Age (Jia *et al.* 2013; Liu and Chen 2012; Liu *et al.* 2014; Shelach 2009; Shelach-Lavi 2015). Several early Bronze Age archaeological cultures have been identified in this region, including Zhukaigou, Siba, Siwa, Xindian, Kayue, Qijia, and many others (Liu and Chen 2012; Shelach-Lavi 2015). Each of these cultures are referred to as existing in the Northern Zone (Liu and Chen 2012; Shelach-Lavi 2015). The focus of this project is the Qijia culture located in Gansu Province, Northwest China.

While varying enough to be considered different archaeological culture groups (although this is debated, see Shelach 2009), Bronze Age archaeological cultures in northern Eurasia/the Northern Zone of China are generally characterized by increasing pastoralism and bronze metallurgy (Liu and Chen 2012). Main differences can be found in material culture such as ceramics, weaponry, and bronze objects. However, diffusion rates of such technological and cultural practices varied for each group, resulting in the complex and transitional nature of this zone and time period.

With regards to subsistence strategies, various sites were influenced by trade connections, local terrain, and climate in different ways. Zhang *et al.* (2016) notes that Houtaomuga, Jinggouzi, and Chenjiagou were three contemporaneous archaeological sites existing during the late Bronze Age in Northern China that practiced three different subsistence strategies. Houtaomuga in Northeast China is located alongside a lake and surrounded by mountain ranges on three sides. The climate in this area is warm and wet in the summer, and very cold (around -24 ℃) and dry in the winter. At this site, subsistence strategies were a combination of hunting-gathering-fishing and limited mixed agriculture. Jinggouzi was located in Inner Mongolia, North China in a landscape that featured a combination of sand dunes, lowland meadows, and savannas (Zhang *et al.* 2016). Based on burial goods composed of domesticated animal bones, and bronze animal husbandry tools, this site was classified as practicing nomadic pastoralism. Lastly, Chenjiagou was located in Central China in a sub-humid and monsoonal climate and practiced sedentary agriculture. Zhang *et al.* (2016) attribute the various subsistence strategies to differing climatic environments. This study determines that various subsistence strategies existed contemporaneously within a relatively small geographic area. This level of diversity is partly what makes this geographic and temporal space so interesting to scholars.

It is clear that across the Northern Zone in China, many factors influenced metallurgy, subsistence strategies, trade, and communications. The diversity in these factors resulted in what scholars have deemed a transitional and liminal time period and location. As such, numerous cultures arose and transformed during Bronze Age China. Due to the variety and overlap of a lot of material culture and practices, chronology of these cultures is still debated in the scholarly literature, particularly concerning which ones gave way to others (Shelach 2009, Shelach-Lavi 2015).

2.2: Chronological Context

The chronology of ancient China is a continual area of focus, both in national and international research. This is due to the large number of archaeological cultures which partially overlap in time periods, location, and cultural practices, and the limited amount of carbon dates. The debate is mainly focused on determining which cultures gave way to, or influenced, others. Since distinguishing separate archaeological cultures depends on differences in material culture, such as ceramic design, cultural sequences can be hard to establish. Some scholars debate whether separation into individual archaeological cultures is accurate, or necessary (see Shelach 2009). As it stands, Bronze Age culture chronology situates the Qijia culture, dating to ca. 2200-1400 BCE, directly after the late Majiayao, a late Neolithic culture dated to ca. 2500- 2000 BCE, and partially contemporaneous with the Siba dated to ca. 1900-1500 BCE (Liu and Chen 2012; Shelach 2009; Shelach-Lavi 2015). Table 1 displays currently accepted chronology and location of these cultures.

Table 1: Chronology of Archaeological cultures in temporal and spatial proximity to the Qijia culture (compiled from Linduff 1998; Liu and Chen 2012; Ma et al. 2013; Shelach-Lavi 2015; Xie 2002).

Culture	Period	Dates	Location (Region or Province)
Late Majiayao	Late Neolithic	~2500-2000 BCE	Gansu Province, Qinghai Province, Ningxia Province
Qijia	Bronze Age	~2200-1400 BCE	Gansu Province, Qinghai Province, Ningxia Province, Inner Mongolia
Siba	Bronze Age	~1900-1500 BCE	Gansu Province- Hexi Corridor
Kayue	Middle Bronze Age	~1600-600 BCE	Qinghai Province
Xindian	Middle Bronze Age	~1400-700 BCE	Gansu Province, Qinghai Province, Shaanxi Province
Siwa	Middle Bronze Age	~1400-700 BCE	Central and Southeast Gansu Province

2.3: The Qijia Culture

The Qijiaping site was discovered in 1924 by archaeologist J. G. Andersson in Gansu Province, China (Liu and Chen 2012; Ma *et al.* 2015; Womack *et al.* 2017). Due to the unique pottery found at this site, including a variety of two handled vases and a simple monochrome decoration, Qijiaping was established as belonging to a new, previously undiscovered archaeological culture. Therefore, Qijiaping, dated to 2300-1500 BCE, became the type site for the Qijia culture (Womack *et al.* 2017).

Geographically, Qijia sites have been found across the provinces of Gansu, Qinghai, and Ningxia, as well as in Inner Mongolia around the upper Yellow River Valley (Liu and Chen 2012). From approximately 2350-1750 BCE there was a cold-dry period, which is often considered a significant factor of Qijia culture expansion. During this time the number of sites grew dramatically in comparison to previous Neolithic cultures. However, the sites were often found to be smaller with shorter settlement periods, relating to smaller community sizes with increased mobility from the pre-Qijia to Qijia period (Dong *et al.* 2013; Liu and Chen 2012; Liu & Feng 2012). Overall, Qijia sites are found near rivers with highly variable site layouts (Dong *et al.* 2013; Liu and Chen 2012). For example, at some sites burials are intermingled with residential structures while in others they are kept distinctly separate (Liu and Chen 2012).

In general, the Qijia culture commonly buried their deceased in rectangular pit graves (Shelach 2009). These graves varied in complexity with the simplest being single rectangular pits. Complexity is considered to increase as side shafts are carved into the grave (i.e. the more side shafts, the more complex a grave is considered). Side shafts could be used for grave goods, which were most often ceramic vessels, precious stones, jade, sacrificial animal bones (Liu and Chen 2012; Shelach 2009), or other individuals. Bronze items often found at Qijia sites include small tools or crafts, including knives, axes, spearheads, awls, rings, mirrors, and plaques (Liu and Chen 2012; Mei 2010). These items were likely used for utilitarian purposes by living members in the community before being interred with the dead.

Burials containing multiple individuals are often found at Qijia culture sites (Liu and Chen 2012; Shelach 2009; Sun & Yang 2004; Womack and Underhill 2017). Joint burials including males, females, and juveniles are common, as well as burials containing one male with multiple females. Joint burials with one male and multiple females have traditionally been interpreted in three ways: the females could have been wives or concubines of the central males (Fitzgerald-Huber 1995; Linduff & Sun 2004); the additional females were familial members being added to the grave as they died (Ye 1997; Womack and Underhill 2017); or the females were sacrificial victims (Chen 2013; Linduff & Sun 2004; Womack and Underhill 2017).

Sun and Yang, in Linduff & Sun (2004), investigate gender ideology in Northwest Bronze Age cultures by analyzing mortuary practices of Majiayao and Qijia groups. Burial practices of the Majiayao peoples indicated fair treatment between the sexes, evidenced by males and females being placed in similar positions, grave goods distributed centrally, and similar uses of tomb furniture (Sun & Yang 2004). However, as we transition into the Qijia period there is an increase in segregation and differentiation. Three Qijia cemeteries, Liuwan, Qinweijia, and Huangniangniangtai all provide evidence of increasingly different burial practices for males and females. At these cemeteries females were placed with grave goods beside a male individual interred in a coffin or in a flexed position facing a central, supine, extended male (Sun & Yang 2004). Sun & Yang (2004) propose that this evidence coupled with the association of tools as grave goods and ceramic designs indicates a shift in ideology that involved male domination over women.

2.4: Bioarchaeological Analysis of sex-based social roles

As previously mentioned, the human skeleton is not a blank slate. As we traverse throughout the life course, certain aspects of our physical and social environment are recorded on our skeleton. Social inequalities or differential treatment of others due to sociopolitical unrest, cultural practices, ideological beliefs, etc. can influence the way we grow and develop, our susceptibility to diseases, or overall health and mortality. This differential treatment can be based on social identities, such as gender, ethnicity, status, class, age, etc., that are historically dependent sociocultural constructs that intersect in dynamic ways to produce lived experience (Meskell 2001). Although gender is a social construct that cannot be understood solely through the human skeleton, it is associated with and transcribed onto male/female bodies (Hollimon 2011; Ortner 1996; Sørensen 2013, 1992).

Skeletal analysis can reveal patterns of engendered activity, particularly when investigating skeletal indicators of stress and health, which can reveal conditions of childhood health and nutrition, systemic stress and disease, disruptions in growth, and physical violence. These are important lines of evidence as access to resources, labor patterns, risk of disease, and frequency of trauma are often linked to sex-based social roles (De la Cova 2012; Geller 2017; Molleson 2007; Stone 2012; Tung 2012). Thus, when interpreted cumulatively, these markers can provide an overall picture of health and stress throughout an individual's life course and can be utilized to understand community and population level trends in health and mortality based on sex. However, it is important to note that there are limitations to bioarchaeological interpretations of health in the past. First and foremost, skeletal lesions take time to respond to stress; while chronic infections or nutritional stress may be well represented on the skeleton, acute infections or short but severe assaults may result in death before lesions form (DeWitte and Stojanowski 2015; Wood *et al.* 1992). Additionally, differences in frailty demonstrate that individuals are not at the same risk of developing skeletal lesions or dying (DeWitte and Stojanowski 2015), resulting in skeletal samples that are inherently biased. It is for these reasons that bioarchaeological data should be interpreted in conjunction with archaeological and mortuary data.

2.4.1. Indicators of Childhood Stress

Cribra orbitalia, porotic hyperostosis, and linear enamel hypoplasia are skeletal and dental indicators of childhood stress. These indicators can stem from malnutrition, parasitic infections, or chronic disease/infectious episodes. These markers can be generally considered to reflect the burden of growth disruptions, burden of physiological insults, or higher frailty in a population. Therefore, differences in CO, PH, and LEH observed between the sexes may indicate different social treatment of individuals during childhood.

Cribra orbitalia and porotic hyperostosis are conditions characterized by macroscopic areas of porosities or lesions, located on the outer table of the cranial vault and on the orbital roofs, respectively (Walker *et al.* 2009; White and Folkens 2005). These pathologies are commonly attributed to anemia caused by malnutrition, infectious diseases, parasites, or other vitamin deficiencies (Walker *et al.* 2009; Weiss 2015). Due to the wide range of possible etiologies associated with CO/PH, they are considered non-specific indicators of stress indicative of metabolic disruption during childhood.

Linear enamel hypoplasia (LEH) is a non-specific indicator of stress that most often indicates the presence of infectious disease, parasite infection, or nutritional deficiencies (Armelagos *et al.* 2009, Goodman and Rose 1990, Reitsema and Mcllvaine 2014). It is a deficiency resulting from the cessation or interruption in the formation (amount and quality) of tooth enamel during amelogenesis (the development of tooth enamel which begins during crown formation). LEH manifests as lines around the tooth, while other forms of enamel hypoplasia can result in pitting, or lack of enamel completely (Armelagos *et al.* 2009, Goodman and Rose 1990, Hillson 2008, Larson 2002); therefore, LEH represents systemic stress lasting significant lengths of time. Importantly, LEH is a temporary interruption in enamel development, which also represents recovery from physiological stress.

2.4.2. Indicators of Infectious Disease

Skeletal changes can also occur in response to long-term infection or inflammation within the body. Two of the more common forms of infectious disease analyzed are osteomyelitis and periosteal reactions. Osteomyelitis and periostitis are nonspecific markers that indicate the presence of some form of infection or disease. Although these markers do not reveal a specific disease, they can speak to the overall frequency, distribution, and severity of disease, providing valuable insights into the health and mortality of past populations (Roberts and Manchester 2005; White and Folkens 2005).

