CHAPTER 1

Introduction

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The focus of this volume is human skeletal trauma in a forensic context, specifically for the forensic anthropologist or forensic pathologist. Forensically, skeletal trauma is extremely important as it may be the only direct evidence of violence indicating the decedent’s cause of death after the decomposition of soft tissues. Therefore, an accurate understanding and interpretation of skeletal trauma is key to forensic investigations.

Forensic anthropologists are increasingly being asked to consult on skeletal trauma cases and the majority of courtroom testimonies provided by forensic anthropologists concern interpretations of skeletal trauma (Murray and Anderson, 2007). The scope and necessity of forensic anthropology has evolved beyond developing a biological profile in order to determine the identity of the unknown remains (Dirkmaat and Cabo, 2012). Forensic anthropologists now routinely reconstruct the death event through detailed skeletal trauma analysis, archaeological recovery, and taphonomic analyses – none of which were envisioned in a routine forensic anthropology consultation in the 1970s (Stewart, 1979).

A better understanding of skeletal trauma has developed over the last few decades through a number of different research avenues; however, the root of modern skeletal trauma interpretation goes back to forensic anthropologists working alongside forensic pathologists at the Medical Examiner’s Office in Memphis, Tennessee (Passalacqua and Fenton, 2013). These original case study interpretations of known incidents set the precedent for how bones break and how to interpret skeletal trauma.

More recently, forensic science and peer-reviewed research has begun to trend toward experimental research with a strong statistical basis and large sample sizes. While this approach to skeletal trauma research informs the field (e.g., Baumer et al., 2010), it is often first-hand experience that is most instructive, as well as the basis for subsequent
large-scale skeletal trauma research projects. As peer-reviewed journals are no longer the best outlets for these types of publications, we felt an edited volume would be a worthy addition to the investigation of skeletal trauma analysis in the field of forensic anthropology. Additionally, many forensic anthropology programs do not receive enough case work to sufficiently train students in skeletal trauma interpretation and it is our hope that this volume will help in developing trauma analysis skills beyond an introductory level.

Skeletal trauma can be considered as any *in vivo* damage that affects bone or hard tissues (e.g., cartilage, dentition) and the importance of skeletal trauma analysis is the fact that these hard tissues offer a permanent record of a traumatic event regardless of the mechanism, and thus skeletal trauma can be broken down into several categories. *Antemortem trauma* deals with any skeletal injury that occurred prior to death and exhibits some evidence of healing or callus formation. While the proper interpretation of antemortem trauma is paramount for documenting a history of repeated injuries that may be seen in child or elder abuse cases, antemortem trauma can also be particularly useful in identification efforts. *Blunt force trauma* occurs when a bone fails (fractures) following an inability to resist extrinsic force. Perimortem blunt force trauma interpretation can reveal the direction of force as well as a minimum number, and possibly sequence, of injuries. *Sharp force trauma* involves an impact with an object with a cutting surface where the bone is incised. This involves knife cut wounds, hacking or chopping events, and dismemberment with both knives and saws. *High-speed projectile or ballistic trauma* results from a fast-moving object where anisotropic bone will respond as a brittle material. Like blunt force trauma, the direction of force and number or sequence of impacts may be interpreted. *Thermal alterations or burned bone* relate to a rapid dehydration of bone as the heat from the fire destroys the organic material of the bone. As a general postmortem process, it is important to distinguish thermal damage from perimortem trauma. As soft tissue is rapidly degraded, the forensic anthropologist is often consulted on these types of cases. These categories of trauma are not discrete and often operate on a continuum which may result in multiple forms of trauma being present simultaneously.

**Skeletal trauma analysis: case studies in context**

The goal of this volume is to present a number of real forensic anthropology case studies by practicing forensic anthropologists. The chapters
that follow deal with a number of issues ranging from how forensic anthropologists approach trauma analysis, to how perpetrators perceive forensic science and attempt to alter the evidence based on their perceptions.

Forensic anthropology is a perpetually developing field whose existence within a medicolegal context requires constant re-evaluation of methods. Spatola opens this volume in Chapter 2 with a challenge to move away from typological approaches of trauma-type classification, and towards the use of descriptive anatomical language and a more focused look at the wound production’s biomechanical continuum. He successfully illustrates how weapon-centric classification can bias or result in over-reaching interpretations of the cause of death. This is especially noticeable in ambiguous cases and can lead to problematic outcomes. His chapter is complimented by that of Pinheiro and colleagues (Chapter 3) who note that the entire process from death to discovery must be known in order to achieve accurate trauma interpretations. They emphasize two types of case knowledge: that contextual details specific to the case must be known, and that the analysts must have an understanding of biological and taphonomic processes. The authors show that a lack of knowledge in either of these areas can have a profound effect on the final case interpretation. Importantly, they demonstrate that the fullest and most accurate understanding of the cause of death is best achieved through a medicolegal death investigation that incorporates multidisciplinary discourse between forensic pathologists, forensic anthropologists, and law enforcement.

Collaboration and a thorough knowledge of biomechanical processes is also discussed in Chapter 4 by Wiersema and Love, who demonstrate that forensic anthropologists play a key role in the interpretation of repetition and the sequence of skeletal injuries – trauma that is not often apparent with only a soft tissue examination. They highlight the importance of this refined skillset to the investigation of child abuse.

The sequence of skeletal injuries is also emphasized by Bartelink’s case study in Chapter 5 involving the documentation of blunt force trauma to the skull and antemortem injuries to the knee. Anthropological findings regarding the antemortem injuries allowed investigators to make progress towards establishing the identification of the decedent. In this case, perimortem trauma analysis was useful as it contradicted the statements made by the suspects and played an important role in developing a plea-bargain for the accused.

