IT'S IN OUR BONES; OSTEOARTHRITIS AND STRUCTURAL VIOLENCE OF THE WORKING CLASS

by

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ABSTRACT

BLUE MURILLO. It’s In Our Bones; Osteoarthritis and Structural Violence of the Working Class. (Under the direction of DR. SARA JUENGST)

There is still a divide between blue-collar and white-collar labor in the modern day. Blue-collar workers are those who tend to work in manufacturing, construction, or transportation (Kruyen & Sowa, 2023; Parietti, 2024). In comparison, white-collar workers tend to work in office environments, management, and administration (Mastracci, 2022; Parietti, 2024). The structural violence of workers manifests not only through socioeconomic status and occupational stressors but within their skeletal systems. Osteoarthritis is a progressive degenerative disease that frequently causes chronic pain. Joint stiffness and pain can become so severe that ordinary tasks become challenging. This study sought to find how structural violence manifests in differing labor practices as reflected by the incidence and prevalence of osteoarthritis. However, there is no safe space in either labor category when it comes to skeletal health as both labor forces show clear signs of osteoarthritis.

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DEDICATION

I dedicate this thesis to my cat, Smokey. She stood by me through all of my life accomplishments.

I hope she can see this one from the Rainbow Bridge.

2008-2024

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LIST OF ABBREVIATIONS

AL	Agribusiness and Low-Level
B.C.	Blue Collar
CMC	Carpometacarpal Joint
Eburn	Eburnation
FAC	Forensic Anthropology Center
InterPhalang	Interphalangeal Joint
KL	Kellgren-Lawrence Grading System
L.	Left
Lat	Lateral
Med	Medial
NIOSH	The National Institute for Occupational Safety and Health
OA	Osteoarthritis
PC	Pink-Collar
Pelvic Ace	Pelvic Acetabulum
Prox	Proximal
R.	Right
Trap	Trapezium

UTK	The University of Tennessee at Knoxville
W.C.	White Collar

CHAPTER 1: INTRODUCTION

While research on osteoarthritis is plentiful, there is little to no research on the embodied occupational differences between blue-collar and white-collar workers concerning osteoarthritis, and how their osteoarthritis varies in terms of location, severity, and onset. Blue-collar and white-collar are terms used to describe different types of labor and work environments. Southern and Kumar (2000) discuss a "class division" (p. 193) between the two common categories of labor. Class division, also known as social class stratification or socioeconomic stratification, refers to the hierarchical arrangement of individuals or groups within a society based on factors such as wealth, income, education, occupation, and social status. In class-divided societies, individuals are typically grouped into distinct social classes or strata, each with its own level of access to resources, opportunities, and privileges (Leo et al. 2016).

In the modern United States, jobs that typically involve manual labor and physical work, such as construction, manufacturing, and transportation, are often referred to as blue-collar (Kruyen & Sowa, 2023; Parietti, 2024). These jobs often require technical or vocational training and may not require a college degree (Parietti, 2024). Blue-collar workers are often paid hourly wages and may be unionized (Parietti, 2024). On the other hand, jobs referred to as white-collar are typically office-based and involve mental or administrative work, such as accounting, finance, and management (Mastracci, 2022; Parietti, 2024). These jobs typically require a college degree or higher education and often involve working with computers and technology. Blue and white-collar workers are often paid salary and may receive benefits such as health insurance, retirement plans, and paid time off. It is important to note that both types of work are essential to the economy and society.

Structural violence in lower-income, blue-collar workers can manifest in diverse ways beyond income, such as health inequities and a lack of affordable, reliable medical insurance. With a lack of time, resources, and funds to properly seek treatment throughout their lives, health problems can grow beyond the capabilities of modern medicine. Thus, there is a need to investigate how structural violence impacts bodies and health, particularly when considering different types of labor. These differing labor practices manifest in blue and white-collar workers through the incidence and prevalence of osteoarthritis, though the ways manifested may vary. This research will thus improve the understanding of how structural violence is embodied in labor workers of both forces, blue-collar and white-collar.

Using works such as Cunha (2006), Chen et al. (2017), and White and Folkens (2005), I investigated the location, onset, and severity of osteoarthritis in thirty individuals from the UTK Donated Skeletal Collection housed at University of Tennessee in Knoxville, Tennessee. The career histories of these donated individuals have been compared and documented along with the presence and complications of any osteoarthritis. Osteoarthritis was observed in the knee, hip, and wrist joints. I hypothesized that blue-collar workers would have more severe and profound knee and hip osteoarthritis, as compared to white collar workers, corresponding to the physical demands and social injustices that occur in their daily work. I argue that blue-collar workers experience social injustices due to a lack of available health insurance, income, sick leave, and the opportunity to maintain their health.

CHAPTER 2: STRUCTURAL VIOLENCE

Structural violence, a term coined by Galtung (1969), refers to embedded political and economic social arrangements that put people "in harm's way" (Farmer et al., 2006, p. 1686). Furthermore, it is a form of violence "exerted systematically – that is indirectly – by everyone who belongs to a certain social order" (Farmer, 2004, p. 307), meaning the social order, "rather than singular villains," maintain oppression "over time through inaccessibility woven into the fabric of society" (Moore and Kim, 2022, p. 206). Structural violence frequently takes the form of a social, economic, or even cultural barrier to a particular segment of the population (Alioto, 2020). Unlike direct violence, which is characterized by obvious forms of physical harm or injury inflicted upon an individual or group, structural violence is often subtle and indirect but can have profound consequences for people's health, well-being, and life chances. Structural violence is a complex phenomenon that can be difficult to address, but it is important for individuals and societies to recognize and work to dismantle the structures that perpetuate it.

The bones of individuals who endured systemic inequalities often exhibit signs of chronic stress, nutritional deficiencies, and physical trauma that reflect the hardships imposed by societal structures. Evidence of repetitive stress injuries from arduous labor (Cunha, 2006), skeletal markers of malnutrition or stunted growth due to limited access to resources (Himes, 1978), and untreated injuries revealing a lack of adequate healthcare access (Rodríguez-Martín, 2006) all speak to the enduring impact of structural violence on the physical bodies of individuals. By closely examining skeletal remains, bioarchaeologists can reveal the subtle but powerful testaments to the systemic injustices inscribed in the skeletons of individuals subjected to oppressive social structures.

2.1 Slow Violence:

"Slow violence" is a term coined by Rob Nixon (2011) to describe forms of violence, which can include structural violence, that occur gradually over time and are often overlooked or undervalued due to their subtle and incremental nature. While the concept of slow violence is typically used in the context of environmental degradation and social injustice, it can also be applied to certain chronic diseases like osteoarthritis. Osteoarthritis is characterized by the gradual breakdown of cartilage in the joints, leading to pain, stiffness, and reduced mobility. The slow violence aspect of osteoarthritis lies in its progressive nature, as the condition develops and worsens over an extended period (Chen et al. 2017). The effects of osteoarthritis can be insidious, with individuals experiencing a slow erosion of their quality of life. The pain and discomfort associated with the disease often emerge gradually, becoming more pronounced over time. This slow progression can lead to a loss of physical function and independence, impacting one's ability to engage in daily activities, work, and leisure pursuits (Chen et al, 2017). As a result, individuals may experience a diminished sense of well-being and an increased reliance on medical interventions, such as pain management and joint replacement surgeries (Mezey et al, 2022; Garrison et al, 2021).

Furthermore, the slow violence of osteoarthritis can also have broader social and economic implications. The chronic nature of the condition can lead to long-term healthcare costs, decreased productivity, and potential limitations in employment opportunities. The burden of managing osteoarthritis falls not only on individuals but also on healthcare systems and society as a whole, which may face challenges in providing adequate care and support for those affected (Brooks, 2002). The theory of slow violence can apply to workers through the nature of the jobs, such as prolonged exposure to harmful substances or dangerous working conditions, which can lead to long-term health problems. For example, workers in industries without proper safety measures may develop respiratory diseases due to inhalation of toxic fumes or suffer from chronic musculoskeletal disorders due to repetitive motions and inadequate ergonomic support. The effects may not be immediately visible but accumulate over time, resulting in chronic pain, disability, and decreased quality of life.

However, slow violence can also be applied to the economic exploitation faced by workers. Many low-wage jobs in these industries offer little job security, limited benefits, and inadequate compensation. The absence of adequate labor protections and the prevalence of precarious employment arrangements leave workers vulnerable to exploitation by employers (Siqueira et al, 2014). Workers may endure long hours without proper overtime compensation, lack access to healthcare or paid sick leave, and face difficulties in organizing or forming unions to protect their rights. Over time, these economic injustices perpetuate cycles of poverty and limit social mobility for workers and their families (Brooks, 2002). In summary, the concept of slow violence can be applied to osteoarthritis to highlight the gradual and often overlooked impacts of structural violence on workers. The progressive nature of the disease and its wide-ranging consequences demonstrate how slow violence can manifest in the context of chronic conditions.