Osteomyelitis is bone inflammation caused by pus-producing microorganisms in bacteria that infect the marrow cavity. While any skeletal element may be affected by osteomyelitis, the most common sites are the knee, the distal third of the tibia, and the proximal third of the femur (Roberts and Manchester 2005). Children aged 3-12 years tend to be the most susceptible to this form of infectious disease; this may be due to the fact that bone growth is most active during this period (Roberts and Manchester 2005).

Periosteal reactions are “a condition of inflammation of the periosteum caused by trauma or infection” (White and Folkens 2005: 318). It appears as fine pitting, longitudinal striations, and new bone formation (Roberts and Manchester 2005). In some situations, periosteal growth can deposit one or more layers of woven bone which remodel into lamellar bone (Ortner 2008). This can potentially cover the entire bone, or only cover a small portion. Subperiosteal new bone growth can also form into spicules (Ortner 2008); this is essentially abnormal bone that grows perpendicular to the original bone, causing protruding formations. The most common site for subperiosteal new bone growth is the tibia (Ortner 2008; Roberts and Manchester 2005; White and Folkens 2005).

2.4.3 Trauma

Trauma is the application of force, accidentally or non-accidentally, by a mechanism extrinsic to the body that results in injury (Lovell 1997; Byers 2011; Blau 2017). Skeletal trauma is defined as “a modification, and ultimately the failure, of bone at the macro and/or microscopic level in cortical and/or trabecular bone as a result of a slow and/or rapid-loaded impact with an object” (Blau 2017: 262). Trauma is directly related to the force, or combination of forces, that may alter the skeleton.

There are a number of factors that can affect bone response to stress. This includes intrinsic (internal) and extrinsic (external) factors. Intrinsic factors are things such as an individual's age, health, the specific bone affected (shape and also because the composition changes slightly depending on the bone), and the location of the injury to the bone (Blau 2017; Love and Symes 2004). Extrinsic factors are those that relate to the force being applied to bone. Force is defined as "an action or influence that is applied to a free body" (Blau 2017). There are five main forces that can result in skeletal fractures (Figure 1). These are compression, tension, torsion, bending and shearing (Byers 2011; Blau 2017; Love and Symes 2004). Compression forces are those that push, compress, or compact the bone from opposite sides (Byers 2011). Tension is when a bone is essentially pulled until it is tight. Torsion force is when one part of a bone (typically long bones) is held stationary and the other end is twisted (Byers 2011). Bending forces are a combination of compression, tension, and shearing; one side is being compressed while the opposite side is being tensed, and an impact is sustained at approximately a right angle (Byers 2011). The way a bone responds to stress depends on the amount, directionality, size, and loading rate of force, which varies within and between types of trauma.

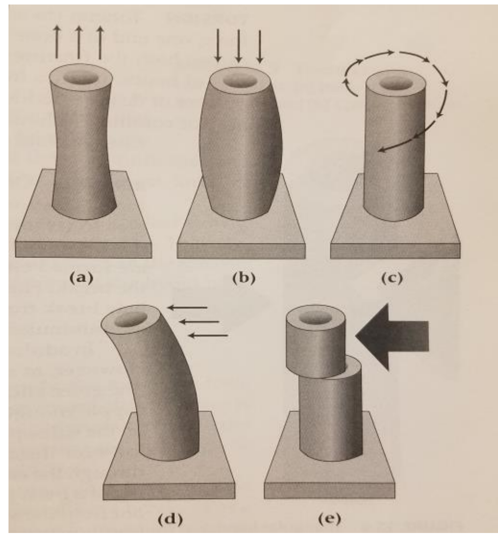

Figure 1: Five directions of force. (a) tension; (b) compression; (c) torsion; (d) bending; (e) shearing. Originally in Ortner and Putschar (1981).

A fracture occurs as "a result of abnormal forces of tension, compression, torsion, bending, or shear applied to the bone" (White and Folkens 2005: 312). Depending on the force, direction, and locality of trauma, different fractures can occur. A complete fracture is when broken ends are separated from each other. An incomplete fracture, also referred to as a "greenstick" fracture, occurs when there is both breakage and bending of a bone

(White and Folkens 2005; Byers 2011). Due to the variability of fractures (due to variable extrinsic factors), there are numerous established types. Additionally, when more than one fracture type occurs simultaneously on a bone, or properties from multiple fractures are present, differential terminology may be used to categorize them. Transverse, oblique, butterfly, spiral, segmental, and comminuted are some of the more common types of fractures. Transverse fractures occur at approximately right angles to the long axis of the bone and are associated with high energy force such as significant falls (Cohen *et al* 2016). Oblique fractures "run diagonally across the diaphysis with short blunt fractures usually ending at a 45° angle with no vertical segment," and are associated with moderate compression forces (Cohen *et al* 2016: 55). Oblique fractures can also be indicative of a simultaneous angulated but rotated force (Lovell 1997). Butterfly fractures occur when two oblique fractures meet. They result in a wedge-shaped fracture where compression on the bone results in the opposite side shearing, breaking into the wedge shape (Blau 2017; Cohen *et al* 2016). These fractures are common in low-speed trauma situations (Cohen *et al* 2016). Butterfly fracture patterns have traditionally been associated with blunt force trauma (Blau 2017). Spiral fractures result from torsion, or essentially the twisting of a bone. Cohen *et al* (2016) note that this can also occur from a combination of torsion and bending, can provide directionality of injuries sustained, and tend to be associated with low-velocity forces. Segmental fractures occur when multiple fractures result in part of the diaphysis being separated from the rest of a bone (Cohen *et al* 2016). Lastly, comminuted fractures occur when the bone splinters, resulting in two or more fragments of bones (White and Folkens 2005; Cohen *et al* 2016).

Blunt force trauma refers to an injury that has been caused by a mechanism of force with a wide area of impact and a relatively low velocity (measured in miles per hour) (Byers 2011; Blau 2017; Hart 2005). Blunt force trauma can consist of impact to the body from an object, but also the impact of a body with a barrier or surface (Blau 2017). Variations in the amount of force, type of weapon used, and location on the body result in different fracture patterns. It is important to note that *high* variability is found in blunt force trauma, more so than other types, and the fracture patterns of this type of trauma are less established than projectile or sharp trauma. Blunt force trauma has been predominantly associated with transverse, butterfly and concentric fractures.

Sharp force trauma refers to an injury from a weapon with a point or beveled edge that may dent, chop, crush, incise, puncture, nick, or gouge a bone (Symes and Chapman 2010; Delabarde *et al.* 2010; Blau 2017). This type of trauma is caused by a mechanism of force with slow loading over a very small surface area (Blau 2017; Humphrey *et al.* 2017). Only stab wounds produce puncture, nicks or gouges; while non-stab wounds produce slices or cuts along the contour of a bone (Symes and Chapman 2010). Wound characteristics of sharp force trauma are highly variable, due to the wide variety of weapons that can be used.

In an archaeological context trauma analysis can provide information reflective of the lived experience of individuals, such as economy and subsistence strategies, social organization, living environment, occupation and interpersonal violence, community standards of care or availability of treatment (Martin *et al.* 2012; Roberts and Manchester 2005; White and Folkens 2005). Being able to differentiate between intentional and accidental injury is essential in understanding the social context of injury or violence and how it relates to the lived experiences of individuals. Accidental trauma is an injury that lacks intentionality and is most often observed in relation to occupational mishaps or falls. However, intentional injuries are conceived as violent acts against another person and can appear in distinct patterns in the archaeological record.

Violence is a phenomenon that has been documented in all cultures across various temporal and spatial contexts (Martin and Harrod 2015). Importantly, what is considered violent can vary cross-culturally, i.e. what is violent in one society may not be considered so in others; it may be individual, or collective, and is often socially sanctioned and organized (Martin and Harrod 2015; Toyne 2007). The concept of violence implies some form of intentionality (Martin and Harrod 2015; Thompson *et al.* 2014; Toyne 2007). As Mays (2014) notes: "few societies shun violence; in pre-state societies, warfare and raiding are often endemic; and violence, or the threat of it, plays an important role in maintaining social hierarchies" (99). There are numerous factors that can influence the frequency of violence in the past, including subsistence intensification, competition for resources, climate, population density, famine, and sociocultural and political instability, among others (Geber 2014; Martin and Harrod 2015; Thompson *et al.* 2014). The results of numerous studies suggest there are three main categories of violence that can directly influence an individual's health and mortality: 1) sociocultural and political turmoil, 2) socially sanctioned or ritual violence, and 3) physical trauma or abuse (Gaither 2012; Lewis 2007; Toyne 2007). To distinguish between these forms of violence bioarchaeologists analyze patterns of skeletal injury. Violent trauma is often found on the skull, arms, torso, and hands. For example, fractures associated with child abuse are most often concentrated in the ribs, long bones, and crania (Lewis 2007), parry fractures are defensive injuries found on the ulna and are thought to be indicative of interpersonal violence (Martin *et al.* 2012), while cranial trauma can indicate face-to-face combat, or blows from behind, when trauma is observed on the frontal bone, or posterior aspect of the cranium, respectively (Martin *et al.* 2012). In conjunction with other lines of evidence, such as comparative ethnography, documents and records, social theory, etc., skeletal analysis of violence can shed light on various aspects of social and physical realities of past populations.

Through bioarchaeological analysis of the human skeleton, lines of evidence such as frequencies and patterns of childhood indicators of stress, skeletal responses to infectious disease, and trauma analysis can be combined to understand the embodied experience of an individual, and thus groups of people within populations. It is clear that throughout time and space different peoples have been subjected to different forms of social inequality. Across China during the transition from the Neolithic to Bronze Age and from early to late Bronze Age there are indications of an increasing dominance in the patriarchy, mostly evidence by grave goods and burial treatment. While grave goods and burial treatment can be incredibly useful in interpreting social ideas of different groups of people, a physical embodiment aspect to this research topic can help build a more robust and holistic understanding of the extent of social change and social inequalities felt by individuals of this time. Additionally, diffusion and alterations of cultural practices and ideologies is not a linear process and does not affect every group or population in a uniform fashion. With the growing interest in paleopathology in China, I hope to use bioarchaeological modes of analysis to investigate whether or not the Qijia individuals at Mogou display skeletal indicators of sex-based social inequality. Since the skeleton relays direct information regarding an individual’s experience of disease and infirmity, their analysis can be used to solidify ideas of differential treatment. Understanding how and why social inequalities formed can aid in the dismantling of modern-day inequalities and improvement in the treatment and life conditions of marginal groups and populations.

CHAPTER 3: MATERIALS AND METHODS

3.1: Skeletal Sample

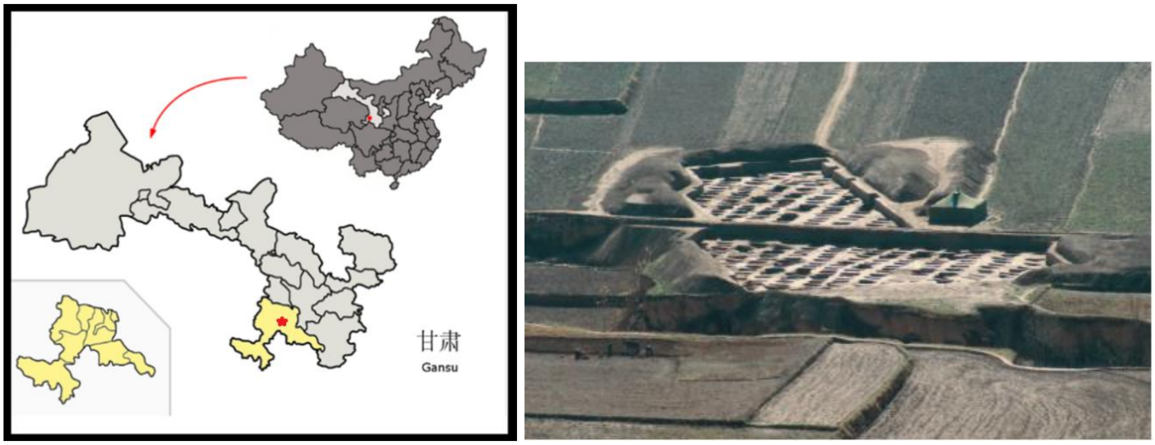

Figure 2: Left: Location of Mogou in Gansu Province (Croquent 2007); Right: Archaeological excavation area at Mogou (Taken from GPICRA and NWARC 2010)

Mogou is located in Chenqi Township, Lintan County, Gannan Tibetan Autonomous Prefecture in southern Gansu Province. The primary use phase of Mogou has been carbon dated to 1750-1100 BCE (Liu *et al.* 2014) and contains mostly Qijia and some Siwa graves. Throughout the cemetery, all Qijia burials were oriented towards the northwest and aligned in rows from the northeast to the southwest (GPICRA and NWARC 2010). Pit graves composed most of the burials and were found in two forms: vertical shaft pits, and vertical pits with side chambers. A small number of cremations were also found.