Passalacqua and colleagues (Chapter 6) contribute an example focusing on the importance of patterns of trauma on individuals recovered
from a Spanish Civil War (1936–1939) mass grave. They provide a unique perspective of what repetitive, state-sanctioned institutionalized violence looks like and how alternative interpretations are worth investigating for individuals whose trauma pattern deviates from the norm.

Cardoso and colleagues (Chapter 7) demonstrate that the physical environment in which the remains are deposited can have significant impacts on the duration of the perimortem interval of bone. Their case study demonstrates that human remains submerged in water allowed the bone to remain in a plastic state and thereby complicated an interpretation of peri- and postmortem lesions. Cardoso and colleagues show that contextual information is key to understanding trauma related to the death event versus damage that occurred postmortem.

Context of the deceased is important in the case study provided by Hart in Chapter 8, who demonstrates the utility of forensic anthropology in distinguishing between ballistic and carnivore trauma by reconstructing skull fragments resulting from a gunshot wound. This analysis contributed to the ruling on manner of death and emphasizes the importance of having anthropologists on staff in the medical examiner’s office.

Berryman and Saul (Chapter 9) present a known case with skeletal evidence of sexual abuse. Through close examination of scavenged remains, they found details useful for the identification of the deceased, the cause of death, and evidence of severe traumatic sexual assault via osseous trauma.

Several chapters in this volume examine blunt force trauma interpretation.

Love (Chapter 10) emphasizes the importance of understanding forces associated with skull fracture patterns. She presents two cases of blunt force trauma in adult crania, and discusses adult cranial fracture pattern interpretation in terms of impact surface, impact energy, typical location of fracture initiation, and amount of fracture propagation.

Blunt force perimortem trauma discussed by Tersigni-Tarrant (Chapter 11) focuses on the axial skeleton as a result of a fall from a height. It also presents a discussion of ante-, peri-, and postmortem modification to the skeleton, all of which were important for the identification of the individual and interpretation of the death event and subsequent taphonomic processes.

Emanovsky (Chapter 12) presents another interesting look at blunt force trauma though his examples of deceleration trauma from low-velocity airplane crashes. The goal of his chapter is to provide
terminology for discussing and reporting on perimortem trauma characteristics using examples from historic aircraft crashes with long postmortem intervals and numerous taphonomic modifications.

The next few chapters are contributed by professionals who have had experience working with specific instances of unique, or destructive forms of trauma.

As noted by Christensen and Smith in Chapter 13, blast trauma is a non-typical type of trauma observed in traditional laboratories; however, increasing involvement of forensic anthropologists in areas of conflict requires a deeper understanding of this type of trauma. Christensen and Smith's chapter provides a useful discussion of the literature, the processes behind the creation of blast trauma, and distinguishing characteristics of blast trauma compared with other trauma. They illustrate their discussion with non-human exemplars, demonstrating the nature of blast injuries in a forensic setting with a focus on blast-related rib fractures.

Another discussion of blast trauma is provided by Willits and colleagues in Chapter 14. Their analysis of two individuals killed during the Korean War shows evidence of blast trauma via skeletal trauma patterns and the presence of embedded shrapnel. Furthermore, the authors argue that based on the skeletal evidence, each of the individuals was subject to multiple blast events and each were at different distances from the blast epicenter.

Thermal modification to the body is discussed by Chrysostomou (Chapter 15), who presents a case dealing with the reconstruction of highly fragmented, thermally altered remains in order to establish identity, and examine patterns of burning and thermally induced fractures. Importantly, this was the first case in the Republic of Cyprus' legal system where an anthropologist testified in court leading to a successful conviction. This has led to growing acknowledgement of the importance of forensic anthropological methods in analysis and the use of forensic anthropologists in cases involving skeletal material.

The importance of forensic anthropology in medicolegal investigations requires continued testing and development of methods for the analysis of human remains. Fojas and colleagues (Chapter 16) have contributed a newly developed, systematic approach using Geographic Information Systems (GIS) in the interpretation of burn patterns to bodies. Their approach provides a quantitative classification system to the overall burn pattern of bodies.

Rainwater (Chapter 17) proposes three typological methods of dismemberment using both weapon type and dismemberment pattern,
which allows for a more in-depth discussion and presentation of modes of dismemberment. He presents unique exemplars for each dismemberment mode.

The case presented by Regucci and Adams in Chapter 18 shows that even when the perpetrator goes to extreme measures to get rid of a body, forensic anthropological knowledge can still find significant evidence relating to the death event and identity of the individual. The skeletal remains of the victim in this case were reduced to a highly fragmentary and burnt state. Forensic anthropological understanding of the processes and results of cremation and fragmentation encouraged multiple scene recoveries, resulting in the successful recovery of large amounts of cremated skeletal remains.

Finally, Murray and Dwyer (Chapter 19) close the volume with an interesting look at the future criminal and how the popularization of “forensics” in pop culture has created the “CSI Effect.” They present a case with multiple forms of trauma resulting from perpetrators’ (mis)understanding of forensic science, and their attempts to alter evidence and destroy remains in order to prevent being caught.

The combination of case studies included within this volume attempts to present a variety of approaches to the analysis of skeletal trauma. The authors and contributors hope that the perspective gained from these chapters and the new directions of methodological approaches will provide professionals with an increased understanding and ability to interpret damage to the skeleton no matter what the origin. Only through increased exposure to skeletal trauma can analysts gain the experience required to properly interpret trauma to the skeleton.

References