2.2 Embodiment:

The term "embodiment" has been used in various disciplines, and its conceptualization has evolved. Scholars and thinkers across disciplines such as philosophy, anthropology, sociology, and psychology have contributed to shaping and elaborating on the idea of embodiment. In anthropology and sociology, scholars like Maurice Merleau-Ponty (Cromby, 2018), a French phenomenologist, and Pierre Bourdieu, a sociologist, were influential in exploring the relationship between the body and culture, laying some groundwork for the concept of embodiment (Lignier, 2018). Meanwhile, in feminist theory and cultural studies, thinkers such as Judith Butler (1988) have expanded on the notion of embodiment, particularly concerning gender and identity. The concept has continued to evolve through interdisciplinary dialogue, with contributions from various fields, making it challenging to attribute its coinage to a single person or moment.

Embodiment encompasses the intricate relationship between the physical body and the broader socio-cultural context in which it exists. It goes beyond the biological aspects of the body, acknowledging how societal norms, cultural practices, and individual experiences shape and are inscribed upon the body (Leung et al., 2011). This concept suggests that our bodies are not just physical entities but also repositories of cultural, historical, and social meaning. Embodiment influences how individuals perceive themselves, interact with others, and experience the world around them (Leung et al., 2011). It encompasses not only the physiological aspects but also the ways in which societal beliefs, behaviors, and power dynamics are embodied, expressed, and experienced through the body. In fields like anthropology and sociology, understanding embodiment involves exploring how cultural, social, and historical contexts become embedded within our bodily experiences, influencing everything from gestures and postures to health outcomes and identity formation.

Embodiment, as observed through skeletal remains, unveils a profound interplay between biological markers and the lived experiences of individuals within their societal and cultural contexts (McClelland & Cerezo-Roman, 2016). The skeleton, while a repository of biological information, also carries traces of cultural practices, social roles, and even the physical effects of behaviors and lived experiences. For example, building on studies on the biology of poverty, Moore and Kim (2022) provide an osteology of structural violence by examining how poverty becomes embodied in skeletal remains in southeastern Michigan. In their review of forensic anthropology casework in Detroit between 2014 and 2021, they situate postmortem analyses of pathology and trauma within political and historical contexts of “vacant” buildings, arson, and access to healthcare.

Through careful analysis, bioarchaeologists and anthropologists decipher how cultural norms, activities, and societal structures were inscribed on the skeleton—whether through evidence of labor-intensive tasks reflected in bone stress markers, dietary patterns imprinted in dental wear, or ritualistic practices evidenced by intentional modifications. By connecting the biological parts of the body with the social and cultural settings in which people lived, these skeletal expressions of embodiment give us a new way to look at how people lived, experienced, and navigated their worlds (McClelland & Cerezo-Roman, 2016).

2.3 Health and Income Disparities:

Health is closely correlated with income in the United States and elsewhere. In the United States, where healthcare delivery is largely market-based, poverty and low income are significant causes of instability in health insurance. Income inequality, joblessness, oppressive working conditions, among other forms of structural violence, manifest in differential healthcare delivery and health status (Rylko-Bauer & Farmer, 2002).

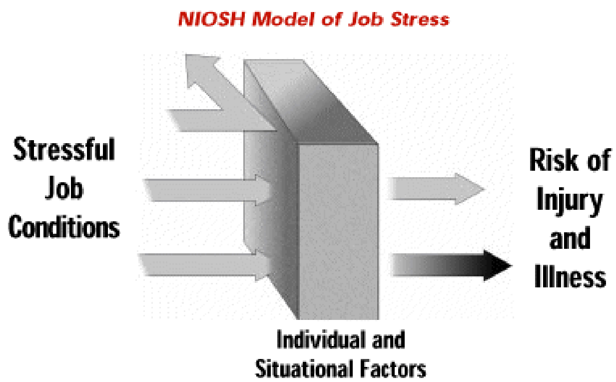
Self-assessments of health can also be shaped by income levels, even in countries with forms of universal healthcare. A study conducted by Mackenback and colleagues (2005) explored these connections, particularly in Belgium, Denmark, England, Finland, France, The Netherlands, and Norway. In these nations, a greater family equivalent income was linked to improved self-rated health, whereas low family income was correlated with negative health outcomes. However, at the lowest income levels in Belgium, Finland, the Netherlands, and Norway, the decline in self-assessed health per unit of diminishing income levels off or changes into an improvement when income was below the $10,000 bracket, especially among women (Mackenbach et al., 2005). Though the countries did not disclose their full government assistance for low-income families, Mackenbach et al. (2005) state that in Denmark and The Netherlands, government assistance can be provided in the forms of allowances and child assistance, which may account for this pattern. A significantly faster deterioration in health with decreasing income at lower income levels would have suggested a significant role for the direct impacts of a low income, or otherwise, poverty and other unfavorable material circumstances. The results raise the prospect that income redistribution can enhance population health on average, particularly in nations where the link between income and health is highly curvilinear (Mackenbach et al., 2005).

2.4 Specific Occupational Stressors:

The National Institute for Occupational Safety and Health (NIOSH) viewpoint holds that exposure to demanding work environments, or “job stressors,” can have a direct impact on employee safety and health. These job stressors can include but are not limited to career concerns, environmental conditions, and management issues. NIOSH correlates job stressors to a higher impact on employee health with issues such as musculoskeletal disorders, psychological disorders, and workplace injuries. However, as illustrated below in Figure 1, there are a variety of situational and individual factors that can work in opposition to this influence. The harmony between work and personal life, as well as the support system of friends and coworkers, are described as these factors (Centers for Disease Control and Prevention, 2014).

Figure 1:

NIOSH Model of Job Stress



For example, in a study conducted on home care workers and their work environment by Johannson (1995), data showed that musculoskeletal symptoms of pain and injuries were significantly higher amongst home care workers that reported exposure to a "poor psychological work environment" and a "high physical workload" (p. 126). The musculoskeletal symptoms reported were related to the neck, shoulders, and lower back. The home care workers blamed their symptoms on working in "twisted postures" for several hours a day, with few breaks. The "twisted postures" are explained as "a deep forward flexed trunk (bending over) frequently" and "hands above shoulders' frequently" (Johannson, 1995, p. 115-120). These actions, along with the repetitive lifting of heavy objects, caused strain on the body. However, home care workers that reported a "good psychological work environment and a high physical workload" (p. 123-124) still had high reports of the same symptoms as their counterparts. The only groups that had low reports of the symptoms were the workers that were either in the control group (good psychological work environment and low physical workload) or the "poor psychological work environment and a low physical workload" (Johannson, 1995, p. 120). It is important to note that in Johannson's study, the control group was a group of 694 municipal workers. Johannson does not state the type of work nor employment the control group conducts, however, all 694 stated that they had a good psychological work environment and a low physical workload.

The relationship between the perceived risk of occupational injury and two factors: control over the pace of work and type of work, was recorded in a study by Harrell (1990). The data was collected through a survey of 244 workers in various occupations. According to the survey, workers in blue-collar jobs are more likely to distinguish their job as hazardous than those in white-collar positions. Harrell discusses that repetitiveness, speed of pace, and the equipment used were major predictors of perceived risks specifically to the blue-collar workers. Harrell (1990) argues that workers who have less control over the pace of their work are more likely to perceive their job as risky, leading to increased stress and anxiety. In contrast, workers who have more control over their work pace are likely to perceive less risk in their job and therefore experience less stress and anxiety.

A study done by Morris et al. (1999) showed that white-collar workers found their occupational "health climate" more positive than blue-collar workers. Morris describes a "health climate" as how an employee views their organization or employment in terms of if the employer "values their health, has supportive supervisors and coworkers, and has clear organizational norms for practicing healthy behaviors, such as eating healthy foods, exercising, and managing stress" (Morris et al, 1999, p. 320). In the study, three categories consisted of different scales, organizational support, interpersonal support, and health norms (Figure 2). The scales were then assigned a five-point response point which included: attitude (strongly disagree to strongly agree), proportion (no employees to almost all employees), and frequency of occurrence (almost never to almost always).

Figure 2:

Scales and sub-scales used by Morris (1999) to gauge how workers feel about the health conditions at work.

Organizational Support (3)	Interpersonal Support (3)	Health Norms (6)
Employer Health Orientation	Supervisor Support	Nutrition Norms
Job Flexibility to Exercise	Coworker Social Support	Exercise Norms
Health Information	Support for Healthy Behavior	Smoking Norms
	Interpersonal Support (3)	Anti-Smoking Norms
		Job Tension Norms
		Pro-Exercise Norms

According to Morris et al.'s (1999) findings, white-collar and blue-collar workers had extremely diverse perspectives on the health climate at their workplaces. White-collar employees reported higher scores than blue-collar employees in every major comparison except for “Smoking Norms” in which 28% of blue-collar workers smoked versus 18% of white-collar workers. The “Supervisor Support” perception varied the most between the groups. Supervisors may act as gatekeepers for blue-collar workers in particular by restricting employees’ access to health promotion initiatives. For instance, managers may forbid employees from attending programs during work hours to keep the production lines moving. Contrary to blue-collar workers, white-collar employees reported feeling greater support from their superiors as well as more support from their coworkers and a better company health orientation. Overall, white-collar workers had a more favorable perception of the environment than did blue-collar workers (Morris et al. 1999).