Variability in the construction of graves has long been inferred as a display of cultural practices, which may relate to religious beliefs or ideological factors (Qian *et al.* 2009). The prevalence of joint burials at Mogou is the highest out of all Qijia sites (Gansu and Xibei 2009; Womack *et al.* 2017). Graves at this site contained two to thirteen skeletons (R. Mao, Personal communication summer 2018), though most contain three to five (Qian *et al.* 2009). High levels of disorganized skeletal remains seem to have occurred with secondary interments; in some situations, this was the addition of juvenile skeletons to a pit, which seems to suggest a value places on family/kinship (Qian *et al.* 2009). Some secondary interments and disturbed remains are coupled, with male/female burials associated with juvenile skeletons (Qian *et al.* 2009).

The numerous skeletons in a pit in addition to the instances of disarray supports a familial ties theory of mortuary practice, since they were not concerned with keeping the earlier interments articulated (Qian *et al.* 2009). If true, the familial ties theory suggests "a more complex society in the Qijia culture represented by the Mogou Site" (Qian *et al.* 2009: 163). Thus, the individuals excavated from this cemetery provide an excellent opportunity to investigate inequality and gender roles during this time.

For this project, I analyzed skeletal material excavated from the Qijia culture cemetery site Mogou for paleopathological markers of inequality as part of a wider research project directed by the Gansu Provincial Institute of Cultural Relics and Archaeology, based in Gansu Province, China. Here, I present the data from a randomly sampled subset (n=44) of approximately 4000+ human skeletons as part of a collaborative data collection effort led by Ivy Yeh, Elizabeth Berger, and Jenna Dittmar.

3.2: Bioarchaeological Methods

Sex and age estimation are routine variables recorded in bioarchaeological studies because they can influence the development of skeletal lesions throughout the life course. I collected estimated sex and age at death for each individual when possible; however, when elements were unavailable or too damaged, sex and age was documented as indeterminate. Additionally, sex was not determined for individuals under 11, since many pelvic traits are associated with puberty and would have been unreliable in such young individuals. With regards to pathology, instances of porotic hyperostosis, cribra orbitalia, periosteal reactions, osteomyelitis, linear enamel hypoplasia, and trauma were recorded as detailed below.

3.2.1. Age Estimation

Age was estimated for each individual based on morphological changes seen throughout the skeleton, along with dental eruption. Skeletal traits considered include the morphology of the pubic symphysis (Brooks and Suchey 1990), morphology of the iliac auricular surface (Buckberry and Chamberlain 2002), morphology of the sternal rib ends (Iscan 1991), degree of epiphyseal fusion of the medial clavicle (Langley-Shirley and Jantz 2010), and cranial suture closure (Meindl and Lovejoy 1985). Since age related changes seen in the pelvis are considered to be most reliable (Buikstra and Ubelaker 1994), this element was given priority. Cranial suture closure was estimated when no other methods were available. Dental eruption is considered a reliable indicator of age (Buikstra and Ubelaker 1994; Hillson 2008; White and Folkens 2005) and was scored using the standard eruption chart found in Buikstra & Ubelaker (1994). Dental eruption was prioritized for juvenile age estimation when possible.

When more than one measure of age was available they were interpreted holistically to provide a more accurate estimate for an individual. Therefore, an estimated age-at-death range was determined based on overlapping age ranges of all available measures for that individual. The age-at-death distribution is presented in Chapter 4: Results.

3.2.2. Sex Estimation

Sex was estimated using cranial and pelvic nonmetric traits detailed in Buikstra & Ubelaker (1994) and White and Folkens (2005). The five standard cranial nonmetric traits observed were: nuchal crest, mastoid process, supraorbital margin, supraorbital ridge/glabella, and mental eminence (White and Folkens 2005: 387-391). These were scored on a scale of 1 to 5, where 1=female, 2=probable female, 3=indeterminate, 4=probable male, and 5=male.

Pelvic nonmetric traits analyzed include the ventral arc, subpubic contour, and the medial aspect of the ischiopubic ramus and were evaluated according to descriptions found in Klales *et al.* (2012). These were also scored on a 1 (female) to 5 (male) scale.

Final sex estimations were made for each individual based on a combination of these measures when available. In cases of poor preservation as many traits as possible were used for sex estimations, with preference given to the pelvic elements when available.

3.2.3. Indicators of Childhood Stress

Cribra orbitalia and porotic hyperostosis were recorded by location and degree of healing, where 0=active (no healing), 1= moderate healing (some pits visible, diploie expanded), and 2= fully healed (smoothed surface with no pits) (Buikstra and Ubelaker 1994). Linear enamel hypoplasia (LEH) was observed for macroscopically visible horizontal lines and by taking my thumb and running it across the surface of the tooth to feel linear defects in enamel. The frequency of LEH per tooth and individual were documented.

3.2.4. Indicators of Infectious Disease

Osteomyelitis and periosteal reactions were recorded by skeletal element, location on element, and severity of the lesion. Osteomyelitis was diagnosed by the presence of cloaca, or a hole that penetrates through the cortex and provides a drainage route for pus; as well as the presence of sequestrated (dead) bone.

Periosteal reactions were recorded as 0=active (appositional bone with no healing), 1= moderate healing (partial smoothing of woven bone with active areas visible), 2= fully healed (remodeling with no active areas visible), or 3= a mix of active and healed lesions (Buikstra and Ubelaker 1994; Ortner 2008).

3.2.5 Trauma

Trauma was recorded by location on the skeleton and timing of the injury. Timing of trauma (antemortem, perimortem, postmortem) was determined by level of healing and was scored as 0=no healing (sharp edges with no remodeling), 1= moderate healing (partial remodeling with new bone growth), and 2= fully healed (significant remodeling visible). Trauma was also thoroughly described (i.e. directionality and types of fractures, displacement, etc.) (Buikstra and Ubelaker 1994).

CHAPTER 4: RESULTS

4.1: Age Estimation

Age categories used in this study include old adults (45+ years), middle adult (25-45 years), young adult (17-25 years), adolescent (12-17), juvenile (3-12 years), infant (birth-3 years), and fetus (prenatal). These categories were chosen because of their relevancy to sociocultural and physiological stages of development.

Overall, age estimations (Figure 3) were made for 40 of the 44 individuals. Of these, adults composed 55% of the sample (young, middle, and old), with individuals from birth to 17 years composing 37%. Young adult (*n*=9), middle adult (*n*=10), and old adult (*n*=4) were 20%, 23%, and 9% of the sample, respectively. Notably, infants composed 16% of the sample (*n*=7), while juveniles (*n*=6) and adolescents (*n*=3) composed 14% and 7%, respectively. There was only one fetal individual in this sample. Due to poor preservation, four individuals were unable to be assigned to an age category.

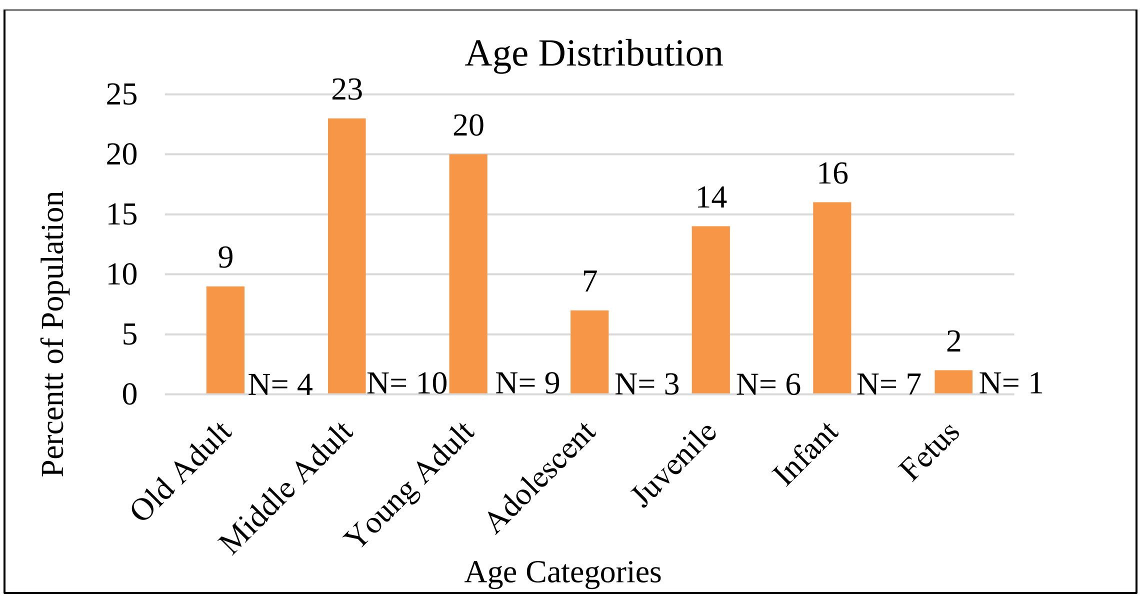

Figure 3: Age Distribution at Mogou

Table 2: Age Distribution by sex at Mogou

Age Category	**Estimated Sex**					
	Male	Probable Male	Indeterminate	Probable Female	Female	Total
Old Adult	2	0	0	1	1	4
Middle Adult	2	3	1	2	2	10
Young Adult	3	1	1	2	2	9
Adolescent	1	0	0	0	2	3
Juvenile	0	0	6	0	0	6
Infant	0	0	7	0	0	7
Fetus	0	0	1	0	0	1
Indeterminate	0	0	2	1	1	4
Total	8	4	18	6	8	44

4.2: Sex Estimation

Sex was estimated for 30 out of 44 individuals using cranial and pelvic nonmetric traits detailed in Buikstra & Ubelaker (1994) and White and Folkens (2005). Fourteen individuals could not be sexed due to poor preservation or their status as an adolescent. Sex estimation was not attempted for those under approximately 16 years of age at the time of death (*n*=14). All individuals above approximately 16 years old (n=30) are represented in Figure 4 below. There were eight females (27%), eight males (27%), six probable females (20%), four probable males (13%), and 4 indeterminate individuals (13%).

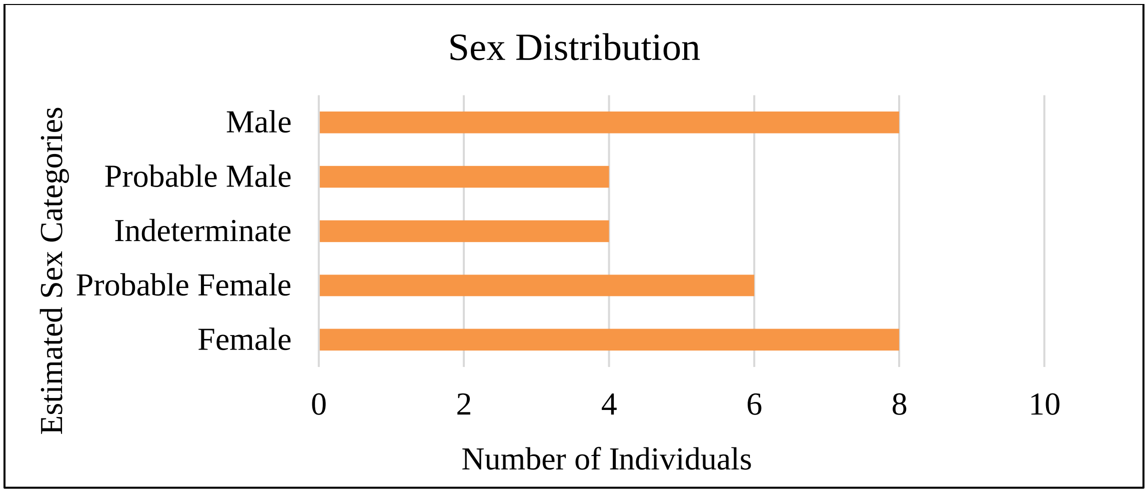

Figure 4: Sex Distribution at Mogou

Due to the small sample size, probable female and female determinations were combined for analysis, as well as probable male and male. These data are presented in Figure 5. When combined, probable females and females compose 47% (14/30) of the sample of individuals whose sex could be estimated, probable males and males represent 40% (12/30), and indeterminate individuals were 13% (4/30) of the sample.

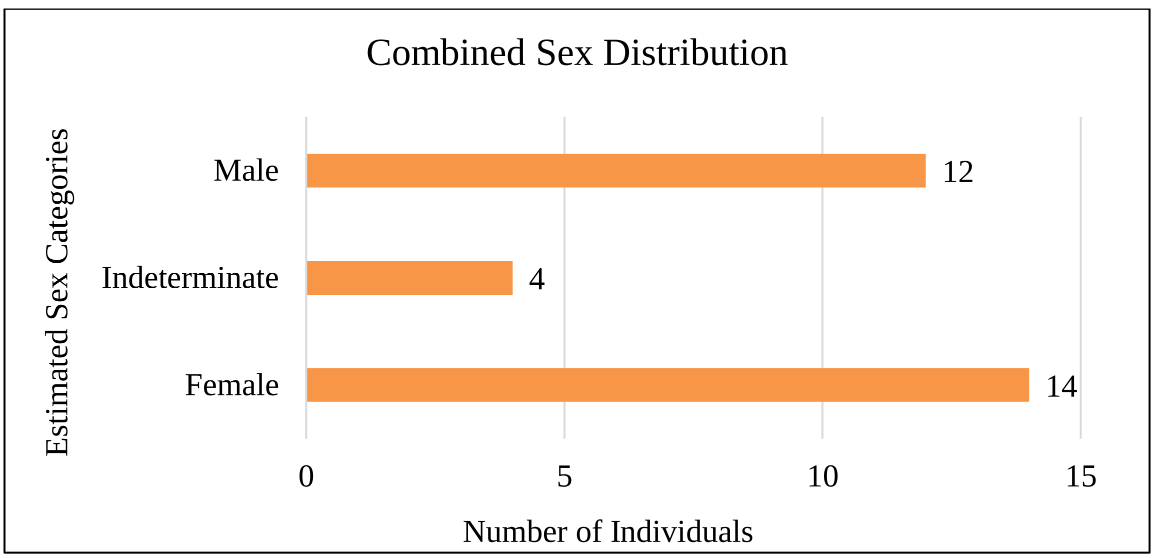

Figure 5: Combined Sex Distribution at Mogou

4.3: Indicators of Childhood Stress

Twenty-six out of 44 individuals were observable for CO; six individuals (23%) were affected (Table 3). Healed lesions represented 50% of the sample, while active lesions occurred on two of six individuals, or 33%. One individual (17%) displayed both active and healed lesions. Interestingly, the three individuals with active CO were from the same tomb. Four of the six individuals were juvenile and unable to be sexed. The other two individuals were estimated to be a probable male (21-25 years, active and healed lesions) and a probable female (30-50 years, healed lesions).

Twenty-five out of 44 individuals had preserved cranial elements; five (20%) out of these 25 displayed lesions consistent with porotic hyperostosis (Table 3). Three individuals had healed lesions (12%) while the other two cases (8%) demonstrated active/healing lesions. Males comprised 3/5 (60%) of the sample, along with a single female, and a juvenile individual. Out of the three male individuals affected, two cases were healed and one had both active/healed lesions; the female individual had healed lesions, while the subadult displayed both active/healed lesions. Only one individual (1015 R1, juvenile) displayed both CO and PH.

Thirty-two individuals had teeth present for observation. Linear enamel hypoplasia (LEH) was found on seven individuals (7/32, 22%). Of those with LEH, 57% (4/7) of affected individuals were estimated to be female or probable female, 29% (2/7) were estimated to be male or probable male, and one individual (14%) was subadult.

Table 3: Cribra Orbitalia and Porotic Hyperostosis by state of healing

State of lesion healing	Cribra Orbitalia	Porotic Hyperostosis	Total
Active	2	0	2
Healed	3	3	6
Active & Healed	1	2	3
Total	6	5	11

4.4: Indicators of Infectious Disease

Osteomyelitis was not observed in any of the 44 individuals analyzed for this project. However, periosteal reactions were abundant, being most common on the tibia, which is consistent with published literature (Ortner 2008; Roberts and Manchester 2005; White and Folkens 2005).

Thirty-four of 44 individuals were observable for periosteal reactions on the long bones. Seventeen out of 34 individuals (50%) were affected, one (6%), 11 (65%), and five (29%) had active, healed, and active/healed lesions, respectively (Table 4 & Figure 6). I estimated that six (35%) were males or probable males, nine (53%) were females or probable females, one (6%) individual was of indeterminate sex, and one (6%) subadult was unable to be sexed. Skeletal elements affected included 25 tibiae, 20 femora, two fibulae (one individual), two radii (one individual) and one subadult humerus. Table 5 below displays rates of periosteal reaction for the left and right femur and tibia. The number of elements affected also ranged from one to six, with the most common number of elements displaying periosteal reaction being three (Figure 7).

Table 4: Periosteal Reaction by state of healing at Mogou

Sex Estimation	Active Lesions	Healed Lesions	Active & Healed Lesions	Total
Male	0	4	2	6
Female	0	7	2	9
Indeterminate	0	0	1	1
Subadult	1	0	0	1
Total	1 (6%)	11 (65%)	5 (29%)	17

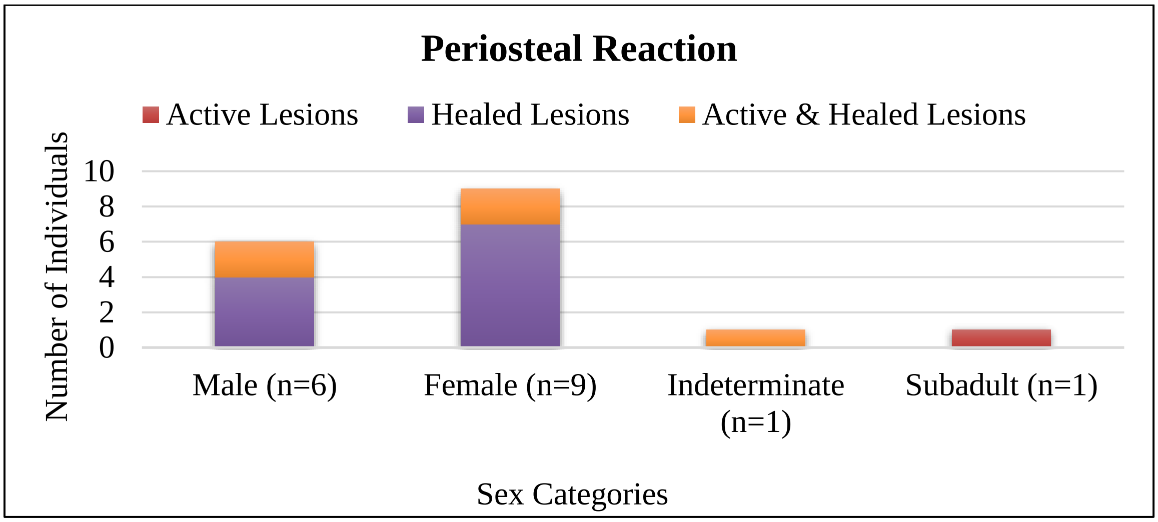

Figure 6: Periosteal reaction broken down by estimated sex and state of healing

Table 5: Periosteal reaction according to estimated sex on the femur and tibia

Sex Estimation	# of Femora with lesions		# of Tibiae with lesions	
	Left	Right	Left	Right
Male	5	4	4	5
Female	1	6	6	5
Indeterminate	1	1	1	1
Totals	7	11	11	11

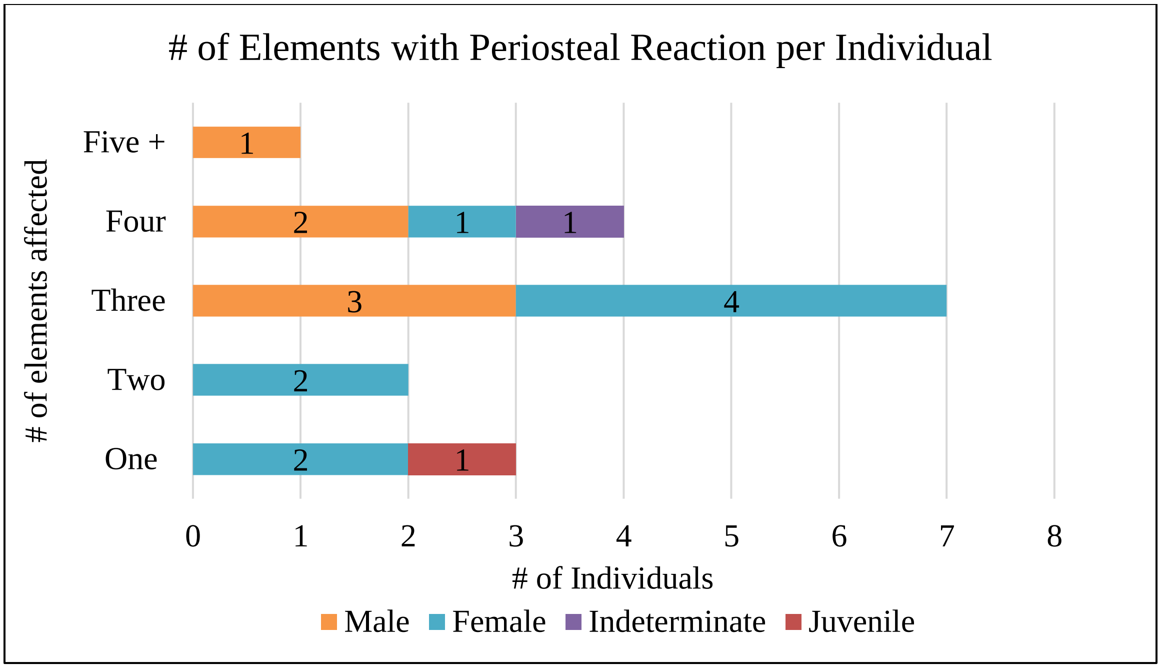

Figure 7: Number of elements with periosteal reaction per individual

4.5: Trauma

Trauma was observed on 11 out of 44 individuals, or 25%. Males/probable males accounted for 45% (5/11 individuals), females/probable females 45% (5/11 individuals), and one indeterminate individual was 9% (1/11 individuals) of the sample. All instances of trauma were antemortem and well healed. Axial trauma was observed on nine individuals, or 82% of the sample, while appendicular trauma was observed on four individuals, or 36% of the sample. Two individuals had both axial and appendicular trauma. Notably, one individual (M380 R4, Male, 21-25) displayed well healed blunt force trauma to the frontal (Figure A15), which is indicative of interpersonal violence (Martin *et al.* 2012). However, all other cases (10/11) of trauma were fractures of long bones/ribs or vertebral compression injuries, which were most likely accidental injuries.

Injuries to the axial skeleton included one individual with well healed blunt force trauma to the frontal, three individuals who each had one well healed rib fracture, and five individuals with compression fractures in the spine. These injuries represented 82% of the sample. Of the nine axial injuries observed, three (33%) were estimated to be male/probable male, five (56%) were estimated to be female/probable female, and one (11%) was estimated to be of indeterminate sex.