2.5 Osteoarthritis and Occupation: Previous Studies:

Two studies that explore the relationship between occupational factors and the prevalence of osteoarthritis in different populations are Rossingnol et al. (2003) and Seok et al. (2017). Both studies utilized large sample sizes to investigate the association between osteoarthritis and occupational factors. Occupations were categorized based on the nature of the work, allowing researchers to assess the correlation between physical workload and osteoarthritis prevalence. Rossignol et al. (2003) used categories like agriculture, blue-collar, white-collar, and a mixed category, while Seok et al. (2017) classified occupations into clusters such as white, pink, blue, and green, each representing different levels of physical demands. Both studies found a correlation between the amount of manual labor and the prevalence of osteoarthritis. In Rossignol et al. (2003), agricultural workers had the highest prevalence of osteoarthritis, followed by blue-collar and mixed-collar workers. Similarly, Seok et al. (2017) found that the green cluster, which included agricultural/fishery workers, had the highest prevalence of osteoarthritis, followed by the blue cluster, which included craft/trade workers and machine operators. Specific factors were identified within high-risk occupations that could contribute to the development of osteoarthritis such as heavy physical work, repetitive movements, and exposure to vibration (Seok et al, 2017). This indicates a consistency in the factors contributing to osteoarthritis across different populations and reinforces the importance of considering occupational factors in disease assessment and management (Rossingnol et al., 2003; Seok et al, 2017). In summary, while conducted in different populations and with different occupational classifications, both studies demonstrate a clear association between physical workload and the prevalence of osteoarthritis. They provide valuable insights into the role of occupational factors in disease development and advocate for preventive measures targeted at high-risk occupational groups.

Kwon et al. (2019) investigated the impact of different types of occupations on the development of knee osteoarthritis in men, using data from the Korean National Health and Nutrition Examination Survey (2010-2012). Data on occupation, lifestyle factors, and health outcomes were collected using a representative sample of Korean men aged 50 years or older. The participants were divided into four occupational clusters, "white-collar (White) workers included managers, professionals, and office workers; pink-collar (PC) workers included service and sales workers; blue-collar workers (Blue) included technicians and device/machine operators; and agribusiness and low-level (AL) workers included skilled workers in agriculture, fishery, and low-level laborers" (Kwon et al, 2019, p. 55). Kwon does not describe what "low-level laborers" entitles. The findings of the study indicated that certain types of occupations were associated with an increased risk of knee osteoarthritis in men. Occupations involving heavy physical labor, such as the AL and Blue workers, were found to have a higher prevalence of knee osteoarthritis compared to sedentary occupations (White). The authors concluded that occupational factors play a significant role in the development of knee osteoarthritis in men and highlights the importance of considering occupational factors when assessing and managing knee osteoarthritis in the population.

CHAPTER 3: OSTEOARTHRITIS

The most prevalent type of arthritis is osteoarthritis (OA), a common degenerative joint disease that occurs when the cartilage between bones breaks down and wears away. Cartilage is a tough, flexible tissue that cushions and protects the joints, allowing them to move smoothly and efficiently. As the cartilage breaks down, bones can rub together, causing pain, swelling, and stiffness in the affected joint. Over time, bone spurs can form, leading to further damage and a limited range of motion. The exact cause of osteoarthritis is unknown, but risk factors include age, obesity, joint injuries or overuse, and genetic factors (Chen et al, 2017). According to the National Library of Medicine, osteoarthritis is the most common joint disorder in the United States, affecting more than 10% of men and 13% of women over 60 (Zhang & Jordan, 2010). A study done using the Global Burden of Disease Study data shows that "osteoarthritis increased globally by 113.25% in nearly three decades, more than doubling from 247.51 million cases in 1990 to 527.81 million cases in 2019" (Long et al, 2022).

3.1 Clinical Assessment of Osteoarthritis:

Healthcare professionals use various osteoarthritis severity scales to assess the extent and severity of the disease in a patient. One of the commonly used scales is the Kellgren-Lawrence (KL) grading system, which classifies osteoarthritis into five stages:

"Stage 0: No radiographic evidence of osteoarthritis.

Stage 1: Doubtful narrowing of the joint space and possible osteophyte (bony outgrowth) formation.

Stage 2: Definite osteophyte formation and possible mild joint space narrowing.

Stage 3: Moderate joint space narrowing and definite osteophyte formation, with possible bone-on-bone contact.

Stage 4: Severe joint space narrowing, significant osteophyte formation, and bone-on-bone contact, with possible joint deformity" (Kellgren & Lawrence, 1957).

According to the information provided in their initial study, the KL classification is generally used only in relation to knee osteoarthritis (Kellgren & Lawrence, 1957). Anteroposterior knee radiographs were initially used to describe the KL classification. Other severity scales may also be used, depending on the specific needs of the patient and the healthcare professional. It is important to note that the severity of osteoarthritis does not always correlate with the severity of symptoms experienced by the patient.

3.2 Formation:

The breakdown of articular cartilage in a joint and the development of surrounding bone, usually in the manner of lipping or spur formations around the joint, are the hallmarks of osteoarthritis (Jurmain & Kilgore, 1995). Osteoarthritis can affect any joint; however, it is most frequently found in the head of the femur and humerus, the distal condyles of the femur, and the vertebral column. (Jurmain & Kilgore, 1995). Primary OA, also known as idiopathic OA, can be brought on by aging and biomechanical activities, and it can have an impact on several articulations, while secondary osteoarthritis may result from traumatic injuries and only affects articulation of a sole joint. This information will be pertinent to my observations during my research in order to estimate if the osteoarthritis is from overuse of the joints or if it is from aging or genetic factors. Since primary osteoarthritis usually appears symmetrically, it is necessary to observe both the left and right sides of the skeleton.

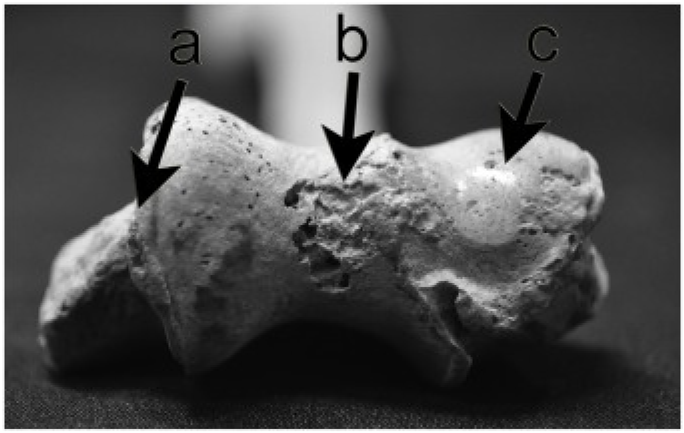
Primary osteoarthritis can be caused by different factors, such as hormones, biomechanical activities, and genetic predisposition (White & Folkens, 2005). Secondary osteoarthritis can be caused by bacteria or a complication of osteomyelitis; however, physical overload can also be a cause (White & Folkens, 2005). The skeletal system's potential insufficiency may hinder intense physical activity as a barrier. Sporting activities place high-intensity, frequent pressures on the skeletal system. Bone, tendons, and ligaments all exhibit a time-dependent load-extension behavior (Maffuli & King, 1992). These activities, which can be exercise or manual labor, are more likely to cause secondary osteoarthritis.

3.3 Osteoarthritis in Forensics & Bioarchaeology:

Osteoarthritis can be identified and studied osteologically through the examination of skeletal remains. The presence of osteoarthritis can provide important clues about an individual's lifestyle, occupation, and overall health. Forensic anthropologists and bioarchaeologists can analyze osteoarthritis by examining the bones for signs of wear and tear, including bone spurs, joint deformation, and cartilage erosion. "Subchondral bone changes, such as marginal outgrowths or lipping, osteophyte development, sclerosis, porosity, and/or eburnation, are associated with osteoarthritis," as explained by Becker (2020, p. 46) See figure 3 below.

Figure 3:

Distal humerus with evidence of osteoarthritis: (a) evidence of lipping, (b) porosity, and (c) eburnation (Becker, 2020).



By analyzing the severity and distribution of osteoarthritis throughout the skeleton, bioarchaeologists can gain insight into the individual's physical activity (Cunha, 2006). Bioarcheologists can also compare the prevalence and severity of osteoarthritis in different populations to understand how factors such as diet, occupation, and physical activity may have affected the development of the disease (Becker, 2020). A variety of techniques to study osteoarthritis in skeletal remains exist including radiography (Runestad, 1993), histology, and biomechanical analysis (Ruff, 2008). One difficulty in studying OA, according to White and Folkens, is due to many factors contributing to primary OA, there is no "coherent relationship between a particular occupation and a particular form of osteoarthritis" (White and Folkens, 1999, p.332). White and Folkens (2005) add:

> "Furthermore, even in cases in which occupationally related activity does seem to be important in determining the expression of arthritis, there are no unique features about this expression—most people who develop arthritis at the finger joints are not mill

> workers, even though mill workers do develop arthritis at these joints. For single skeletons, therefore, the prospects seem bleak. (p.457)"

However, the assessments at the population or community level are possible even while individuals or individual activities are not visible. This is because population assessments often rely on aggregated data and statistical analyses rather than individual-level observations. By collecting data from a representative sample of individuals or subgroups within a population, researchers can make general inferences about the overall characteristics, trends, or behaviors of the entire population or community (White and Folkens, 2005).