Appendicular trauma was observed on four individuals, or 36% of the sample, with fractures being observed on two radii, a glenoid fossa, and a patella. Two of these four individuals (50%) were estimated to be males/probable males, one (25%) was estimated as probable female, and one (25%) was indeterminate.

When excluding the individual estimated as indeterminate sex and combining males/probable males and females/probable females, the frequencies of trauma shift to axial (n=8): males—three of eight, or 37.5%, females—five of eight, or 62.5%; appendicular (n=3): males—two of three, or 67%, females—one of three, or 33%. Although this is a small sample size, similar numbers of males and females were observed for this population, therefore it would seem as though preliminary patterns of trauma location based on sex are present.

CHAPTER 5: DISCUSSION

The purpose of this project was to investigate whether or not the Qijia individuals buried at Mogou conform to the trend of emerging female inferiority to males observed in mortuary data across China during the Bronze Age. Specifically, I was interested in the possibility of differences in the frequency and severity of skeletal lesions based on sex, or the male/female dichotomy, that would indicate the burden of social inequalities. In this chapter I discuss the results of paleopathological and trauma analysis for this subsample and relate it to previously published literature.

5.1: Age and Sex Distribution

Individuals in this sample seem to display a normal mortality pattern where those at highest risk of dying were young children and young adults (White and Folkens 2005; Roberts and Manchester 2005). In this sample, infants and juveniles displayed rates of mortality that are most likely related to the demands of childhood growth and development (White and Folkens 2005; Roberts and Manchester 2005). Additionally, for the infants (n=7, 16% of population), weaning stress could be a factor of mortality (White and Folkens 2005; Roberts and Manchester 2005). Mortality related to normal stresses of childhood growth, development, and weaning are further supported by the lack of paleopathological indicators of stress for these individuals. Only one subadult, a fetus estimated to be ~36-40 weeks, displayed pathology indicative of stress in the form of periosteal reaction on the left humerus and appositional bone on the greater sphenoid wings (Figure A7). The lack of pathology on other subadults lends to the conclusion that they were not subjected to systemic stress, but rather acute assaults that resulted in quick death before lesion formation (Wood *et al.* 1992).

For the adults, middle adults were at highest risk of mortality, followed by young adults and old adults. There are no apparent differences in mortality between the sexes, with similar numbers of male and females falling into each age category (Table 2). For the overall sample (n=44) I estimated 14/44 individuals or 32% to be female/probable female, and 12/44 individuals or 27% to be male/probable male. Sex could not be estimated for 18/44 individuals (41%) due to age, i.e. subadults, or poor preservation. Similar numbers of males and females in this sample suggest an overall similar risk of mortality between the sexes at Mogou.

5.2: Childhood Indicators of Stress

Childhood indicators of physiological stress including cribra orbitalia (CO), porotic hyperostosis (PH), and linear enamel hypoplasia (LEH) were observed in this population. CO was observed on six individuals, with three individuals exhibiting healed lesions, two having active lesions, and one individual having both active and healed lesions. Four of the individuals affected were juvenile, which is typical for CO as it is a lesion only formed in childhood (White and Folkens 2005; Roberts and Manchester 2005). One adult probable male, 21-25 years old had active and healed lesions and one probable female, 30-50 years old had healed lesions. There is not a statistical significant difference for CO between males and females (Fisher exact test p = 0.90958).

Since CO is a skeletal indicator of childhood stress that can only be created in subadult individuals, its identification as active lesions in adults is rare. While the identified lesions could have resulted from taphonomic changes, it is also possible that the impacted young adult male (21-25 yrs) had unremodeled lesions from childhood that were possibly unable to heal due to some form of other stress, indicating overall poor health and increased frailty. Notably, this individual had well healed blunt force trauma to the frontal. This injury could have taken priority over CO remodeling.

Interestingly, the individuals who displayed active lesions were all from the same tomb. It has been previously suggested that the burials at Mogou are familial units due to the high levels of disorganized skeletal remains that are associated with secondary interments, which was determined to often be the addition of juvenile skeletons to a pit (Qian *et al.* 2009). If this theory holds true, it could be postulated that this tomb represents a particularly stressed family. However, further analysis and DNA testing would need to be performed to confirm such a theory.

Porotic hyperostosis was observed on five individuals, three males (two healed, one active/healed), one female (healed lesions), and one juvenile (active/healed). The differences between sex with regards to PH are not significant (Fisher exact test p = 0.3061). Only one individual (1015 R1, juvenile) displayed both CO and PH. Linear enamel hypoplasia was observed on seven individuals total, with four females, two males, and one subadult being affected. There was not a significant difference between males and females (Fishers exact test p = .6522). Overall, the rates of CO, PH, and LEH within this sample seem to indicate that both males and females were subjected to and able to recover from childhood health assaults.

Similar frequencies of childhood indicators of stress have been found in Northern China and Mongolia (Eng 2007; Karstens *et al.* 2018). Eng (2007) conducted a study comparing frequencies of health or diet related paleopathological markers in nomadic pastoralists, agropastoralists, and agriculturalists throughout the Neolithic and Bronze Age periods in north-west, north-central, and north-eastern China. She discovered that

North-western groups displayed lower frequencies of paleopathological markers than other regions of China. Additionally, agropastoralists displayed lower frequencies of diet related pathology, possible due to their transitional nature between sedentary agriculture and nomadic pastoralism. Therefore, it is possible that the increasing agropastoralism practiced by Qijia groups buffered the population from health assaults, as Qijia groups are known to have practiced millet farming along with pig and cattle husbandry, sheep/goat herding, which was supplemented by hunting (Berger 2017; Jia *et al.* 2012).

5.3: Indicators of Infectious Disease

Periosteal reactions were the most observed pathology in this study. They were found on 39%, or 17/44 individuals. The range of elements affected include 25 tibiae, 20 femora, two fibulae (one individual), two radii (one individual) and one subadult humerus (Figure A7). The wide range of elements affected in this population is important because periosteal reactions observed not only on the tibia but also other long bones is highly indicative of systemic infection. Since they are most common on the tibia, an area easily and commonly injured, it has been suggested that minor and/or recurrent injuries can produce these reactions (Roberts & Manchester 2007; White & Folkens 2005). While these reactions can be caused by seemingly minor injuries, most individuals in this sample had more than one element affected. In fact, one individual had a total of six long bones with periosteal reaction, with the most common number of elements affected being three. The fact that reactions were often observed bilaterally or on more than one element would lend more support towards infection rather than simple injury.

For this sample, periosteal reactions were slightly more common for females (64%, 9/14) than males (50%, 6/12). However, this difference is not statistically significant (Fishers exact test p = 0.6922). The majority of lesions were healed (65%) and only one individual displayed solely active lesions. Since inflammation of the periosteum takes time to produce reactions on the bone, healed lesions suggest that these individuals were able to endure these periods of infection and subsequently recover from health assaults (Wood *et al.* 1992). Therefore, those individuals who survived childhood insults were most likely less frail.

5.4: Trauma

Trauma was observed on 11 out of 44 individuals, or 25% of the sample. All instances of trauma were antemortem and well healed. Overall, five males (5/12), five females (5/14), and one indeterminate individual were affected. There is not a statistically significant relationship between the number of males and females who display trauma (Fishers exact test p = 1). However, there does seem to be an interesting, albeit preliminary and not statistically significant, pattern in trauma distribution where females have primarily axial injuries while males have primarily appendicular injuries.

When excluding the individual estimated as indeterminate sex (for the rest of this section) and combining males/probable males and females/probable females, the frequencies of trauma are males (n=12): axial 3/12 or 25%, appendicular 2/12 or 24%; females (n=14): axial 5/14 or 36%, appendicular 1/14 or 7%. As mentioned above, this pattern is not statistically significant (Fisher exact test p = 0.5455), but it could speak to differential roles in society.

Axial injuries observed in this population include one blunt force injury to the frontal bone, three well healed rib fractures, and four healed or healing compression fractures in the thoracic and lumbar spine. Rib fractures are some of the most frequently observed fractures in the archaeological record and have been linked with numerous causes, including accidental injuries associated with occupational activities, as well as intentional, directed violence (Brickley 2006; Lovell 1997; Roberts and Manchester 2005). Physical causes of rib fractures can be blunt force trauma, falls, and even severe coughing or sneezing (Lovell 1997; Roberts and Manchester 2005).

Vertebral compression fractures are often found in the archaeological record and are most common in the lumbar and thoracic spine, although they can occur in the cervical as well (Roberts and Manchester 2005). Compression fractures have numerous etiologies. For example, they can occur from vertical force (such as jumping from a significant height onto the feet). In older individuals osteoporosis can lead to weakening of the bones and result in compression fractures, even from moderately intensive activities. Importantly, post-menopausal women are at an increased risk of sustaining compression fractures due to decrease in bone mass (Curate *et al.* 2016).

In this sample, there were five females out of 14 displaying axial trauma. Individual M1388 R2 (40-50 yrs) (Figure A8 and A9) and M1597 (26-32 yrs) had well healed fractures on the right 11^{th} and right 5^{th} ribs, respectively. Individuals M1412 R1 (30-50 yrs) and M1488 R3 (21-24 yrs) displayed compression fractures in the lumbar spine, while M367 R7 (59-75 yrs) had compression injuries to the upper thoracic region. Given the mixed etiologies of compression factures and the older age distribution of those affected, it would seem plausible to suggest that both age and activities could be the cause of this form of injury in this sample.

Appendicular trauma was less common than axial injuries; four individuals had well healed fractures. One male individual aged 20-25 yrs had a well healed fracture on the right distal radius that was misaligned with latero-distal displacement of the posterior shaft (Figure A16), while an older, 33-45 year old, indeterminately sexed individual had a well healed fracture to the left radius. Another male, estimated to be 17-18 years of age displayed a healed fracture to the right lateral patellar articular surface. This could have been the result of an accidental fall or intentional injury (Lovell 1997; Redfern 2017). The one female individual that had appendicular trauma was 59-75 years old with a healed fracture on the right glenoid fossa. This individual also had compression fractures in the upper thoracic region. These fractures were most likely accidental and related to activities, rather than some form of interpersonal trauma (Lovell 1997).

Most of the fractures observed in this sample seem to be from accidental injury related to daily living. Only one male individual estimated to be 21-25 years old displayed trauma indicative of interpersonal violence—healed antemortem blunt force to the frontal (Figure A15). The distribution patterns of accidental fractures, axial injuries more often found in females, appendicular injuries found in males, and only one instance of violent trauma could indicate that overall males and females may have been participating in differential activities in their day to day lives, but that violence, or intentional injury, was rare.

5.5: Sex-based Differences

Since paleopathology is a moderately new avenue of research in China, most studies of inequality fall on mortuary practice. This involves the analysis of burial treatment and associations of grave goods. Sun & Yang (2004) demonstrate that during the transitional period from the Majiayao to Qijia cultures/periods there is clear evidence of differential treatment of males and females but that these treatment patterns varied regionally. With regards to gender and tools, Sun & Yang (2004) found that spindle whorls were associated with female burials, while stone chisels, adzes, axes, and knives were found in male burials. The distribution of tools was statistically significant in the Qijia populations, indicating an increasing presence of engendered identities where males were associated with agriculture and females with craft activities. Furthermore, analysis of burial treatment alludes to a patriarchal dominance in Qijia societies. As described previously in Chapter 2, burial treatment of males and females differed, with females being placed in subordinate positions relative to males (Sun & Yang 2004). Similar burial treatment has been observed at Mogou.

Burial descriptions provided by the Gansu Provincial Institute of Cultural Relics and Archaeology (GPICRA) and the Research Center for Cultural Heritage and Archaeology, Northwest University (NWARC) demonstrate that differential burial treatment between males and females were occurring at Mogou. They document multiple instances where women were placed in a flexed position on their side, oriented to be facing a male individual (GPICRA and NWARC 2010; Qian *et al.* 2009). For example, Tomb M208 contained an adult female buried on the side in a flexed position facing a male individual. Additionally, human skeletal remains have been found in the grave shafts of some tombs, along with animal bones used in sacrificial activities. The positioning of individuals in the shaft area may be indicative of human sacrifice; however, more evidence and analysis are needed to make this statement. Therefore, the mortuary treatment of females observed indicate that Qijia individuals at Mogou may have held social and ideological values that would have resulted in preferential treatment towards male individuals.

Although there is evidence of the emergence of sex-based inequality in Northwest China during the Bronze Age, the population presented here does not seem to follow this trend. I propose that, based on this subsample (n=44), the individuals at Mogou were not subjected to sex-based inequality to a degree that resulted in differences in skeletal lesions. This study contributes an important line of evidence—the physically embodied experience of individuals and groups (females, males)—to contribute to the investigation of differential treatment between males and females in the larger context of Bronze Age China.

CHAPTER 6: CONCLUSIONS

Overall, the individuals presented in this study display skeletal indicators of stress and disease that were in a state of healing, with few individuals displaying solely active lesions. This can indicate that 1) Qijia individuals at Mogou were sustaining and recovering from health assaults successfully, or 2) this population was frail and died before skeletal lesions could form. Based on the frequency and distribution of skeletal indicators analyzed, especially periosteal reaction, I favor the former explanation—individuals at Mogou were experiencing and recovering from stress episodes.

Within Northwest China, and across China as whole, there is evidence of females being treated as inferior to males, mainly evidenced by mortuary ritual. However, my results show no significant differences between the sexes in relation to skeletal lesions and trauma analysis. As stated above, the human body does not exist in a vacuum, but rather records our experiences as we traverse through life. Therefore, paleopathological analysis of human skeletal remains has the opportunity to provide a more robust understanding of the differential lived experience of individuals in relation to social inequalities and sex-based hierarchies. Although the individuals in this study do not demonstrate statistically significant levels of difference with regards to pathology and trauma, it is important to keep in mind that inequality is experienced individualistically and comes in many shapes and sizes that are not always identifiable on the human skeleton. Additionally, the research I have presented here is only a small proportion of the overall 4000+ individuals excavated from Mogou. As more bioarchaeological/paleopathological analyses are conducted and more data is compiled, clearer trends may emerge.

REFERENCES

Armelagos, George J, Alan H. Goodman, Kristin N. Harper, and Michael L. Blakey. "Enamel Hypoplasia and Early Mortality: Bioarcheological Support for the Barker Hypothesis." *Evolutionary Anthropology: Issues, News, and Reviews*, vol. 18, no. 6, 2009, pp. 261-271.

Atahan, Pia., *et al*. “Temporal trends in millet consumption in northern China.” *Journal of Archaeological Science*, vol. 50, 2014, pp. 171-177.

Berger, Elizabeth and Hui Wang. “Bioarchaeology of adaptation to a marginal environment in bronze age Western China.” *American Journal of Human Biology*, vol. 29, 2017, pp. 1-10.

Berger, Elizabeth. “Bioarchaeology of Adaptation to Climate Change in Ancient Northwest China.” PhD Dissertation. The University of North Carolina at Chapel Hill, Department of Anthropology, *ProQuest Dissertations & Theses Global*, 2017.

Blau, Soren. "How Traumatic: a Review of the Role of the Forensic Anthropologist in the Examination and Interpretation of Skeletal Trauma." *Australian Journal of Forensic Sciences*, vol. 49, no. 3, 2017, pp. 261-280.

Brickley, Megan. "Rib fractures in the archaeological record: a useful source of sociocultural information?" *International Journal of Osteoarchaeology*, vol. 16, no. 1, 2006, pp. 61-75.

Brooks, Sheilagh, and Judy M. Suchey. "Skeletal age determination based on the os pubis: a comparison of the Acsádi-Nemeskéri and Suchey-Brooks methods." *Human evolution* 5.3 (1990): 227-238.

Buckberry, Joanne L., and Andrew T. Chamberlain. "Age estimation from the auricular surface of the ilium: a revised method." *American Journal of Physical Anthropology: The Official Publication of the American Association of Physical Anthropologists* 119.3 (2002): 231-239.

Buikstra, J. E. and Ubelaker, D. H. *Standards for data collection from human skeletal remains*. Fayetteville, AK: Arkansas Archaeological Survey, 1994.

Byers, Steven N. *Introduction to Forensic Anthropology*. Pearson, 2011.

Cohen, Haim, Chen Kugel, Hila May, Bahaa Medlej, Dan Stein, Viviane Slon, Israel Hershkovitz, and Tamar Brosh. "The Impact Velocity and Bone Fracture Pattern: Forensic Perspective." *Forensic Science International*. 266 (2016): 54-62.

Croquant. “Location of Lintan within Gansu China.” September 2007. https://en.wikipedia.org/wiki/File:Location_of_Lintan_within_Gansu_(China).png

Curate, F., T. F. Silva, and E. Cunha. "Vertebral compression fractures: towards a standard scoring methodology in paleopathology." *International Journal of Osteoarchaeology*, vol. 26, no.2, 2016, pp. 366-372.

Daegling, David J, Michael W. Warren, Jennifer L. Hotzman, and Casey J. Self. "Structural Analysis of Human Rib Fracture and Implications for Forensic Interpretation*." *Journal of Forensic Sciences*, vol. 53, no.6, 2008, pp. 1301-1307.

Delabarde, Tania, and Bertrand Ludes. "Missing in Amazonian Jungle: a Case Report of Skeletal Evidence for Dismemberment*." *Journal of Forensic Sciences*, vol. 55, no. 4, 2010, pp. 1105-1110.

De la Cova, Carlina. "Patterns of trauma and violence in 19th-century-born African American and Euro-American females." *International Journal of Paleopathology*, vol. 2.2, no. 3, 2012, pp. 61-68.

Dewitte, Sharon N. “Differential Survival among Individuals with Active and Healed Periosteal New Bone Formation.” *International Journal of Paleopathology*, vol. 7, 2014, pp. 38-44.

DeWitte, Sharon N., and Christopher M. Stojanowski. "The osteological paradox 20 years later: past perspectives, future directions." *Journal of Archaeological Research* 23.4 (2015): 397-450.

Di Cosmo N. 2002. Ancient China and Its Enemies: The Rise of Nomadic Power in East Asian History. Cambridge: Cambridge University Press.

Dong, Guang-Hui, Zong-Li Wang, Le-Le Ren, Giedre Motuzaite Matuzeviciute, Hui Wang, Xiaoyan Ren, and Fahu Chen. “A Comparative Study of ^{14}C Dating on Charcoal and Charred Seeds from Late Neolithic and Bronze Age Sites in Gansu and Qinghai Provinces, NW China.” *Radiocarbon*, vol. 56, no. 1, 2014, pp. 157-163.

Dong, Yu, Chelsea Morgan, Yurii Chinenov, Ligang Zhou, Wenquan Fan, Xiaolin Ma, and Kate Pechenkina. “Shifting Diets and the Rise of Male-Biased Inequality on the Central Plains of China During Eastern Zhou.” *Proceedings of the National Academy of Sciences of the United States of America*, vol. 114, no. 5, 2017, pp. 932-937.

Dong, G., Jia, X., Elston, R., Chen, F., Li, S., Wang, L., ... & An, C. "Spatial and temporal variety of prehistoric human settlement and its influencing factors in the upper Yellow River valley, Qinghai Province, China." *Journal of Archaeological Science* 40.5 (2013): 2538-2546.

Eng J. *Nomadic Pastoralists and the Chinese Empire: A Bioarchaeological Study of China's Northern Frontier.* University of California, Santa Barbara, 2007.

Eng, Jacqueline T. "A Bioarchaeological Study of Osteoarthritis Among Populations of Northern China and Mongolia During the Bronze Age to Iron Age Transition to Nomadic Pastoralism." *Quaternary International*, vol. 405, 2016, pp. 172-185.

Fitzgerald-Huber, Louisa G. "Qijia and Erlitou: The question of contacts with distant cultures." *Early China*, vol. 20, 1995, pp. 17-67.

Flad R, Li S, Wu X, and Zhao Z. Early wheat in China: Results from new studies at Donghuishan in the Hexi Corridor. The Holocene, vol. 20, no. 6, 2010, pp. 955-965.

Gansu Provincial Institute Of Cultural Relics And Archaeology And Research Center For Cultural Heritage And Archaeology. "The Qijia Culture Cemetery at Mogou in Lintan, Gansu." *Chinese Archaeology*, vol. 10, no. 1, 2010, pp. 15-23.

Gaither, C. M., & Murphy, M. S. "Consequences of conquest? The analysis and interpretation of subadult trauma at Puruchuco-Huaquerones, Peru.' *Journal of Archaeological Science*, vol. 39, no. 2, 2012, pp. 467-478.

Geber, J. (2014). "Skeletal manifestations of stress in child victims of the Great Irish Famine (1845–1852): Prevalence of enamel hypoplasia, Harris lines, and growth retardation." *American Journal of Physical Anthropology*, 155(1), 149-161.

Geller, P. "The Bioarchaeology of Socio-Sexual Lives." Springer: Switzerland, 2017.

Goodman, Alan H, and Jerome C. Rose. "Assessment of Systemic Physiological Perturbations from Dental Enamel Hypoplasias and Associated Histological Structures." *American Journal of Physical Anthropology*, Vol. 33, no. 11, 1990, pp. 59-110.

---"Dental Enamel Hypoplasias as Indicators of Nutritional Status." *Advances in Dental Anthropology*, 1991, pp. 279-293.

Grauer, Anne L. "A Companion to Paleopathology." Chichester, West Sussex : Wiley-Blackwell, 2016.

Hart, Gina O. "Fracture Pattern Interpretation in the Skull: Differentiating Blunt Force from Ballistics Trauma Using Concentric Fractures." *Journal of Forensic Sciences*, vol. 50, no. 6, 2005, pp. 1276-81.

Hillson, Simon. *Dental Pathology*. In *Biological Anthropology of the Human Skeleton.* Edited by M. Anne Katzenberg and Shelley R. Saunders, John Wiley & Sons, Inc., 2008.

Hollimon, S. E. *Sex and gender in bioarchaeological research*. Social bioarchaeology, 2011, pp. 149-182.

Humphrey, Caitlin, Jaliya Kumaratilake, and Maciej Henneberg. "Characteristics of Bone Injuries Resulting from Knife Wounds Incised with Different Forces." *Journal of Forensic Sciences*, vol. 62, no. 6, 2017, pp. 1445-1451.

Işcan, Mehmet Yaşar. "The aging process in the rib: An analysis of sex-and race-related morphological variation." *American journal of human biology* 3.6 (1991): 617-623.

Jaang, Li. "The Landscape of China's Participation in the Bronze Age Eurasian Network." *Journal of World Prehistory*, vol. 28, no. 3, 2015, pp. 179-213.

Jia X, Chen F, Zhang K, Ma M, Wang H, An C, Li H, Brunson K, and Dong G. The development of agriculture and its impact on cultural expansion during the late Neolithic in the Western Loess Plateau, China. The Holocene. Vol. 23, no. 1, 2013, pp.85-92.

Jia, Xin, Guanghui Dong, Hu Li, Katherine Brunson, FaHu Chen, Minmin Ma, Hui Wang, Chengbang An, and Keren Zhang. "The Development of Agriculture and Its Impact on Cultural Expansion During the Late Neolithic in the Western Loess Plateau, China." *The Holocene,* vol. 23, no. 1, 2012, pp. 85-92.

Karstens, S., Littleton, J., Frohlich, B., Amgaluntugs, T., Pearlstein, K., & Hunt, D. "A palaeopathological analysis of skeletal remains from Bronze Age Mongolia." *HOMO*, vol. *69*, no. 6, 2018, pp. 324-334.

Klales, Alexandra R., Stephen D. Ousley, and Jennifer M. Vollner. "A revised method of sexing the human innominate using Phenice's nonmetric traits and statistical methods." *American journal of physical anthropology*, vol. 149, no. 1, 2012, pp. 104-114.