Studying osteoarthritis in bioarchaeology can provide essential insights into the health and lifestyles of past and modern populations, as well as how these populations may have adapted to the challenges posed by degenerative joint diseases. By studying the skeletal remains of individuals, bioarcheologists can learn about the prevalence and impact of diseases like osteoarthritis on these populations.

CHAPTER 4: MATERIALS AND METHODS

I spent two weeks analyzing 24 individuals from the UTK Donated Skeletal Collection at the University of Tennessee Knoxville, from the 6th of November through the 18th of November of 2023. I included adult individuals between the ages of 30 to 60 years at the time of death that had occupational records. The UTK Donated Skeletal Collection, established in 1981 as part of the Forensic Anthropology Center (FAC), houses donated ("willed") body human skeletons (The University of Tennessee, 2022). The collection is often used by researchers and students in the field of forensic anthropology and bioarchaeology for educational or research purposes. Since the collection is indefinitely curated at UTK, the program has documentation on each individual I analyzed regarding their life history, and therefore, their occupation.

The ages of the selected individuals were between 30 and 60 years old. The upper age limit was applied in order to mitigate the impact of old age on the prevalence of OA. I was given the age, occupation, and occasionally the hobbies of each individual available. Each of the individuals ideally would have had to have at least the pelvis, both femora, both radii and ulnae, both trapezia, and the proximal and distal sides of the interphalangeal joints for me to access osteoarthritis of the hip, knees, wrists, and hands. I decided to observe these skeletal elements (the femur and pelvis) due to their important roles in manual labor, such as constant lifting or bending over. However, for the white-collar workers, I chose to observe the wrists and hands due to their roles in constant use of typing and computer skills. I preferred to have both femora, radii, and ulnae in order to identify primary vs secondary OA.

4.1 Data Analysis:

I inventoried each skeleton, listing which bones were present and their condition. After completion, I observed the interphalangeal joints, trapezia, radii, ulnae, pelves, and femora for OA and documented my findings using Google Sheets and a camera, along with any other pathologies affecting the bone. My observations followed the Buikstra & Ubelaker (1994) assessment. A precise, descriptive grading system based on the presence or absence of osteoarthritic change is used by Buikstra and Ubelaker (1994) to categorize OA. A given joint that is impacted by one of four features is scored by this system: 1) degree of lipping, 2) degree of surface porosity, and 3) degree of eburnation (Buikstra & Ubelaker, 1994). They propose noting the area of the joint surface impacted as 1) less than one-third is affected, 2) one-third to two-thirds is affected, and 3) more than two-thirds of the joint surface is affected (Buikstra & Ubelaker, 1994). Then, I documented the age, occupation, and known biological sex of the skeleton based on the available documents. I decided to document these after my observations to avoid observation bias.

I chose to observe the pelvic acetabulum, the femoral head, the patellar, medial condyle, and lateral condyle articular surfaces of the distal femur, distal radioulnar, the trapezium, carpometacarpal, proximal interphalangeal, and distal interphalangeal joints because of the amount of usage by both blue-collar and white-collar workers. I analyzed each joint for signs of osteoarthritis based on the presence and degree of lipping, porosity, and eburnation. Once my observations were complete, I then transferred it into IBM SPSS and calculated the p-value of each skeletal feature and area for lipping, porosity, and eburnation.

CHAPTER 5: RESULTS

Table one presents the known ages and occupation for all analyzed individuals. This included 13 males and 11 females. Blue collar occupations included a variety of construction labor types, factory work, and other generic manual labor, while white collar occupations included teaching, therapy, and other office roles (Table 1). A total of 504 sites were observed for potential OA, with 254 on the right side and 250 on the left. For blue collar, a total of 245 sites were observed and 259 for white collar.

Table 1:

Table chart of individuals observed. Includes ID number given, age, labor type, and occupation.

ID	Sex	Age	Labor	Occupation
1	M	57	Blue	Construction Worker
2	M	48	Blue	Machine Operator
3	M	46	Blue	Chef
4	M	44	White	Computer Programmer
5	F	54	White	Accounting
6	M	57	White	Marketing
7	M	51	Blue	Laborer
8	M	49	Blue	Construction Worker
9	F	60	Blue	Factory Laborer
10	F	52	White	Teacher
11	M	42	White	Manager
12	M	35	White	Phone Sales
13	M	60	Blue	Laborer
14	M	47	Blue	Laborer
15	M	45	Blue	Construction Worker
16	F	54	Blue	Textile Mill Worker
17	F	45	Blue	Cashier
18	F	58	White	Teacher
19	F	39	White	Office Worker
20	F	33	White	Medical Counselor
21	M	50	White	Office Supervisor
22	F	35	White	Public Relations
23	F	48	Blue	Factory Laborer
24	F	57	White	Therapist

All 24 individuals observed had at least some form of osteoarthritis. The most common occurrence of lipping was on the acetabulum of the right innominate bone (23/24 individuals, 96%). Similarly, the left acetabulum exhibited a high occurrence of lipping (20/24 individuals, 83%), particularly for blue collar individuals (12/12). Furthermore, the right patella (12/22 individuals, 55%) was the most common site for porosity, whereas the left side showed a varied distribution. The acetabulum of the both innominates exhibited porosity in 12 of 24 individuals (50%). Eburnation was most commonly present in the acetabulum of both innominates with 10 of 24 individuals or 42% of the sample presenting eburnation in the right acetabulum and 13 of 23 individuals or 57% showing eburnation in the left acetabulum. The trapeziometacarpal joint surface exhibiting the least occurrence for signs of osteoarthritis. Table 2 shows the number of occurrences for right and left side lipping, porosity, and eburnation for both labor forces along with the total number of sites observed.

Table 2:

Blue-collar, white-collar, and total numbers for right and left lipping, porosity, eburnation. Total number of sites of OA over the total number of sites observed.

	R. Lipping	R. Porosity	R. Eburn	L. Lipping	L. Porosity	L. Eburn
B.C.	61	49	20	64	39	23
W.C.	64	41	18	51	32	20
Total	125/254	90/254	38/254	115/250	71/250	43/250

For blue collar workers, the most common site for right (12/12) and left (12/12) lipping was the acetabulums of the innominate bones. This is then followed by the right femoral head (9/12) and the articular surface of the medial condyle (9/12) and lateral condyle (9/12) of the left distal femur. Each site had an area of lipping for at least one blue collar individual. The lowest prevalence for lipping was the right (1/12) and left (1/12) distal interphalangeal joint, the left CMC joint (1/12), and the left proximal interphalangeal joint (1/12).

The most common occurrence of right side porosity amongst blue collar workers was also in the acetabulum of the innominate bone (7/12). However, for left side porosity, blue collar workers had an equal number of occurrences within the distal radius, distal ulna, acetabulum of the innominate bone, and the articular surface of the medial condyle of the distal femur (all 5/12). The least common area for right and left side porosity was the trapezium. Two out of ten blue collar individuals presented lipping on the right trapezium, while no blue collar individuals had lipping on the left trapezium.

The most common occurrence of right and left side eburnation for blue collar individuals was the acetabulums of the innominate bones. Six out of twelve individuals presented right side eburnation, while seven out of twelve individuals presented left side eburnation. This was then followed by the left patella (6/12), and the right articular surface of the lateral condyle of the distal femur (5/12). No blue collar individuals had signs of eburnation on the right and left trapezia, the right and left distal interphalangeal joints, the right proximal interphalangeal joints, the right CMC joint, or the left distal radius and distal ulna.

For white collar workers, the most common sites for right side lipping was the acetabulum of the innominate bone (8/12), the articular surface of the medial condyle of the distal femur (8/12), and the patella (8/11). The most common site for left side lipping was the patellae (11/11), followed by the acetabulum of the innominate bone (8/11). Each site had an area of lipping for at least one white collar individual. The least common occurrence of lipping was in the proximal and distal interphalangeal joints (both 1/12).

The most common occurrence of right side porosity amongst white collar workers was the patella (8/11), followed by the articular surface of the lateral condyle of the distal femur (6/12). For left side porosity, acetabulum of the innominate bone was the most common occurrence amongst white collar workers (6/11). Then followed by the distal radius (4/12) and the articular surface of the lateral condyle of the distal femur (4/12). Each site had an area of porosity for at least one white collar individual. The least common area for right porosity was the trapezium. For the left side, the CMC joint and the distal interphalangeal joint were both the least common (both 1/12).

For right side eburnation, the acetabulum of the innominate bone, the patella, and the articular surface of the lateral condyle of the distal femur (all 4/12). The acetabulum of the innominate bone had the most common occurrence of eburnation for the left side (6/11). This was followed by the articular surface of the lateral condyle of the distal femur (4/12). No signs of eburnation were located on the right or left trapezia, CMC joints, and the proximal and distal interphalangeal joints for any white collar individuals.

Statistical tests indicate three areas of significance related to the left patellar articular surface, and medial and lateral condylar articular surfaces of the distal femur. In the right patella, lipping is noted at p-values of .090 (feature) and .086 (area) approaching significance, while the left patellar lipping is significant at a p-value of .034 (feature) between the different labors. Additionally, lipping is observed in the left medial, with a p-value .029 significance, and lateral condyles with a p-value of .044 significance between blue-collar and white-collar.