Klaus, Haagen D. "Frontiers in the Bioarchaeology of Stress and Disease: Cross-disciplinary Perspectives from Pathophysiology, Human Biology, and Epidemiology." *American Journal of Physical Anthropology*, vol. 155, no. 2, 2014, pp. 294-308.

Langley-Shirley, Natalie, and Richard L. Jantz. "A Bayesian approach to age estimation in modern Americans from the clavicle." *Journal of forensic sciences* 55.3 (2010): 571-583.

Larsen, Clark S. "Bioarchaeology: the Lives and Lifestyles of Past People." *Journal of Archaeological Research*, vol. 10, no. 2, 2002, pp. 119-166.

Lewis, M. E. *The bioarchaeology of children: perspectives from biological and forensic anthropology*. Vol. 50, 2007, Cambridge University Press.

Li, Mingqi, *et al*. “Starch Grains Analysis of Stone Knives from Changning Site, Qinghai Province, Northwest China.” *Journal of Archaeological Science*, vol. 40, no. 4, 2013, pp. 1667-1672.

Li, MingQi, Yang XiaoYan, Wang Hui, Wang Qiang, Jia Xin, and GE QuanSheng. “Starch Grains from Dental Calculus Reveal Ancient Plant Foodstuffs at Chenqimogou Site, Gansu Province.” *Science China Earth Sciences*, vol. 53, no. 5, 2010, pp. 694-699.

Linduff, Katheryn M. "The emergence and demise of bronze-producing cultures outside the Central Plain of China." *The Bronze Age and early Iron Age peoples of eastern central Asia*, vol. 2, 1998, pg. 619-644.

Linduff, Katheryn M., and Yan Sun, eds. *Gender and Chinese archaeology*. Rowman Altamira, 2004.

Liu, Fenggui, and Zhaodong Feng. "A dramatic climatic transition at~ 4000 cal. yr BP and its cultural responses in Chinese cultural domains." *The Holocene* 22.10, 2012, pp. 1181-1197.

Liu, Li., and Xingcan Chen. *The Archaeology of China: from the Late Paleolithic to the Early Bronze Age*. Cambridge: Cambridge University Press, 2012.

Liu, W, Q.C. Zhang, X.J. Wu, and H. Zhu. “Tooth Wear and Dental Pathology of the Bronze–Iron Age People in Xinjiang, Northwest China: Implications for Their Diet and Lifestyle.” *Journal of Comparative Human Biology*, vol. 61, no. 2, 2010, pp. 102-116.

Liu, Xinyi *et al*. “From Necessity to Choice: Dietary Revolutions in West China in the Second Millennium BC.” World Archaeology, vol. 46, no. 5, 2014, pp. 661-680.

Love, Jennifer C, and Steve A. Symes. "Understanding Rib Fracture Patterns: Incomplete and Buckle Fractures." *Journal of Forensic Sciences*, vol. 49, no. 6, 2004, pp. 1153-8.

Lovejoy, C. Owen, *et al*. "Chronological metamorphosis of the auricular surface of the ilium: a new method for the determination of adult skeletal age at death." *American Journal of Physical Anthropology*, vol. 68, no. 1, 1985, pp. 15-28.

Lovell, Nancy C. "Trauma Analysis in Paleopathology." *American Journal of Physical Anthropology*, vol. 104, 1997, pp. 139-170.

Mao, Ruilin. Personal communication. Summer 2018.

Ma, Minmin *et al*. “Dietary Shift after 3600 Cal Yr BP and Its Influencing Factors in Northwestern China: Evidence from Stable Isotopes.” *Quaternary Science Reviews*, vol. 145, 2016, pp. 57-70.

Ma, M. *et al*. “Stable Isotope Analysis of Human and Animal Remains at the Qijiaping Site in Middle Gansu, China.” *International Journal of Osteoarchaeology*, vol. 25, no. 6, 2015, pp. 923-934.

Ma, M. M. *et al*. “Stable Isotope Analysis of Human and Faunal Remains in the Western Loess Plateau, Approximately 2000 Cal Bc.” *Archaeometry*, vol. 56, 2014, pp. 237-255.

Martin, Debra L., and Ryan P. Harrod. *The bioarchaeology of violence*. University Press of Florida, 2012.

Martin, Debra L., Ryan P. Harrod, and Ventura R. Pérez. 2012. Introduction: Bioarchaeology and the study of violence. In *The Bioarchaeology of Violence*, edited by Debra L. Martin, Ryan P. Harrod, and Ventura R. Pérez. University Press of Florida, Gainesville, pp. 1–10.

Mays, S. “The Bioarchaeology of the Homicide of Children.” In *Tracing Childhood: Bioarchaeological Investigations of Early Lives in Antiquity*. (eds. Thompson, J. L., Alfonso-Durruty, M. P. & Crandall, J. J.) Gainesville: University Press of Florida, 2014.

Mei, Jianjun. “Early Metallurgy and Socio-Cultural Complexity: Archaeological Discoveries in Northwest China.” In Outram, Alan, Hanks; Linduff, Bryan K, and Katheryn M. *Social Complexity in Prehistoric Eurasia: Monuments, Metals, and Mobility*. Cambridge Archaeological Journal, 2010, pp. 467–468.

Meindl RS, and Lovejoy CO. 1985. Ectocranial suture closure: A revised method for the determination of skeletal age at death based on the lateral-anterior sutures. American Journal of Physical Anthropology 65:57-66.

Meskell, L. “Archaeologies of Identity.” In *Archaeological Theory Today. (Ed. Hodder, Ian)*. Cambridge, UK: Polity Press, 2001.

Molleson, Theya. “A method for the study of activity related skeletal morphologies.” *Bioarchaeology of the Near East*, vol. 1, 2007, pp.5-33.

Neitzel, Jill E. "Gender hierarchies: A comparative analysis of mortuary data." *Women and men in the Prehispanic Southwest,* 2000, pp. 137-68.

Ortner, Donald J. *Identification of Pathological Conditions In Human Skeletal Remains*. Elsevier Science (USA), 2003.

Ortner, Donald J. *Differential Diagnosis of Skeletal Lesions in Infectious Disease*. In *Advances in Human Palaeopathology.* Edited by Ron Pinhasi and Simon Mays, John Wiley & Sons, LTD, 2008.

Ortner, Donald J. “Human Skeletal Paleopathology.” *International Journal of Paleopathology*, vol. 1, no. 1, 2011, pp. 4-11.

Ortner, Sherry B. *Making gender: The politics and erotics of culture*. Beacon Press, 1996.

Pechenkina, Kate. “From morphometrics to holistics: The emergence of paleopathology in China.” In Jane E. Buikstra & Charlotte Roberts (Eds.), *The global history of paleopathology: Pioneers and prospects*, pp. 345-360, 2012. Oxford: Oxford University Press.

Qian, Yaopeng *et al*. “A Brief Discussion on Joint Burial in Mogou Cemetery of Qijia Culture.” *Chinese Archaeology*, vol. 10, no.1, 2010, pp. 158-163.

Reber, Samantha L, and Tal Simmons. "Interpreting Injury Mechanisms of Blunt Force Trauma from Butterfly Fracture Formation." *Journal of Forensic Sciences*, vol. 60, no. 6, 2015, pp. 1401-1411.

Redfern, R. C. (2017). Identifying and interpreting domestic violence in archaeological human remains: a critical review of the evidence. *International Journal of Osteoarchaeology*, *27*(1), 13-34.

Reitsema, Laurie J, and Britney K. McIlvaine. "Reconciling “stress” and “health” in Physical Anthropology: What Can Bioarchaeologists Learn from the Other Subdisciplines?" *American Journal of Physical Anthropology*, vol. 155, no. 2, 2014, pp. 181-185.

Roberts, Charlotte A., and Keith Manchester. *The Archaeology of Disease*. 3rd ed. Ithaca, N.Y.: Cornell University Press, 2005.

Shelach, Gideon. *Prehistoric Societies on the Northern Frontiers of China: Archaeological Perspectives on Identity Formation and Economic Change during the First Millennium BCE*. Equinox Publishing Ltd, 2009.

---"The Earliest Neolithic Cultures of Northeast China: Recent Discoveries and New Perspectives on the Beginning of Agriculture." *Journal of World Prehistory*, vol. 14, no. 4, 2000, pp. 363-413.

Shelach-Lavi, Gideon. *The Archaeology of Early China: From Prehistory to the Han Dynasty*. Cambridge University Press, 2015.

Sofaer, Joanna R. *The body as material culture: a theoretical osteoarchaeology*. Vol. 4. Cambridge University Press, 2006.

Sørensen, Marie Louise Stig. *Gender archaeology*. John Wiley & Sons, 2013.

Sørensen, Marie Louise Stig. "Gender archaeology and Scandinavian Bronze age studies." *Norwegian Archaeological Review* 25.1 (1992): 31-49.

Steinbock, Ted. *Paleopathological Diagnosis and Interpretation: Bone diseases in ancient human populations.”* Charles C Thomas, 1976.

Stone, Pamela K. "Binding women: Ethnology, skeletal deformations, and violence against women." *International Journal of Paleopathology,* vol. 2.2, no. 3, 2012, pp. 53-60.

Sun, Yan., and Yang, Hongyu. *Gender Ideology and Mortuary Practice in Northwestern China*. In Linduff, Katheryn M., and Yan Sun, eds. *Gender and Chinese archaeology*. Rowman Altamira, 2004.

Symes, Steve A, and Erin N. Chapman. *Knife and Saw Toolmark Analysis in Bone: A Manual Designed for the Examination of Criminal Mutilation and Dismemberment*. Erie, PA: Mercyhurst College, 2010.

Temple, Daniel H, and Alan H. Goodman. "Bioarcheology Has a “health” Problem: Conceptualizing “stress” and “health” in Bioarcheological Research." *American Journal of Physical Anthropology,* vol. 155, no. 2, 2014, pp. 186-191.

Thompson, J. L., Alfonso-Durruty, M. P. & Crandall, J. J. (2014). Tracing Childhood: Bioarchaeological Investigations of Early Lives in Antiquity. Gainesville: University Press of Florida.

Thorp, Robert L. *China in the Early Bronze Age : Shang Civilization*. Philadelphia: University of Pennsylvania Press, 2006.

Toyne, Marla. “A Childhood of Violence: A Bioarchaeological Comparison of Mass Death.” In *Children and Childhood in Bioarchaeology. (ed.* Beauchesne, Patrick, Agarwal, Sabrina C., and Larsen, Clark Spencer). Gainesville, FL: University Press of Florida, 2018.

Tung, T. “Violence Against Women; Differential treatment of local and foreign females in the heartland of the Wari Empire, Peru.” In Martin DL, Harrod RP, Perez VR (eds.), The Bioarchaeology of Violence: 180-200. University Press of Florida: Gainesville FL, 2012.

Walker, Phillip *et al.* “The Causes of Porotic Hyperostosis and Cribra Orbitalia: A Reappraisal of the Iron-Deficiency-Anemia Hypothesis.” *American Journal of Physical Anthropology*, vol. 139, 2009, pp. 109-125.

Weiss, Elizabeth. *Paleopathology in Perspective: Bone Health and Disease through Time*. Rowman & Littlefield, 2015.

White, Tim D, and Pieter A. Folkens. *The Human Bone Manual*. Amsterdam: Elsevier Academic, 2005.

Wood, James., George Milner, Henry Harpending, and Kenneth Weiss. “The Osteological Paradox: Problems of Inferring Prehistoric Health from Skeletal Samples.” *Current Anthropology*, vol. 33, no. 4, 1992, pp. 343-370.

Womack, Andrew, and Underhill, Anne. “Crafting Community: Exploring Identity and Interaction through Ceramics in Late Neolithic and Early Bronze Age Northwestern China.” ProQuest Dissertations Publishing, 2017.

Womack, Andrew, *et al.* "Mapping Qijiaping: New Work on the Type-Site of the Qijia Culture (2300-1500 B.c.) in Gansu Province, China." *Journal of Field Archaeology*, vol. 42, no. 6, 2017, pp. 488-502.

Xie, Duanju. (2002). *Ganqing diqu shiqian kaogu (Prehistoric Archaeology of Gansu and Qinghai)*. Beijing: Wenwu chubanshe.