CHAPTER 6: DISCUSSION

The connection between structural violence in blue-collar and white-collar work is a complicated and interesting topic that needs thorough investigation. People today experience structural violence in many ways, not just through direct physical violence or discrimination. It is built into the systems and structures that rule labor relations. The point of this study was to investigate how structural violence shows up in the daily lives of workers in both blue-collar and white-collar jobs.

When looking at prevalence, blue collar workers had more overall osteoarthritis in each right and left category (lipping, porosity, and eburnation) with the exception of right side lipping (Table 2). This does correlate with research done by Rossingal (2003), Seok (2017), and Kwon (2019) stating that blue collar or agricultural workers have a higher prevalence of osteoarthritis. It seems clear that regular labor associated with blue-collar jobs in the sample here does indeed reflect similar conditions of violence as seen in other studies.

However, white-collar workers had the highest recorded levels of severity in each category (except for both right and left side porosity). Additionally, while originally I hypothesized that blue-collar workers would show more severe hip and knee osteoarthritis specifically, the data shows that both labor forces experience hip and knee osteoarthritis in similar quantities. This could be due to a variety of factors outside of occupation, such as hobbies or other lifestyle activities. Automation and the common use of machines in different factory jobs could also potentially help reduce the strain on certain laborers, whereas large machines are less likely to provide physical assistance for jobs such as teachers or office workers.

This shows that white-collar workers were still impacted by osteoarthritis of higher severity, regardless of their status. Without the ability to see the gross income, spending habits, or household size of the 24 individuals, I cannot determine their economic status. Occupation category alone might not be a good predictive factor of income or ability to control the amount of physical labor. Additionally, I did not know how long each individual had been in the occupation that was listed on their form. The importance of the length of the occupation could have given more information about how long they were enduring the impact of their work or subjecting the individual to different repetitive motions.

However, this could also be due to the wide, and mostly uncategorized, definition of white collar. The individuals used in my study did not consist of only office and desk workers, but consisted of a variety of jobs, including teachers and managers of different stores. These individuals were, most likely, on their feet for extended periods of time while working and therefore putting a strain on their hips and knees.

Regardless of their occupation, the individuals could have endured financial hardship causing them to not have access to affordable and adequate healthcare. As discussed by Cunha (2006), Himes (1978), Rodriguez-Martin (2006), lack of healthcare along with arduous labor can lead to repetitive stress injuries and an impact on physical bodies. This impact could lead to other complications, such as a reliance on pain management or medical intervention as mentioned by Mezey et al (2022) and Garrison et al (2021) over time and worsen if the individual does not have the funds or resources to seek medical assistance. This in return can lead to a diminished feeling of well-being, both mentally and physically. While Chen et al (2017), Johannson (1995), and NIOSH all correlated high job-stressors with blue collar workers, those studies may have not taken into account the multitude of ways that stress, whether that be physical or mental, exists in different workplaces and occupations. Therefore it may be that while those studies are still valid in the sense of slow violence against blue collar laborers, my results show that white collar individuals may also face some sort of injustices when it comes to either healthcare or healthcare availability.

Other lifestyle factors could have also impacted these results. While I was given a description of each individual's occupation, I did not receive each individual’s hobbies. Multiple studies show that hobbies such as soccer, football, and other sports lead to wear and tear on joints which in return can cause damage to the articular cartilage (Rall et al, 1964; Kujala et al, 1995; Mow & Rosenwasser, 1998; Tveit et al, 2012). Given that many Americans participate in athletic hobbies in young adulthood, and sometimes throughout the life course, these activities may be having a stronger impact than I anticipated. Life outside of work can also impact how much or little strain is put on the body.

According to Teichtahl et al (2012) and Lee et al (2023), an individual’s natural height can decrease the potential risk of knee osteoarthritis. In both studies, taller individuals had less of a risk for developing knee osteoarthritis. However, in a study conducted by Welling et al (2017), it was determined that a taller height actually increases the risk of osteoarthritis overall. Other studies debate the connection of weight (obesity) and osteoarthritis. Studies such as King (2013) and Nedunchezhiyan (2022) suggest that obesity can play a part in the formation of osteoarthritis on weight and non-weight bearing joints. This additional stress can accelerate the wear and tear of cartilage, leading to cartilage degeneration and the onset of osteoarthritis. Conversely, an article by Aspden (2011), discusses that obesity does not cause nor truly affect the formation of osteoarthritis. In this case, it seems that the underlying culprit could be adipose tissue, a specialized connective tissue primarily composed of adipocytes, or fat cells. It should be noted that those studies, and many more, focus on the outdated method of using BMI (Flegal, 2023; Kirky 2022) to determine weight and height correlation, suggesting that newer studies using more accurate measures of body dimensions and stature are needed. Overall, osteoarthritis risk should not be categorized solely based on height nor weight.

Innate immunity also plays a significant role in the development and progression of osteoarthritis. While osteoarthritis is traditionally considered a non-inflammatory condition compared to rheumatoid arthritis, innate immune responses are still implicated in its pathogenesis due to features such as synovial inflammation (Orlowsky & Kraus, 2015). Even though I specifically looked for signs of secondary osteoarthritis, genetics may still play a part in the individual's overall health and likelihood of developing the disease.

Ultimately, my findings are inconclusive regarding how blue-collar laborers might be impacted by embodied structural violence in the form of OA, at least in the context of the skeletal collection at UT Knoxville. This outcome emphasizes the need to investigate the bigger picture of how the United States treats labor forces of all kinds in terms of not only healthcare but also the structural violence embedded into the workforce through economic exploitation. This exploitation may come in many forms including a lack of time off to seek medical care, leisurely pursuits, or simply time to rest, but ultimately all of which are necessities in order to maintain a healthy balance of living.

6.1 Future Directions:

To those who may build on this research or something similar, I recommend a larger test group. This is simply because I feel as though 24 subjects is not a high enough number to truly capture the wide amount of occupations involved in the labor force. I also recommend broadening the scope outside of blue-collar and white-collar to include labor listed under pink-collar. Occupations such as teachers, nurses, and doctors (which for the sake of this study were categorized under white-collar) all endure a large amount of time on their feet. Therefore their knees and hips may be equally as impacted as occupations listed under blue-collar. Future studies should consider the actual physicality of occupations rather than merely the category of labor. I think that race could also be taken into consideration due to the overall lack of healthcare and healthcare adequacy that minority populations face within the United States.

CHAPTER 7: CONCLUSION

The result of this research emphasizes the need for more investigation into the occupational differences in osteoarthritis that exist between blue-collar and white-collar workers. The results imply that, in terms of skeletal health, neither work group has a safe haven, since both labor groups exhibit pronounced symptoms of osteoarthritis. The study's findings also imply that structural violence affects bodies and health, especially when taking various forms of labor into account. This research has advanced our understanding of how structural violence manifests in labor workers from both sides by examining the location, onset, and severity of osteoarthritis in blue-collar and white-collar workers. To fully understand the significance of this study and examine potential strategies to address the health disparities that workers confront, more research is required.

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APPENDIX: TABLES

Right Distal Radius Lipping (P Value = .596)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	4	5	1	1	0	0	11
White	7	4	0	1	0	0	12
Total	11	9	1	2	0	0	23

Right Distal Radius Lipping Area (P Value = .543)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	4	5	2	0	0	0	11
White	7	4	1	0	0	0	12
Total	11	9	3	0	0	0	23

Blue = 7/11
White = 5/12
Total = 12/23 (one ID missing R. Radius)

Right Distal Ulna Lipping (P Value = .499)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	4	4	2	1	0	0	11
White	6	4	0	1	1	0	12
Total	10	8	2	2	1	0	23

Right Distal Ulna Lipping Area (P Value = .624)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	4	6	1	0	0	0	11
White	6	4	1	0	1	0	12
Total	10	10	2	0	1	0	23

Blue = 7/11
White = 6/12
Total = 14/23 (one ID missing R. Ulna, one ID damaged R. Ulna)

Right Trap Lipping (P Value = .937)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	6	4	0	0	0	0	10
White	7	5	0	0	0	0	12
Total	13	9	0	0	0	0	22

Right Trap Lipping Area (P Value = .937)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	6	4	0	0	0	0	10
White	7	5	0	0	0	0	12
Total	13	9	0	0	0	0	22

Blue = 4/12
White = 5/12
Total = 9/22 (two ID missing R. Trap)

Right CMC Lipping (P Value = .365)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	8	2	0	0	0	0	10
White	8	2	1	1	0	0	12
Total	16	4	1	1	0	0	22

Right CMC Lipping Area (P Value = .608)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	8	2	0	0	0	0	10
White	8	2	1	1	0	0	12
Total	16	4	1	1	0	0	22

Blue = 2/22
White = 4/22
Total = 6/22 (two ID missing R. CarpoMeta)

Right Prox InterPhalang Lipping (P Value = .231)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	8	3	0	0	0	0	11
White	11	1	0	0	0	0	12
Total	19	4	0	0	0	0	23

Right Prox InterPhalang Lipping Area (P Value = .231)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	8	3	0	0	0	0	11
White	11	1	0	0	0	0	12
Total	19	4	0	0	0	0	23

Blue = 3/12
White = 1/12
Total = 3/23 (one ID missing R. InterPhalang)

Right Distal InterPhalang Lipping (P Value = .949)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	10	1	0	0	0	0	11
White	11	1	0	0	0	0	12
Total	21	2	0	0	0	0	23