Zhang, Hua, *et al.* “A Comparative Study of Oral Health in Three Late Bronze Age Populations with Different Subsistence Practices in North China.” *Quaternary International*, vol. 405, 2016, pp. 44-57.

Zhao, Hui *et al.* “New Evidence for the Catastrophic Demise of a Prehistoric Settlement (the Lajia Ruins) in the Guanting Basin, Upper Yellow River, NW China.” *Journal of Asian Earth Sciences*, vol. 146, 2017, pp. 134-141.

Zhao, Yongsheng. ‘A Research of the Human Skeletons of Mogou Graveyard, Lintan County, Gansu Province.” 2013.

APPENDIX: FIGURES

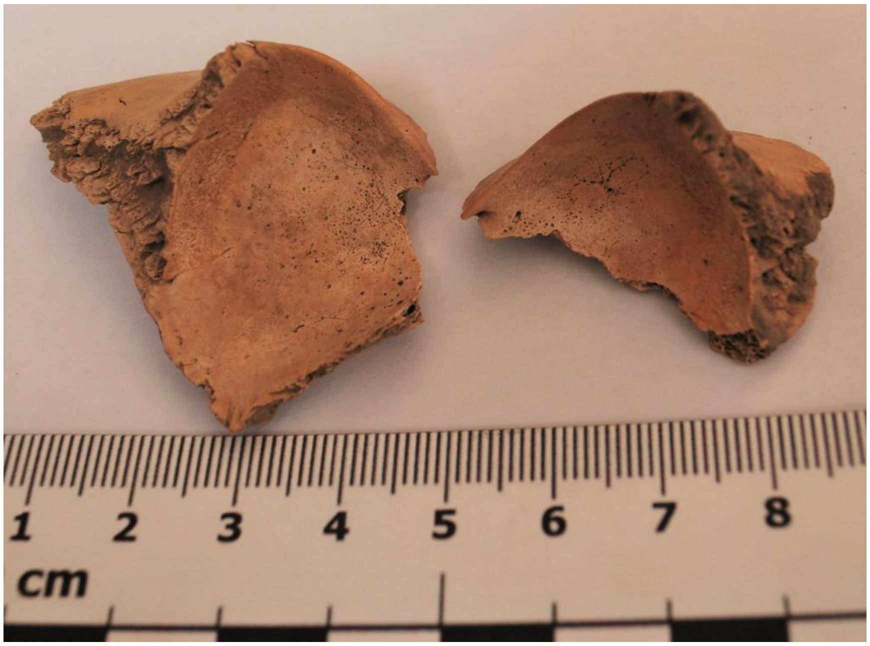

Figure A1: Infant (1-3 yrs), (M380 R9); Cribra Orbitalia

Figure A2: Probable Male, 22-32 yrs, (M604 R6); PH on Cranium

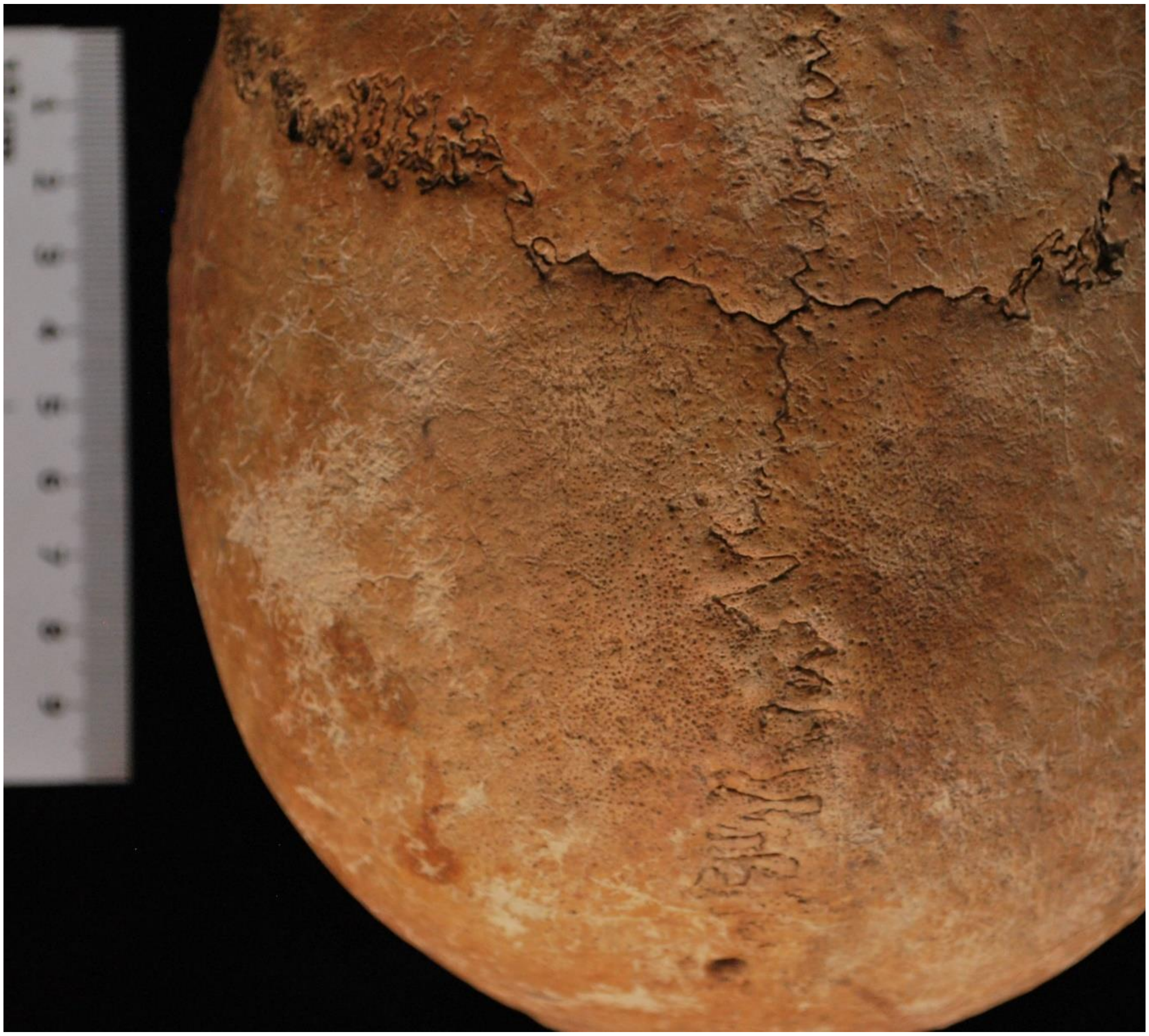

Figure A3: Probable Male, 22-32 yrs, (M604 R6); Close up of PH on Cranium

Figure A4: Probable Female, 59-75 years, (M367 R7); LEH

Figure A5: Periosteal Reaction, Male, 45-60 yrs, (M604 R5); A) lateral view - left tibia, B) left tibia lateral midshaft

Figure A6: Periosteal Reaction, Male, 45-60 yrs, (M604 R5); A) lateral view- right tibia, B) right tibia mid-distal shaft.

Figure A7: Fetus, 36-40 weeks, (M956 R4); A) apositional bone on greater sphenoid wings; B) periosteal reaction encompassing the left humerus.

Figure A8: Female, 40-50, (M1388 R2), Superior view of healed fracture to the right 11th rib

Figure A9: Female, 40-50, (M1388 R2), Anterior view of healed fracture on right 11th rib

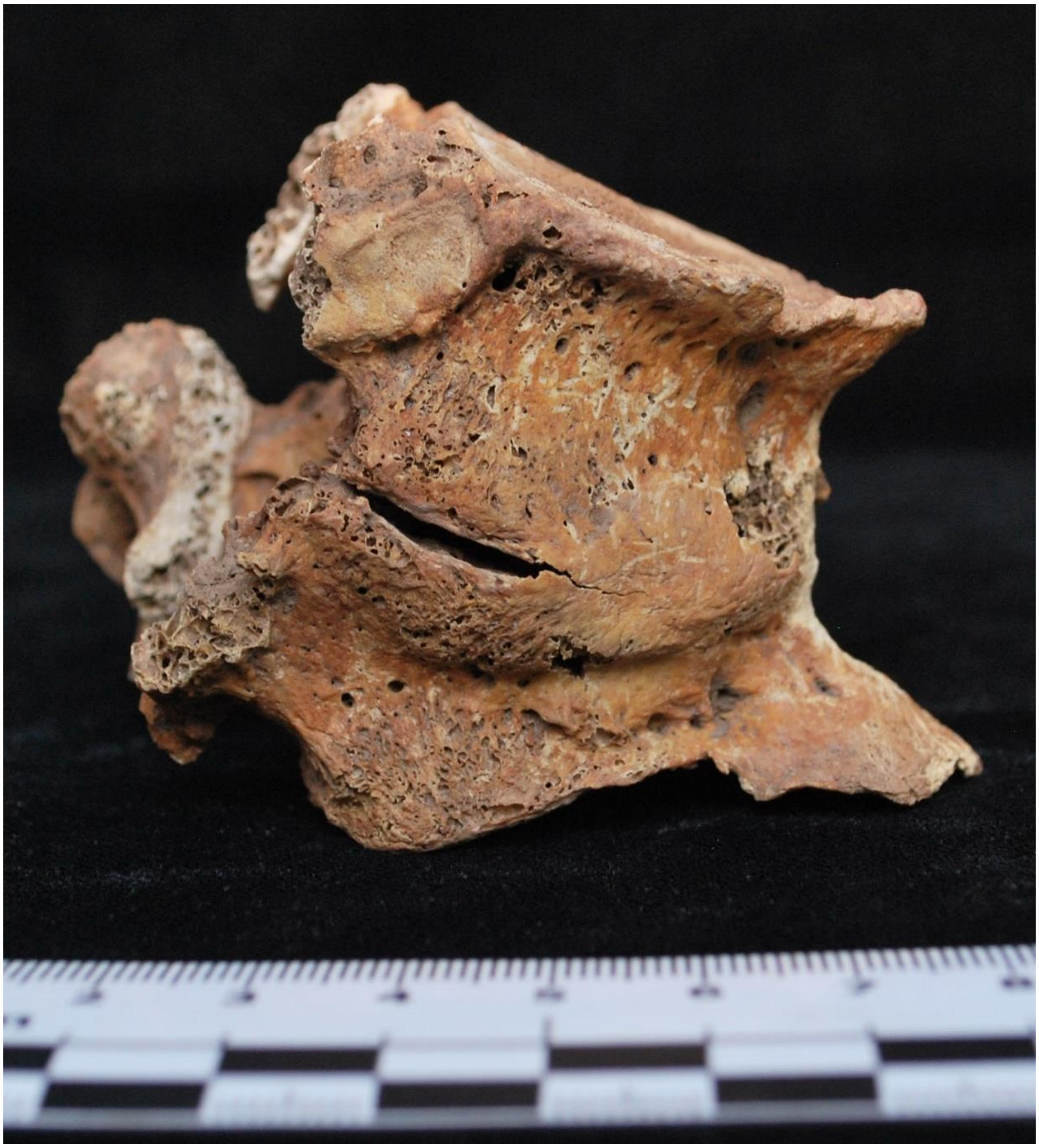

Figure A10: Male of indeterminate Age (M823), Ankylosis of T12 and L1

Figure A11: Male of indeterminate age (M823), compression fracture superior body of L1

Figure A12: Male of indeterminate age (M823), Compression fracture superior body of L2

Figure A13: Male of indeterminate age (M823), Compression fracture of superior body L4

Figure A14: Male of indeterminate age (M823), Left lateral view of T11, T12, L1, L2, L4, L5

Figure A15: Male, 21-25 years, M380 R4, Healed Blunt Force Trauma on the Frontal

Figure A16: Male, 20-25, (M1 R1); Fracture of the right distal radius- likely an oblique fracture, well healed, with laterodistal displacement of the posterior shaft. Secondary OA on distal articular surface. A) Anterior view right radius; B) posterior view right radius