Right Distal InterPhalang Lipping Area (P Value = .949)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	10	1	0	0	0	0	11
White	11	1	0	0	0	0	12
Total	21	2	0	0	0	0	23

Blue = 1/12
White = 1/12
Total = 2/23 (one ID missing R. InterPhalang)

Right Pelvic Ace Lipping (P Value = .774)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	0	5	5	2	0	0	12
White	1	5	4	2	0	0	12
Total	1	10	9	4	0	0	24

Right Pelvic Ace Lipping Area (P Value = .506)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	0	5	7	0	0	0	12
White	1	5	5	1	0	0	12
Total	1	10	12	1	0	0	24

Blue = 12/12
White = 11/12
Total = 23/24

Right Femoral Head Lipping (P Value = .184)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	3	8	0	1	0	0	12
White	4	5	3	0	0	0	12
Total	7	13	3	1	0	0	24

Right Femoral Head Lipping Area (P Value = .330)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	3	8	0	1	0	0	12
White	4	6	2	0	0	0	12
Total	7	14	2	1	0	0	24

Blue = 9/12
White = 8/12
Total = 15/24

Right Patellar Lipping (P Value = .090)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	5	6	0	0	0	0	11
White	3	3	2	3	0	0	11
Total	8	9	2	3	0	0	22

Right Patellar Lipping Area (P Value = .086)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	5	6	0	0	0	0	11
White	3	4	4	0	0	0	11
Total	8	10	4	0	0	0	22

Blue = 6/11
White = 8/11
Total = 11/22 (two ID missing R. Patella)

Right Med Condyle Lipping (P Value = .620)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	4	4	4	0	0	0	12
White	4	5	2	1	0	0	12
Total	8	9	6	1	0	0	24

Right Med Condyle Lipping Area (P Value = .380)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	4	7	0	1	0	0	12
White	4	6	2	0	0	0	12
Total	8	13	2	1	0	0	24

Blue = 8/12
White = 8/12
Total = 16/24

Right Lat Condyle Lipping (P Value = .774)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	5	5	2	0	0	0	12
White	5	4	2	1	0	0	12
Total	10	9	4	1	0	0	24

Right Lat Condyle Lipping Area (P Value = .311)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	5	7	0	0	0	0	12
White	5	5	2	0	0	0	12
Total	10	12	2	0	0	0	24

Blue = 7/12
White = 7/12
Total = 14/24

Overall R. Lipping
Blue = 61
White= 64
Total = 125

Right Distal Radius Porosity (P Value = .288)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	6	3	0	2	0	0	11
White	9	2	1	0	0	0	12
Total	15	5	1	2	0	0	23

Right Distal Radius Porosity Area (P Value = .408)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	6	1	3	1	0	0	11
White	9	2	1	0	0	0	12
Total	15	3	4	1	0	0	23

Blue = 5/11
White = 3/12
Total = 8/23 (one ID missing R. Radius)

Right Distal Ulna Porosity (P Value = .492)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	7	3	0	1	0	0	11
White	9	2	0	0	1	0	12
Total	16	5	1	1	1	0	23

Right Distal Ulna Porosity Area (P Value = .637)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	7	2	1	1	0	0	11
White	9	1	0	1	1	0	12
Total	16	3	1	2	1	0	23

Blue = 4/11
White = 2/12
Total = 7/23 (one ID missing R. Ulna, one damaged R. Ulna)

Right Trap Porosity (P Value = .427)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	8	2	0	0	0	0	10
White	11	1	0	0	0	0	12
Total	19	3	0	0	0	0	22

Right Trap Porosity Area (P Value = .427)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	8	2	0	0	0	0	10
White	11	1	0	0	0	0	12
Total	19	3	0	0	0	0	22

Blue = 2/10
White = 1/12
Total = 3/22 (two ID missing R. Trap)

Right CMC Porosity (P Value = .537)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	6	4	0	0	0	0	10
White	8	3	0	0	0	0	11
Total	14	7	0	0	0	0	21

Right CMC Porosity Area (P Value = .537)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	6	4	0	0	0	0	10
White	8	3	0	0	0	0	11
Total	14	7	0	0	0	0	21

Blue = 4/10
White = 3/11
Total = 7/21 (three ID missing R. CMC)

Right Prox InterPhalang Porosity (P Value = .135)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	6	1	2	2	0	0	11
White	9	3	0	0	0	0	12
Total	15	4	2	2	0	0	23

Right Prox InterPhalang Porosity Area (P Value = .427)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	6	4	1	0	0	0	11
White	9	3	0	0	0	0	12
Total	15	7	0	0	0	0	23

Blue = 5/11
White = 3/12
Total = 8/23 (one ID missing R. InterPhalang)

Right Distal InterPhalang Porosity (P Value = .413)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	8	2	0	1	0	0	11
White	11	1	0	0	0	0	12
Total	19	3	0	1	0	0	23

Right Distal InterPhalang Porosity Area (P Value = .296)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	8	1	2	0	0	0	11
White	11	1	0	0	0	0	12
Total	19	2	2	0	0	0	23

Blue = 3/11
White = 4/12
Total = 7/23 (one ID missing R. InterPhalang)

Right Pelvic Ace Porosity (P Value = .343)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	5	4	1	2	0	0	12
White	8	1	0	2	0	1	12
Total	13	5	1	4	0	1	24

Right Pelvic Ace Porosity Area (P Value = .449)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	5	3	3	1	0	0	12
White	8	1	1	1	0	1	12
Total	13	4	4	2	0	1	24

Blue = 7/12
White = 3/12
Total = 10/24

Right Femoral Head Porosity (P Value = .264)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	8	2	0	2	0	0	12
White	8	4	0	0	0	0	12
Total	16	6	0	2	0	0	24

Right Femoral Head Porosity Area (P Value = 1.0)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	8	2	2	0	0	0	12
White	8	2	2	0	0	0	12
Total	16	4	4	0	0	0	24

Blue = 4/12
White = 4/12
Total = 8/24

Right Patellar Porosity (P Value = .291)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	7	0	0	4	0	0	11
White	6	2	1	2	0	0	11
Total	13	2	1	6	0	0	22

Right Patellar Porosity Area (P Value = .557)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	7	1	2	1	0	0	11
White	6	3	2	0	0	0	11
Total	13	4	4	1	0	0	22

Blue = 4/11
White = 8/11
Total = 12/22 (two ID missing R. Patella)

Right Med Condyle Porosity (P Value = .565)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	8	3	0	1	0	0	12
White	8	4	0	0	0	0	12
Total	16	7	0	1	0	0	24

Right Med Condyle Porosity Area (P Value = .766)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	8	2	2	0	0	0	12
White	8	3	1	0	0	0	12
Total	16	5	3	0	0	0	24

Blue = 4/12
White = 4/12
Total = 8/24

Right Lat Condyle Porosity (P Value = .478)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	7	4	0	1	0	0	12
White	6	6	0	0	0	0	12
Total	13	10	0	1	0	0	24

Right Lat Condyle Porosity Area (P Value = .665)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	7	3	1	1	0	0	12
White	6	5	1	0	0	0	12
Total	13	8	2	1	0	0	24

Blue = 5/12
White = 6/12
Total = 11/24

Overall R. Porosity
Blue = 49
White= 41
Total = 90

Right Distal Radius Eburn (P Value = .949)

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	10	0	1	0	0	0	11
White	11	0	1	0	0	0	12
Total	21	0	2	0	0	0	23

Right Distal Radius Eburn Area (P Value = .366)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	10	1	0	0	0	0	11
White	11	0	1	0	0	0	12
Total	21	1	1	0	0	0	23

Blue = 1/11
White = 1/12
Total = 2/23 (one ID missing R. Radius)

Right Distal Ulna Eburn (P Value = .619)

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	10	0	1	0	0	0	11
White	10	0	1	0	1	0	12
Total	20	0	2	0	1	0	23

Right Distal Ulna Eburn Area (P Value = .619)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	10	1	0	0	0	0	11
White	10	1	0	0	1	0	12
Total	20	2	0	0	1	0	23

Blue = 1/11
White = 1/12
Total = 2/23 (one ID missing R. Ulna, one ID damaged R. Ulna)

Right Trap Eburn (P Value = 0)

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	10	0	0	0	0	0	10
White	12	0	0	0	0	0	12
Total	22	0	0	0	0	0	22

Right Trap Eburn Area (P Value = 0)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	10	0	0	0	0	0	10
White	12	0	0	0	0	0	12
Total	22	0	0	0	0	0	22

Blue = 0/10
White = 0/12
Total = 0/22 (two ID missing R. Trap)

Right CMC Eburn (P Value = .262)

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	9	1	0	0	0	0	10
White	12	0	0	0	0	0	12
Total	21	1	0	0	0	0	22

Right CMC Area (P Value = .262)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	9	0	0	0	0	0	10
White	12	0	0	0	0	0	12
Total	21	0	0	0	0	0	22

Blue = 0/10
White = 0/12
Total = 0/22 (two ID missing R. CarpoMeta)

Right Prox InterPhalang Eburn (P Value = 0)

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	11	0	0	0	0	0	11
White	12	0	0	0	0	0	12
Total	23	0	0	0	c	0	23

Right Prox InterPhalang Eburn Area (P Value = 0)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	11	0	0	0	0	0	11
White	12	0	0	0	0	0	12
Total	23	0	0	0	0	0	23

Blue = 0/11
White = 0/12
Total = 0/23 (one ID missing R. InterPhalang)

Right Distal InterPhalang Eburn (P Value = 0)

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	11	0	0	0	0	0	11
White	12	0	0	0	0	0	12
Total	23	0	0	0	0	0	23

Right Distal InterPhalang Eburn Area (P Value = 0)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	11	0	0	0	0	0	11
White	12	0	0	0	0	0	12
Total	23	0	0	0	0	0	23

Blue = 0/11
White = 0/12
Total = 0/23 (one ID missing R. InterPhalang)

Right Pelvic Ace Eburn (P Value = .683)

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	6	4	2	0	0	0	12
White	8	3	1	0	0	0	12
Total	14	7	3	0	0	0	24

Right Pelvic Ace Eburn Area (P Value = .330)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	6	4	2	0	0	0	12
White	8	3	0	1	0	0	12
Total	14	7	2	1	0	0	24

Blue = 6/12
White = 4/12
Total = 10/24

Right Femoral Head Eburn (P Value = .358)

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	9	3	0	0	0	0	12
White	10	1	1	0	0	0	12
Total	19	4	1	0	0	0	24

Right Femoral Head Eburn Area (P Value = .824)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	9	2	1	0	0	0	12
White	10	1	1	0	0	0	12
Total	19	2	2	0	0	0	24

Blue = 3/12
White = 2/12
Total = 5/24

Right Patellar Eburn (P Value = .338)

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	9	2	0	0	0	0	11
White	7	4	0	0	0	0	11
Total	16	6	0	0	0	0	22

Right Patellar Eburn Area (P Value = .338)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	9	2	0	0	0	0	11
White	7	4	0	0	0	0	11
Total	16	6	0	0	0	0	22

Blue = 2/11
White = 4/11
Total = 6/22 (two ID missing R. Patella)
Similar.

Right Med Condyle Eburn (P Value = .358)

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	10	1	1	0	0	0	12
White	9	0	3	0	0	0	12
Total	19	1	4	0	0	0	24

Right Med Condyle Eburn Area (P Value = .496)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	10	2	0	0	0	0	12
White	9	1	1	1	0	0	12
Total	19	3	1	1	0	0	24

Blue = 2/12
White = 3/12
Total = 5/24

Right Lat Condyle Eburn (P Value = .673)

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	7	0	5	0	0	0	12
White	8	0	4	0	0	0	12
Total	15	0	9	0	0	0	24

Right Lat Condyle Eburn Area (P Value = .875)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	7	3	2	0	0	0	12
White	8	2	2	0	0	0	12
Total	15	5	4	0	0	0	24

Blue = 5/12
White = 4/12
Total = 9/24
Similar.

Overall R. Eburn
Blue = 20
White= 18
Total = 38

Left Distal Radius Lipping (P Value = .319)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	6	4	2	0	0	0	12
White	8	4	0	0	0	0	12
Total	14	8	2	0	0	0	24

Left Distal Radius Lipping Area (P Value = .497)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	6	5	1	0	0	0	12
White	8	4	0	0	0	0	12
Total	14	9	1	0	0	0	24

Blue = 6/12
White = 4/12
Total = 10/24

Left Distal Ulna Lipping (P Value = .162)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	5	5	2	0	0	0	12
White	9	3	0	0	0	0	12
Total	14	8	2	0	0	0	24

Left Distal Ulna Lipping Area (P Value = .098)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	5	7	0	0	0	0	12
White	9	3	0	0	0	0	12
Total	14	10	0	0	0	0	24

Blue = 7/12
White = 3/12
Total = 10/24

Left Trap Lipping (P Value = .690)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	6	2	0	0	0	0	8
White	8	4	0	0	0	0	12
Total	14	6	0	0	0	0	20

Left Trap Lipping Area (P Value = .690)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	6	2	0	0	0	0	8
White	8	4	0	0	0	0	12
Total	14	6	0	0	0	0	20

Blue = 2/8
White = 4/12
Total = 6/22 (four ID missing L. Trap)

Left CMC Lipping (P Value = .650)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	9	1	0	0	0	0	10
White	10	2	0	0	0	0	12
Total	19	3	0	0	0	0	22

Left CMC Lipping Area (P Value = .650)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	9	1	0	0	0	0	10
White	10	2	0	0	0	0	12
Total	19	3	0	0	0	0	22

Blue = 1/10
White = 2/12
Total = 3/22 (two ID missing L. CarpoMeta)

Left Prox InterPhalang Lipping (P Value = .650)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	9	1	0	0	0	0	10
White	10	2	0	0	0	0	12
Total	19	3	0	0	0	0	22

Left Prox InterPhalang Lipping Area (P Value = .650)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	9	1	0	0	0	0	10
White	10	2	0	0	0	0	12
Total	19	3	0	0	0	0	22

Blue = 1/12
White = 2/12
Total = 3/22 (two ID missing L. InterPhalang)

Left Distal InterPhalang Lipping (P Value = .650)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	9	1	0	0	0	0	10
White	10	2	0	0	0	0	12
Total	19	3	0	0	0	0	22

Left Distal InterPhalang Lipping Area (P Value = .650)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	9	1	0	0	0	0	10
White	10	2	0	0	0	0	12
Total	19	3	0	0	0	0	22

Blue = 1/10
White = 2/12
Total = 3/22 (two ID missing L. InterPhalang)

Left Pelvic Ace Lipping (P Value = .171)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	0	6	6	0	0	0	12
White	3	4	3	1	1	0	12
Total	3	10	9	1	1	0	24

Left Pelvic Ace Lipping Area (P Value = .177)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	0	7	5	0	0	0	12
White	3	4	3	1	1	0	12
Total	3	11	8	1	1	0	24

Blue = 12/12
White = 8/11
Total = 20/24

Left Femoral Head Lipping (P Value = .494)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	4	6	2	0	0	0	12
White	6	3	2	0	1	0	12
Total	10	9	4	0	1	0	24

Left Femoral Head Lipping Area (P Value = .171)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	4	6	0	2	0	0	12
White	6	3	2	0	1	0	12
Total	10	9	2	2	1	0	24

Blue = 8/12
White = 5/11
Total = 13/24

Left Patellar Lipping (P Value = .034)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	4	6	1	1	0	0	12
White	0	3	5	3	0	0	11
Total	4	9	6	4	0	0	23

Left Patellar Lipping Area (P Value = .103)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	4	7	1	0	0	0	12
White	0	9	2	0	0	0	11
Total	4	16	3	0	0	0	23

Blue = 8/12
White = 11/11
Total = 19/23 (one ID missing L. Patella)

Left Med Condyle Lipping (P Value = .146)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	3	7	2	0	0	0	12
White	7	2	2	1	0	0	12
Total	10	9	4	1	0	0	24

Left Med Condyle Lipping Area (P Value = .029)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	3	9	0	0	0	0	12
White	7	2	2	1	0	0	12
Total	10	11	2	1	0	0	24

Blue = 9/12
White = 5/12
Total = 14/24

Left Lat Condyle Lipping (P Value = .044)

Labor	None	BD	Sharp	Spicule	Damage	Trauma	Total
Blue	3	7	2	0	0	0	12
White	7	1	2	2	0	0	12
Total	10	8	4	2	0	0	24

Left Lat Condyle Lipping Area (P Value = .11)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	3	9	0	0	0	0	12
White	7	2	3	0	0	0	12
Total	10	11	3	0	0	0	24

Blue = 9/12
White = 5/12
Total = 14/24

Overall L. Lipping
Blue = 64
White = 51
Total = 115

Left Distal Radius Porosity (P Value = .783)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	6	3	1	2	0	0	12
White	7	3	0	2	0	0	12
Total	13	6	1	4	0	0	24

Left Distal Radius Porosity Area (P Value = .815)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	6	3	1	2	0	0	12
White	7	2	2	0	0	0	12
Total	13	5	3	3	0	0	24

Blue = 5/12
White = 4/12
Total = 9/24

Left Distal Ulna Porosity (P Value = .587)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	7	4	0	1	0	0	12
White	8	4	0	0	0	0	12
Total	15	8	0	1	0	0	24

Left Distal Ulna Porosity Area (P Value = .630)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	7	4	1	0	0	0	12
White	8	2	1	1	0	0	12
Total	15	6	2	1	0	0	24

Blue = 5/12
White = 2/12
Total = 7/24

Left Trap Porosity (P Value = .224)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	8	0	0	0	0	0	8
White	10	2	0	0	0	0	12
Total	18	2	0	0	0	0	20

Left Trap Porosity Area (P Value = .224)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	8	0	0	0	0	0	8
White	10	2	0	0	0	0	12
Total	18	2	0	0	0	0	20

Blue = 0/8
White = 2/12
Total = 2/20 (four ID missing L. Trap)

Left CMC Porosity (P Value = .078)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	6	4	0	0	0	0	10
White	11	1	0	0	0	0	12
Total	22	5	0	0	0	0	22

Left CMC Porosity Area (P Value = .078)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	6	4	0	0	0	0	10
White	11	1	0	0	0	0	12
Total	22	5	0	0	0	0	22

Blue = 4/10
White = 1/12
Total = 7/21 (two ID missing L. CarpoMeta)

Left Prox InterPhalang Porosity (P Value = .242)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	6	1	1	2	0	0	10
White	10	2	0	0	0	0	12
Total	16	3	1	2	0	0	22

Left Prox InterPhalang Porosity Area (P Value = .242)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	6	2	0	2	0	0	10
White	10	2	0	0	0	0	12
Total	16	4	0	1	0	0	22

Blue = 4/11
White = 2/12
Total = 5/22 (two ID missing L. InterPhalang)

Left Distal InterPhalang Porosity (P Value = .427)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	8	2	0	0	0	0	10
White	11	1	0	0	0	0	12
Total	18	3	0	0	0	0	22

Left Distal InterPhalang Porosity Area (P Value = .521)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	8	1	0	1	0	0	10
White	11	1	0	0	0	0	12
Total	19	2	0	1	0	0	22

Blue = 2/11
White = 1/12
Total = 3/22 (two ID missing L. InterPhalang)

Left Pelvic Ace Porosity (P Value = .688)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	7	3	0	2	0	0	12
White	5	4	0	2	1	0	12
Total	12	7	0	4	1	0	24

Left Pelvic Ace Porosity Area (P Value = .603)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	7	2	2	1	0	0	12
White	5	3	3	0	1	0	12
Total	12	5	5	1	1	0	24

Blue = 5/12
White = 6/11
Total = 12/24

Left Femoral Head Porosity (P Value = .572)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	6	5	1	0	0	0	12
White	6	5	0	0	0	0	12
Total	12	10	1	0	0	0	24

Left Femoral Head Porosity Area (P Value = .543)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	8	2	2	0	0	0	12
White	8	2	2	0	0	0	12
Total	16	4	4	0	0	0	24

Blue = 4/12
White = 4/12
Total = 8/24

Left Patellar Porosity (P Value = .717)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	9	1	0	2	0	0	12
White	8	1	1	1	0	0	11
Total	17	2	1	3	0	0	23

Left Patellar Porosity Area (P Value = .711)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	9	1	0	2	0	0	12
White	8	2	0	1	0	0	11
Total	17	3	0	3	0	0	23

Blue = 3/11
White = 3/11
Total = 6/23 (one ID missing L. Patella)

Left Med Condyle Porosity (P Value = .901)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	7	4	0	1	0	0	12
White	8	3	0	0	0	0	12
Total	15	7	0	1	0	0	24

Left Med Condyle Porosity Area (P Value = .785)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	7	3	1	1	0	0	12
White	8	3	0	1	0	0	12
Total	15	6	1	2	0	0	24

Blue = 5/12
White = 3/12
Total = 8/24

Left Lat Condyle Porosity (P Value = .422)

Labor	None	Pin	Coal	P & C	Damage	Trauma	Total
Blue	9	2	0	1	0	0	12
White	8	4	0	0	0	0	12
Total	17	6	0	1	0	0	24

Left Lat Condyle Porosity Area (P Value = .560)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	9	1	1	1	0	0	12
White	8	3	0	1	0	0	12
Total	17	4	1	2	0	0	24

Blue = 3/12
White = 4/12
Total = 7/24

Overall L. Porosity
Blue = 39
White = 32
Total = 71

Left Distal Radius Eburn (P Value = .307)

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	12	0	0	0	0	0	12
White	11	0	1	0	0	0	12
Total	23	0	1	0	0	0	24

Left Distal Radius Eburn Area (P Value = .307)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	12	0	0	0	0	0	12
White	11	1	0	0	0	0	12
Total	23	1	0	0	0	0	24

Blue = 0/12
White = 1/12
Total = 1/24

Left Distal Ulna Eburn (P Value = .140

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	12	0	0	0	0	0	12
White	10	0	2	0	0	0	12
Total	22	0	2	0	0	0	24

Left Distal Ulna Eburn Area (P Value = .140)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	12	0	0	0	0	0	12
White	10	2	0	0	0	0	12
Total	22	2	0	0	0	0	24

Blue = 0/12
White = 2/12
Total = 2/24

Left Trap Eburn (P Value = 0)

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	8	0	0	0	0	0	8
White	12	0	0	0	0	0	12
Total	20	0	0	0	0	0	20

Left Trap Eburn Area (P Value = 0)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	8	0	0	0	0	0	8
White	12	0	0	0	0	0	12
Total	20	0	0	0	0	0	20

Blue = 0/8
White = 0/12
Total = 0/22 (four ID missing L. Trap)

Left CMC Eburn (P Value = .286)

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	10	0	1	0	0	0	11
White	12	0	0	0	0	0	12
Total	22	0	1	0	0	0	23

Left CMC Eburn Area (P Value = .286)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	10	0	0	0	0	0	11
White	12	0	0	0	0	0	12
Total	22	0	0	0	0	0	23

Blue = 1/11
White = 0/12
Total = 1/23 (one ID missing L. CarpoMeta)

Left Prox InterPhalang Eburn (P Value = .262)

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	9	1	0	0	0	0	10
White	12	0	0	0	0	0	12
Total	21	1	0	0	c	0	22

Left Prox InterPhalang Eburn Area (P Value = .262)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	9	1	0	0	0	0	10
White	12	0	0	0	0	0	12
Total	21	1	0	0	0	0	22

Blue = 1/10
White = 0/12
Total = 1/22 (two ID missing L. InterPhalang)

Left Distal InterPhalang Eburn (P Value = 0)

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	10	0	0	0	0	0	10
White	12	0	0	0	0	0	12
Total	22	0	0	0	0	0	22

Left Distal InterPhalang Eburn Area (P Value = 0)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	10	0	0	0	0	0	10
White	12	0	0	0	0	0	12
Total	22	0	0	0	0	0	22

Blue = 0/11
White = 0/12
Total = 0/23 (one ID missing L. InterPhalang)

Left Pelvic Ace Eburn (P Value = .076)

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	5	7	0	0	0	0	12
White	6	2	3	0	1	0	12
Total	11	9	3	0	1	0	24

Left Pelvic Ace Eburn Area (P Value = .684)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	5	6	1	0	0	0	12
White	6	4	1	1	1	0	12
Total	11	10	2	1	1	0	24

Blue = 7/12
White = 6/11 (one ID L. Pelvic Ace damaged)
Total = 13/23

Left Femoral Head Eburn (P Value = .277)

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	8	4	0	0	0	0	12
White	9	1	1	0	1	0	12
Total	17	5	1	0	1	0	24

Left Femoral Head Eburn Area (P Value = .277)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	8	4	0	0	0	0	12
White	9	1	1	0	1	0	12
Total	17	5	1	0	1	0	24

Blue = 4/12
White = 2/11 (one ID L. Femoral Head damaged)
Total = 6/23

Left Patellar Eburn (P Value = .265)

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	6	6	0	0	0	0	12
White	8	3	0	0	0	0	11
Total	14	9	0	0	0	0	23

Left Patellar Eburn Area (P Value = .265)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	6	6	0	0	0	0	12
White	8	3	0	0	0	0	11
Total	14	9	0	0	0	0	23

Blue = 6/12
White = 3/11
Total = 9/23 (one ID missing L. Patella)

Left Med Condyle Eburn (P Value = .135)

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	10	2	0	0	0	0	12
White	10	0	2	0	0	0	12
Total	20	2	2	0	0	0	24

Left Med Condyle Eburn Area (P Value = .513)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	10	2	0	0	0	0	12
White	10	1	1	0	0	0	12
Total	20	3	1	0	0	0	24

Blue = 2/12
White = 2/12
Total = 4/24

Left Lat Condyle Eburn (P Value = .346)

Labor	None	BD	Polish	Groove	Damage	Trauma	Total
Blue	10	0	2	0	0	0	12
White	8	0	4	0	0	0	12
Total	18	0	6	0	0	0	24

Left Lat Condyle Eburn Area (P Value = .491)

Labor	None	<1/3	1/2-1/3	>2/3	Damage	Trauma	Total
Blue	10	0	2	0	0	0	12
White	8	1	3	0	0	0	12
Total	18	1	5	0	0	0	24

Blue = 2/12
White = 4/12
Total = 7/24

Overall L. Eburn
Blue = 23
White = 20
Total = 43

Link to Google Sheets of units and inventory.
https://docs.google.com/spreadsheets/d/1Y5HCmnCCVer9omYMNdFrIsLa-3f0y3rk/edit?usp=sharing&ouid=104144458993521327942&rtpof=true&sd=true

Link to Excel copy of IBM SPSS Data (Data had too many variables and will not fit on graph).
DATA ANALYSIS.xlsx

Codes Used-

Lipping	**Code**	**Lipping Area**	**Code**
Barely Discernible	1	<1/3	1
Sharp	2	1/3-2/3	2
Spicule	3	>2/3	3
None	0	None	0
N/A	9999	N/A	9999

Porosity	Code	Porosity Area	Code
Pinpoint	1	<1/3	1
Coalesced	2	1/3-2/3	2
P & C	3	>2/3	3
None	0	None	0
N/A	9999	N/A	9999

Eburnation	Code	Eburnation Area	Code
Barely Discernible	1	<1/3	1
Polish Only	2	1/3-2/3	2
Polish with Grooves	3	>2/3	3
None	0	None	0
N/A	9999	N/A	9999